

TerraGreen

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VOLUME 17 | ISSUE 2 | May 2024

SPECIAL HIGHLIGHTS

India's Carbon Market
Embracing Climate Disclosure Governance

Water Equation

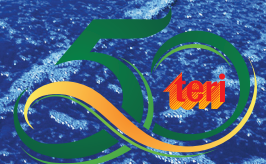
India and the Nordics

TERRA YOUTH

The Vanishing Bristled Grassbird

IN CONVERSATION

Ankit Sharma,
Co-Founder & Director, Vidyuta Materials Pvt. Ltd.





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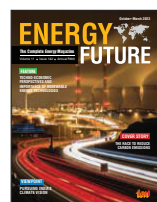
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TerraGreen is India's most respected monthly magazine dedicated to informing and enlightening its readers on issues of environment, energy, and sustainable development. Launched in 2004, TerraGreen has made an indelible impression on the minds of readers, 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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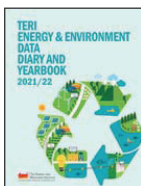
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Energy Future draws from a deep well of expertise at TERI, India's leading research institute on energy and green growth. Knowledge of energy security and development is a critical requirement in the modern global economy, and Energy Future aims to educate and inform you about the wide world of energy; its history, its future, how the energy industry works, how it has affected the world, and how it continues to affect you and me.

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A TERI Publication

TERI Energy & Environment Data Diary and Yearbook, or TEDDY, is an annual publication brought out by TERI since 1986. TEDDY is often used as a reference in other peer-reviewed books and journals for energy and environment-related data. It gives an annual overview of the developments in the energy supplying and consuming sectors as well as the environment sector. It also provides a review of the government policies that have implications for these sectors of the Indian economy.

402 pages • Hardback • 220mm × 280mm • ₹1995/\$129 (Online only)

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EDITORIAL



“ It is imperative to invest in innovation and technology across the water and wastewater sectors. Needless to say that making these sectors more efficient calls for building adequate water infrastructure, futuristic thinking, and technical advisory. ”

The phrase ‘water for all’ embodies a fundamental principle of ensuring universal access to clean and safe water for all people, regardless of their socio-economic status, geographical location or cultural background. It reflects the recognition that water is a fundamental human right and is essential for sustaining life, promoting health, ensuring livelihoods, and fostering socio-economic development. It is imperative to invest in innovation and technology across the water and wastewater sectors. Needless to say that making these sectors more efficient calls for building adequate water infrastructure, futuristic thinking, and technical advisory.

This month, our cover story on efficient and innovative water management systems in the Nordic countries highlights that the Indian industries can utilize the expertise and cutting-edge technologies from the Nordic region, leverage their valuable learnings and adopt the proven approaches to enhance their water management systems, resource efficiency and reduce pollution. The Nordic countries offer invaluable knowledge and technologies to improve sustainable water management practices. From state-of-the-art water purification systems to sustainable irrigation techniques, Nordic expertise offers important tools to mitigate the effects of climate change on water resources.

The Nordic countries, viz., Sweden, Denmark, Norway, Finland and Iceland participated in the SPRING Water Summit 2024 that was organized by the India Nordic Water Forum (INWF)—a joint network and platform for the private and public sectors in India and the Nordic countries and shared their insights regarding the water-related initiatives, challenges, and green solutions that have a replication value. This kind of knowledge exchange, technology adoption and bilateral collaboration may open up the door for engaging with potential partners or setting up manufacturing centres for the Indian as well as international markets. A partnership with the Indian industry can provide a great opportunity to serve the global market. All in all, joint research and development, knowledge sharing and technology transfer can leverage the strengths of the Nordic countries to effectively address India’s water challenges, improve quality, efficiency and conservation while fostering strong bilateral relationships.

Significantly, the increasing collaboration between India and the Nordic countries in green and clean energy and an intent to combating climate change and promoting sustainable development, is marked by technological cooperation, shared expertise, and diplomatic goodwill. I am confident that the articles in this edition of *TerraGreen* will strongly resonate with our readers. Your insightful suggestions have greatly improved the publication, and I eagerly encourage you to continue sharing your valuable ideas and feedback.

A handwritten signature in black ink that reads 'Vibha Dhawan'.

Vibha Dhawan
Director-General, TERI



I liked reading the cover story of the April 2024 issue of *TerraGreen*. The cover story on water scarcity in Bengaluru is very apt. Water scarcity in Bengaluru, India's Silicon Valley, has become an alarming issue over recent years. Rapid urbanization and a burgeoning population have exerted immense pressure on the city's water resources. The primary sources of water, including the Cauvery River and groundwater reserves, are increasingly insufficient to meet the growing demand. Mismanagement of water distribution, pollution, and erratic monsoons further exacerbate the situation. The depletion of lakes and over-extraction of groundwater have led to a significant drop in water tables, while the city grapples with frequent water shortages and poor quality of the available water. Innovative solutions, such as rainwater harvesting, wastewater recycling, and stringent water management policies, are urgently needed to mitigate the crisis

and ensure sustainable water availability for Bengaluru's future.

Harish Uthappa
Bengaluru, Karnataka

I liked reading the feature story on solid waste and marine litter published in the April 2024 issue of *TerraGreen*. Solid waste and marine litter represent critical environmental challenges with far-reaching impacts on ecosystems, human health, and the global economy. Solid waste, which encompasses everyday items such as packaging, food scraps, and discarded electronics, often ends up in landfills or, worse, improperly managed and littering natural landscapes. When this waste makes its way into waterways, it becomes marine litter, polluting oceans and coastal areas. Marine litter, particularly plastics, is especially pernicious due to its durability and persistence in the environment. It harms marine life through ingestion and entanglement, disrupts marine ecosystems, and contaminates food chains with microplastics. The economic costs are substantial, affecting tourism, fishing industries, and coastal communities. Addressing this issue requires comprehensive waste management strategies, including reducing plastic use, enhancing recycling efforts, promoting sustainable product designs, and international cooperation to clean up oceans and prevent further pollution. Public awareness and community engagement are also crucial in fostering responsible consumption and disposal habits to mitigate the problem of solid waste and marine litter, which has been addressed in this article.

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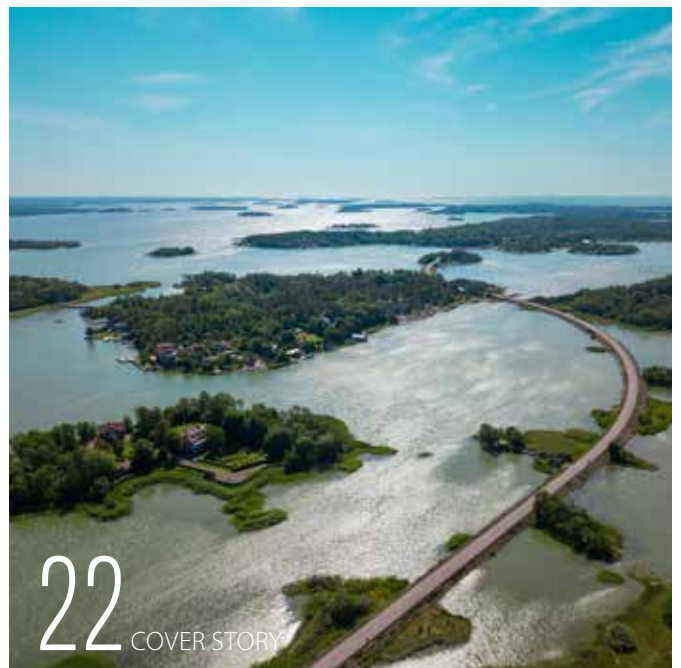
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IIT Jodhpur's Groundbreaking Research on Air Pollution

In a significant step towards addressing air pollution issue, a researcher from Indian Institute of Technology (IIT) Jodhpur has published groundbreaking research in *Nature Communications* journal, shedding light on the sources and composition of particulate matter (PM) in Northern India that are harmful to human health. Contrary to the common belief that reducing overall PM mass would alleviate health impacts, this comprehensive study highlights the importance of addressing local inefficient combustion processes—such as biomass and fossil fuel burning, including traffic exhaust in effectively reducing PM-related health exposure and their associated impacts in Northern India—says Dr Deepika Bhattu, Associate Professor and lead author of the article.

Source: <https://pib.gov.in/>

Share of Non-Fossil Fuel to Grow to 50 Per Cent in Domestic Energy Generation Capacity by 2030

The government aims to raise the share of non-fossil fuel in India's electricity generation capacity to 50 per cent by 2030, according to MNRE Secretary Mr Bhupinder Singh Bhalla. Currently, non-fossil fuel-based capacity constitutes about 42 per cent of India's installed energy generation. Shri Bhalla mentioned this during his address at the World Hydrogen Summit 2024 in Rotterdam, Netherlands, on May 15, 2024. He highlighted a 10.79 per cent increase in non-fossil fuel-based capacity addition in 2023–24 compared to the previous year.

Source: <https://economictimes.indiatimes.com>



India Overtook Japan to Become World's 3rd Largest Solar Power Generator in 2023

India accelerated its solar energy deployment, surpassing Japan to rank as the world's third-largest solar power generator in 2023. This growth aligns with global trends, emphasizing the importance of clean electricity to meet rising demand and combat climate change. The report by global energy think tank Ember said India ranked ninth in solar energy deployment in 2015. With electricity generation accounting for nearly half of India's annual carbon dioxide emissions (1.18 gigatonnes in 2023), accelerating the transition to cleaner generation sources is imperative for the country to meet both its developmental and climate goals.

Source: <https://economictimes.indiatimes.com>



Centre Aims to Train 600,000 Workers to Power Green H₂ Goal

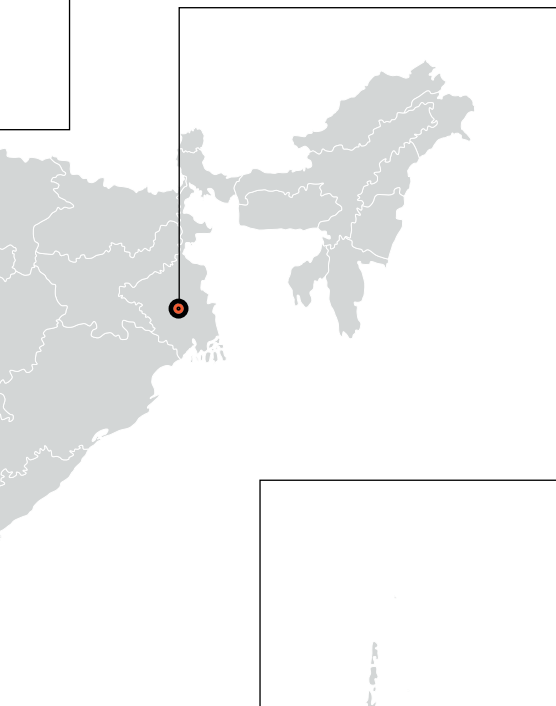
The Government of India aims to develop 600,000 skilled workers for National Green Hydrogen Mission by 2030, identified by the Ministry of Skill Development and Entrepreneurship and MNRE. Skilling includes renewable energy generation, hydrogen production, transformation, storage, transport, and end use applications, requiring specific skill sets and a coordinated programme between institutions.

Source: <https://economictimes.indiatimes.com>

Bengal Lagging in Harnessing Renewable Energy Potential: Study

West Bengal's progress in clean electricity generation has been slower than other states, as it harnessed just 8 per cent of its renewable energy potential till February 2024, according to a new study. The eastern state's share of renewable energy consumption out of the total electricity consumption within West Bengal accounted for just 10 per cent, the joint study by US-based research organization, Institute for Energy Economics and Financial Analysis (IEEFA) and clean energy think tank, Ember said.

Source: <https://www.thehindubusinessline.com>



SocGen's \$1 Billion Loan for ReNew's Green Energy Projects

Europe's Societe Generale has agreed to lend up to \$1 billion for Nasdaq-listed ReNew Global's energy transition projects over the next three years, at a time the Indian company aims to expand its footprint across green power and decarbonization. The financing would help develop ReNew's projects in India and abroad. The two entities have signed a memorandum of understanding (MoU) to collaborate on solar, wind, complex renewables, green hydrogen, energy storage and solar modules manufacturing. The amount will include debt financing and advisory solutions.

Source: <https://www.livemint.com/companies/news>



Germany's Solar Installations Up 35 Per Cent in Early 2024

Germany's solar power installation rose by 35 per cent year-on-year in the first four months of 2024, boosted by a rise in industrial, commercial and ground-mounted photovoltaics demand, solar power association BSW said recently. Since Russia's invasion of Ukraine and the sudden drop in Russian fossil fuel exports to Germany, Berlin has introduced several pieces of legislation to accelerate solar power expansion, part of Berlin's plan to cover 80 per cent of its energy needs from renewables by 2030 and to become climate neutral by 2045.

Source: <https://www.reuters.com/>



Leading Academics Call for Extending, Reframing Sustainable Development Goals

A group of leading academics are calling for the UN Sustainable Development Goals to be extended past their 2030 target date and updated with consideration for the impact of artificial intelligence (AI), and with more input from communities affected by the goals, among other recommendations. Halfway to the targeted completion date of 2030, many of the UN's ambitious 17 Sustainable Development Goals (SDGs) are off track or progressing too slowly, due to the slowing of the global economy by COVID-19 and international conflicts. In the run-up to the Summit of the Future in New York next September, the authors are recommending the goals be extended to 2050 and retooled with an ambitious timeline and greater clarity about specific goals—such as those pertaining to climate and “planetary health.”

Source: <https://phys.org/>

Italy's 2023 Farm Output Hit by Climate Change

Italian agricultural production shrank last year as wine, fruit and olive oil output all took a hit from extreme weather events linked to climate change, national statistics bureau ISTAT said recently. Europe suffered its hottest summer in 2000 years in 2023—a finding based in part on an analysis of tree rings—and this month temperatures in parts of the continent have already surpassed 40 degrees Celsius (104 degrees Fahrenheit).

Source: <https://www.reuters.com/>

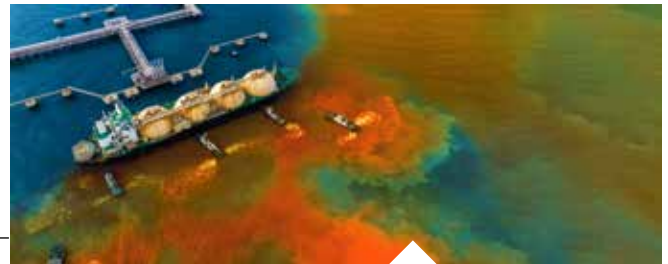




Korean Study Forecasts 110,000 Premature Deaths by 2050 due to PM_{2.5} and Aging

A new study from the Pohang University of Science and Technology (POSTECH) indicates that fine particulate matter, which is less than 2.5 µm in diameter (PM_{2.5}), is increasingly impacting the rapidly aging Korean population. Due to this population aging, PM_{2.5}-related premature deaths are projected to be more than three times higher by 2050 than they are today if PM_{2.5} exposure persists. A research team of Professor Hyung Joo Lee and MSc student Na Rae Kim from the Division of Environmental Science and Engineering at POSTECH has projected the number of deaths by 2050 based on the combined effects of PM_{2.5} and the aging population. They also suggested the concentration of PM_{2.5} needed to maintain the current PM_{2.5}-related health burden. The study was recently published in the journal *Environmental Research*.

Source: <https://phys.org/>



Singaporeans Rush to Clean Oil Spill After Boats Collide

A dredger boat which suddenly lost engine and steering control hit a stationary cargo tanker, causing an oil spill in Singapore. Singaporean authorities said the Netherlands-flagged dredger *Vox Maxima* struck Singaporean fuel supply ship *Marine Honor* on June 14, 2024. It ruptured one of the cargo tanks on the *Marine Honor*, which leaked low-sulphur oil into the sea. Although the leak has been contained, tides have washed the oil along Singapore's shoreline, including to the popular resort island of Sentosa. Singapore's Maritime and Port Authority, in a joint statement with the National Environment Agency, the National Parks Board and Sentosa Development Corporation, said the master and crew members of *Vox Maxima* were assisting with ongoing investigations into the matter.

Source: <https://www.abc.net.au/>

Gaza Conflict has Caused Major Environmental Damage, UN Says

The conflict in Gaza has created unprecedented soil, water and air pollution in the region, destroying sanitation systems and leaving tonnes of debris from explosive devices, a United Nations report on the environmental impact of the war said recently. The war between Israel and Hamas, the Islamist movement that controls the Gaza Strip, has swiftly reversed limited progress in improving the region's water desalination and wastewater treatment facilities, restoring the Wadi Gaza coastal wetland, and investments in solar power installations, according to a preliminary assessment, opens new tab from the UN Environment Programme (UNEP).

Source: <https://www.reuters.com/>



Hiccups in the Himalayas

Reading the Warning Signs in Uttarakhand

Joshimath's location on the middle slope of a hill, built on the debris of an ancient landslide triggered by an earthquake, contributes to its vulnerability to natural disasters. In this article, **Priyanka Vadrevu** says there is an urgent need to focus on the preventive measures to protect the endangered ecology of Joshimath and nearby areas. Large-scale afforestation plans need to be undertaken to boost soil binding and holding capacity which will eventually recharge underground aquifers as a portable source of water and also will fill the voids in rocks, enhancing the land resistance.

Joshimath, also known as Kartikeyapura named after Kartikeya, the God of Katyuri kings and the son of Lord Shiva, is the ancient and picturesque town in the Chamoli district of Uttarakhand, which has been breaking for some time now, however, the urgent pleas to mend it has been ignored every time. The town lies in seismic zone V, which makes it the most active earthquake prone area in the Indian Himalayan geographical region

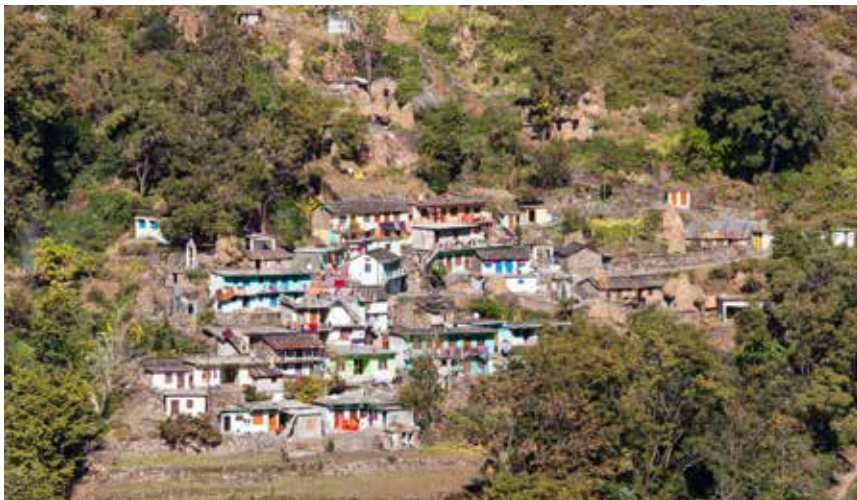
and is anyway precariously positioned when it comes to frequent as well as high intensity earthquakes.

The Himalayan biome works in a very complex manner compared to the other biomes on the planet. Further, the geosphere (land), hydrosphere (water) and biosphere (ecology) are all the combined components of the Himalayan mountains and they keep interacting with each other continuously and comprehensively in the young Hindu-

Kush Himalayan (HKH) region. Being an active plate tectonic collision zone it adds onto the continuity of geographical events, majorly disastrous (flash floods, avalanches, landslides, earthquakes, debris flow, etc.) which results in the loss of human lives, flora & fauna, and livestock on the third pole of the earth.

The land subsidence being witnessed in Uttarakhand's Joshimath in 2023 has triggered an ecological and humanitarian crisis, and it arises from the complex mechanism of Himalayan plates active for almost over a century now when the area was formed by debris of a landslide that happened at the time.

It is also to be noted that the hydrogeological cycle never works in silos, instead is always interdisciplinary in nature. With the majority of the Himalayan states in the country covered under the watershed of the three mighty glacier-fed river water systems, the Ganga, the Brahmaputra and the Indus; springs, which is one of the major natural source of groundwater, are the result of the same interactive processes (aids in the formation of karst geomorphology,





fractures and cracks in the rocks) that keeps going on inside-out in the Himalayan mountains. The dynamic weather phenomenon associated with glaciers plays an equally important role in the formation of clouds for rainfall and also in interaction with the forest reservoir.

A joint report from the Food and Agriculture Organization (FAO) and United Nations Environment Programme published in 2020 underscores the impact of the COVID-19 pandemic on the sustainable management of forests. In the recent years, Uttarakhand has been wrecked by natural calamities; the flash floods in Chamoli in February 2021, an avalanche above Joshimath town in April the same year, cloud burst in Devprayag in May 2021, and most recently in 2023, the land subsidence and houses on unsteady ground in Joshimath town. The young and varied rock formation, especially the loamy sand to sandy clay loam, in the Himalayas exacerbates the frequency of the extreme events.

The extreme weather events have resulted in the disappearance of a vast section of vegetation from the state's forested and inhabited areas, including

the villages. A sense of fear pervades the villages, especially those perched on the steep, inclined ranges of fragile slopes. The twin combination of deforestation and controlled blasting for large infrastructural projects are the prime anthropogenic activities responsible for frequent devastating events in Uttarakhand being witnessed now. The drying of springs due to dropping water recharge and increased extraction is leading to pores in the soil and rocks and, hence, accelerates the land subsidence.

There is an urgent need to focus on the preventive measures to protect the endangered ecology of Joshimath and nearby areas. Large-scale afforestation plans need to be undertaken to boost soil binding and holding capacity which will eventually recharge underground aquifers as a portable source of water and also will fill the voids in rocks, enhancing the land resistance. It is high time for the state to rework its policy structures and build strong systems towards big hydropower and infrastructural projects with private partners. It is imperative to have participatory involvement of village communities at the grassroots level since they are the primary stakeholders of the

resources. Women in the mountains often undertake responsibilities of farming and run small shops. It is important to involve them to build a sense of ownership and security in the community.

Controlled blasting which generate little tremors in the earthquake prone Himalayas should be stopped urgently or an alternative to controlled blasting should be brought in place after proper scientific studies. Development should not be at the cost of sustainable practices or destruction of the natural habitat. Most importantly 'green tourism' should be the way ahead to reduce the pressure on mountains, while generating employment opportunities and preserving the heritage of Himalayas as much as possible.

It is the need of the hour to keep our mutual and short-term benefits aside if the horrific histories of Kedarnath disaster in 2013, and Rishiganga and Dhauliganga disaster of 2021 is not to be repeated. Another instance of neglect will have us hurtling down a disastrous path which has no return. ■

Priyanka Vadrevu is a Research Associate at the Centre for Himalayan Ecology, TERI, New Delhi. This article has been republished from <https://www.teriin.org/>

Renewable Grid

Recovering electricity from heat storage hits 44 per cent efficiency

Closing in on the theoretical maximum efficiency, devices for turning heat into electricity are edging closer to being practical for use on the grid, according to a new research.

Closing in on the theoretical maximum efficiency, devices for turning heat into electricity are edging closer to being practical for use on the grid, according to University of Michigan research. Heat batteries could store intermittent renewable energy during peak production hours, relying on a thermal version of solar cells to convert it into electricity later.

“As we include higher fractions of renewables on the grid to reach

decarbonization goals, we need lower costs and longer durations of energy storage as the energy generated by solar and wind does not match when the energy is used,” Andrej Lenert, U-M associate professor of chemical engineering and corresponding author of the study recently published in *Soule*.

Thermophotovoltaic cells work similarly to photovoltaic cells, commonly known as solar cells. Both convert electromagnetic radiation into electricity,

but thermophotovoltaics use the lower energy infrared photons rather than the higher energy photons of visible light. The team reports that their new device has a power conversion efficiency of 44 per cent at 1435°C, within the target range for existing high-temperature energy storage (1200°C–1600°C). It surpasses the 37 per cent achieved by previous designs within this range of temperatures.

“It’s a form of battery, but one that’s





very passive. You don't have to mine lithium as you do with electrochemical cell, which means you don't have to compete with the electric vehicle market. Unlike pumped water for hydroelectric energy storage, you can put it anywhere and don't need a water source nearby," said Stephen Forrest, the Peter A Franken Distinguished University Professor of Electrical Engineering at U-M and contributing author of the study.

In a heat battery, thermophotovoltaics would surround a block of heated material at a temperature of at least 1000°C. It might reach that temperature by passing electricity from a wind or solar farm through a resistor or by absorbing excess heat from solar thermal energy or steel, glass or concrete production.

"Essentially, using electricity to heat something up is a very simple and inexpensive method to store energy

relative to lithium ion batteries. It gives you access to many different materials to use as a storage medium for thermal batteries," Lenert said.

The heated storage material radiates thermal photons with a range of energies. At 1435°C, about 20–30 per cent of those have enough energy to generate electricity in the team's thermophotovoltaic cells. The key to this study was optimizing the semiconductor material, which captures the photons, to broaden its preferred photon energies while aligning with the dominant energies produced by the heat source.

But the heat source also produces photons above and below the energies that the semiconductor can convert to electricity. Without careful engineering, those would be lost. To solve this problem, the researchers built a thin layer of air into the thermophotovoltaic

cell just beyond the semiconductor and added a gold reflector beyond the air gap—a structure they call an air bridge. This cavity helped trap photons with the right energies so that they entered the semiconductor and sent the rest back into the heat storage material, where the energy had another chance to be re-emitted as a photon the semiconductor could capture.

"Unlike solar cells, thermophotovoltaic cells can recuperate or recycle photons that are not useful," said Bosun Roy-Layinde, U-M doctoral student of chemical engineering and first author of the study.

A recent study found stacking two air bridges improves the design, increasing both the range of photons converted to electricity and the useful temperature range for heat batteries. ■

Source: <https://www.sciencedaily.com/>





The Magic of Traditional Indian Barbeque

Strengthening local economy and sustainability

Manu Shrivastava's article highlights the traditional dishes of South Gujarat and Maharashtra's Konkan region—ubadiyu, undhiyu, and popti. Made with fresh, seasonal vegetables and herbs, these dishes are rich in nutrients such as vitamins, minerals, and antioxidants. They also boost the local economy and promote sustainability by ensuring food and nutritional security. Amid fleeting culinary trends, these dishes remain timeless symbols of the region's rich gastronomic heritage.

Ubadiyu being served along the highway in South Gujarat



The best time to enjoy seasonal vegetables, especially in western India, is during the winter months. In South Gujarat and in Maharashtra's Konkan region, locals create culinary magic with dishes such as ubadiyu, undhiyu and popti, which are prepared in similar fashion in traditional style using fresh vegetables and herbs.

Ubadiyu, also known as umbadiyu, a culinary gem hailing from the sun-kissed and prosperous lands of South Gujarat, holds within its name the essence of its creation. Derived from the Gujarati words 'ubad' and 'yu' signifying 'knead' and 'mixture,' respectively, this delectable dish finds its roots deeply embedded in the fertile soil of Valsad and Navsari districts.

The journey of ubadiyu begins with a symphony of flavours as the masala, a concoction of spices and herbs, is lovingly kneaded into a delectable blend with a mixture of seasonal vegetables. This aromatic assortment is then put in an earthen pot, known as 'matla' in the local language, transforming it into a

vessel of culinary alchemy.

But the magic of ubadiyu doesn't end there. With reverence for tradition, the pot is ceremoniously buried in a pit, a sacred fusion of earth and fire. Layers of hay, sugarcane waste, and other natural materials are used to form a protective cloak around the earthen pot, shielding it from the elements as the fire covers the pot to create unmatched blended flavours.

As the hours pass and the flames caress the earth, Ubadiyu undergoes a metamorphosis, its flavours intertwining with the smoky embrace of the pit. Each moment spent in the earth imparts a depth and complexity to the dish, infusing it with a rich blend of earthy, natural flavours that tantalize the senses.

In the busy thoroughfares lining the Mumbai–Ahmedabad highway, specifically in Valsad in the stretch between Udvada and Pardi and nearby Dungri, Umargam, etc., ubadiyu finds its home among roadside vendors, its aroma mingling with the flurry of travellers

and locals alike. Here, amid frenzied movement of humans and traffic, Ubadiyu stands as a beacon of culture and sustenance, offering a respite for the weary traveller.



Geeta Patel holding the Kalhar herb, which is a mandatory ingredient for Ubadiyu

Known far and wide for her ubadiyu, Pardi local Geeta Patel unveils the secrets of this traditional barbecue with pride and passion. With meticulous care, she selects the finest ingredients, sourcing fresh seasonal vegetables from the vegetable market in Udvada and infusing the dish with the aromatic essence of the kalhar leaves.

Kalhar, a local herb, is an important ingredient in the preparation of ubadiyu. Interestingly, the plant is extensively used in homoeopathic, Ayurvedic and Unani medicinal systems. It is grown locally in South Gujarat and lends the unique aromatic flavour to Ubadiyu.

Geeta says, "We use papdi (beans), aloo (potato), ratalu (yam), sakarkand (sweet potato), and greens, along with kalhar leaves for the fragrance and to prevent the papdi from burning." The chutney, a well-curated blend of spices and herbs added to the vegetables in the pot, renders a distinct taste to ubadiyu.

As ubadiyu graces the tables of homes and roadside stalls alike, it is often accompanied by the tangy embrace of green chutney, the comforting warmth of boiled corn, and the refreshing coolness of chilled buttermilk. Each bite is a celebration of Gujarat's rich culinary heritage, a tribute to the enduring legacy of ubadiyu and the communities that cherish it.



Undhiyu, just like ubadiyu, is also a tantalizing winter delicacy. Both the preparations share a common base of seasonal vegetables including purple yam, sweet potato, baby potato, brinjal, surti papdi, tuvar lilva, green peas, raw banana, etc. However, beyond their ingredient similarities lie stark differences in cooking techniques, flavours, and regional roots.

Undhiyu, a beloved winter staple, in Gujarat and among Gujarati food lovers all across, has derived its name from the Gujarati word 'undhu' which translates to 'upside down.' The traditional and unique

cooking method involves preparation in an inverted earthen pot, underground, over a fire pit. Undhiyu embodies the essence of Gujarati tradition and innovation and is widely popular especially in the prosperous town of Surat.

The dish boasts two primary styles—Surti and Kathiawadi—each with its distinct cooking methods and levels of spiciness. While Surti Undhiyu delights with its stuffed vegetables cooked in oil and garnished with grated coconut and peanuts, Kathiawadi Undhiyu embraces a spicier masala with fried vegetables sans stuffing, catering to diverse palates across the region.

Authentic undhiyu is made from green beans called surti papdi which are small in size, small brinjal, raw banana, potato, purple yam, etc. The 'dryish' gravy which is also quite spicy is made from ginger, garlic, coriander leaves, green chilli, etc. The vegetables are often complemented with fenugreek leaves dumplings known as muthias, and a unique blend of coconut, peanut, sesame seeds, green chili, ginger, garlic, coriander leaves, sugar, lemon juice, and salt.

Undhiyu takes centrestage during festive occasions like Uttarayana and Diwali, pairing impeccably with golden-fried pooris or wholesome phulkas. The





As the stage is set, an array of seasonal vegetables is gathered—yam, potato, peas, brinjal, *val* beans, etc. Each ingredient is lovingly prepared, with a mixture of salt and an aromatic blend of spices, before being put within the clay pot alongside marinated chicken and country eggs, also known as gaavthi eggs. These are sometimes covered in foil during preparation to keep the flavours intact.

The key ingredient of the dish—the *val* beans or the *val phalli*—with a delicate yet nutty flavour, are rich in nutrients including natural protein, fibre, and minerals. Val beans are also known as butter beans as these have a buttery and starchy texture and are a key ingredient in many traditional dishes of Maharashtra and Gujarat.

This time of the year, another fresh harvest enriching the land is that of groundnuts, also known as sheng or shengdana. Local farmers harvest the seasonal produce which is available in abundance for the preparation of traditional recipes such as popti, among other things.

The pot, now brimming with a cornucopia of flavours, is placed over an open fire, where the magic of popti begins to unfold. This method of cooking, reminiscent of ancient traditions, infuses

meal often culminates with desserts such as shrikhand or basundi, elevating the dining experience to new heights of indulgence.

An icon of Gujarati culinary finesse, Undhiyu epitomizes the versatility and richness of regional cuisine. From the meticulous preparation method to distinctive flavours, it reflects the intricate nuances of Gujarat's gastronomic heritage. Beyond merely tempting the taste buds, *ubadiyu* and *undhiyu* embody the very essence of Gujarati cuisine and tradition, offering a comforting respite from winter's chill and infusing gatherings and festivities with warmth and vitality.

Not too far away in western India, the vibrant Raigad district of Maharashtra is home to another culinary tradition, which some believe is as old as the land itself, in the form of popti. Derived from the name of a particular shrub that grows wildly in the region, and known locally as 'bhamburdi', this traditional dish embodies the essence of the region's bounty.

As winter blankets the landscape and the harvest season unfolds, the locals of Raigad gather to celebrate with a feast fit for the gods. In the rustic kitchens

of Maharashtra's Raigad, the age-old tradition of preparing popti unfolds with reverence and skill.

To embark on this culinary journey, a clay pot is carefully selected and lined with leaves from the *bhamburdi* shrub, which flourishes in the region from December to May. These leaves, renowned for their medicinal properties, impart a subtle yet distinct flavour to the dish as it cooks. The aroma of these leaves is reminiscent of carom seeds.



the dish with a smoky, earthy essence that speaks to the soul of Maharashtra's countryside.

As the flames dance and the aromas mingle, popti stands as a testament to the ingenuity and resourcefulness of Maharashtra's rural communities, where tradition and innovation converge to create culinary masterpieces that feed both body and soul.

But popti is more than just a dish; it is a celebration of community, of tradition, and of the land itself. Community participation is a distinct feature of Popti preparation and comes into play when each ingredient is carefully selected and prepared. It is the perfect homage to Maharashtra's rich agricultural heritage.

In recent years, popti has emerged from the shadows of obscurity to claim its rightful place among Maharashtra's culinary treasures. From the fertile fields of Raigad to the bustling streets of Mumbai, enthusiasts flock to experience the magic of a popti first-hand. Its legacy lives on in the hearts and minds of those who gather to celebrate the harvest season. Popti is symbolic of the enduring bond between food, community, and culture.

Drawing parallels to Gujarati winter staples like undhiyu and ubadiyu, popti shares a common lineage rooted



in seasonal abundance and culinary ingenuity. All three are crafted as one-pot meals yet popti stands apart, its flavours a melange of spices and herbs, its aroma a tantalizing invitation to partake in the community feast.

Despite the similarities, each dish possesses its own unique identity and flavour profile. While undhiyu delights with its stuffed and fried vegetables and delectable curry seasoned with aromatic spices and grated coconut, ubadiyu and popti captivate with their earthy, rustic charm, transporting diners to the heart

of rural culinary heritage with every savoury bite.

These culinary preparations are also a rich source of nutrients including vitamins, minerals and antioxidants as they incorporate locally-grown, seasonal produce. Additionally, they strengthen local economy and further sustainability by ensuring food and nutritional security. In a world swept up by fleeting culinary trends, ubadiyu, undhiyu and popti stand as timeless symbols of the region's rich gastronomic legacy. Their presence and popularity is indicative of their enduring appeal and cultural significance, amidst a landscape ever-evolving with new culinary delights.

For many these dishes signify childhood memories, highlighting a deeper connection to tradition and culture amidst the modern flurry of fast food options. They carry forth a legacy of festive feasts and communal celebrations, fostering a sense of togetherness and joy. They serve as culinary ambassadors, bridging generations and communities through the universal language of food. ■

Manu Shrivastava is a journalist and lawyer with DraftCraft International. She writes widely on environment, climate change, women laws, and policy perception. The original article was first published on <https://tinyurl.com/TheDraftWorld>





Charging towards Sustainability

The Circular Revolution of EV Battery Recycling

Ankit Sharma is the Co-Founder & Director, Vidyuta Materials Pvt. Ltd., which stands at the forefront of innovation in the energy storage industry, pioneering the manufacturing of cutting-edge battery materials for the batteries used in energy storage systems (ESS), electric vehicles (EVs), mobiles, laptops, etc. Currently, Vidyuta is engaged in the manufacturing of cathode active materials (CAM) for lithium-ion cells. Vidyuta embodies a commitment to sustainability and technological advancement, with a vision to revolutionize the energy storage industry in India and the rest of the world by creating a closed loop battery ecosystem.



Could you please provide details about the work your organization is doing?

Vidyuta Materials Pvt. Ltd. initially started with a state-of-the-art pilot manufacturing facility, with an initial annual production capacity of 200 tonnes or 150 MWh focused on high nickel cathode active materials. The current plant can grow up to 1 GWh annual capacity of materials which will include production of high nickel materials as well as LFP (Lithium Ion Phosphate). The facility not only produces the final material, but also the

necessary precursors for cathode active materials, which is a crucial process for achieving self-sustainability. Vidyuta has already made concrete steps in identifying land parcels within India to establish one of the largest integrated facilities in India. This facility will be developed in phases and is expected to eventually produce approximately 10 GWh capacity of cathode active materials, including both high nickel and LFP.

Embracing sustainable practices and a commitment to a greener planet, Vidyuta follows the circular economy principle, ensuring that materials are reused, repurposed, and recycled wherever possible. This approach minimizes environmental impact and positions Vidyuta as a leader in sustainable manufacturing practices.

With a first-mover advantage in India's burgeoning clean energy sector, Vidyuta is poised to become the leading supplier of battery materials. As the global demand for lithium-ion batteries continues to soar, driven by the proliferation of EVs and renewable energy solutions, Vidyuta stands ready to meet the needs of medium to large enterprises worldwide, including cell manufacturers, electric vehicle manufacturers, and energy storage system integrators.

In an industry dominated by Chinese manufacturing, Vidyuta's presence offers an alternative for companies seeking reliable, high-quality battery materials. With a strategic focus on market expansion, revenue generation, and brand awareness, Vidyuta aims to carve a niche as a trusted partner in the journey towards a sustainable, electrified future.

Are electric vehicles the future of transportation?

Electric vehicles (EVs) are not just the future of transportation—they represent a pivotal step towards a sustainable energy ecosystem. However, as the adoption of EVs grows, so does the question of what to do with their batteries once they reach the end of



their primary life cycle. Fortunately, through refurbishment, repurposing, and recycling with the help of sustainable cathode materials, we can extend the lifespan of lithium-ion EV batteries and unlock valuable resources for a greener tomorrow. Between 2010 and 2018, battery demand surged annually by 30 per cent, reaching 180 GWh in 2018. Continuing this trend, the market is projected to expand at a rate of approximately 25 per cent per year, hitting 2600 GWh by 2030. This growth is primarily propelled by the electrification of transportation and the increased use of batteries in electricity grids.

The rapid expansion of the lithium-ion battery industry has revolutionized energy storage but poses environmental challenges in cathode manufacturing due to primary material extraction. To address concerns such as resource depletion and emissions, the industry is increasingly embracing recycling as a sustainable solution for cathode material production.

Please throw some light on the power of circular economy.

In embracing a circular economy model, we recognize the importance of maximizing resource efficiency and

minimizing waste. By refurbishing, repurposing, and recycling EV batteries, we not only reduce environmental impact but also create economic opportunities within the battery industry. This paradigm shift towards circularity is essential for fostering sustainability and driving innovation in energy storage. The production or manufacturing of sustainable cathode materials would further give a fillip to the EV battery recycling industry to meet the vision of a circular economy.

What are the benefits of repurposing batteries for second life?

When EV batteries reach the end of their primary life, they still retain substantial energy capacity. Instead of disposing of these batteries, repurposing them for second or third-life applications using sustainable cathode materials presents a more sustainable alternative. Rapid advancements in battery recycling technologies have enabled us to achieve impressive recovery rates, a process known as urban mining. As battery volumes are projected to increase significantly by 2030, the urban mining industry is poised for substantial growth.

What are some global trends in battery recycling?

Europe leads the charge in battery recycling, supported by robust regulatory frameworks that mandate producers to manage the end-of-life of their batteries responsibly. China, the largest EV and battery market globally, has also implemented policies requiring manufacturers to recycle a significant portion of used batteries by 2025. In the United States, initiatives like the Department of Energy's focus on developing recycling technologies highlight a growing emphasis on battery recycling. With the Li-ion battery market projected to soar, the recycling sector and cathode materials industry are poised for substantial growth, offering lucrative opportunities for sustainable innovation.

How would a responsible battery management shape the future in India?

NITI Aayog forecasts India's EV battery recycling market to skyrocket to 128 GWh by 2030, up from just 2 GWh in 2023. This surge is fuelled by over a 200 per cent year-on-year growth in EV sales post-pandemic. However, recycling modern batteries, with their complex material composition, demands specialized policies and infrastructure for India to achieve its recycling objectives. Apart from that, the government's introduction of Battery Waste Management Rules, 2022 underscores a commitment to responsible battery management. By incentivizing recycling and promoting the use of sustainable cathode materials in new batteries, India aims to reduce reliance on imports and foster domestic battery manufacturing. This proactive approach aligns with India's broader vision of sustainable development and economic growth.

What is the vision for a sustainable future in the energy storage sector?

At the vanguard of the energy storage sector, numerous Indian entities dedicated to battery recycling lead the charge in innovation. Focusing on the production of cathode active materials (CAM) for lithium-ion cells, these pioneers exemplify a dedication to sustainability and technological progress. Their vision entails establishing a closed-loop battery ecosystem, poised to transform the energy storage landscape not only in India but also globally. Through inventive recycling methods and strategic resource management, these companies or start-ups aspire to realize a future characterized by abundant, cost-effective, and eco-friendly power solutions. By using sustainable energy transition materials through recycling, repurposing, and low-carbon refining within the group company, the aim is to ensure a sustainable supply chain while minimizing its carbon footprint.

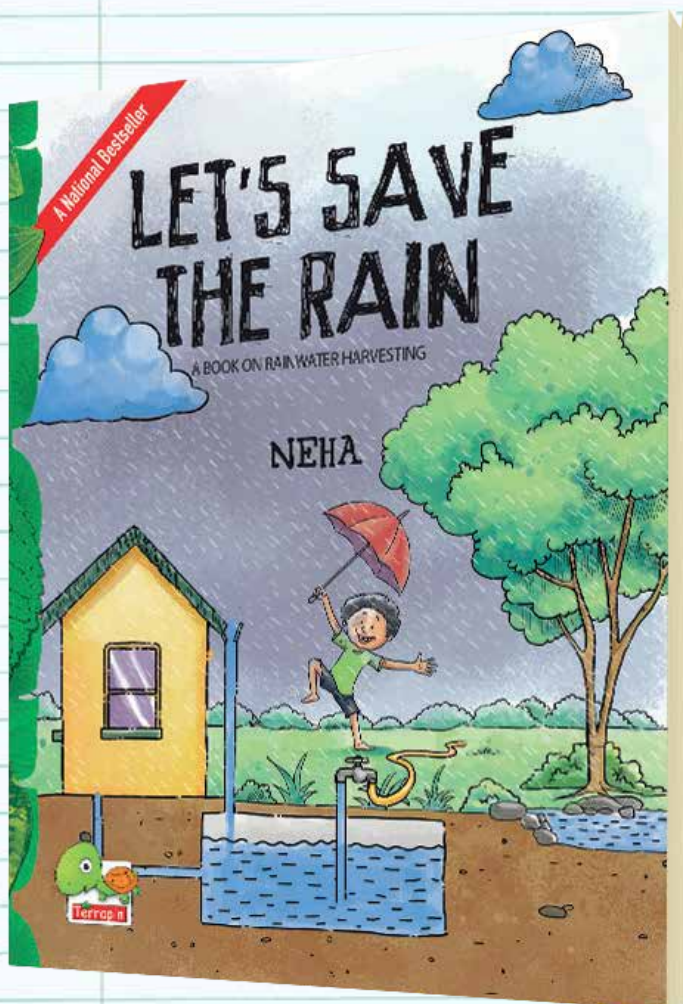
Which practices are essential to be embraced for a greener future in cathode production?

The rise of the lithium-ion battery industry has brought about environmental challenges in cathode manufacturing, primarily due to the extraction of primary materials such as lithium, nickel, cobalt, and manganese. Recycling emerges as a sustainable solution, offering multiple benefits. It conserves natural resources by reducing the demand for primary extraction, curbing energy consumption, and lowering greenhouse gas emissions in cathode production. Additionally, recycling minimizes waste, pollution, and costs associated with material extraction and processing. By fostering closed-loop production, recycling ensures a stable supply chain of critical materials and promotes a circular economy approach, vital for sustainability in cathode manufacturing. The industry is witnessing a shift towards recycling technologies, driven by collaboration and innovation, to meet the increasing demand for lithium-ion batteries sustainably. Embracing these practices is essential for a greener future in cathode production.

What is the future of energy storage?

The future of energy storage lies in embracing sustainability and innovation. By recycling used EV batteries and embracing sustainable cathode materials, we mitigate environmental impact and unlock resources for future generations. Responsible battery management, collaboration, and a commitment to sustainability are paramount as we build a greener, resilient energy ecosystem for generations to come. In this direction, cathode material recycling offers sustainable solutions, including resource conservation, energy reduction, emission cuts, waste minimization, cost efficiency, and supply chain resilience. As we transition towards a circular economy model, the importance of this approach cannot be overstated. ■

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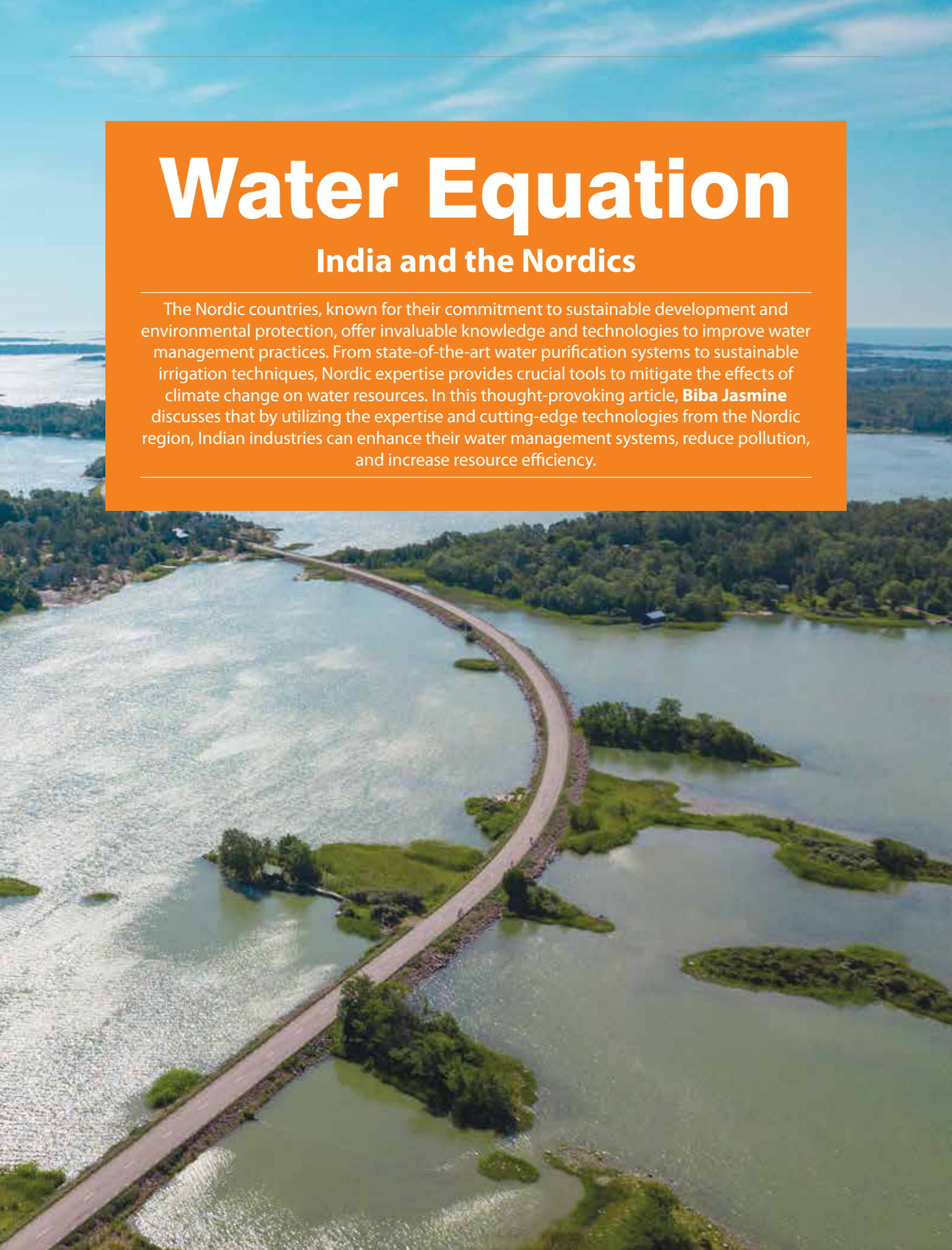
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Water Equation

India and the Nordics

The Nordic countries, known for their commitment to sustainable development and environmental protection, offer invaluable knowledge and technologies to improve water management practices. From state-of-the-art water purification systems to sustainable irrigation techniques, Nordic expertise provides crucial tools to mitigate the effects of climate change on water resources. In this thought-provoking article, **Biba Jasmine** discusses that by utilizing the expertise and cutting-edge technologies from the Nordic region, Indian industries can enhance their water management systems, reduce pollution, and increase resource efficiency.





Water serves many purposes: it is a vital necessity, a home, a local and global resource, a transportation corridor, and a climate regulator. For some, it is the destination for pollutants released into nature, while for others, it is a newly discovered mine rich in minerals to be exploited. For us to continue to enjoy clean water and healthy oceans and rivers, we need to change the way we use and treat water.

In many ways, water is a local resource. But water is also a global commodity—a common good shared by all people and all living things on our planet. Water moves through countries and connects continents. What starts as a local problem can become one of many contributors to a larger problem.

It is crucial to emphasize the importance of remembering that the phrase ‘water for all’ embodies a fundamental principle of ensuring universal access to clean and safe water for all people, regardless of their socio-economic status, geographical location or cultural background. It reflects the recognition that water is a fundamental human right and is essential for sustaining life, promoting health, ensuring livelihoods, and fostering socio-economic development.

The United Nations Sustainable Development Goals, in particular Goal 6: Clean Water and Sanitation, emphasize the importance of ensuring universal

access to water and sanitation by 2030. Clean water is recognized by the United Nations General Assembly as a fundamental human right. Clean water is essential for maintaining health and preventing waterborne diseases. Access to safe drinking water and adequate sanitation can significantly reduce the risk of diseases such as diarrhoea, cholera and typhoid, especially in developing countries where these diseases pose a significant threat to public health.

In June 2023, the World Health Organization (WHO) published a report highlighting the significant benefits of India’s flagship ‘Jal Jeevan Mission’ programme in India. It estimates that ensuring safe drinking water for all households in the country has the potential to avert



nearly 400,000 deaths annually from diarrhoeal diseases and prevent about 14 million disability-adjusted life years (DALYs) related to these diseases. Issues like these make water conservation and management much more desirable and important.

Water=Prosperity

Water is the basis of all prosperity. Without sufficient water there can be no agriculture, no industry, and no cities. So, water really is the key to prosperity and growth. The need of the hour is to invest in innovation and technology across the water and wastewater sectors, from building water infrastructure to providing advisory services to make the sector more efficient.

According to the World Bank, 4.2 billion people in the world do not have access to safe sanitation and 80 per cent of the world's wastewater is not treated properly. Around 36 per cent of the world's population lives in areas of water scarcity, and water demand is expected to increase to 55 per cent by 2050 due to rapid urbanization. Therefore, wastewater recycling can become a saviour in solving water needs and represents a huge opportunity for companies and cities to reduce their environmental impact while safeguarding water resources for citizens.

At the corporate level, if a company has successfully prioritized water reuse, it is useful to design a variety of water recycling projects and associated savings and develop models for working with surrounding communities and/or cities, which is a critical next step on the path to water security. By building and showcasing some positive efforts, companies can mitigate the energy industry's contribution to freshwater scarcity and quality issues.

Reimagining Water Ecosystem

Water and ecology, revered as life-giving forces, have played a fundamental role in the Nordic region and in India's cultural and historical ethos. India's historical practices embody a deep respect for nature and an understanding of the importance of ecological harmony. From time-honoured agricultural practices that prioritize sustainability to age-old principles of living in harmony with the environment, India's cultural and historical ethos is in tune with the principles of the green economy. Even in the Nordic countries, where water is abundant, reverence for the environment and sustainable practices are deeply rooted in history. From the ancient Nordic belief in spirits dwelling in lakes and rivers to the sustainable use of water for transportation and energy production, the connection to water has remained strong.

Partnership for Water

Partnering for water by creating better water solutions and contributing to a more sustainable future is based on the principles of shared values that emphasize knowledge sharing, innovation and mutual support to achieve the goal of a safe water supply for present and future generations—all in the midst of climate change.

The Nordic countries, known for their appreciation and progress in sustainable development and environmental protection, offer invaluable knowledge and technologies to improve sustainable water management practices. From state-of-the-art water purification systems to sustainable irrigation techniques, Nordic expertise offers important tools to mitigate the effects of climate change on water resources.

A paradigm shift is needed in wastewater treatment, where wastewater is transformed from simple waste to a valuable and rich resource. Wastewater, if managed properly, can help address other challenges, including climate change, biogas production and the creation of green jobs. To achieve this, a multi-stakeholder partnership like India Water Partnership, which has been working with the 2030 Water Resources Group (a public-private civil society platform) for the Hindon river rejuvenation efforts since 2015, is crucial. Such platforms are sustainable, intentional, long-term spaces to promote dialogue, deliberation, and joint action between social groups and organizations/businesses that are positively or negatively affected by decisions of public importance in a particular area. Co-creation increases the shared responsibility and acceptance of solutions that are jointly developed on such platforms. This makes it more likely that behavioural changes will be brought about and that different actors will be brought together in a structured dialogue.



Water Conservation and Management—through Nordic Lens

The SPRING Water Summit was organized by the India Nordic Water Forum (INWF), which acts as a joint network and platform for the private and public sectors in India and the Nordic countries. It adheres to existing EU standards and utilizes water expertise to address the challenges of the Indian water sector. The Nordic countries Sweden, Denmark, Norway, Finland and Iceland participated in the Water Summit 2024 and presented water-related initiatives, challenges, and green solutions.

The INWF creates an important platform to promote cooperation and exchange with the promise of informing stakeholders across sectors and supporting cooperation and progress on water issues. Given the fact that all the Nordic countries have excellent expertise and experience in water issues and good solutions to the challenges of the Indian water sector.

It was therefore important to deconstruct the Nordic expertise in the water sector and find out how India can best utilize it.

Sweden with its abundant freshwater resources and abundant rainfall, is a world leader in sustainable water management and innovation. Through forward-thinking policies, technologies and public awareness campaigns, it has charted a course towards water stewardship from which other countries can learn important lessons.

Advanced treatment technologies, Sweden has managed to keep its water sources untouched. Sweden was an early pioneer in centralized wastewater disposal. From the 1960s onwards, Swedish municipalities invested heavily in wastewater treatment plants and used processes such as chemical precipitation and activated sludge to remove pollutants. Today, over 95 per cent of wastewater in Sweden is treated in plants that meet stringent standards so that wastewater can be safely discharged into local lakes and rivers. State-of-the-art plants such as Hammarby Sjöstadsverk, which use ultrafiltration and biologically activated membranes to produce wastewater of drinking water quality, are now exemplary worldwide.

Seeking ever greater efficiency, Sweden has emerged as an innovator in water reuse. Technologies such as membrane bioreactors allow treated effluent to be recycled for applications like industrial processes and agricultural irrigation.

Finland has the most efficient strategy for integrated



water management, the Finnish Waterway. The Finns have also managed to successfully protect clean water through holistic governance, smart technologies and the engagement of public authorities, the private sector, and civil society.

The Finnish strategy is based on long-term capacity building and good governance, accompanied by cooperation between the public and private sectors and the active participation of civil society and local stakeholders. Together with its innovation expertise and technological know-how, Finland is now in a unique position to offer sustainable water solutions to its partners worldwide.

One of Finland's strengths is the combination of smart metering and digitalization, which offers new opportunities for more efficient water use in water-scarce areas. A practical example of this is tackling the problem of unclaimed water, which is a major problem worldwide, including here in India. Efficient data management and the use of artificial intelligence open up new opportunities to manage and monitor our environment and also address cyber security concerns. The second stronghold is Finland's expertise in industrial wastewater treatment and especially in the pulp and paper industry, where Finland has a long and strong tradition.

Norway, capital Oslo, its main river "Akers Elva" used to be a polluted and almost dead river. Today, it is the green lung of the city, where you can fish and swim. This has been made possible by long-term work and decades of sewage flushing and water restoration. Norway ranks second in the world when it comes to the best tap water. This is no coincidence. The country has special programmes to protect groundwater and other water systems, ensuring water quality for its citizens.

Norwegian water policy is based on the principles of conservation, equitable access, and environmental

responsibility. Norway places great emphasis on maintaining water quality and has strict regulations to protect against pollution from industrial, agricultural, and domestic sources. Continuous monitoring and research ensure early detection of pollution so that action can be taken quickly to reduce the risks to aquatic ecosystems and human health. Given Norway's recognized strengths in water management, it is natural for the country to collaborate with India to share knowledge and technology. Partnerships with Norway can support India's efforts to: develop new hydropower projects in an environmentally sustainable manner; improve irrigation efficiency for agriculture; manage water resources across states and jurisdictions; develop "smart city" water distribution networks; desalinate seawater for coastal cities and industries; and improve coastal and port infrastructure against flooding

Denmark is a world leader in modern technology and new water solutions, and has the highest water export per capita in Europe. In Denmark, there is a long tradition for maintaining and optimizing the operation of "old" waterworks. Many well-functioning waterworks have thus been in operation for more than 100 years. Like any new waterworks, these are closely monitored as regards operational economy and quality. Increasing manpower reductions and associated automation contribute to Denmark's extensive experience with optimal operation and maintenance procedures. Denmark is a world leader as regards aquatic environment issues and is renowned for exemplary cooperation between the public and private sectors.

Iceland has cultivated a vibrant water technology industry serving global markets. Icelandic companies are leading innovators in sustainable systems including hydro turbines, geothermal plant components, renewable energy control systems, district heating networks, and wastewater heat exchangers. Firms like



Mannvit provide consulting for large international hydro and geothermal projects. The Iceland Ocean Cluster nurtures startups focusing on sustainable utilization of marine resources. Iceland's unique expertise has made it a coveted research and commercial partner in renewable water technology. The country has truly earned its reputation as a trailblazing water wizard.

Is Water Stewardship, Answer to Strengthening Water Initiatives and Actions of Nordic Countries in India?

Water stewardship essentially focuses on using water in a way that is socially and economically beneficial while being environmentally sustainable. Through proactive and ongoing engagement with a wide range of stakeholders to ensure that stewardship measures improve local water conditions, this benefits the environment and society as a whole and has the power to create a desirable impact. The intention behind promoting stewardship in the water sector is to ensure that a greater number of companies adopt sustainable water practices. For example, companies can use their



influence to get suppliers and buyers to understand the impact of water on ecosystems and help them take action to preserve ecosystems so that water security can be strengthened.

It is All about Resilience and Sustainability

When governments and the private sector put water at the centre of their activities, this can lead to better relationships between stakeholders, customers, communities, and regulators. This can create a great potential for Nordic technology to come to India and collaborate with partners or set up manufacturing centres not only for the Indian market but also for the international market. India itself is a large market but the technical manpower and developed environment can support large-scale manufacturing with technology transfer from the Nordic countries. A partnership with the Indian industry can provide a great opportunity to serve the global market. For example, one of the Indian companies in the water sector, Vishvaraj Environment Private Limited, is keen to partner and invest in such an opportunity. There is great value in collaborating with Nordic water technologies and developing sustainable and innovative solutions that meet our challenges. Joint research and development, knowledge sharing and technology transfer can leverage the strengths of the Nordic countries to effectively address India's water challenges, improve quality, efficiency and conservation while fostering strong bilateral relationships.

The partnership between India and the Nordic countries in the field of green and clean energy is on the rise. Their commitment to combating climate change and promoting sustainable development is evident and reinforced by technological cooperation, shared expertise, and diplomatic goodwill. The alliance represents a significant step in India's transition to green

and clean energy and underscores the shared mission to create a more sustainable and environmentally conscious future. India is well on its way to achieving its green and clean energy goals and moving closer to a sustainable future.

Needless to say, all of these efforts will require a great deal of demonstration, communication and a push for effective adoption. The above suggestions are by no means exhaustive. Much has already been done, both in terms of innovation and implementation. The challenge now is to scale it up. We need to mobilize all actors, including civil society, cooperatives and the private sector, and not expect the government to provide the solution to every problem. The water problem is too big and urgent and needs to be addressed here and now.

Indian industry can benefit significantly from collaboration with the Nordic countries, which are known for their advanced water technologies and sustainable practices. This collaboration can take the form of technology transfers, joint ventures, and research & development projects. For example, Nordic innovations in water purification, wastewater management and efficient water use could be adapted to the specific needs of various sectors in India, including agriculture, manufacturing, and urban development. By utilizing the expertise and cutting-edge technologies from the Nordic region, Indian industries can improve their water management systems, reduce pollution, and increase resource efficiency.

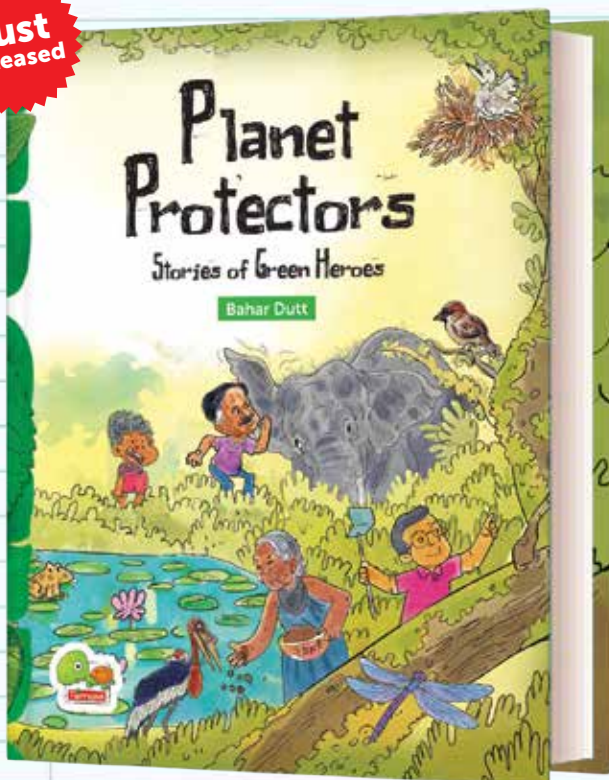
In addition, promoting partnerships through platforms such as trade agreements, sectoral conferences and bilateral summits can facilitate the exchange of knowledge and best practices between the two regions. Setting up pilot projects in key Indian locations could demonstrate the effectiveness of Nordic solutions in the local context, thus promoting wider acceptance in the industry. These joint efforts not only support sustainable development, but also open up new business opportunities and promote economic growth and innovation in both regions. Such partnerships can help solve India's critical water challenges and create a more sustainable and prosperous future. It's about rethinking, reimagining and redoing! ■

Biba Jasmine is a Nehru-Fulbright Scholar with a major in sustainable development and conservation biology at the University of Maryland, College Park, USA. She is also a Policy Leader Fellowship recipient at the School of Transnational Governance, European University Institute, Florence, Italy. She is currently working as Advisor at the Swedish Embassy in New Delhi.



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India's Carbon Market

On the Verge of Reality

In this article, **Yukta Anand** and **Prof. Asheesh Pandey** throw light on carbon market, which is soon going to be a reality for India.

India is poised to pioneer its carbon market transformation! The rapidly increasing global warming around the world has become a cause of concern for every economy today. The Paris Agreement on Climate Change and the Kyoto Protocol serve as the major guiding lights for institutions and other bodies working towards climate change, former being a landmark document.

The Paris Agreement states that the global temperature should be

increased to well below 2 degrees Celsius, while taking best efforts to keep it under 1.5 degrees. The major cause of global warming is the ever-increasing greenhouse gas (GHG) emissions. The United Nations Framework Convention on Climate Change (UNFCCC) believes that the GHG emissions should be at their peak latest by 2025 and then should decline by 43 per cent by the year 2030.

The Kyoto Protocol lays the foundation of Clean Development

Mechanism (CDM). It is a mechanism that allows a nation having an emission-reduction target to carry out an emission-reduction project in a developing country. This mechanism benefitted many developing nations such as India, Brazil, and China around the year 1997. The CDM mechanism allowed projects to earn Certified Emissions Reduction (CER), where again 1 CER was equivalent to 1 tonne of carbon dioxide. These CERs were also tradeable in the market.





Another way by which the countries can be encouraged to reduce their GHG emissions is by charging a price on their carbon emissions and incentivizing them for reductions in the emissions, thus, by treating carbon as a commodity. This is where the concept of carbon markets comes into picture. A carbon market is a tool or any market that helps to put a price on carbon, by enabling trade to be done as a carbon credit or as a carbon offset. Thus, a carbon credit acts as a trading unit for a carbon market.

Currency of Carbon Market: The Carbon Credit

A carbon credit is a general term that represents a tradeable permit or certificate representing a right to emit 1 metric tonne of carbon. Governments of many countries set up allowances allowing the industrial entities coming under their jurisdiction to emit a certain amount of carbon, which is usually based

on the country's emission targets. The entities that have emitted lesser amount of carbon than permitted may sell their surplus or extra allowances as credits, which can be purchased by entities proposing to emit or actually emitting more carbon than allowed.

These markets don't just exist in theory, but have practical implications too, especially for emerging nations such as India, that have two-fold objectives of meeting reduction in emissions and of ensuring sustainable economic growth. As of December 2023, the total number of CDM projects in India stood at 1703.¹

Carbon Markets: Global Penetration

There are majorly two kinds of carbon markets—compliance and voluntary. Compliance carbon markets, as the name suggests, are primarily government-regulated carbon markets where the

government sets a cap on the total GHG emissions allowed in a country across a certain period of time. This cap is divided into various number of allowances and distributed among the entities (mostly through auction process). If any entity crosses its allowed carbon limits, it has to buy the required additional allowances from another entity that has surplus of them. Such a system leads to the establishment of an Emission Trading System (ETS) that works on a 'cap-and-trade' principle. The price of a carbon credit in an ETS depends on the demand and supply factors.

Voluntary carbon markets, true to their name, are the ones which act as a platform for institutions, organizations and even individuals to do their part in helping to reduce emissions. They do so mostly as a part of their CSR strategies. The carbon credits in such markets are acquired with the help of brokers or project developers. The credits are required to be verified by an independent, third-party institution like Gold Standard Foundation and Verra. The

¹ Details available at <https://india.mongabay.com/2023/12/explainer-what-are-carbon-markets/>

voluntary market was worth \$2 billion in the year 2021. Many experts have claimed that the voluntary market can lie anywhere between \$10 billion and \$40 billion by the year 2030.²

Voluntary markets usually pave way for offset (project-based) approach. In this mechanism, the reduction in emission is measured against a baseline scenario which is estimated assuming that there will be higher emissions if this project would not materialize. These reduced emissions serve as coupons or 'offsets' for buyers to make emissions elsewhere. In this case, the units are credited to the buyers post-verification and proper certification.

The most prominent ETS exists in the European Union (EU). EU ETS started in the year 2005 and is the oldest ETS in force. It was established under the 'European Green Deal' and uses auctioning to distribute emissions among the covered entities. The system is now operating in its fourth phase (2021–2030). From 2024, emissions from maritime transport are also included in the EU ETS. Other sectors already covered under the EU ETS include power, industry, and domestic aviation.

The California cap-and-trade programme is the second-most prominent ETS that began operations in the year 2012. It covers emissions from sectors such as power, transport, industries, and real-estate. Auction and free allocation methods are used to distribute allowances among the entities. The funds that are raised from the auction are used to fund initiatives that cut emissions and improve the environment, public health, and economy—particularly in underprivileged areas.

The Indian Story

The Ministry of Power (MoP), Government of India (GoI) and the

² Details available at <https://www.bcg.com/publications/2023/why-the-voluntary-carbon-market-is-thriving>



Bureau of Energy Efficiency (BEE) have notified in June, 2023 the establishment of Carbon Credit Trading Scheme (CCTS) and the setting up of Indian Carbon Market under the ambit of Energy Conservation Act, 2001.

The scheme is currently in force and aims to set emission reduction targets under various selected sectors which

are yet to be named by the MoP. The Ministry will list the obligated entities (those that will be required to register for the scheme) and shall also fix emission intensity targets which will then be handed over to the Ministry of Environment, Forest and Climate Change (MoEFCC). The MoP will be guided by the recommendations





of the BEE in discharging its duties, which will act as the administrator of the scheme. The BEE will also be the carbon-credit issuing authority and will also discharge the duty of accrediting verifying agencies. Moreover, the Central Electricity Regulatory Authority (CERC) will be acting as a regulator to maintain oversight on the trading of the credits. A meta-register of all obligated entities and of all the trading transactions will be maintained by the Grid Controller of India (GCI). To regulate all this, a national steering committee (NSC) consisting of the secretaries and the joint secretaries of the MoP and the MoEFCC, and other expert members from the CERC and GCI will be formed to assist the BEE and overlook the entire mechanism of the scheme. India's carbon market will also function in two forms—compulsory and voluntary.

Another important notification is related to the setting up of Carbon Trade eXchange (CTX) India, a partnership of CTX, world's first voluntary carbon exchange, with SASA ENVIRO, which is an Indian environmental and agricultural solutions provider based in Chennai. This will enable Indian brokers, corporates and institutions to have a handy access to various multiple projects listed on CTX worldwide having millions of carbon credits.

In the last few years, India also witnessed the implementation of Perform, Achieve, and Trade (PAT) Scheme which was established under the National Mission for Enhanced Energy Efficiency (NMEEE). The aim of the scheme is to enhance industrial efficiency and it enabled the trade of energy-saving certificates. The years 2008 and 2009 witnessed the formation of Indian Energy

Exchange (IEX) and Power Exchange India Limited (PXIL). These are institutes facilitating trading of power offering trading and transmission clearance simultaneously. Additionally, PXIL has announced in March, 2024 that it intends to introduce its carbon-credit trading platform by the second quarter of the upcoming financial year (FY25), as the platform's technology is currently being developed. It is anticipated that each of the nation's three power exchanges—Indian Energy Exchange Ltd., Power Exchange India Ltd., and Hindustan Power Exchange Ltd.—will create a distinct platform for trading carbon credits. Thus, it can be said that carbon market is soon going to be a reality for India. ■

Yukta Anand, Research Scholar, Indian Institute of Foreign Trade (IIFT), Delhi and Prof. Asheesh Pandey, Professor (Finance), IIFT, Delhi.

Embracing Climate Disclosure Governance

India's Banking Sector's Resilient Step

With the introduction of the 'Disclosure Framework on Climate-related Financial Risks (2024)' by RBI, it is quite apparent that the banking sector is continuously striving towards sustainability and climate sensitization. The new framework evolves the narrative, acknowledging the inevitability of climate change affecting these entities and, consequently, the broader financial stability. The framework not only acts as a means to inform the various stakeholders about climate-related issues but also to develop a narrative of financial resilience in the face of unprecedented challenges related to climate risks. **Naman Mishra** and **Dr Megha Jain** say that the framework is built upon four main pillars—Governance, Strategy, Risk Management, and Metrics & Targets. Keep reading to know more...

The foreboding challenge of climate change has been a threat to the whole global community. The role of the banking sector remains pivotal for developing nations such as India. With the introduction of the 'Disclosure Framework on Climate-related Financial Risks (2024)' by RBI, it is quite apparent that the sector is continuously striving

towards sustainability and climate sensitization.

Looking at the concept of financial stability, the role played by risk assessment has been an irreplaceable one. This is visible in the introduction of the discussion paper by RBI in 2021 which highlights the relationship between the various sources of climate

risk and their impact on regulated entities (REs).

The new framework evolves the narrative, acknowledging the inevitability of climate change affecting these entities and, consequently, the broader financial stability. Mitigating the effects of climate change requires just more than acknowledgement; it requires prompt





actions and as such these REs must not only adapt to the changing challenges but also cater to the financial instability in a sustainable economy. It calls for the implementation of robust climate-related financial risk management policies. This framework is not only a regulatory requirement but it also fulfils the duty of the bank as a custodian of the financial system to safeguard it against climate-induced shocks.

Nurturing Transparency through Standardized Disclosure—at its core is a call for standardized disclosure. The rationale is clear, i.e., insufficient information about climate-related financial risks can lead to mispricing of assets and misguided capital allocation. These aim to rectify and contribute to the same by fostering better, consistent and comparable disclosure practices among regulated entities. The framework not only acts as a means to inform the various stakeholders about climate-related issues but also to develop a

narrative of financial resilience in the face of unprecedented challenges related to climate risks. The framework is built upon four main pillars—Governance, Strategy, Risk Management, and Metrics & Targets to help REs to follow upon. It calls upon them to follow these four pillars to articulate their actions and plans concerning climate-related financial risks.

Governance

Transparency as the cornerstone: In the framework, governance takes centre stage demanding from the financial institutions a report on how the various climate-related risks are being tackled. It also calls for the REs to share with the world the various skills and learnings that they have developed in the course of mitigating such complex climate finance problems.

Strategy

Navigating uncertainty with resilience: In terms of implementation and strategy

development, it directs the REs to detail and document the various implications of the climate-related risks and the areas where improvements could be made. As such, the need to integrate climate resilience into the business model is stressed upon, to be fairly able to navigate these new and unprecedented challenges.

Risk Management

Anticipating, assessing, and mitigating: Another aspect of climate resilience focused by the framework is risk management, which demands a thorough and detailed understanding of how the various entities/financial institutions evaluate the nature, likelihood and magnitude of climate-related financial risks. The framework calls for a comprehensive approach to cover every aspect from credit risks to operational risks, thereby ensuring that every consideration from the climate aspect is taken under consideration.



Metrics and Targets

Illuminating the path to a sustainable future: The final part of the framework stresses the importance of using Metrics and Targets. REs have been urged not only to set targets but also to detail their progress using metrics while progressing towards climate-related risks. The framework urges the various entities to be transparent in providing information regarding greenhouse gas emissions, and

financed emissions so that they could be aligned with the national targets.

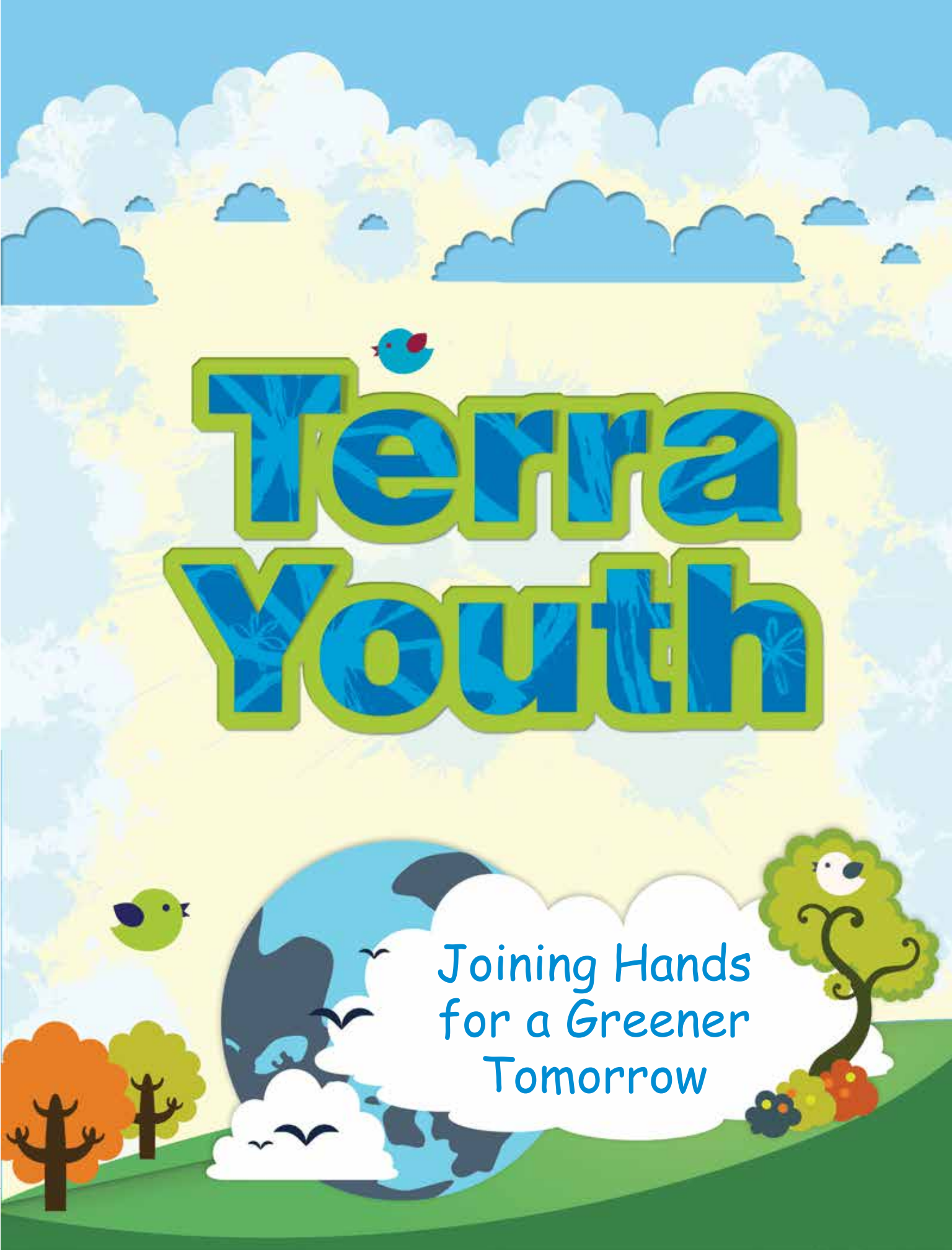
In all, the framework is a comprehensive implementation plan which serves as a guiding pathway for the various entities based on their categories. The framework is expected to be adopted by every financial institution like scheduled commercial banks, All India Financial Institutions, and NBFCs from the financial year 2025–26, with 2026–2027 serving as the year for the

Urban Co-operative banks are going to be part of the same. The adoption of the guidelines issued has not been made mandatory, demonstrating that the framework is not only transformative but also flexible. One could argue that this framework is not only a regulatory framework but also a tool for the various institutions to assess their roles and responsibilities in the changing scenario of climate-related risks. It presents an opportunity to call for innovation and a contribution towards a sustainable economy.

The framework requires a call to action, urging financial institutions to not only weather the storm but to emerge as a beacon of resilience in the face of climate uncertainty.

Disclaimer: There is no affiliation of the current piece to any institution or any person. Views are personal. ■

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Terra Youth

Joining Hands
for a Greener
Tomorrow

The Vanishing Bristled Grassbird

In this article, **Dr Surya Prakash** tells us about the bristled grassbird, known scientifically as **Chaetornis striatus**. Endemic to the Indian subcontinent, the bristled grassbird finds itself perilously perched on the brink of endangerment, classified as a 'Vulnerable Species' by the IUCN since 2010. The relentless decline in its population can be attributed primarily to habitat loss. Keep reading to know more...

The bristled grassbird, known scientifically as *Chaetornis striatus*, and also fondly referred to as the bristle grass warbler, casts a cloak of mystique over the hearts of many across India, Nepal, Bangladesh, and Pakistan. Despite the diligent efforts of previous generations of bird watchers and scholars, including luminaries such as Ali Ripley (1987), Roberts (1992), Grimmett, *et al.* (1998), and Bird Life International (2001),¹ the enigma surrounding its residency status in places like Delhi–NCR persists. Various theories swirl around this globally threatened, endemic species of the Indian subcontinent.² Among these, the prevailing consensus, one that I find myself aligning with, suggests that the bristled grassbird locally migrates to Delhi–NCR with the advent of the South–West monsoon, settling for its breeding season between July and September, only to retreat to the South–Eastern regions post-breeding season. However, the scarcity of concrete data on its seasonal movements necessitates reliance on historical databases regarding



its non-breeding habitats (Baral, H.S., 1997a & 2004; Rasmussen and Anderton, 2005).³

Often mistaken for its close cousin, the striated grassbird (*Megalurus palustris*), due to shared habitats, the bristled grassbird possesses distinguishing features. Notably, the five pairs of stout

rectal bristles, which form protective barriers around its eyes during foraging and nesting forays.⁴

Habitat and Its Diminution

Endemic to the Indian subcontinent, the bristled grassbird finds itself perilously

1 Details available at BirdLife International (2001) Threatened birds of Asia: the BirdLife International Red Data Book. Cambridge, UK: BirdLife International.

2 Details available at Inskipp, T.P. (1996) Little-known Oriental bird: Bristled Grassbird *Chaetornis striatus*. *Oriental Bird Club Bull.* 24: 46–47.

3 Details available at Rasmussen, P.C. & Anderton, J.C. (2005) *Birds of South Asia: the Ripley guide*. Washington, DC and Barcelona: Smithsonian Institution and Lynx Edicions.

4 Details available at Ali, S & Ripley, S.D. (1973) *Handbook of the birds of India and Pakistan*, 8. Bombay: Oxford University Press.

perched on the brink of endangerment, classified as a 'Vulnerable Species' by the IUCN since 2010. The relentless decline in its population can be attributed primarily to habitat loss. The marshlands, wetland-grasslands, and riverine banks, adorned with an abundance of *Saccharum* species, *Imperata* spp., *Desmostachya* spp., and other vital grasses that the bird favours for nesting and roosting, face an existential threat. These very habitats, thriving across Delhi-NCR and serving as fodder for domestic cattle in regions like Delhi, Haryana, Uttar Pradesh, and Gujarat, are dwindling at an alarming rate. Anthropogenic pressures, including overgrazing, rampant developmental activities, and the conversion of land into agricultural fields, further compound the crisis. The insidious influx of industrial waste, laden with toxic substances and traces of heavy metals, poisons the very sanctuaries that sustain these delicate ecosystems.

Breeding and Courtship

The bristled grassbird orchestrates a breathtaking courtship ballet, synchronized with the monsoon's arrival in Delhi-NCR. Their breeding season, spanning July to August, offers a fleeting glimpse into their secretive world. The male, with his distinctive two-note call, 'wheet-s-s-s-stchew,' stakes territorial claims and woos potential mates with aerial acrobatics that rival fighter jets in prowess. Despite the clamour of courtship, locating their nests remains a Herculean task. However, tantalizing records from Nepal (Baral, H.S. et al., 2000)⁵ and field observations in Uttar Pradesh (Anand Arya, 2010)⁶ offer tantalizing insights into their nesting habits.

5 Details available at Baral, H.S., Wattel, J., Brewin, P.A., et al. (2014) Status and distribution of the globally threatened Bristled Grassbird *Chaetornis striata* (Jerdon, 1841) (Fam. Sylviidae) in Nepal. The Initiation 5: 1-15.

6 Details available at Arya, A. (2010) Bristled Grassbird *Chaetornis striatus*—a breeding record in Uttar Pradesh. 14: 95–98.



Conservation and Challenges

As habitat loss accelerates, the urgency for conservation interventions intensifies. Sustainable cattle grazing practices, particularly during the monsoon, are imperative to mitigate overgrazing's toll on nesting sites. Efforts to curb soil erosion through reforestation, especially along riverine floodplains, are critical to the survival of these habitats. Stringent governmental measures to curb industrial pollution and pesticide use are indispensable to safeguard the microhabitats vital for avian sustenance. Only by restraining anthropogenic stress

and developmental encroachments can we secure the future of not just the bristled grassbird but also countless other species.

In the poignant words of Ruskin Bond, "If we have eyes to see, and ears to listen, the world is never without things to soothe the hearts. Each day there is birdsong and moonlight, flowers and old familiars, food to satisfy our hunger and water to quench our thirst." Let us heed his wisdom and strive to preserve the symphony of life that surrounds us. ■

Dr Surya Prakash, PhD (Retired), Member- BNHS, IBCN, WWF, School of Life Sciences, Jawaharlal Nehru University, New Delhi.

Bizarre Facts

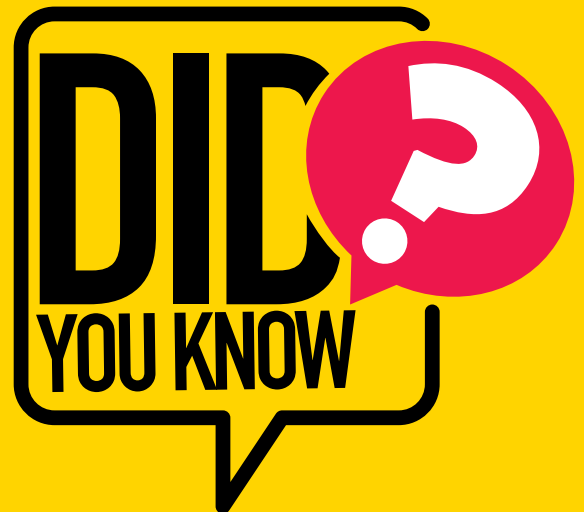


1. The Statue of Liberty was once a lighthouse.
2. A blue whale's heartbeat can be detected up to 2 miles away.
3. Native to Central and South America, a fruit called black sapote tastes like a combination of sweet custard and chocolate.
4. Ketchup used to be sold as medicine.
5. Dolphins give each other names.
6. A blue whale's tongue can weigh as much as a young elephant.
7. You could fall through the centre of the Earth in 42 minutes.
8. Hawaii gets 3 feet closer to Alaska every year.
9. Deaf people use sign language in their sleep.
10. Animals can be allergic to humans.



Did You Know?

- Sloths can hold their breath longer than dolphins.
- The letter "J" was the last added to the English alphabet.
- The moon has moonquakes.
- Humans have tongue prints.
- The Eiffel Tower was supposed to be in Barcelona.
- Dogs have a unique nose print.
- Giraffes are much more likely to get hit by lightning than humans.
- Identical twins don't have the same fingerprints.
- Almonds are part of the peach family.
- Bees may fly up to 60 miles in one day.



Source: <https://www.weareteachers.com/weird-fun-facts/>

ISA Cares Initiative

Mauritius Advances in Solar Energy at Jawaharlal Nehru Hospital

Mauritius, in line with the International Solar Alliance (ISA) Cares Initiative, launched in October 2020, has made significant strides in solarizing its primary healthcare facilities. This initiative, aimed at solarizing primary health care centres in Small Island Developing States (SIDS) Member Countries, has not only seen Mauritius receive a substantial grant to further its clean energy goals but also brought about tangible improvements in the healthcare facilities. The Ministry of Health and Wellness, in collaboration with the Ministry of Energy and Public Utilities, the Central Electricity Board and the Development Bank of Mauritius, implemented the project promptly and efficiently, enhancing the healthcare services in the process.

ISA has inaugurated a 25-kilowatt solar rooftop project at Jawaharlal Nehru Hospital in Mauritius. This hospital currently consumes 141,846 units of electricity monthly, costing approximately 1.2 million Mauritian rupees. With the newly installed solar PV panels, the hospital is set to produce 3200 units of electricity per hour, substantially reducing its fixed electricity costs. This reduction in energy costs will enable the hospital to reallocate funds towards enhancing the quality

of healthcare services provided to the public.

In 2021, Mauritius was awarded a grant of 50,000 US Dollars (approximately 2.3 million Mauritian rupees) to install around 25 kilowatts of solar panels at Jawaharlal Nehru Hospital. This pilot project, co-financed by the Ministry of Health and Wellness and the Development Bank of Mauritius, has successfully installed a 26.4-kW solar rooftop system. The success of this project has not only bolstered confidence in the feasibility of replicating such initiatives across public buildings in the country but also defined the path towards a sustainable and brighter future for all Mauritians. The formal grant agreement between the Ministry of Health and Wellness and the International Solar Alliance was signed on October 31, 2023, marking a significant milestone in the collaboration. These aspects were touched upon by the Hon'ble Ministers of Health and Wellness & Energy and Public Utilities in their inaugural remarks announcing the solar project's successful completion and operationalization.

Dr Ajay Mathur, Director General of ISA, noted, "This initiative highlights Mauritius's commitment to renewable energy and the successful

implementation of solar technology in public health infrastructure, showcasing the country's progress towards sustainable energy solutions. Floating solar, agro-photovoltaics, and rooftop solar are innovative solutions that can enhance earnings for the Mauritian people, provide new jobs, and help the government secure its goal of generating 60 per cent of its electricity by 2030 with solar. ISA remains a steadfast partner in Mauritius's clean energy transition journey, enthusiastically supporting the nation's efforts to meet its renewable energy goals by 2030."

In the long term, the Mauritian government is committed to maximizing the use of solar PV panels across all government institutions, including public health infrastructure. This initiative aligns with Mauritius's target of achieving 60 per cent renewable energy in its electricity mix by 2030. The maturity and viability of rooftop solar technology make it a pivotal solution for increasing solar energy penetration in Mauritius.

The solarizing initiative at Jawaharlal Nehru Hospital in Mauritius was inaugurated on June 3, 2024 by the Hon'ble Kailesh Kumar Singh Jagutpal, Minister of Health and Wellness and Hon'ble Georges Pierre Lesjongard, Minister of Energy and Public Utilities in the presence of Hon'ble Mahen Kumar Seeruttun, Minister of Agro-Industry and Food Security; Hon'ble Naveena Ramyad, Minister of Industrial Development, SMEs and Cooperatives; Hon'ble Teenah Jutton, Parliamentary Private Secretary; and H.E. K Nandini Singla, the High Commissioner of India in Mauritius, and senior officials from the Ministry of Energy, Ministry of Health, Mauritius Development Bank and the International Solar Alliance.



Lady Banks' Rose

A Lady's Shady Rose

The world may have been having an irate look towards China, cursing her for COVID-19 virus, assertions in South China Sea, and her alleged expansionist policies and so on. Whether she really deserves these insinuations may be a matter of academic discussions; there however, is no denying to the fact that the old Dragon has bestowed the world with things beautiful enough to capture anybody's attention, writes **Rajshekhar Pant**.

One of the most unusual varieties of creeper roses—which may go as high as 50 feet, cover an area of 5000 square feet with the girth of its main trunk as enormous as 14 feet—is a unique gift from China to the rest of the world. Now commonly known as Lady Banks' Rose, it was originally grown over the centuries in the central and western provinces of China. Provinces of Gansu, Henan, Yunnan, Sichuan and Hubei happened to be its home. Way back in the first decade of the nineteenth century William Kerr, a Scottish plant collector, was sent to China for the first time by Sir Joseph Banks, an eighteenth-century botanist from England, for a massive

plant hunt. A veteran of seafaring with Captain Cook, Sir Joseph was the person who introduced the western world with eucalyptus and advised the then King George III to establish the Royal Botanic Garden at Kew. William Kerr sourced the original white variety of this rose from Fa Tee nursery in China to England where it was named after lady Dorothea Banks—the accomplished wife of Sir Joseph Banks, then the Director of Kew garden. Lady Banks was herself an avid collector and connoisseur obsessed with all things Chinese. Of her rich legacy just a manuscript has survived which speaks at length of her best Chinaware and collection methodologies. Certainly, this



precious gift from China could not have earned a better name than Lady Banks' Rose or *Rosa banksiae* as the botanists would call it.

Its another cultivar, the thornless yellow version, arrived in England through JD Parks in 1824. It is said to be the first yellow climbing rose in Britain. Banksiae roses got distributed throughout the colonial empire in nineteenth century itself. As early as 1860 both white and yellow forms were there in the catalogue of William Hayes' Nursery in Nelson, New Zealand. In India the Royal Horticulture Society in Kolkata's Botanic Garden was the first to have it in



the first half of the eighteenth century. Unfortunately, this stunning flora is disappearing quite speedily here and is confined to a few hill stations in north India as an uncared-for legacy of British Empire. Incidentally, world's largest rose



bush at Tombstone in Arizona is also a banksiae. Its vitals have been referred to in the beginning. It is Guinness certified and has a very interesting story which goes back to 1884. Immediately after his marriage Henry Gee, a Scottish miner left for Arizona with his bride Mary. They initially boarded a hostel namely Cochise run by one Amelia Adamson. The homesick Mary became friendly with her and in the spring of 1885 when she received from her family at Scotland a box consisting of the rooted cuttings of banksiae, which she had planted as a child, she shared these with Amelia. They planted one of these cuttings near the woodshed in the backyard of the boarding house. How a rose from Scotland managed to thrive in the desert of Arizona is a mystery. By 1920 the boarding house got transformed into a hotel and the old woodshed got replaced by a trellis. The enormous size of rosebush by then had become an attraction. In 1933, John Hix in his famous

column 'Strange As It Seems' referred to it as the "largest rose tree in the world". Shortly, the hotel was renamed as The Rose Tree Inn. In 1936, Robert Ripley stayed in this hotel and what followed was the inclusion of this 'bush with a gnarled trunk' in his widely syndicated column 'Believe it or not'. Its status in The Guinness Book of World Records also has never been challenged. An annual rose festival is held here every year in April and rose lovers from all over the world attend it.

This easy to grow, least demanding and disease resistant ancient species from the east, once used for treating advance stages of gangrene and leprosy, is in the dire need of attention from those who care for environment and plants. ■

Mr Rajshekhar Pant is an amateur filmmaker, photographer, and writer, who has written over a thousand write-ups, reports, etc., published in the leading newspapers and magazines of the country. He can be reached at pant.rajshekhar@gmail.com



Advanced Artificial Intelligence: A Revolution for Sustainable Agriculture

The rise of advanced artificial intelligence (edge AI) could well mark the beginning of a new era for sustainable agriculture. A recent study proposes a roadmap for integrating this technology into farming practices. The aim is to improve the efficiency, quality and safety of agricultural production, while addressing a range of environmental, social, and economic challenges. One of the main objectives of sustainable agricultural practices is to efficiently feed a growing world population. Digital technology, such as artificial intelligence (AI), can bring substantial benefits to agriculture by improving farming practices that can increase the efficiency, yield, quality and safety of agricultural production. Edge AI refers to the implementation of artificial intelligence in an advanced computing environment. "This technology enables calculations to be carried out close to where the data is collected, rather than in a centralized cloud computing facility or off-site datacenter," explains Moussa El Jarroudi, researcher in Crop Environment and Epidemiology at the University of Liège (Belgium).

Source: <https://www.sciencedaily.com/>

Does Exercise in Greenspace Boost the Individual Health Benefits?

Health practitioners and fitness buffs have long known that regular physical activity offers numerous health benefits, including the prevention of chronic conditions such as cardiovascular disease, diabetes, some cancers, and osteoporosis. In addition, exercise enhances immune function and pain control, reduces fall risk and extends life expectancy. Mental health benefits include improved mood, reduced anxiety and decreased risk of dementia and depression. Studies have also found that outdoor places such as parks and trails are effective settings for physical activity. The COVID-19 pandemic made this especially clear. Moreover, being in nature provides physical and mental health benefits similar to those of physical activity.

Source: <https://www.sciencedaily.com/>



To know more... Read



RECLAIMING THE BLUE EARTH CONNECTING PEOPLE WITH WATER-RELATED ISSUES

Neha and Pragya Gaur

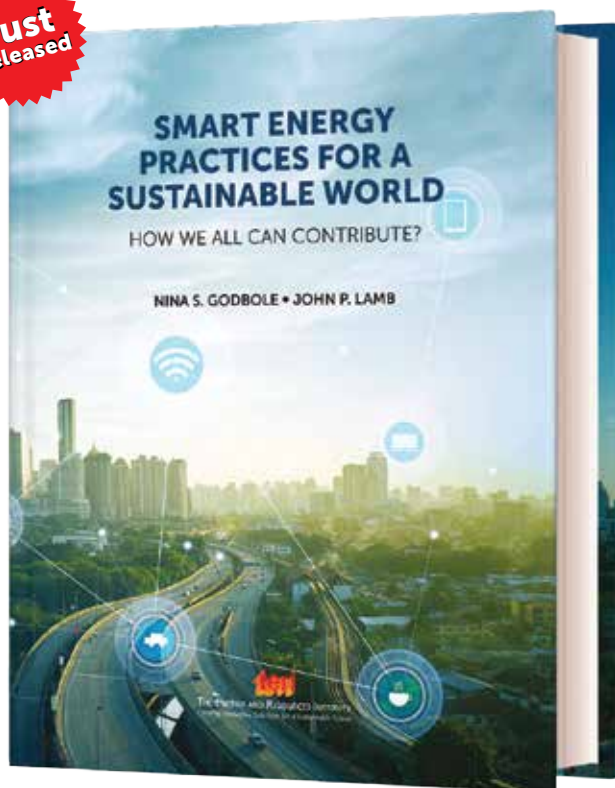
Reclaiming the Blue Earth aims to generate awareness and develop consciousness about water use, reuse, and reclamation. The book also makes the readers realize their strength and role; change their thoughts, perspectives, and attitude towards the use and misuse of water. Contents are developed to sensitize people towards the use and reclamation of wastewater through critical thinking and problem-solving. The text has been supplemented with simple solutions for effectively dealing with potential problems related to water at homes and in the community at large. Let us take a step forward to save water for our future generations.

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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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Water Sustainability

Flexible approaches for managing and conserving water resources

In this article, **Vijeta Thakur** and **Dr S K Bhardwaj** discuss innovative technologies for water conservation along with urban water management solutions. They also explore policy and governance approaches regarding water conservation. Implementing Integrated Water Resource Management (IWRM) helps coordinate the management of water resources across different sectors and stakeholders, balancing competing demands and ensuring sustainable use. Developing transparent and equitable water allocation systems, coupled with appropriate pricing mechanisms that reflect the true value of water, can incentivize conservation and efficient use while ensuring access for all.

Did you know that roughly half of the world's population is experiencing severe water scarcity for at least part of the year and 2.2 billion people in the world still live without safely managed drinking water, including 115 million people who drink surface water?

Beyond a mere statistic, the above dire situation underscores a fundamental injustice and a looming

crisis that touches every corner of our planet. It is a stark reminder of the profound inequalities that persist in our world today and the urgent need for collective action to address this pressing humanitarian issue. Understanding the root causes of this crisis reveals a complex web of factors, including population growth, unsustainable water management practices, pollution, climate change-

induced droughts, and inadequate infrastructure. These interconnected issues exacerbate each other, creating a vicious cycle that perpetuates water scarcity and threatens the well-being of communities worldwide. The consequences of global water scarcity ripple far and wide, affecting not only access to drinking water but also food security, public health, economic development, and environmental sustainability. Communities are forced to contend with reduced crop yields, increased food prices, waterborne diseases, displacement, and conflicts over dwindling water resources. Moreover, ecosystems suffer as water scarcity disrupts natural habitats and exacerbates biodiversity loss. The ramifications of this crisis are profound and demand immediate attention from policymakers, businesses, and individuals alike. Addressing global water scarcity requires a concerted effort on local, national, and international levels. It demands innovative solutions, sustainable practices, and a commitment to equity and justice. By working together to implement effective water management



strategies, promote conservation efforts, and invest in infrastructure, we can ensure a future where clean and safe water is accessible to all. The time to act is now, before the wells run dry and the consequences become irreversible. Let us rise to the challenge and secure a more water-secure and sustainable world for generations to come.

Innovative Technologies for Water Conservation

Innovative technologies for water conservation are crucial in addressing the global water crisis. One such technology is smart irrigation systems, which utilize sensors and data analytics to optimize water usage in agriculture by delivering water directly to plants when and where it's needed, reducing waste. Additionally, advancements in desalination technologies have made it more energy-efficient and cost-effective to convert seawater into freshwater, offering a sustainable solution to water scarcity in coastal regions. Furthermore, the development of leak detection systems using drones and satellite imagery helps identify and repair water infrastructure leaks promptly, minimizing water loss in urban areas. Nanotechnology also plays a role, with nanomaterials being used to filter and purify water at the molecular level, improving access to clean drinking water. These innovative technologies offer hope for conserving water resources ensuring a sustainable future for generations to come.

Sustainable Agricultural Practices

One key approach is the adoption of precision irrigation techniques, such as drip irrigation and micro-sprinklers, which deliver water directly to plant roots, minimizing wastage through evaporation or runoff. Implementing agroforestry systems, which integrate trees into farming landscapes; helps reduce water runoff and soil erosion

while enhancing water retention in the soil. Conservation tillage methods, like no-till or reduced tillage, help maintain soil structure, allowing water to infiltrate more efficiently and reducing water loss through surface runoff. Moreover, the use of cover crops helps improve soil health and water retention, further reducing the need for irrigation. By integrating these sustainable agriculture practices, farmers can mitigate water stress, enhance resilience to drought, and contribute to the long-term conservation of precious water resources.

Urban Water Management Solutions

Urban water management solutions are critical for ensuring sustainable and efficient use of water resources in densely populated areas. The implementation of green infrastructure, such as green roofs, permeable pavements, and rain gardens, help capture and absorb rainwater, reducing stormwater runoff and mitigating urban flooding. Additionally, decentralized water treatment systems, like constructed wetlands and biofiltration systems, offer cost-effective alternatives to traditional centralized wastewater treatment plants, improving water quality and reducing the strain on existing infrastructure. Smart water metering and monitoring technologies enable real-time tracking



of water usage, empowering both utilities and consumers to identify and address inefficiencies and leaks promptly. Furthermore, public education and outreach programmes play a vital role in promoting water conservation practices and fostering a culture of water stewardship within urban communities.

Community-based Water Conservation Projects

These projects are vital initiatives that empower local residents to take ownership of their water resources and promote sustainable practices. These projects often involve collaboration between community members, local organizations, and government agencies to address water challenges collectively. Rainwater harvesting systems capture and store rainwater for various uses such as irrigation, landscaping, and non-potable indoor uses, reducing reliance on municipal



Aerial view of agriculture plowed field. Minimal tillage for healthier soils.

water supplies. Community-led water education and outreach programmes raise awareness about the importance of water conservation and provide practical tips for reducing water consumption at the household level. Additionally, participatory watershed and springshed management initiatives engage residents in monitoring and restoring local water ecosystems, fostering a sense of environmental stewardship and community cohesion. Conducting water audits in collaboration with local utilities or environmental organizations helps identify areas where water is being wasted and provides recommendations for improving efficiency, such as fixing leaks or upgrading appliances. Establishing networks of community volunteers to monitor water usage, leaks, and quality in their neighbourhoods facilitates early detection of issues and promotes collective action to address them effectively.

Policy and Governance Approaches

Implementing Integrated Water Resource Management (IWRM) approaches helps coordinate the management of water resources across different sectors and stakeholders, balancing competing demands and ensuring sustainable use. Developing transparent and equitable water allocation systems, coupled with

appropriate pricing mechanisms that reflect the true value of water, can incentivize conservation and efficient use while ensuring access for all. Enacting and enforcing regulations to protect water resources, including water quality standards, pollution control measures, and groundwater management regulations, helps prevent overexploitation and degradation of water sources. Developing comprehensive drought management plans that incorporate early warning systems, emergency response measures, and long-term adaptation strategies helps mitigate the impacts of droughts on water availability and ensure resilience. Engaging diverse stakeholders, including communities, indigenous groups, businesses, and civil society organizations, in decision-making processes fosters ownership, promotes inclusivity, and increases the effectiveness of water management initiatives.

Corporate Water Stewardship

Corporate water stewardship refers to the responsibility and actions taken by businesses to manage their water use sustainably, protect water resources, and address water-related risks. Water Footprint Assessment by conducting a thorough assessment of

water use throughout the supply chain, including direct operations, agricultural sourcing, manufacturing processes, and product life cycles, helps companies understand their water footprint and identify areas for improvement. Setting Water Targets by establishing specific, measurable targets to reduce water consumption, improve water efficiency, and minimize water pollution helps drive progress and accountability in corporate water stewardship efforts. Water Risk Assessment by identifying and assessing water-related risks, such as physical scarcity, regulatory constraints, reputational risks, and supply chain disruptions, enables companies to prioritize actions and implement mitigation measures to safeguard their operations and reputation. Communicating transparently about water stewardship efforts, performance, and progress through sustainability reporting and disclosure platforms, such as the CDP Water Security Questionnaire or the CEO Water Mandate, enhances accountability and builds trust with stakeholders.

Addressing water scarcity demands a multifaceted approach that integrates both technological innovation and behavioural changes. By implementing efficient water management practices, investing in infrastructure upgrades, promoting water conservation measures, and fostering community engagement, we can mitigate the impacts of water scarcity and ensure sustainable access to this vital resource for current and future generations. Collaboration among governments, industries, communities, and individuals is essential to effectively manage and conserve water resources, safeguarding our planet's most precious resource for the well-being of all. ■

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Eco-conscious and Sustainability-focused Brand Kheoni

Paving the Way for a Greener Future

“If you really, truly are into sustainability, you cannot operate in isolation. You need to be transparent.”
-Khayal Garg, Green Warrior

It is a well-known fact that beauty and cosmetic products use palm oil as a vital ingredient, but have you ever wondered what impact this has on biodiversity? Studies suggest that the use of palm oil in beauty products represents approximately 7 per cent of the European markets and a staggering 10 per cent of the global markets. The result is depleting forest covers!

Palm oil is used by the biggest of self-proclaimed sustainable, inclusive and exclusive beauty brands, not only for its skin-benefits but also because of how reasonable it is to source. But is it ethical to opt for affordability at the cost of our environment when there are more beneficial alternatives out there? Let us try and find answer to this question.

The Detrimental Effects of Palm Oil Production on the Environment

The global demand for palm oil is so high that large areas of rainforests are cut down and burned to make way for palm oil plantations. This deforestation severely impacts biodiversity, destroying habitats and endangering wildlife.



Moreover, the increasing emissions of greenhouse gases (GHGs) contribute to climate change, causing global warming and unusual weather patterns that have become increasingly common. In places like Indonesia, where palm oil plantations are most widespread, there are higher emissions of GHGs and societal issues such as child labour and exploitation.

However, the damage doesn't end here. Tribes and communities that rely on forests for their livelihoods are tormented because of their habitats being destroyed. The affected communities struggle to survive while many go extinct.

The Game of Words Played by Beauty Brands

The ones in the business are very well aware of the environmental impacts of using palm oil in manufacturing beauty and wellness products. Hence, to maintain the false image of environmentally conscious brands, they subtly use synonyms for listing palm oil in their ingredients. Some commonly used names are: vegetable oil; vegetable fat; palmate; palmitate; palmolein;

palm kernel; *Elaeis guineensis*; palmitoyl oxostearamide, sodium laureth sulphate, and sodium kernelate.

Which Beauty Products Should You Use: With or Without Palm Oil?

Palm oil is a highly sought-after ingredient because of its price and ease in sourcing. Its benefits for the skin are unquestionable, but its impact on biodiversity is irreparable! Today, replacing palm oil is still a challenge for many brands. However, there do exist a few eco-conscious brands that choose sustainability above everything else. The choice is yours, but isn't choosing the environment a better option when you have alternative products that are equally or even more beneficial?

Sustainability-focused Brands Paving the Way for a Greener Future

While the biggest brands neglect depleting biodiversity, inclusive businesses have cracked the code to



crafting beauty and wellness products that not only prevent deforestation but also encourage biodiversity. Kheoni – born from nature is a brand that uses only sustainably-sourced ingredients and elite alternatives to palm oil, thus exhibiting a strong devotion towards sustainability and the well-being of the environment. Kheoni was born out of a need to plant and sustain a forest (now a biodiversity-awarded site in central India). This involved planting 35,000 trees over a barren hill in the last 7 years. To support this and several such initiatives across various forest ecosystems in India, Kheoni now has a beautiful collection of inclusive, hand-made, sustainable, and wellness-oriented products that also positively impact the environment.

Special mention must be made of Khayal Garg who is a 17-year-old environmental and sustainability enthusiast, and has taken numerous initiatives to help preserve biodiversity. Till date, she has planted 2000+ trees and actively assisted in local campaigns for the environment. She likes to talk about practical problems and tangible solutions to encourage sustainability and preserve biodiversity. She is also an entrepreneur, with a range of products to her name— Khayali by Kheoni.



Initiatives by Kheoni That Have Truly Made a Difference

Kheoni, a brand rooted in nature, was born out of the need to plant and sustain a forest. The forest, now known as Keshar Parvat, was once a barren land with no water resources nearby. Over the last 7 years, Kheoni has planted over 35,000 trees, the water required being bought and brought in tankers. Today the forest is renowned as a biodiversity awarded site.

During the COVID-19 pandemic, forest fires emerged as a serious problem at the Kheoni Wildlife Sanctuary, causing significant damage to both trees and wildlife, including the five resident tigers. The founders, passionate environmental activists, were compelled to step in and find a solution. Upon investigating the cause of the wildfires, it was discovered that nearby tribal communities, denied access to the forest, intentionally started these fires to distract officials, allowing them to gather mahua and other resources essential for their livelihood.

The founders of Kheoni thus stepped in and empathized with the communities, understanding their struggle to earn a living. Collaborating with the forest officials and tribal communities, they helped tribals source their requirements easily from the forest, including mahua. Since then, no forest fires have been witnessed.

Furthermore, removing dependency from the forests and giving the communities other means of income



like product making brought a win-win situation for all—and hence, Kheoni the brand was born. Today, Kheoni provides fair prices to communities for their hand-made, natural products, and the profits gained by selling these products in urban cities is utilized for the betterment of Keshar Parvat.

An inclusive brand that honours nature and thrives in inclusivity, Kheoni supports several such communities, establishing itself as a transparent, eco-conscious, and truly sustainable brand.

Conclusion

We cannot survive without biodiversity and it's high time we make the right choices. Tiny acts of consideration and conscious choices can help prevent deforestation and save millions of lives!

By supporting sustainable brands, you prioritize the environment over individual convenience. Isn't that beautiful? ■

For more information, please write to Khayal Garg at email address khayal.kheoni@gmail.com



Empowering Tomorrow's Workforce

The Rise of Vocational Education in India

The young population in India presents both opportunities and challenges, as the workforce needs practical skills that conventional education often lacks. Vocational education and training (VET) is essential to provide job-specific expertise, bridging the gap between academic knowledge and industry demands. In this article, **Amarpreet Kaur** and **Vidhi Rani** highlight that vocational education and training serve as a cornerstone in India's efforts to propel economic growth and empower its burgeoning workforce. Vocational education and training are a fundamental component of modern education systems, addressing a pressing need in society. The alignment of VET with the G20 objectives emphasizes its crucial role in inclusive growth, employment, and human capital development.

India stands at a critical juncture in its economic evolution, seeking to capitalize on its demographic dividend while tackling the challenges of a rapidly evolving job market. The country's young population presents both an opportunity and a challenge, as the workforce requires practical skills that conventional education often fails to impart. Vocational education and training (VET) emerged as a fundamental solution to equip individuals with job-specific expertise, offering a bridge between academic knowledge and industry demands.

India's vocational education and training landscape faces significant challenges, with only about 5 per cent of workers aged 19–24 having received formal vocational education according to the 12th Five-Year Plan (2012–2017). The Periodic Labour Force Survey (PLFS) indicates that 92.6 per cent of people in the 12- to 59-year-old age group in 2017–18 and 84.4 per cent in 2020–21 did not receive any VET (Palash Baruah et al., 2022).¹ This raises concerns about the country's ability to achieve growth



in labour productivity, especially for its aspirations in manufacturing and financial services. In stark contrast, the figures in other nations, such as the USA (52%), Germany (75%), and South Korea (96%), emphasize the critical disparity and the pressing need for an accelerated adoption of vocational education in India.² The lack of vocational education and training has hindered the country's

efforts to develop a skilled workforce capable of meeting the demands of a rapidly growing economy. Without suitable vocational education and training opportunities, young adults in India are left without the necessary skills to secure stable employment. This not only perpetuates high levels of unemployment but also hampers the country's ability to compete globally. The primary factors behind this gap are due to vocational education having in the past focused largely on Grades 11–12 and on dropouts in Grade 8 and upwards.

¹ Details available at <https://www.ncaer.org/news/who-is-vocational-education-training-for-data-shows-over-84-indian-didnt-get-any>

² Details available at https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf

Moreover, it is often considered the 'last resort' for students who are unable to pursue higher academic education.

India's Commitment to Sustainable Development Goal 4

In light of the pressing need to bridge this gap, the Government of India launched the Skill India Mission in 2015. This mission aims to train over 400 million people in different skills by 2022, focusing on skill development through large-scale programmes and fostering entrepreneurship. Additionally, in 2018, the Ministry of Skill Development and Entrepreneurship introduced two new schemes: Skill Acquisition and Knowledge Awareness for Livelihood Promotion (SANKALP) and Skill Strengthening for Industrial Value Enhancement (STRIVE) that helped in boosting the better implementation of Skill India Mission.

Aligned with the 2030 Agenda and SDG4, the Skill India Mission emphasizes vocational education and aims to provide market-relevant training, thus enabling job seekers to meet the demands of various industries. Additionally, this initiative focuses on creating employment opportunities by developing talent within the country to establish the scope for underdeveloped

sectors and equal growth opportunities for youth.

The National Education Policy (NEP) of 2020 further underscores the government's commitment to vocational education. It emphasizes the need for collaboration between educational institutions and industries to align vocational education with workforce demands. By 2025, the policy aims to ensure that at least 50 per cent of learners through the school and higher education system receive exposure to vocational education. Vocational education and training has lately been considered as the launching pad to the future in this era of new-age education. The convergence of government efforts, particularly through the Skill India Mission and the NEP 2020, with a focus on vocational education, serves as a significant step towards addressing the skills gap in India.

Need for Vocational Education and Training VET

Notably, the demand for VET has risen globally. In the past years, vocational education and training were not as prominent, and people predominantly relied on traditional schooling and study criteria to continue their desired careers. By providing a holistic

approach that bridges the gap between theoretical knowledge and practical skills, VET has emerged as a pivotal driver of economic development. Its comprehensive strategies not only foster more employment opportunities but also play a crucial role in alleviating unemployment, thereby fuelling social and economic progress, particularly in developing nations. VET transcends traditional learning paradigms by fostering lifelong learning through hands-on experiences and a holistic understanding of subjects. Its multifaceted benefits and emphasis on innovative learning methods enable individuals to adapt to technological advancements effectively.

Top of Form Relevance of Vocational Education and Training VET Post G20

The relevance of VET in the post-G20 era is paramount, given the platform's focus on global economic issues and the imperative of inclusive growth and workforce development. Acknowledging VET's pivotal role, the G20 has underscored its significance in fostering equal opportunities, driving innovation, and bolstering productivity within the labour market. Aligning with the G20 agenda, member countries, including India, are urged to prioritize investments in human capital development, with VET emerging as a key strategy in bridging the skills gap and preparing individuals for employment in emerging industries.

Moreover, the National Education Policy (NEP) 2020 in India places a strong emphasis on vocational training, drawing inspiration from the successful models implemented by G20 nations such as South Korea, Germany, and various European countries. These countries have demonstrated the efficacy of vocational educational centres in cultivating skilled workforces and driving economic growth. Building



on this momentum, G20 leaders have collectively endorsed initiatives aimed at expanding access to high-quality Technical and Vocational Education and Training (TVET), fostering scientific cooperation, and promoting lifelong learning opportunities, particularly for vulnerable and marginalized groups. By championing these efforts, the G20 aims to ensure a more inclusive and resilient global workforce poised to navigate the challenges of the modern economy.

Strategies for Advancing VET in India

To bolster and expand VET in India, a comprehensive strategy involving various stakeholders is essential. This can involve:

- **Curriculum Enhancement:** Collaborating with industry leaders is crucial to ensuring that VET curricula remain relevant and responsive to the changing needs of the job market. This collaboration involves regularly updating course materials, incorporating emerging technologies, and aligning skill development with industry standards. By doing so, students are equipped with the most up-to-date knowledge and skills required by employers, enhancing their employability and job readiness upon graduation.

- **Infrastructure Development:** Investing in modern training facilities and workshops is essential for providing students with hands-on learning experiences across various fields. These facilities should be equipped with state-of-the-art equipment and technology to simulate real-world work environments. Such infrastructure development not only enhances the quality of education but also ensures that students gain practical skills that are directly transferable to the workplace.
- **Teacher Empowerment:** Empowering instructors through regular training and exposure to current industry practices is critical for enhancing the quality of VET education. Teachers should receive ongoing professional development opportunities to stay abreast of advancements in their respective fields and to improve their teaching methodologies. By investing in teacher training and support, educational institutions can ensure that instructors are better equipped to deliver high-quality instruction and mentorship to students.
- **Public-Private Partnerships (PPPs):** Establishing strategic partnerships between educational institutions and private industries is essential for providing students with real-world

exposure and opportunities for job placements. Through PPPs, students can gain hands-on experience through internships, apprenticeships, and industry collaborations, thereby bridging the gap between classroom learning and practical application. These partnerships also enable educational institutions to tailor their programmes to meet the specific needs of employers, ultimately enhancing graduates' employability and career prospects.

- **Changing Perceptions:** Actively working to alter societal perceptions of VET is crucial for promoting it as a dignified and equally valuable career pathway compared to traditional academic routes. This involves raising awareness about the diverse career opportunities available through VET, highlighting the success stories of VET graduates, and dispelling misconceptions about vocational education. By fostering a positive attitude towards VET, stakeholders can encourage more individuals to pursue vocational training and contribute to the skilled workforce required for India's economic growth and development.

Vocational education and training serve as a cornerstone in India's efforts to propel economic growth and empower its burgeoning workforce. Vocational education and training are a fundamental component of modern education systems, addressing a pressing need in society. The alignment of VET with the G20 objectives emphasizes its crucial role in inclusive growth, employment, and human capital development. Through strategic investments and enhancement of VET, India can effectively close the skills gap, empowering its workforce and fostering a more resilient and adaptable economy.

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