

TerraGreen

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VOLUME 15 | ISSUE 8 | November 2022

COP27

Climate Chaos and Warfare
for People and the Planet

SPECIAL HIGHLIGHTS

Resurrecting the Past in the World of Dinosaurs, UK
Accelerating India's Low-Cost Net-Zero Transition

IN CONVERSATION

Pranesh Chhibber,
Country Director of Forestry
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TERRA YOUTH

Sustainability in the FMCG Sector

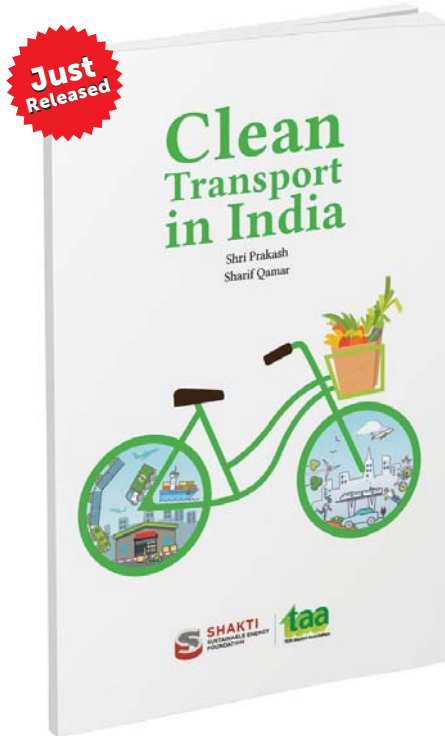
COP27

SHARM EL-SHEIKH

6-18 NOVEMBER 2022



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This book not only presents all the relevant statistics but, more important, explains the implications of those numbers and the interconnections between different facets of transport: for example, the greater number of vehicles on roads may seem to favour mobility but in fact makes roads more congested—and the congestion makes air pollution more severe, thereby aggravating its impact on health. At the same time, the book is not a prophet of doom but also touches upon electric vehicles, hydrogen fuel cells, drones, and even flying cars.

Instead of fretting and fuming when you are caught in a traffic jam, read this book: it will not only calm you but, who knows, may inspire you to be a 'green' commuter.

This book is useful for adults who are concerned about topical issues but lack the understanding to make sense of what they read or watch in the mass media.

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EDITORIAL



“ Bringing the focus on the deliberations at COP27, our cover story for this issue highlights that in Sharm el-Sheikh, a mitigation work programme was launched in order to scale up mitigation ambition and implementation. ”

The 27th Conference of the Parties (COP27) to the United Nations Framework Convention on Climate Change (UNFCCC) at Sharm el-Sheikh in Egypt closed on November 20, 2022 with a historic agreement to provide 'loss and damage' funding for vulnerable countries hit hard by climate disasters. COP27 also resulted in countries delivering a package of decisions that reaffirmed their commitment to limit global temperature rise to 1.5°C above pre-industrial levels. The package also strengthened action by countries to cut greenhouse gas emissions and adapt to the unavoidable impacts of climate change, as well as boosting the support of finance, technology and capacity building needed by developing countries. At the recently-concluded COP27, TERI hosted multiple events both as organizer and co-organizer, launched policy briefs at the venue, and engaged with important stakeholders in the climate change discourse. With India taking over the G20 Presidency as well, TERI has been granted the position of chair and co-chair for T20 taskforce four on 'Refuelling Growth: Clean Energy and Green Transitions', and taskforce three on 'LiFE, Resilience & Values for Wellbeing', respectively.

Bringing the focus on the deliberations at COP27, our cover story for this issue highlights that in Sharm el-Sheikh, a mitigation work programme was launched in order to scale up mitigation ambition and implementation. Governments called for reexamining and strengthening the 2030 targets in their national climate plans by the end of 2023, and speeding up efforts to phase-down unabated coal power and phase-out inefficient fossil fuel subsidies. At the COP27 Climate Change Conference, there were discussions on work programmes in order to urgently scale up mitigation ambition and the Global Goal on Adaptation (GGA). On mitigation, developed and climate-vulnerable countries pushed for a strong outcome to ramp up the efforts to reduce emissions before 2030, calling this "the critical decade." In the end, countries agreed to a process that will explore topics, which are to be decided, and identify opportunities and gaps to reduce emissions. Several countries expressed some worry that the mitigation outcome may not be enough to "keep 1.5°C alive." The Parties agreed to a long-term, structured effort that will help countries to collectively achieve the global adaptation goal. It will be reviewed before the second Global Stocktake (GST) in 2028. The unanimity of the countries to continue the technical dialogue under 'Global Stocktake' was seen as a virtuous outcome of COP27.

I sincerely hope that this issue of *TerraGreen* will strike a chord among our readers and that you shall come back with your thoughts and invaluable inputs for this publication to keep growing from strength to strength.

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

Vibha Dhawan
Director-General, TERI



I read the October 2022 issue of *TerraGreen* online and found the articles very interesting and succinct. The cover story on solar energy for India's energy security is very apt. I agree with the author that systems such as solar PV-based hybrid systems offer a less polluting alternative to diesel fuel, serve as a hedge against rising diesel fuel prices, and help minimize the logistical challenges of transporting and storing diesel fuel at remote tower sites. In addition, the government plans to make it mandatory for cell towers to be powered by solar energy, in the hope of reducing pollution and curbing one of the main reasons for diesel consumption in the country. The number of telecom towers is expected to increase by another 0.1 million in the next year, and it is important to note that the newer telecom towers are being

installed based on new technology that uses less electricity and also eliminates the need for air conditioning, which is so important to telecom towers.

Anil Sharma

Mumbai, Maharashtra

The article on Chhath puja published in the October 2022 issue of *TerraGreen* is an interesting read. I agree with the author that Chhath, celebrated with fervour across India after Diwali, over four days, is perhaps the only festival that is environment friendly. Intriguingly, all the offerings used on this occasion are fully biodegradable. There is no discrimination on the basis of class and caste as all share the same platform to offer puja and help one another as one large family. Everyone celebrating Chhath prepare the same *thekua* to offer the Sun God too. Interestingly, Chhath is the only occasion in which offerings are made to the Sun God both during sunrise and sunset. Surya Dev, the Sun God, is the ultimate source of energy for all living organisms surviving on the planet and provides energy to green plants for photosynthesis—their primary source of food.

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Coal Demand Likely to Peak between 2030 and 2035

As coal is the major source of energy in India, the demand will continue with likely peak between 2030 and 2035. In 2022–23 (April 22 to October 22), the coal consumption in coal-based power plants has increased to 447.6 million tonnes (MT) as compared to 398.2 MT during the same period of last year with a growth of 12 per cent. Being an affordable source of energy with substantial reserve, coal is going to stay as major source of energy in the foreseeable future. The country will require base load capacity of coal-based generation for stability and also for energy security. The Ministry of New and Renewable Energy plans to achieve about 50 per cent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030.

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

High-Temperature Torch to Convert Waste into Fuel

A low-cost, energy-efficient technology developed by the Bhabha Atomic Research Centre that can burn any waste—municipal, hazardous and even nuclear—to produce gases that can then be used to generate electricity was transferred to a Kolkata-based firm that will now develop commercial grade incinerators that can each process 100 tonne waste per day. Like gas cutters used to slice metals, the technology uses air plasma torch generating high energy particles that bombard the waste, breaking them down into an ionized state, leaving behind some dust and synthesized gas—carbon monoxide and nitrogen—that can then be used to produce energy. Scientists said 1 kg of municipal solid waste can yield 0.6–7 kWh of electricity.

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



Karnataka Bags National Energy Conservation Award 2022 by Power Ministry

The Union Ministry of Power has selected Karnataka Renewable Energy Development Ltd (KREDL) to be the winner of the first prize in the State Designated Agency (SDA Group-1) sector at the National Energy Conservation Awards – 2022 (NECA 2022). The National Energy Conservation Awards – 2022 was organized by the Bureau of Energy Efficiency (BEE) as part of the 'National Energy Conservation Day' at Vigyan Bhawan in Delhi recently. KREDL was chosen for the prestigious award based on the energy efficiency projects implemented by them in the state as well as the information collected from the other respective state government departments.

Source: <https://www.business-standard.com/>



Power Giant NTPC to Build Nuclear Fleet to Aid Climate Goal Chase

NTPC Ltd., India's top power producer, is planning to build a massive nuclear fleet that'll aid the nation's push to shift away from coal and curb emissions to hit net-zero by 2070. The state-run company aims to install 20–30 GW of nuclear capacity by 2040, according to a person familiar with the plans, who said the target remains tentative. India currently has 22 operational reactors with about 6.8 GW of capacity. NTPC is considering deploying small-scale modular reactors, known as SMRs, as part of the strategy, according to multiple people with knowledge of the company's plans. The producer has an overall power fleet of 70 GW, of which more than 80 per cent is coal-fired. The company will also keep pursuing larger projects in a joint venture with state-run Nuclear Power Corp. of India Ltd.—which currently operates all of India's atomic generation capacity.

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

New Species of Elusive Wren Babblers in Arunachal Pradesh

Birdwatchers have discovered a new species of the elusive wren babblers in remote northeastern Arunachal Pradesh, which has been named by them as Lisu wren babbler. The team, comprising of birdwatchers from Bengaluru, Chennai, and Thiruvananthapuram had sighted the new species in March 2022 at Mugaphi peak in Changlang district. The sighting was a chance one as team members along with two guides from Arunachal Pradesh had reached the area in search of the rare and elusive grey bellied wren babblers, which are found mostly in Myanmar and in smaller numbers in China and Thailand. Their finding was published by *Indian BIRDS*, a peer-reviewed journal of south Asian ornithology.



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



Significant Programmes to Boost Participation of Women in Energy Sector

The Ministry of New and Renewable Energy has been supporting capacity building programmes for skill development in the area of renewable energy including solar energy (Suryamitra), wind energy (Vayumitra), and small hydro power (Jalurjamitra). The Suryamitra skill development programme is being implemented since financial year 2015–16, wherein 2251 women candidates were trained since inception of the programme till November 2022, out of which 836 candidates have been reported to be employed. The Ministry had also supported six months' training programme specifically for semi-literate women of rural areas on assembly, installation, operation and maintenance of solar lanterns, lamps, etc.

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



Canadian Researchers Study Ways to Reduce Underwater Noise Pollution

Canadian researchers, led by an Indo-Canadian engineer, are working on devising solutions to the problem of underwater noise pollution given its adverse impact on marine mammals. The constant barrage of noise from ships and other vessels can cause problems like hearing loss and stress for mammals such as dolphins and whales. Propellers used by ships are among the main culprits. The solutions the UBC research team is pursuing include design improvements to control propeller noise as well as artificial intelligence-based tools. Among the solutions being studied are “injecting a jet of fluid to help control propeller movement or introducing wavy and serrated edges to break up flow patterns that cause noise,” according to a release from UBC.

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



Yemen Introduces Solar Project to Reduce Severe Electricity Outages

Yemen will establish a new solar project to reduce electricity outages in the country's southern port city of Aden with the support of the UAE. Yemen's Ministry of Electricity signed a joint cooperation agreement with Masdar, a renewable energy company based in Abu Dhabi, the capital of UAE, to build a 120-MW solar park in Aden in order to alleviate peoples' suffering in the war-ravaged Arab country. Under the agreement, Masdar will also build transmission lines and conversion stations to distribute the solar park's energy to the city's neighbourhoods

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

Using Deep Learning to Monitor India's Disappearing Forest Cover

Using satellite monitoring data, researchers have developed a deep learning algorithm that could provide real-time monthly land use and land cover maps for parts of India. One of the 10 most forest-rich countries in the world, about 80.9 million hectares of trees cover India— about 25 per cent of the nation—but this is a significant decline from years past. Between the 1890s and the 1990s, a combination of rapid economic development and overexploitation of local resources led to India losing nearly 80 per cent of its native forest area. Now, as India's forests still continue to disappear, researchers are focused on helping preserve what remains.

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





S Korea's Sea Level Rises due to Climate Change

South Korea's sea level rose nearly 10 cm over the past 33 years as a result of climate change. The country's average coastal surface height grew 9.9 cm between 1989 and 2021, with the yearly average coming to 3.01 mm, Yonhap News Agency quoted the Korea Hydrographic and Oceanographic Agency as saying. The East Sea saw the largest increase of 3.53 mm per year on average, followed by the Yellow Sea with 3.08 mm and the southern sea 2.55 mm per year, the data showed. The analysis was based on data collected from 21 observation posts in the country's coastal areas.

Source: <https://www.business-standard.com/>



Renewable Energy Sector to Boom in 2023

With an oil price shock threatening to derail economies globally, the focus has shifted to renewable energy with over USD 25 billion or INR 2 lakh crore investment planned in India for using sunlight, water, and air to produce energy. Oil and gas prices shooting through the roof in 2022 in the aftermath of Russia's war in Ukraine sent governments in import-dependent nations like India scrambling for options. Not just imports but a shift to renewables is also seen as a way to cut carbon footprint and meet net-zero targets. And so the government in 2022 aggressively pushed for the adoption of electric vehicles, the production of green hydrogen, manufacturing of solar equipment and energy storage in pursuit of its ambitious 500 GW renewable capacity target by 2030.

Source: <https://indianexpress.com/>

Most Asian Countries behind Biodiversity Targets for Protected Areas

Most countries in Asia have failed to achieve a global minimum target of protecting at least 17 per cent of land by 2020, according to a study based on data from 40 countries. Under current trends, the outlook for achieving the UN Global Biodiversity Framework's 2030 target to protect at least 30 per cent of land is bleak, with Asia set to miss this by an even greater margin, the researchers said. To counter the global biodiversity crisis, at the 2010 UN Convention on Biological Diversity, almost 200 countries pledged to protect at least 17 per cent of their terrestrial environments by 2020 (known as Aichi Target).

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



Accelerating India's Low-Cost Net-Zero Transition

The Role of Smart Climate and Innovation Policy

Saswata Chaudhury and **Vidhu Kapur** have been working as part of the Economics of Energy Innovation and System Transition (EEIST) consortium, which is dedicated to developing tools to support government decision making around low-carbon innovation and to accelerate technological change towards a net-zero energy system. In this op-ed, Saswata and Vidhu detail how fostering synergies between actors and timely policy interventions helped to grow the LED industry in India and dramatically improve energy efficiency.

Energy efficiency is a key element in the low carbon transition in India. The mainstream adoption and use of energy-efficient appliances is necessary for effective demand management—and that, in turn, can help India to meet its carbon reduction target. Growing populations, increasing urbanization and 100 per cent electrification are expected to increase residential lighting demand significantly in the coming decades. As per a recent TERI estimate, the share of lighting demand from the total residential electricity demand in India is approximately 20–27 per cent, but, this share varies across regions and income groups, and is as high as 60 per cent for poor households.

India has a mixed basket of lighting technologies, including incandescent bulbs (ICB), compact fluorescent lamps

(CFL), fluorescent tube lights (FTL), and light-emitting diodes (LED). Among these technologies, LEDs are the most energy-efficient, consuming just 10 per cent of the energy required by an ICB, for a similar level of light output. In 2005, ICB and FTL together held around 95 per cent of the Indian market. However, due to various government initiatives, the market has undergone significant changes in the last decade or so, with LED holding a major market share. Survey findings by Agrawal revealed that by 2019, about 90 per cent of electrified households met their lighting demand using LED bulbs, of which 63 per cent used only LEDs. This article explores the role of government and price management initiatives in promotion of new technologies.

Accelerated Transition to LEDs in India

Owing to the projected growth of lighting demand, the Government of India rolled out two national-level initiatives in January 2015—the Unnat Jyoti by Affordable LED for All (UJALA) scheme and the Street Lighting National Program (SNLP), with a twin objective of boosting the adoption of energy-efficient lighting alternatives at affordable prices and achieving India's commitments of emissions reduction. The design of the UJALA scheme was based on lessons drawn from previous government initiatives to promote technology intervention related to decarbonization pathways.

Key Enablers

The high initial investment cost of LEDs and easy availability of low-priced lighting alternatives (such as ICBs) were critical barriers to the adoption of LEDs, especially among poor households. Bureau of Energy Efficiency (BEE) designed a new business model for the UJALA scheme called 'Pay-As-You-Save', reducing the upfront cost of LEDs, keeping them on par with ICBs. The balance amount can be paid through successive electricity bills. This was supported by technological advances in



China that led to the scaling-up of low-cost, medium-grade LED bulbs, procured in bulk at historically low prices. As per a recent study by Dhupia, India's LED sales went from just 3 million in 2012 to 670 million in 2018 with prices dropping from INR 800 in 2010, to INR 400 in 2014, and to just INR 70 in 2019. The innovative approach implemented by EESL for LED bulbs made UJALA the world's most extensive energy efficiency promotion programme.

As people became more aware of their benefits, the UJALA scheme led to the creation of a parallel market for LEDs. According to IBEF estimates, till May 25, 2022, over 36.79 crore of LED bulbs had been distributed, resulting in an estimated energy savings of 47.78 billion kWh per year and avoiding a peak demand of 9567 MW. This also leads to an annual GHG emission reduction of 39 million t CO₂ and estimated annual monetary savings of INR 19,114 crore.

Under SNLP, EESL entered into an innovative arrangement with Indian municipalities (or Urban Local Bodies—ULBs). The contract offered minimum guaranteed energy savings on replacing conventional streetlights with LEDs and provided free maintenance services for the following seven years with no new investment required by the ULBs. ULBs were able to repay EESL with the savings accrued from reduced energy consumption and maintenance costs. This encouraged nearly half of all Indian ULBs to sign up for the scheme.

Encouraging Domestic Manufacturing of LEDs

UJALA's secondary objective was to promote and enhance the domestic manufacturing of LEDs. In 2015, the GOI announced a Preferential Market Allocation (PMA) policy, mandating government agencies to procure LEDs for the UJALA and SLNP schemes, whereby India imported LED components and assembled the final LED bulbs domestically. To further promote small-

scale manufacturing, in 2017, duties on the import of final LED products were increased relative to duty on the import of LED components.

As a result, the import of LED components has rapidly increased in recent years, and the import of final products has reduced. In April 2021, the Department for the Promotion of Industry and Internal Trade (DPIIT) announced a Production Linked Incentive (PLI) scheme that would further incentivize the production of components of LEDs instead of just the assembled product.

Lessons for Future Transition

The Economics of Energy Innovation and System Transition (EEIST) consortium's analysis of the LED experience in India presents a strong case for fostering synergies between actors and timely policy interventions, unlocking incremental and cross-sectoral change. The EEIST consortium is engaging with policymakers and stakeholders in Brazil, China, India, the UK, and the EU. The project aims to contribute to the economic development of emerging nations and support sustainable development globally by providing governments, new tools and analysis, by supplementing traditional cost-benefit analysis (CBA) with Risk Opportunity Analysis (ROA) in situations where transformational change may result—like transitioning to a low carbon economy.

The experience provides valuable lessons for how to create accessible markets and scale innovation, particularly for important sectors and technologies such as electric vehicles, batteries, and green hydrogen, especially through stimulating domestic manufacturing and supply chain development.

The learning acquired from earlier schemes and the constant exchange of knowledge among stakeholders helped identify and address the barriers posed by LED adoption. This is clearly seen with



BEE drawing its experience from various previous schemes and how the standard and labelling (S&L) programme, was able to create synergies between stakeholders to quickly develop the minimal technical standards for LEDs.

Similarly, EESL engaged with the state regulator and distribution utilities to create the required distribution value chain, developed initially for promotion of CFLs (under previous initiatives) and subsequently efficiently utilized for LEDs. Further, the EESL marketing strategies and campaigns advocating the energy and cost-saving benefits of LEDs and their availability at a lower price created awareness not only for the targeted consumers of UJALA but also for the larger target group. It added to the demand, thereby driving the local LED market. Subsequently, the initiative led to mandating the need for domestic value addition and enabled local manufacturing and supply capacity for the LED final product. The proportion of domestic value reached 20 per cent by 2017, and with the PLI scheme announced recently, this share is expected to increase significantly in near future.

As India transitions towards electric mobility, the LED experience opens up the space to examine possibilities for similar holistic approaches to assess wider socio-economic implications for decision-making and greater use of new renewables and green technologies. ■

Saswata Chaudhury, Senior Fellow and AC, Integrated Assessments and Modelling Division, TERI, New Delhi and Vidhu Kapur, Associate Fellow, Earth Science and Climate Change Division, TERI, New Delhi. Authors acknowledge valuable inputs and feedback received from Ms Ulka Kelkar, Director, WRI India and consortium member EEIST project.

Shorter Honey Bee Life Spans

Fifty Per Cent Shorter Today than 50 Years Ago

A new study by entomologists shows that the lifespan for individual honey bees kept in a controlled, laboratory environment is 50 per cent shorter than it was in the 1970s. As the first study to show an overall decline in honey bee lifespan potentially independent of environmental stressors, this work hints that genetics may be influencing the broader trends of higher colony turnover rates seen in the beekeeping industry.

A new study by University of Maryland entomologists shows that the lifespan for individual honey bees kept in a controlled, laboratory environment is 50 per cent shorter than it was in the 1970s. When scientists modelled the effect of today's shorter lifespans, the results

corresponded with the increased colony loss and reduced honey production trends seen by US beekeepers in recent decades.

Colony turnover is an accepted factor in the beekeeping business, as bee colonies naturally age and die off. But over the past decade, US beekeepers

have reported high loss rates, which have meant having to replace more colonies to keep operations viable. In an effort to understand why, researchers have focused on environmental stressors, diseases, parasites, pesticide exposure, and nutrition. This is the first study to show an overall decline in honey bee





lifespan potentially independent of environmental stressors, hinting that genetics may be influencing the broader trends seen in the beekeeping industry. The study was published on November 14, 2022, in the journal *Scientific Reports*.

"We're isolating bees from the colony life just before they emerge as adults, so whatever is reducing their lifespan is happening before that point," said Anthony Nearman, a PhD student in the Department of Entomology and lead author of the study. "This introduces the idea of a genetic component. If this hypothesis is right, it also points to a possible solution. If we can isolate some genetic factors, then maybe we can breed for longer-lived honey bees."

Nearman first noticed the decline in lifespan while conducting a study with entomology associate professor Dennis van Engelsdorp on standardized protocols for rearing adult bees in the laboratory. Replicating earlier studies, the researchers collected bee pupae from honey bee hives when the pupae were within 24 hours of emerging from the wax cells they are reared in. The collected bees finished growing in an incubator and were then kept as adults in special cages. Nearman was evaluating

the effect of supplementing the caged bees' sugar water diet with plain water to better mimic natural conditions when he noticed that, regardless of diet, the median lifespan of his caged bees was half that of caged bees in similar experiments in the 1970s. (17.7 days today versus 34.3 days in the 1970s.) This prompted a deeper review of published laboratory studies over the past 50 years.

"When I plotted the lifespans over time, I realized, wow, there's actually this huge time effect going on," Nearman said. "Standardized protocols for rearing honey bees in the lab weren't really formalized until the 2000s, so you would think that lifespans would be longer or unchanged, because we're getting better at this, right? Instead, we saw a doubling of mortality rate."

Although a laboratory environment is very different from a colony, historical records of lab-kept bees suggest a similar lifespan to colony bees, and scientists generally assume that isolated factors that reduce lifespan in one environment will also reduce it in another. Previous studies had also shown that in the real world, shorter honey bee lifespans corresponded to less foraging time and lower honey production. This is the first

study to connect those factors to colony turnover rates.

When the team modelled the effect of a 50 per cent reduction in lifespan on a beekeeping operation, where lost colonies are replaced annually, the resulting loss rates were around 33 per cent. This is very similar to the average overwinter and annual loss rates of 30 per cent and 40 per cent reported by beekeepers over the past 14 years.

Nearman and vanEngelsdorp noted that their lab-kept bees could be experiencing some sort of low-level viral contamination or pesticide exposure during their larval stage, when they're brooding in the hive and worker bees are feeding them. But the bees have not shown overt symptoms of those exposures and a genetic component to longevity has been shown in other insects such as fruit flies.

The next steps for the researchers will be to compare trends in honey bee lifespans across the US and in other countries. If they find differences in longevity, they can isolate and compare potential contributing factors such as genetics, pesticide use and presence of viruses in the local bee stocks. ■

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



Meycode

An Idyllic Hamlet with the Bounty of Nature

In this beautifully-woven account, **Dr Elsa Lycias Joel** reminisces the time she spent and still spends at her mother's home in a lush-green remote village called Meycode in Tamil Nadu. Meycode abounds with exotic species of different flora and fauna. She says if you visit Meycode, do spend a few minutes by the ponds and lakes, particularly Kaakapon Kulam.





In that lush-green remote village called Meycode, known for its artesian aquifers, animals and birds seem to read human minds, especially my mother's. Crows either wake her up or wait for her at her doorstep and caw in different intonations when they do and don't get what they expect. Seven sisters go a step ahead; fly into the house to eat savouries spread out for them in newspapers.

As they eat, they chirp loudly, taking their turns or sometimes in unison. Or do they know my mom named her house 'Sangeetham' which means music! Is that why these birds sing aloud and plants dance in praise just like King David!

My mother listens to them as if her schedule is part of their itinerary. I won't be surprised if Geetha Lycias Joel turns out to be another Aileen Fisher.

Mynas join the seven sisters often. It's a sight to behold!

During rainy days they fly in together, act erratically, peck away squirrels and pretend like they completely lost it.

Another animal in the scene is the cat that acts nasty with the birds. That's

when the cane comes out of my mom's kitchen.

My mother just doesn't get the fact that an obligate carnivore surviving on human food will definitely have a craving for meat. Watering her small garden that has all the herbs, creepers and shrubs is what my mom enjoys the most, more than teaching English, counselling or managing the church library. While watering she counts the number of newborn fishes, water lilies in her mini pond and realizes her garden is a heaven for glowworms, snails, butterflies, dragonflies, humming birds, and birds of prey too.

Blessed with a green thumb, supposedly a matrilineal genetic disposition, my mom has an unusual yearning to grow all that Margaret, her grandmother had in her garden. Even if the garden doesn't look aesthetically pleasing due to a lot of plants growing here and there, it's a near carbon-copy of Margaret's.

Every phone conversations of ours begin and end about a new feathered visitor, an injured one, those sparrows

that fly into her house, that snail on her wall, beetles that eat rosebuds, a hatchling that sleeps on her button rose plant, how the fish in her mini pond hide beneath the water lilies to escape from white-necked storks, a bird on the route to recovery, complaints about crows becoming fussy eaters or crow chicks that vociferously demand savouries.

When I try to convince her that food habits of birds living close to human settlements are changing, she defensively retorts "But they are scavengers". Yet, she dutifully fills her

A hatchling asleep on mom's button rose plant



snacks cabinet with stuff that would please them.

Darlings of the village are a charm of humming birds that built nests on the two golden cypress trees on either side of her gate. My mom had no idea of the nests until she set out to find the reason behind the high pitched screeches and cries of crows, squirrels and that cat.

It was a King Cobra, prowling for eggs and fledglings. That venomous snake stopped being my mom's headache after she discussed her concern with her neighbours, who consider snakes as a symbol of rebirth and mortality.

Feathered visitors and their habitat are venerated and nobody harms anything. Every house garden in Meycode, exceptional or ordinary, has a story to tell. Vegetable patches are a common sight in front yards too and hence I see no vegetable shops anywhere around this village. Curry trees are an indispensable part of all houses because few sprigs of these are tossed into hot oil to flavour curries, soups, and stews. Herbs such as coriander, mint and basil are found in nooks and crannies. Sessile joyweed, false daisies and spinach grow like weeds right where the water overflows from my mom's water tank.

A cloth bag is hung on gates. I thought it was for the milk packets. In no time I came to know that a small share of vegetables and fruits harvested by any benevolent neighbour were dropped into those bags, mostly by my father's school mate Madhavan Kutty, fondly addressed as Cheta. Such is the generosity.

Branches of a mulberry bush and a jackfruit tree from the adjacent grove extend past into my mother's property dropping ripe fruits. When she discussed this with Prasad, the owner, he told her he would cut off overhanging branches. Discouraging the idea she told him to harvest his fruits on time. From that time on, he would harvest jackfruits in good time and forcibly give her at least one of those.

When cyclone Vardah brought down the two golden cypresses, my mom's friends did everything possible to revive it. Majority in the village mourned the fall of the cypresses for days on end. Their collapse is still talked about with much sadness and unease. "The storm was just too much for those beauties," said my mom, a distinct sadness in her voice.

Mom planted two coral jasmine plants in their place. Fragrant coral jasmines



Mom admiring water lilies in her garden

adorn the puja rooms of many homes in Meycode since this is the only flower offered to gods despite being fallen on the ground.

Symphony of those little amphibians is a regular affair. On a rainy night, my mom reminded me to lock the gate. As I was about to step out with an umbrella I saw a dozen frogs just outside the door. Not that I hate frogs but I don't like them either. So I literally scrambled inside the house screaming, "Oh my, that's an army!" My mom grabbed the keys from my hand and stepped out, rather tiptoed carefully. Not one frog hopped away. "They are here every night," she said in a light tone. "Hope you remember Fergus and Bessie, story of two frogs you read as a child as if 100th time was another first time."

While at Meycode, my daughters believe in fairytales. To be woken up by birds pecking on your window is no small wonder. Though there exists various explanations on why birds peck on tinted windows, waking up to it is a surreal experience.

A week's stay would give anybody a clear idea of what an evening in Meycode looks like. Rendezvous of locals by those ponds is a familiar sight. Most evenings begin with the absence of that actively engaged, yet kind neighbour Vimala akka whose senses



My mom and her little friend Nivedika

are alert to everything. She can tell you the buses that ply that route, postman who retired and the present one in charge, temperament of the linesman, which registered mail or courier or delivery service delivered a big or small something to which house, resume of the prospective brides and grooms, those juicy stories of love lost and found and detailed reports of teetotalers and alcoholics. Effortlessly, this person can create an online assistance or yellow pages directory.

From my mom's terrace I hear cries of birds, calls of people beckoning their hens to coops, bleating of goats that are walked back home after a day of grazing, bells or *shlokas* from tiny temples, a church bell, and the recital of *adhan* or *azaan* from some mosque I can't see.

"Reshmi is late, I guess," my mom would sound concerned. Reshmi, an English lecturer comes across as another go-to person. She knows the best vegetable vendors and fishmongers and the right time to visit the ration shop. Her two-wheeler doubles up as a multipurpose vehicle for many. My mother's love for Reshmi and vice versa is



My mom relaxing by the Kaakapon Kulam

obvious in many ways.

"Oh there he goes," she would say pointing at Pachaimal *annan* who seemed to suffer from camptocormia. "He didn't come to collect his snacks today." His goats keep pace with him so beautifully, no pulling or pushing. Both the shepherd and the goats seem naturally inclined to safeguard the welfare of one another.

"It's been a week since Rahul Thampy came over and he wanted to meet you

all," said mom earnestly. "May be he will be home for weekend". Before he moved to Kerala for work, this immediate neighbor would visit her every evening to ensure all is well and to take her opinion on things that mattered to him.

Cliques of kingfishers and congregations of egrets flying around and about do not amaze me for this village is blessed with six water bodies, namely Kaakapon kulam, Kothan kulam, Valankulam, Meycode kulam, Oorukulam,



and Kulapura. But the fact that a few egrets and cranes took refuge in my mom's terrace at some point of time does astound me.

Then came two monkeys that needed lessons on etiquette. Plundering ripe mangoes, guavas and mulberries were tolerated but never their idea of plucking raw ones to throw at one another or breaking branches. They would throw a plastic water bottle at my mom anytime they saw her in her backyard. Taking the cue, she would fill water and throw it back to them. Strategies planned to help the monkeys find another habitat weren't executed.

One fine day, they were gone. Though all were thankful, nobody knew the exact reason. Vimala akka trumpeted her assumptions which sounded reasonable. "It should be the festival, drums or fireworks," she said in an assertive tone to all and sundry. Talking about this often my mom would chuckle, "Don't you dare misjudge her. She is capable of communicating with an alpha." All festivals are celebrated with pomp spoiling one another with delicious cuisines. The village regales in myths, superstitions, and folklores. Try busting these and you'll know how defensive they can get.

Nowadays, the one person I miss terribly is Vijaya akka, the encyclopedia of mythologies and her voice was heard

throughout Meycode. Her passing away was so sudden. After two years, people still mourn her because, almost always, she was at the right place at the right time, when people needed a helping hand, a listening ear, a full-fledged meal or a few crazy comments to cheer them up. The way she addressed me as *Makkaa*, a term of endearment still rings in my ear. Ada pradhama, a creamy dessert known to Kerala has never tasted the same ever since her death because the one she offered was condensed with love.

Free-ranging dogs are known to ward off intruders. There were two instances when I was left terrified and perplexed. Once, when I had walked quite a distance from my mom's house to buy a few things from the one and only provisional store, a dog walked up to me and began to bark. He didn't look ferocious but wouldn't let me move. A passerby came to my rescue. That woman spoke to the dog like she would do to another human. "This one is our teacher aunty's daughter," she told the dog in an innocently casual sort of voice. The dog moved away wagging its tail. When I narrated this to my mom she never displayed a tinge of surprise.

"Oh that white-brown one!" she said, "He doesn't let outsiders walk in around here." Another time, when my cousin Navina Joseph visited me, she wanted to go for a walk in spite of me telling



Chasing away the cat

her about the dogs. Ten minutes into walking, two dogs came to rest near our feet gnarling and wagging their tails. "Don't these know you?" Navina muttered under her breath. I started speaking to the dogs hoping they get my tone and they let us go.

Probably, aesthetes or deep ecologists or ornithophiles or entomophiles or zoophilists will be able to see, hear or feel Meycode the way I do. Many a time, I've wondered why my mom chose to live in Meycode and not Neyyoor, my dad's native village that's just a five minute drive from Meycode. Observing her, I understand she has got it in her to appreciate life or she thought water scarcity or risk is not worth a peaceful retired life.

If you visit Meycode, do spend a few minutes by the ponds and lakes, particularly Kaakapon Kulam to appreciate its lustre which is due to mica deposition (magnesium mica). The glimmering soft sand along the bank is sure to make your feet happy. ■

Dr Elsa Lycias Joel regularly contributes articles in TerraGreen.



Canadian Wood

Harvesting Wood from Sustainably Managed Forests

Mr Pranesh Chhibber is the Country Director of Forestry Innovation Consulting India Pvt. Ltd (FII India) since 2014. FII India, better known as 'Canadian Wood' is a not-for-profit crown agency of the Govt. of British Columbia, supported by NRCan (Natural Resources, Canada). It is engaged in the promotion of its forest products in the offshore markets.

Here, we are in conversation with **Mr Chhibber** for *TerraGreen*.



How does Canadian Wood run its operations in India?

Canadian Wood, formally known as FII, is a crown agency of the provincial government of British Columbia (BC), the westernmost province of Canada. It is a not-for-profit organization that is engaged in promoting BC Forest products in the international markets, including educating new prospects in emerging markets about its 5 distinct species, their properties, and applications, besides positioning BC

Canada as a long-term reliable supplier of certified wood from sustainably managed forests. FII's techno-commercial team also provides technical assistance and handholding while trialling Canadian Wood species with its target audience in India.

What trend do you see gaining momentum in the industry?

The paradigm shift in how the end-user group values the importance of individual well-being, environmental concerns about global warming and the carbon footprint, is increasingly prompting the leading architects, builder-developers, and contractor-manufacturers to view sustainability as a necessity for their projects.

Additionally, architects and designers, real-estate developers, and the hospitality sector are rediscovering wood for its sheer beauty, biophilic benefits, and as a renewable raw material, which is easy to work with and saves on man hours deployed on construction sites, along with placing more focus on the use of natural solid wood as against manmade materials in re-man applications, such as doors and windows, furniture, and innumerable other interior and exterior applications, whether it's an apartment, a country home, a farmhouse, or even a resort.

What does the re-manufacturing of wood mean?

It is a North American term. Since mills in Canada process logs to produce lumber (sawn-timber), which is consistently sized as per international standards, duly graded and seasoned, it is referred to as manufacturing. Simply put, manufacturing any product using this lumber (sawn-wood) is known as re-manufacturing, abbreviated as re-man.

What re-man applications the Canadian wood lumber can be used for?

Canadian wood is primarily traded in five distinct species harvested from



sustainably managed forests in British Columbia, Canada, each with its own distinct character and properties and suitable for a wide range of indoor and outdoor applications such as furniture, doors and windows, panelling, cladding, decking, handrails and balustrades, saunas, pergolas, gazebos, and so on.

What makes the five distinct species of Canadian Wood different from one another and unique for certain type of applications?

As mentioned earlier, each species has its own character and unique properties that sets it apart from the other Canadian wood species, besides its looks. These are slow-growing species and are often harvested well past 100 years. The wood from such mature trees is highly stable, unlike many other imported softwood species available in the Indian market.

Western Hemlock: It is the largest growing species along the Pacific Coast and is considered highly suitable for indoor furniture, panelling, and door jambs, etc., amongst many other applications. It has straight grain, a beautiful appearance, and has a smooth finish.

Douglas Fir: It is highly appreciated across the world for its exceptional strength-to-weight ratio, which makes it the ideal material for demanding structural applications, including being preferred for various mass timber products, such as Glulam and CLT.

Yellow Cedar: The inherent extractives in yellow cedar make it

naturally durable and an ideal wood for outdoor applications. It very well resists natural elements, decay, and insects, as it emits a pleasant fragrance that insects abhor and humans like. This species is frequently used for making door jambs in termite-infested areas and in other external applications.

Western Red Cedar: It is the perfect choice for outdoor applications because of its remarkable natural durability; it performs very well in challenging outdoor conditions. It is appreciated both for interior panelling and external cladding. It has a warm, dark hue that, if left uncoated in the open, turns into a fine grey over a period of time.

Spruce-Pine-Fir: Spruce-Pine-Fir (S-P-F) is a combination of Engelmann Spruce, Lodgepole Pine, and Alpine Fir. All these three species grow together and have almost similar properties and characteristics, hence they are grouped together. S-P-F is stress rated and graded for structural applications; thus, it is the preferred choice for building with wood, considering its excellent strength-to-weight ratio. In many places, manufacturers also use their higher grades for making furniture and other products.

Why does India need to switch to importing wood from sustainable sources?

India is a wood fibre deficit nation and thus has to depend on imported wood to meet its needs. It must be noted here that the government had to step in towards the end of the last century

to protect India's forests after decades of incessant logging and deforestation resulting in the loss of vital forest cover. It is therefore critical for India, as well as the rest of the world, to use this beautiful natural resource responsibly by sourcing wood ONLY from sustainably managed forests in order to prevent further loss of forest cover, which is necessary to mitigate global warming and leave a healthy environment for future generations. Canada is a world leader in forest certification and sustainable forest management practices, thus guarding against deforestation.

Canadian wood has recently collaborated with many regional designers and architects. Is there any other such project in the pipeline?

We at Canadian Wood, since our inception, have been regularly engaging with leading architects, developers, contractors, and manufacturers in India during the last 7–8 years. We have collaborated with many of them in some truly amazing demo projects, which were essential initially to get the concept of building with wood, North American style, off the ground. There have been great examples of varying techniques adopted by different stakeholders in India in structural applications—from T&G (Tongue & Groove) to WFC (Wood Frame Construction) to Post & Beam and hybrid with wood in conjunction with local stone or bricks. The movement has since gained momentum and the journey now continues through close to a hundred commercial projects that are in

various stages of planning and execution. You will hear about them as and when they keep happening.

How does Canadian Wood harvest wood sustainably?

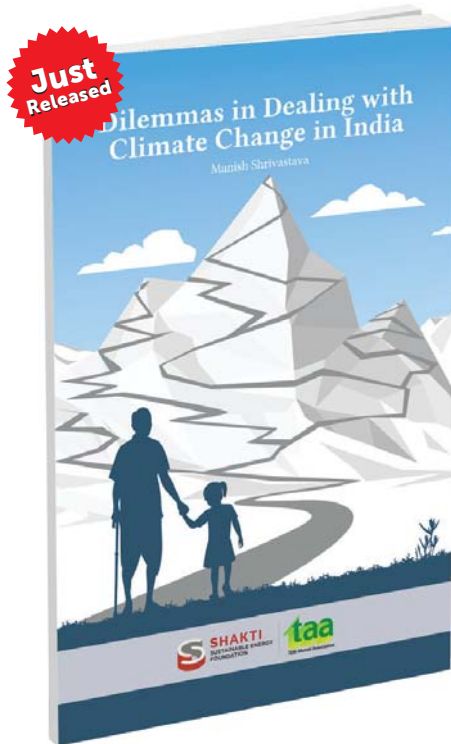
Canada is home to nearly 10 per cent of the world's total forest cover. It has made efforts to create sustainably managed forests with 0 per cent deforestation. Ninety-five per cent of the wood from Canada comes from sustainably managed and publicly owned forests that are protected by the strict forest management laws of the country. Even though the nation harvests under 0.35 per cent of its forest acreage annually, having enough wood for self-sufficiency, it also exports wood to other nations. For every tree that Canadians harvest, three trees are planted in its place of the same species as harvested. Additionally, they care for these saplings until they can support themselves. By following this procedure, the newly planted trees are given time to mature and become self-sustaining. Over 37 per cent of Canada's forests are certified by international, non-profit, non-governmental organizations such as PEFC and FSC, who promote sustainable forest management through independent third-party certifications. Canada, by far, is the world leader in forest certification with a huge lead over the second-placed nation.

What is the company's plan for the year?

We will continue to reach out to our target audience with our programme to spread awareness about BC Canada as a long-term reliable source of legally harvested and certified wood from sustainably managed forests and educate them about its five distinct wood species, their properties, and applications. One-on-one engagements with the stakeholders in India too will continue, in addition to product trials, technical assistance, and hand-holding, besides connecting prospective buyers in India with lumber suppliers in Canada. ■



HIGHLIGHTS THE SOCIAL, ECONOMIC, AND GOVERNANCE ISSUES



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Be it an extremely hot day or a day of heavy rains, people jokingly attribute the weather to climate change—and that is the sole extent of public discourse on the topic. Seldom does anyone pause to think of such extreme-weather days becoming threateningly frequent and whether that threat is avoidable.

Dilemmas in Dealing with Climate Change in India invites the general public to engage with the issue of climate change, shows how it affects the country and the lives of its citizens, and suggests what should be done to counter climate change. The book sets out themes that its readers can readily relate to and those that will prompt readers to want to know more, challenges them to form informed opinions, but also cautions them about forming them in haste—a must-read for those looking for a source that explains climate change simply, clearly, and concisely.

This book is useful for adults who are concerned about topical issues but lack the understanding to make sense of what they read or watch in the mass media.

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COP27

Climate Chaos and Warfare for People and the Planet

COP27 took place in November 2022 in the Egyptian coastal city of Sharm el-Sheikh. The Conference concluded with a historic decision to establish and operationalize a loss and damage fund. **Dr Anil Pratap Singh** takes us through the highlights of this important climate conference and concludes that at COP27, unrelenting deliberations took place on setting needs and priorities of the Parties; thereby resolute implementation plans for the future were developed during the deliberations.



OP 27

M EL-SHEIKH

PT 2022



The 27th Conference of the Parties (COP27) to the United Nations Framework Convention on Climate Change (UNFCCC) took place in November 2022 in the Egyptian coastal city of Sharm el-Sheikh. The Conference concluded with a historic decision to establish and operationalize a loss and damage fund. The meeting also featured the Sharm el-Sheikh Implementation Summit, where over 100 Heads of State and Government attended and about 35,000 delegates from 190 countries took part in the conference, which was chaired by Egyptian Foreign Minister Sameh Shoukry and by the end of the meeting, the Parties had adopted 60 well-intentioned decisions.

The global average temperature rise is already 1.1°C and people around the world are facing a range of climate change impacts from droughts to floods and heat waves to superstorms that only the richest countries can cope with. Therefore, from the opening session of this climate change conference, the speakers not only recalled the important messages of climate science, but also the current geostrategic challenges related to energy and food, while underlining the devastating climate effects and expressed the common sentimentalities to act urgently. Pointing out their impact on ecosystems, the speakers stressed the exigent need to focus on implementation. Also, emphasis was laid on the ‘polluter-pays’ principle for outlays of climate compensation by historical emitters

of greenhouse gases (GHGs). But still, on the issue of climate change, there seemed, rich nations’ wavering attitude in assisting developing and poor countries.

Justice and Ambition vis-à-vis Mitigation and Adaptation

UN Secretary-General António Guterres said that our planet is still in the emergency room and we need to drastically reduce emissions now and this is an issue this COP did not address. Warning that humanity is on a “highway to climate hell,” he besought the world to act before it is too late. However, from the beginning, COP27 has been driven by two overriding themes: justice and ambition. ‘Justice’ for those on the frontlines who did so little to cause the crisis and ‘Ambition’ to keep the 1.5 degree limit alive and pull humanity back from the climate cliff.

Mitigation and adaptation discussions were centric in COPs until recently. The United Nations Intergovernmental Panel on Climate Change (IPCC) backed mitigation as reducing climate change by reducing the flow of heat-trapping GHGs into the atmosphere, either by reducing sources of these gases or enhancing the ‘sinks’ that accumulate and store these gases, e.g., oceans, forests, and soil. The ultimate aim is to stabilize GHG levels in a timeframe ample to allow ecosystems to adapt naturally to climate change, ensure

that food production is not threatened, and to enable economic development to proceed in a sustainable manner. In addition, adaptation, that is, adapting to life in a changing climate, which involves adjusting to actual or expected future climate, is also vital. Here, the goal is to reduce risks from the harmful effects of climate change, e.g., sea-level rise, extreme weather events, or food insecurity, etc.

In Sharm el-Sheikh, a mitigation work programme was launched in order to scale up mitigation ambition and implementation. Governments called for reexamining and strengthening the 2030 targets in their national climate plans by the end of 2023, and speeding up efforts to phase-down unabated coal power and phase-out inefficient fossil fuel subsidies.

At the Sharm El-Sheikh Climate Change Conference, there were discussions on work programmes in order to urgently scaling up mitigation ambition and the Global Goal on Adaptation (GGA). On mitigation, developed and climate-vulnerable countries pushed for a strong outcome to ramp up the efforts to reduce emissions before 2030, calling this “the critical decade.” In the end, countries agreed to a process that will explore topics, which are to be decided, and identify opportunities and gaps to reduce emissions. Several countries expressed some worry that the mitigation outcome may not be enough to “keep 1.5°C alive.”

At COP27, countries were more pleased with the outcome on the GGA and the Parties agreed to a long-term, structured effort that will help countries to collectively achieve the global adaptation goal. It will be reviewed before the second Global Stocktake (GST) in 2028. The unanimity of the countries to continue the technical dialogue under ‘Global Stocktake’ was seen as a virtuous outcome of COP27. It is worthwhile to mention that the GST is a fundamental component of the Paris Agreement, which is used to monitor its implementation and evaluate the collective progress



made in achieving the agreed targets.

At COP27, after a hard political bargain, countries, for the first time agreed to recognize the need for finance to respond to loss and damage associated with the adverse effects of climate change, and quickly established a fund and the necessary funding arrangements, with the details to be worked out over the coming year.

During the opening ceremony, COP26 President Alok Sharma underlined recent reports suggesting that full enactment of current commitments will set the world on track to limit average global temperature increase to 1.7°C, which he acknowledged as deficient and further urged world leaders to explain clearly what they have attained in the last year and how they will proceed further.

COP27 President Sameh Shoukry believed that the recent extreme events all over the world are another wake-up call to act with all precaution in accordance with commitments and targets. Shoukry urged for moving from negotiations and pledges to implementation, including scaling up ambition according to countries’ capacities. The Presidents of COP26 and COP27 released a report on Finance for Climate Action, taking into account the needs of countries with developing and emerging economies, except China.

Necessitating Improved Investment for Loss and Damage

Recognizing climate change, in view of the loss and damage, an increased level of investments are required for development and growth. An estimated cost of USD 2 trillion per year by 2030 would be needed for sustainable agriculture in such a stance.

“Loss and damage can no longer be hidden,” UN Secretary-General Antonio Guterres said on the first day of COP27, adding that climate justice and international solidarity are not only a fundamental question but also a moral imperative. This COP has taken an important step towards justice and UN Secretary-General welcomed the decision to launch a loss and damage fund and to operationalize it in the coming period. Guterres unveiled the “Early Warnings for All” executive action plan, which calls for USD 3.1 billion in the initial new targeted investments between 2023 and 2027 in early-warning systems to limit damage from climate change where priority would be to support the most vulnerable first. Furthermore, with the intentions to start immediately, Global Shield against Climate Risks, with new commitments of over USD 200 million as initial funding, was also launched at COP27. Also, for immediate climate adaptation needs, new fund-mobilization announcements were also made. Besides, the new Indonesia Just Energy Transition Partnership, announced at the G20 Summit as held parallel with COP27, committed to mobilize USD 20 billion over the next 3–5 years to accelerate energy transition.

During COP27, developed countries such as the



United Kingdom, the United States, Australia, and the European Union acknowledged paucity of funds to compensate for loss and damage. The UNFCCC Executive Secretary Simon Stiell stressed three critical lines of action, i.e., demonstrating a transformational shift to implementation; strengthening progress on work streams on mitigation, adaptation, finance, and loss and damage; and augmenting delivery on the principles of transparency and accountability all the way through the process.

Chair of the IPCC, Dr Hoesung Lee, presaged and said that “the world is not on track to limit global warming to 1.5°C”. During COP27, on discussions of de-carbonization in climate change negotiations, the rich countries, another time, did not pay considerable responsiveness to it, while the past decade has been the warmest on record, and the ongoing Earth’s average temperature is on rise. In recent years, across the world, this record warming has led to melting of snow and glaciers, wildfires, floods and droughts, as well as extreme events such as severe cyclones.

Representatives from the Least Developed Countries (LDCs), stressed the need to emphasize not only on adaptation but also on loss and damage and accentuated that those who were suffering from the climate emergency cannot wait for negotiators to deliver. Whereas developing countries like India admonished developed countries to honour their commitments, and called on all countries to forge a multilateral response to adapt to climate change and assist one another in dealing with the associated loss and damage and also to focus on ways to practically assist countries in implementing their nationally determined contributions (NDCs).

Since the Paris Agreement entered into force on November 4, 2016 with 194 parties, they expected to submit NDCs and review the aggregate progress on mitigation, adaptation, and means of implementation every five years through a global stocktake (GST). It is worthwhile to mention that the GST of the Paris Agreement is a process for taking stock of the implementation of the Paris Agreement with the aim to assess the world’s collective progress towards achieving the purpose of the agreement and its long-term goals as delineated in Article 14.

‘Ocean Action Day’ of COP27

The Parties during the Ocean Action Day at COP27, deliberated with due prominence, on significance of oceans to safeguard the planet in the context of climate change. Since oceans not only absorb large



amounts (around 25 per cent) of anthropogenic carbon dioxide (CO₂) but also produce more than 50 per cent of the essential oxygen. Minute ocean flora, i.e., phytoplankton, mostly exist near surface of the water and drift with its currents, contribute 50–85 per cent of the oxygen in the Earth's atmosphere. Using CO₂ and sunlight to make their food during photosynthesis, these phytoplankton generate oxygen, as a byproduct, which is essential for animals' breathing process including human beings. Oceans not only absorb CO₂ emissions but also capture around 90 per cent of the heat generated from these emissions and safeguard the planet against the brunt of climate change; thereby help in placating SDG13 as well. In the meetings of the UNFCCC, to achieve the objectives of SDG14, i.e., 'Life Below Water', ocean issues were incorporated into the NDCs and National Adaptation Plans (NAPs) by the Member States. In August 2015, 193 countries had appropriately agreed on this. Also, the period from 2021 to 2030 declared in the 72nd session of the United Nations General Assembly (UNGA) as 'UN Decade of Ocean Science for Sustainable Development' more particularly to achieve SDG14 in order to conserve and sustainably use oceans, seas as well as marine resources. More than three-fourths of the biodiversity exist in oceans. Coastal regions are specifically important both because of livelihood and other economic activities including tourism and transportation. The global ocean economic activity, per annum, is estimated between USD 3 trillion to

USD 6 trillion contributing to the world economy, i.e., 'blue economy'. On the other hand, pollution, ocean-acidification, climate change, etc., are creating turmoil in marine biochemistry and losses in its biodiversity, apprehending food and human welfare on the whole.

SDG14 also expected to benefit the other SDGs such as poverty eradication (SDG1), hunger eradication, food security and promote better nutrition and sustainable agriculture (SDG2), protect health and promote healthy lives at all ages (SDG3), reduce inequality between and within countries (SDG10), etc. Hence, these issues were upstretched earnestly by the Parties during the Ocean Action Day at COP27.

During the Ocean Action Day at COP27, governments, businesses, experts and other professionals called upon to work together to assess the actions pertaining to ocean and climate and to identify the gaps, because seas and oceans, despite being scientifically proven to be solutions to climate change and central to the sustainable development, still funded deficiently.

In his keynote address, Ralph Regenvanu, Minister of Climate Change Adaptation, Meteorology and Geo-Hazards, Energy, Environment and Disaster Risk Management of Vanuatu (being an island nation located in the South Pacific Ocean), stressed that the ocean is the world's largest carbon sink but the developed countries are not gratifying their commitments and they were not only lagging behind in making the required contribution to properly



implement the 'Paris Agreement' but also not providing the necessary funding. He said the island nation is now paying for the loss and damage as already caused and urged for fighting against new efforts to mine sea beds. Mark Haver of Sustainable Ocean Alliance, also highlighted certain calls for a deep-sea mining ban and emphasized moving from talk to action, pinching whether COP27 was 'a crisis of commitment or a crisis of empathy'. Tarek Temraj from Egypt's Environment Ministry emphasized that the ocean connects us all and knowledge exchange is crucial to saving it and preserving human well-being.

Panellists at COP27's Ocean Day said that good governance and funding were key to adaptation but to

solve ocean problems, increased mitigation that also aid adaptation, improved knowledge base, equitable trust building among stakeholders as well as stronger regional diplomacy to exchange best practices need to be kept properly onto the agenda. Arghya Sinha Roy of Asian Development Bank (ADB) told that the ADB's Healthy Oceans Action Plan, finances technical assistance for ocean health and marine economy projects, under Bank's blue financing.

During the discussions on financing coastal adaptation, it has been acknowledged that 37 per cent of the world's population live within 100 km of a coast, however, SDG14 (life below water) receives the least amount of long-term funding as compared to any of the other SDGs.

New 'Loss and Damage' Fund for Vulnerable Countries

Amongst several other benevolent decisions as the Parties adopted, one of the major developments of COP27 considered as reaching a breakthrough agreement on new 'Loss and Damage' fund for vulnerable countries, which were hit hard by climate disasters. UN Climate Change Executive Secretary, Simon Stiell said that this outcome will not only move the world forward but also address the impacts on





communities whose lives and livelihoods have been ruined by the very worst impacts of climate change. COP27 also ensued in reaffirming commitment to limit global temperature rise to 1.5°C above pre-industrial levels and to cut GHG emissions and adapt to the inexorable impacts of climate change, which will also enhance the sustenance in terms of finance, technology and capacity building desired especially by developing countries.

Significant progress on adaptation was observed in COP27, with governments agreeing upon the ways to move forward on the Global Goal on Adaptation, which will conclude at COP28 and inform the first GST, improving resilience amongst the most vulnerable. New pledges, totalling more than USD 230 million, were made to the Adaptation Fund at COP27. These pledges will help many more vulnerable communities adapt to climate change through concrete adaptation solutions. 'Sharm el-Sheikh Adaptation Agenda' was also declared in order to enhance resilience for people living in the most climate-vulnerable communities by 2030. UN Climate Change's Standing Committee on Finance

would be preparing a report on doubling adaptation finance for consideration at COP28 next year.

The 'Sharm el-Sheikh Implementation Plan' as COP 27's cover decision, acmes that a global transformation to a low-carbon economy is expected to require investments of at least USD 4–6 trillion a year. Delivering such funding will require a swift and comprehensive transformation of the financial system and its structures and processes, engaging governments, central banks, commercial banks, institutional investors, and other financial actors. Moreover, a new five-year work programme was also launched at COP27 to promote climate technology solutions in developing countries.

At COP27, unrelenting deliberations took place on setting needs and priorities of the Parties, thereby developed schema and resolute implementation plans for the future, henceforward we must win this battle for 'People and the Planet'. ■

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Resurrecting the Past

In the World of Dinosaurs, UK

Set in acres of natural forest, the World of Dinosaurs is one of the UK's biggest and most spectacular animatronic dinosaur attractions as it features 30 life-size, moving and roaring dinosaurs.

Dr Marianne Furtado de Nazareth gives an overview of the park, which is a real thrill for any dinosaur adventurer.

Dinosaurs were not big in our lives in the past, as much as they fascinate the little kids of today. Driven by marketing gimmicks, dinosaurs have fired a child's imagination and knowledge to learn all about them and proudly rattle off their tongue twisting names and also explain what each of them ate or did. Beautifully illustrated books, puzzles, cartoon movies and toys have ignited their interest. And it's not unusual for a child to share fun facts that they know about each species. All thanks to smart marketing of dinosaur

merchandise.

The 1993 movie *Jurassic Park* began it all, and is based on the 1990 novel of the same name by Michael Crichton. As research suggests, the film is set on the fictional island of Isla Nublar, located off Central America's Pacific Coast near Costa Rica. There, wealthy businessman John Hammond and a team of genetic scientists had created a wildlife park in order to resurrect extinct dinosaurs. Trouble erupts when industrial sabotage leads to a catastrophic shutdown of the park's power facilities and security

precautions. Then the small group of visitors and Hammond's grandchildren struggle to survive and escape the perilous island with seemingly real and terrifying dinosaur chases that terrified us, watching the film.

So, on a recent trip to the UK, we went to the World of Dinosaurs at Hertfordshire to enjoy a kids' day out learning about these prehistoric beings. The park features thirty, life-sized moving, snapping, and roaring dinosaurs. From cunning Velociraptors, to enormous Brachiosaurus, terrifying Spinosaurus to unpronounceable Pachycephalosaurus, plus of course, a mighty *Tyrannosaurus rex*—they are all there, enthraling visitors who come with their entire families to enjoy learning about our planet's past. Set in acres of natural woodland, the World of Dinosaurs is one of the UK's biggest and most spectacular animatronic dinosaur attractions as it features 30 life-size, moving and roaring dinosaurs—a real thrill for any dinosaur adventurer! Hissing, snorting, roaring and spitting, the dinosaurs also emit their actual sounds as one walks past, with their massive jaws opening, displaying their rows of sharp teeth.

There's a Dino Dig area too plus lots of other dinosaur-themed treats for all the family members. Visitors can also





experience a Dinosaur Train ride, the 'Rex Express', through the World of Dinosaurs, where every twist and turn reveals a new prehistoric surprise. At £2 per person there was a large queue to get onto the ride. The train was appealing to all the kids with a dinosaur head for the engine and many adults would have loved the ride too.

Dinosaurs roamed the earth 225 million years ago. They lived and died long before humans arrived on Earth. They lived and evolved as the planet developed and 65 million years ago the last of the dinosaurs died out. It was at the start of the Triassic period the dinosaurs began to appear. The Jurassic period was the golden age of the dinosaurs. There were a variety of Allosaurs, Stegosaurus, and Apatosaurs. During the Cretaceous period—the famous Tyrannosaurus and Triceratops appeared as did the earth's first birds.

By the Cenozoic Era, mammals and birds dominated the Earth. Snakes, lizards and crocodiles are all reptiles and are the

only living reminders of dinosaurs today. However, dinosaurs walked differently from reptiles. Most reptiles slither or crawl because their legs are affixed to the sides of their body. Dinosaurs' legs protruded from under their bodies so like mammals they could walk on four feet. Many like the vicious *Tyrannosaurus rex* (*T. rex*) could stand on two feet.

So, the question uppermost in our minds is—where did the dinosaurs come from? Since all animals develop from other animals, this process is called evolution and takes centuries to change. Scientists believe that dinosaurs evolved from creatures called thecodonts, which were animals that lived before dinosaurs. They ate meat and insects. Thecodonts had strong back legs and their front legs were short and weak. They could stand almost straight on their back legs and run very fast too.

Dinosaurs roamed the earth for millions of years and over time some died out and new species took their place. Scientists have uncovered 600 different

varieties of dinosaurs. Dinosaurs lived only on land, but the Protosaurus who were as tiny as a sparrow could fly. Their wings were leathery and tough, not feathery like the wings of our birds. Plesiosaurus lived in the sea and looked a bit like dinosaurs but they had flippers to help them to swim.

There are hundreds of species of dinosaurs as scientists have unearthed so many and over time have split them into two main types of dinosaurs: Saurischia and Ornithischia. It was English palaeontologist Harry Seeley who first noticed that there were two main types of dinosaurs: those whose hips were lizard-like in structure, and those whose hips were bird-like in structure. Among the animals that lived when dinosaurs did were some that could fly and some that could swim, but they were all reptiles. Flying reptiles included the great winged pterosaurs.

The Triceratops is the most common dinosaur at 40 per cent; Tyrannosaurus is second at 24 per



Pterosaurs

Cretaceous period theropods, but had *Jurassic Park* been more period accurate, this dinosaur could've been the signature predator terrorizing park guests.

Spinosaurus

Large and long, this long-snouted theropod was one of the biggest predators to walk on land — maybe even bigger than a *T. Rex*. Essentially, the Spinosaurus was a huge crocodile on two legs. But its resemblance to those modern reptiles is more than cosmetic: based on the high location of its nostrils, and fossilized stomach contents that have been discovered, researchers have guessed that the Spinosaurus was semi-aquatic and likely specialized in hunting water-based prey—kind of like a croc. With a name derived from its distinctive spinal sails, the Spinosaurus—with its resemblance to contemporary reptiles—is a fascinating creature.

Troodon

Sometimes, the smartest hunter is the coolest. Troodon was a small, possibly omnivorous theropod dinosaur, notable for having the highest brain-to-size ratio among dinosaurs; leading some to conclude that it may've been the most intelligent dinosaur. And its large, forward-facing eyes may've had something to do with its brainpower, since it would've needed more intelligence to handle more visual input. It's also theorized that Troodon's big peepers allowed it to hunt nocturnally, which would've been handy, since it could be found as far north as the Arctic Circle. Despite its possible status as a genius among dinosaurs though, scientists estimate it would've only been about as smart as a modern bird.

cent; Edmontosaurus is third at 20 per cent followed by Thescelosaurus at 8 per cent, Ornithomimus at 5 per cent, and Pachycephalosaurus and Ankylosaurus at 1 per cent.

Some of the most famous dinosaurs are also some of the coolest dinosaurs to excite any child or adult. From the Brachiosaurus and its extremely long neck, to the Stegosaurus and its characteristic spiked tail, the Spinosaurus, which was basically just a big crocodile on two legs, these prehistoric creatures may be extinct animals, but they're still dinosaurs and interesting today.

Brachiosaurus

Belonging to the long-necked sauropod category of dinosaurs, these tall, titanic creatures are among the most famous members of that group. Compared to their fellow sauropods, brachiosaurs have more steeply inclined necks, which—thanks to their longer forelimbs and treetop

grazing habits—means they were basically the giraffes of the Jurassic period. Although it is unlikely that brachiosaurs could stand on their hind legs as we've seen on film, their distinctive arched heads and familiar posture are now a mainstay of popular fiction, making the brachiosaurus one of the most well-known dinosaurs on this list.

Allosaurus

The first of several theropods, or bipedal and generally carnivorous dinosaurs, on this list, the Allosaurus was one of the top predators of its day, taking down medium-sized sauropods and other large herbivores. With a name that means "different lizard," its body was more evenly proportioned than many of the other large, meat-eating dinosaurs. That means Allosaurs were better suited to running at high speeds, with scientists estimating they could've reached up to 34 mph. Today, the Allosaurus is less recognizable than some of the

Iguanodon

The Iguanodon holds the distinction of being one of the first dinosaurs ever named. And, although it's similar in build to other herbivore dinosaurs, it tended to stick out for other reasons—mainly thanks to its so-called “thumbs,” which took the form of spikes. The spiky digits are generally thought to have acted as a form of defence or as a means to break up tough plant growth. What's more, specimens of the Iguanodon have been found on nearly every continent, so it can claim to be one of the most thoroughly studied species as well.

Deinonychus

Thanks to “Jurassic Park,” this dinosaur is what most people picture when they think of a Velociraptor. Though the two are related, the “Jurassic Park” films and the novels they're based on rebranded the Deinonychus,

probably because, let's face it, the name “Velociraptor” does sound cooler. But the real Velociraptor was only about the size of a turkey. Deinonychus, on the other hand, was much closer to the man-sized, hunter dinosaurs with the wicked claws everyone loves to see onscreen... even if studios still haven't given them anatomically accurate feathers.

Triceratops

Few dinosaurs have captured the attention of humans quite like this creature. Like some of our other entries, Triceratops calls to mind a more recent animal—namely the rhinoceros. Its renowned facial horns and bony neck frill, along with its beak-like mouth, give it a great deal more personality than most other dinosaurs. While closely related dinosaurs with more horns and more elaborate frills have been discovered, Triceratops remains the best known and most



Tyrannosaurus

popular, thanks to its depiction in popular culture as a herbivorous dinosaur capable of going toe-to-toe, or rather tooth-to-horn, with carnivores.

Tyrannosaurus Rex

One of the largest land predators to ever walk the Earth, but not the biggest as we've already seen, the *T. rex* was, as its name proclaims, the king of its day. Some theorists have tried to dethrone it, claiming it was more scavenger than hunter, but the recent discovery of a *T. Rex* tooth embedded in the fossilized remains of a Hadrosaurus strongly suggests “predator.” Either way, its intimidating size, savagely powerful bite, and those absurdly small forelimbs have cemented it in pop culture as the coolest dinosaur of them all.

You can watch a quick video, which will show you around the park if you are reading this online—<https://www.youtube.com/watch?v=jUVCYcFllqA> ■

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Triceratops

Riverine Ecosystem

Conservation and Management Strategies

A riverine ecosystem also called a lotic ecosystem is the ecosystem of any spring, stream, or river. From the source to the mouth, the waters are flowing (lotic) and show a longitudinal gradient in temperatures, the concentration of dissolved material, turbidity, and atmospheric gases. Rivers are very much necessary for the existence of our civilization and considered to be a crucial and precious national asset of India.

India is one of the countries with a significant number of rivers and tributaries in the world, which are helpful not only in the field of agriculture but also in inland transport system of the country. Riverine systems are under threat in human-dominated world due to a number of issues, due to various factors which necessitate policies for the conservation of rivers.

Today's rivers are so severely contaminated by industry or unevenly distributed due to poor water management techniques that it literally means life or death. The Central Pollution Control Board (CPCB) in 2018 identified 351 polluted river stretches in India. The restoration and conservation of rivers must be given top attention for sustaining humanity and ecology for the present and future generations. River conservation is a deliberate action

connected with various habitat features and outlines how to conserve all the rivers spread across India.

What is Riverine Ecosystem?

The origin and distribution of the main streams and their tributaries are known as the 'drainage system or river system'. A riverine ecosystem, also called a lotic ecosystem, is any spring, stream, or river viewed as an ecosystem.

Potential of the Indian Riverine System

The country possesses an overall river length (including canals) of 2.52 lakh km, out of which the potential length is 29,000 km. India has been gifted with 15 major, 45 medium, and numerous minor

rivers that run through contributing to the current production of 1 lakh tonne. The total inland capture fisheries production is greatly boosted by the riverine fisheries resources. The riverine environment changed significantly due to water abstraction, dam construction, sedimentation, and irrational fishing. These activities affected the natural riverine fish production showing a continuous downward trend.

Importance of Riverine Ecosystem

Direct economic importance:

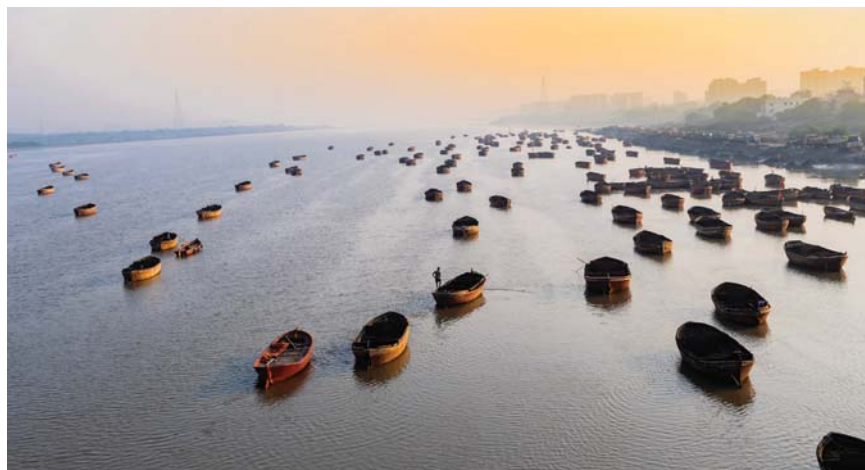
Transportation; water supply; energy; and provision of harvestable products.

Indirect importance (ecosystem services):

Biogeochemical transfer of energy and matter; the physical transformer of the landscape; and provision of a wide variety of habitats.

Impacts of Deteriorating Quality on Communities and Ecosystems

Fish kills are a frequent occurrence, hence, local or native fish species are becoming extinct. In coastal areas of Maharashtra, with more than six Chemical Industrial Development Corporations, estuarine fisheries are in danger of extinction. Chromium and aluminium have been found in samples of human milk over the allowable



limits in the Lote Parshuram area, so, the health issues such as asthma and gastrointestinal disorders have been recorded to be significantly higher.

Common effluent treatment plants (CETPs) set up in these industrial belts have a track record of utter inefficiency, lack of involvement, and transparency. This is taking place in the Western Ghats, which is a global biodiversity hotspot.

Downstream rural communities are bearing the brunt of polluting cities upstream. Summertime has seen a sharp upsurge in waterborne infections in the villages downwind of Ujani Reservoir.

Strategic River Restoration

- Identify, understand, and work with the catchment and riverine processes
- Include a connection to socioeconomic principles and integrate it into broader planning and development efforts
- Restore ecosystem structure and function by working at the appropriate scale to address limiting factors to river health
- Set clear, achievable, and explicit goals
- Become more adaptable to future change
- Make sure the results of the restoration are long-lasting
- Include all necessary parties
- Keep track of evaluate, adapt and provide evidence of restoration outcomes.

River Conservation

- The government establishment of a National River Conservation Authority
- This process includes consideration of ecological, economic, technological, and social dimensions
- The primary goal of the Ganga Action Plan was to address the municipal sewage that was entering River Ganga
- Urban water conservation and demand management programmes should be included
- Overextraction of water from rivers is



nowadays a serious problem

- Promoting rainwater harvesting is necessary.

Conservation and Management

Effective conservation and management should include:

- Problem-related to the management practices
- Take the appropriate future research strategy to overcome that problem.

Problems and Constraints Related to Conservation and Management of Indian Rivers

- Except for River Ganga, all the work done on the other rivers is essentially fragmentary, and there is no coordination, harmony, or linking of the information from headwater to mouth.
- With the exception of River Ganga, no other river has an extensive inventory type of information available and collated.
- There is insufficient knowledge on the functions of riparian vegetation and flood plains in the river ecosystem.
- Most of the basic research works are carried out by workers in academic

institutions (rather than river basin managers), but they provide less attention to 'in-field' practical application of such studies for promoting conservation.

- The 'in-field' setting of experiments, which provides an accurate spectrum of the eco-biological conditions of the rivers, has received less attention.
- The ecological aspects of the system are less taken into account during river regulation, lift irrigation, and water allocation, especially for those rivers that traverse interstate and international borders.
- Due to procedural faults in sampling designs, the ecological impact assessment (EcolIA) is inaccurate due to diverse natural variances, which causes the management strategies to be misdirected and less successful in achieving the aim.

Future Research Strategy

The following steps may be considered for future research strategy based on which an effective management plan can be formulated:

- Selection of appropriate biomonitor
- Sampling design
- Emphasis on maintaining riparian vegetation as well as the functional dynamics of the river and flood plain

Different Programmes for Conservation and Management of Riverine System

- Water (Prevention and Control of Pollution) Act, 1974
- Namami Gange programme, 2014
- Ganga Action Plan
- Ganga River Basin Management Plan (GRBMP)
- Urban River Management Plan (URMP)
- Integrated River Basin Management (IRBM)
- Water (Prevention and Control of Pollution) Act, 1974
- Water (Prevention and Control of Pollution) Cess Act, 1977

Conclusion

In the world dominated by humans, rivers are significant water bodies of water that are in danger for a variety of reasons, necessitating laws for river conservation. Due to a lack of legislative tools, government policies, and a lack of a comprehensive strategy, the state of India's rivers is deteriorating at the moment. River conservation is considered a joint effort by all humans as individuals and not just government

regulators. But with a regulatory body, this work can be executed more effectively. The governance of such policies has to be enhanced through consultation, empowerment, and engagement by all. If all of these riverine ecosystems in our nation begin to deteriorate, it should be a top national priority to revive these vital ecosystems.

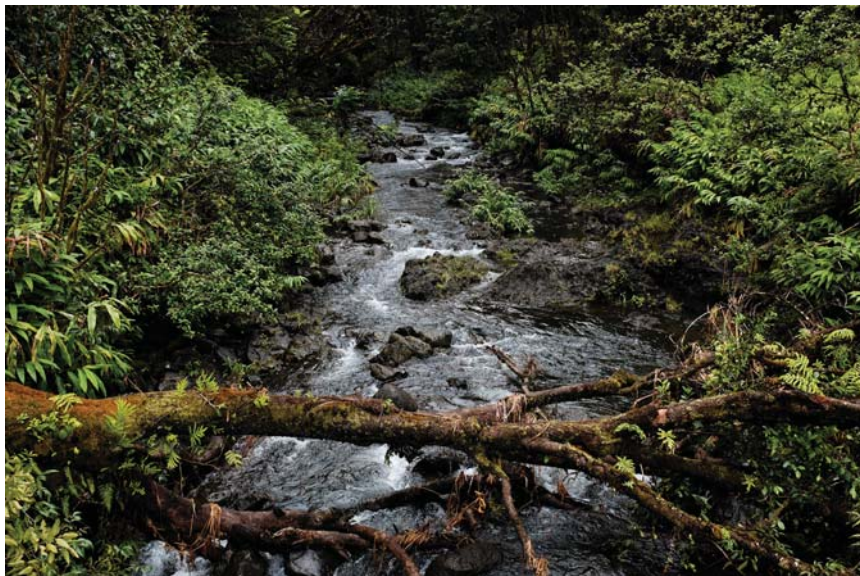
The revival of such rivers can be made with the understanding of river management, experience, and conservation knowledge. Additionally, this will increase security, environment, and water scrutiny.

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Terra Youth



Joining Hands
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Tomorrow

Sustainable Sari

A Novel Idea for Entrepreneurs

A sari is a popular women's garment from the Indian subcontinent. In this article, **Ram Ramprasad** discusses some innovative ideas to make sari sustainable. While sari's growth in the Indian market is significant, it does present an opportunity for entrepreneurs to design a sari that uses fewer resources without compromising fashion, taste, style, appeal, or aesthetics.

Almost all women in the Indian subcontinent know everything about a sari (also spelt as saree). It is an unstitched long woven garment that comes in various fabric styles, designs, and colours. The sari is wrapped around the body, one end tied at the waist and the other end going over the shoulder. According to Statista.com in FY 2021, the sari, petticoat, and blouse sales in India was INR 288 billion, this is expected to almost double in 2025 to

about INR 617 billion. Assuming sari's account for 85 per cent of this total, then in 2025, sari sales alone could reach at least INR 525 billion. While the growth is significant, it does present an opportunity for entrepreneurs to design a sari that uses fewer resources without compromising fashion, taste, style, appeal, or aesthetics.

The idea to manufacture a sustainable sari is a simple one. Based on style and drape, about 10–30 per cent of a sari

could be in plain cotton, the balance of the sari needs to be in its original format. The portion of the sari that is in plain cotton is the initial wrap around that is not visible, the other major portion of the sari wraps around the plain cotton and is the visible portion of the sari. Therefore, it is one and the same sari with two different sections; the unseen part and the seen part. Now, such a business model does not compromise a woman's choice of a sari. In fact, the concept of





sustainability may be more appealing to them. Further, the cost of the sari itself is lowered as the sustainable sari uses less of the expensive material. Plus, for a tropical country like India, the portion of the sari that is in plain cotton keeps the wearer of the sari cool and comfortable. Such a sustainable sari may save anywhere between INR 53–158 billion based on a market size of INR 525 billion as noted above. These savings could double or triple based on other sustainability initiatives as listed below.

A start-up entrepreneur could further embellish the sustainable sari manufacture if he/she switches his/her entire textile processing solutions to liquid CO₂ that offers water free and chemical free options. A company such as DyeCoo Textile Systems in the USA has accomplished this feat. It is likely that there are other companies playing in this space. Manufacture of a single T-shirt requires 2500 litres of water and a switch to liquid CO₂ lowers the use of water to almost zero. For certain other textile manufacturers, advancements in sustainability can also be achieved by switching from chemical dyeing to natural dyeing. Many companies such as Colorifix, Huue, Vienna Textile Labs, etc., based in the USA are manufacturing natural dyes in the lab by using microbes. All these initiatives will lower the cost for the consumer significantly, protect the environment, and give a sense of

purpose for the person wearing the sari. People often feel they are a victim to a consumerist business model. But, start-ups can transform a consumption oriented business model to a more conservation oriented business model by leveraging innovative out-of-the-box thinking and knowledge of clean tech solutions occurring all across the world.

One can further extend the sustainable sari idea to other multiple value added functions that can extend its life. In the Indian subcontinent, a cotton sari has been used as a hammock-crib for an infant. This is more preferred than a wooden crib primarily in the rural areas. A wooden crib uses more resources than a sari-hammock-crib with a lower carbon footprint. The sari-hammock-crib passes through a single hook on the ceiling and mimics a mother's womb; mothers do not worry about sudden infant death concerns with a sari-hammock-crib compared to a wood crib. Although chances of sudden infant death are extremely low in a wooden crib, fears still persist. India has an opportunity to leverage such eastern concepts and ideas globally. A transition to a conservation-oriented business model is a win-win for consumers, businesses, and the environment. Business schools and media should encourage the adoption of such products or ideas.

A used sari can also be used as a mop. Used sari can be folded and

inserted into pocket like structures to create a mattress, a suggestion that needs further exploration. Several such ideas should be explored to make our textiles sustainable. In the USA, used blue denims are used to manufacture currency bills. India imports used clothing to make blankets. Global business models need to shift from consumption-oriented models to conservation-oriented models. The sari idea stated above is one such example. Women entrepreneurs have a golden opportunity to shape the buying preferences of women all over the Indian subcontinent including target markets in the USA, Europe, and Australia.

The concept of 'Jugaad' in India needs a new meaning, i.e., to make all our everyday products more and more sustainable. For example, our toothbrushes can have a permanent handle with a snap-on brush to save tonnes of plastic waste. Bath towels can have a different colour on each side to extend its use and save water. In this manner, sustainability has to penetrate our everyday lives. India has a rich tradition of culture to transform all products to circularity or to at least work towards such a goal. Embracing such models creates domestic and global markets while addressing environmental issues. ■

Ram Ramprasad is a frequent contributor to TerraGreen. He worked as a Global Marketing Director for a Fortune 100 company in the USA.

Bizarre Facts



1. Elephants can't jump.
2. Dolphins sleep with one eye open.
3. Pigs do not sweat.
4. The circulatory system is more than 60,000 miles long.
5. The Philippines consists of 7641 islands.
6. People once ate arsenic to improve their skin.
7. Lemons float, but limes sink.
8. McDonald's once made bubblegum-flavoured broccoli.
9. The first oranges weren't orange.
10. A cow-bison hybrid is called a beefalo.



Did You Know?

- Humans are the only animals that blush.
- The first speeding fine took place in 1896.
- A film star invented wifi.
- Pineapples were once luxury objects.
- Sudan has more pyramids than any country in the world.
- The bumblebee bat is the world's smallest mammal.
- The world's first animated feature film was made in Argentina.
- Japan has one vending machine for every 40 people.
- Sloths can hold their breath longer than a dolphin.
- Candy floss was invented by a dentist.



The IKEA Foundation Awards BOMA \$10.1 Million

To Empower Vulnerable Communities Impacted by Climate Change

Founded 15 years ago to eliminate extreme poverty among pastoralist women in Kenya, BOMA has since transformed the lives of more than 450,000 participants in multiple countries and is on a growth trajectory to lift 3 million people out of extreme poverty by 2027. BOMA's mission is to provide the people and governments of Africa's drylands with economic inclusion programmes that increase resilience to multiple crises. BOMA is a registered 501(c) (3) in the United States and a Kenyan NGO.

The IKEA Foundation is a strategic philanthropy that focuses its grant making efforts on tackling the two biggest threats to children's futures: poverty and climate change. It currently grants more than €200 million per year to help improve family incomes and quality of life while protecting the planet from climate change. Since 2009, the IKEA Foundation has granted more than €1.5 billion to create a better future for children and their families. In 2021 the Foundation decided to make an additional €1 billion available over the next five years to accelerate the reduction of greenhouse gas emissions.

On December 12, 2022, IKEA Foundation awarded BOMA, a grant of \$10.1 million to support the organization's innovative approach to alleviating poverty in regions severely impacted by climate change. "We know that there's an inextricable link between climate change and extreme poverty, especially in the arid regions of Africa," said BOMA's CEO, John Stephens. "At BOMA, we're optimizing our approach to

not only lift people out of poverty—but to do it in ways that are sustainable and even restorative." "This partnership with the IKEA Foundation is a transformative step forward in that mission," said Stephens. "We're grateful for the funding and support."

"We are excited to be partnering with BOMA to establish green enterprises in Kenya," said Per Hegggenes, CEO of IKEA Foundation. "By working together with BOMA to scale their innovative approach to helping vulnerable communities withstand climate change and build their own resilience, we can lift more people out of poverty and also protect our planet." BOMA's new initiative, Livelihoods and Inclusion for Transformation in Kenya (LIFT), funded by this grant will catalyse opportunities for 15,600 people living in extreme poverty. It will focus particularly on women, youth, refugees, and displaced people, supporting them to launch and build 3650 environmentally friendly enterprises in Samburu and Turkana counties. The programme will be implemented in partnership with Smart Regional Consultants Danish Church Aid, Kenya, and respective county governments and local community organizations. It is ultimately expected to benefit more than 93,000 people in Northern Kenya over two years.

Throughout the three-year initiative, BOMA and the IKEA Foundation will partner with researchers from Innovations for Poverty Action. The researchers will conduct an independent randomized controlled trial to evaluate the effectiveness of BOMA's

climate-focused approach for future expansion. LIFT Kenya will build upon an initial pilot of BOMA's climate-adapted approach, known as Green REAP. This was conducted with support from Whole Planet Foundation and the Climate Justice Resilience Fund in Samburu County, Kenya from 2019 to 2021.

The successful Green REAP pilot demonstrated that, after two years of implementation, 60 per cent of participants had shifted away from destructive livelihoods such as charcoal harvesting and into sustainable enterprises. These included tree nurseries, beekeeping, and soil-restoring aloe farms. Furthermore, 60 per cent of participants joined local community conservation groups and more than 30,000 tree seedlings have been planted that help restore and create healthy ecosystems and tackle climate change. BOMA's poverty graduation approach—the Rural Entrepreneur Access Project, REAP—has been proven to have a lasting impact on participants. It empowers women, youth, and refugees by providing the resources, tools, knowledge, and connections to develop reliable incomes that help families to invest in the future—from saving for a rainy day to paying for their daughter's school fees. Upon graduating from REAP, participants report marked increases in well-being, resilience to shocks, and quality of life including a 509 per cent increase in savings and a 32 per cent increase in household income, on average. ■

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Sustainability in the FMCG Sector

Drive towards a Better Environment in the Future

FMCG market has always been closely connected to its consumers and their diverse choices; hence, a long-term shift in consumers' habits and choices is bound to have a definite impact. The new-age consumers have become sustainability advocates to protect the environment and their purchases are prime examples of their careful consideration of making eco-friendly choices in every sphere of their lives. Sustainability has become the top priority for brands and consumers. No wonder the FMCG sector, responsible for over one-third of all greenhouse gas emissions, is evolving rapidly to include sustainable practices in its procedures and let the consumer know of the change.

The fast-moving consumer goods (FMCG) market has always been closely connected to its consumers and their diverse choices; hence, a long-term shift in consumers'

habits and choices is bound to have a definite impact. For a while, the new-age consumers have been facing extreme climatic conditions and changes, which have affected their purchasing habits

and made them more careful. They have become sustainability advocates to protect the environment and their purchases are prime examples of their careful consideration of making eco-



friendly choices in every sphere of their lives.

Sustainability has become the top priority for brands and consumers. No wonder the FMCG sector, responsible for over one-third of all greenhouse gas emissions, is evolving rapidly to include sustainable practices in its procedures and let the consumer know of the change. The best effect of this transformation is that the environment is actually showing changes. Here we discuss some primary sustainability movements we are observing in the FMCG sector.

Sustainable Sourcing

FMCG companies are making active efforts to use eco-friendly ingredients from sustainable sources for manufacturing today. Certain brands are shifting from plastic inner separators to a sustainable option such as paper, plant-based alternatives such as certain leaves and bamboo, etc. They are also more forthcoming in recycling non-eco-friendly materials present in their supply chains to minimize waste.

Sustainable Packaging

Packaging, especially plastic packaging, has been a bane of the environment

and now of the industry as well. To reduce their carbon impact, companies have to necessarily reduce their plastic waste. So, fresh produce such as fruits and vegetables are being delivered in plant- or paper-based wrappers or offered in reusable cloth bags. Switching to biodegradable, reusable packing alternatives is a great zero-waste option. As it is, in case they forget to carry their own bags, consumers are ready to spend extra to purchase cloth carry-bags at stores. Another back-to-the-roots alternative is to facilitate the use of refillable containers or allow them to opt for the bring-your-own-cup option. This way, consumers too feel great about being able to contribute more in lessening the mounting burden of single-use containers in landfills.

Efficient Use of Energy

Replacing traditional incandescent bulbs with LED lights is already a gold standard in the industry as energy consumption is reduced by approximately 40 per cent. The next big shift will be to renewable energy for sustainable manufacturing and distributing procedures. Company-wise commitment to using only zero-carbon electric vehicles by a certain date is becoming more common as is



investing in dry factories with closed-loop water systems. Sustainability is now at the heart of the retail business strategies and the sector is taking more steps every day towards actively reducing environmental footprints, in every way possible.

Caring for the Environment

Consumers are progressively more aware today of the sustainability labels on products and what values they convey. So, they are keen on supporting companies that show that they care for the ecology and enthusiastically contribute towards it. So, organizations that are active in the sustainability sphere by supporting environmental causes and speaking about it on their social media platforms and in advertisements are buying the trust of consumers as well as their mindshare. Today, it is as essential to choose the path of sustainability as it is to be seen to do so.

The FMCG sector is heavily dependent on consumer tastes but this consumer-led shift is leading companies and brands to work gradually towards a sustainable environment. While the transformation has to be gradual and demands change from the bottom-up, it is important since it will ensure that we will all live in a more harmonious milieu in the future. ■

Article contributed by Mr Manish Aggarwal, Director, Bikano, Bikanerwala Foods Pvt. Ltd.





Researchers Propose New Structures to Harvest Untapped Source of Freshwater

An almost limitless supply of freshwater exists in the form of water vapour above Earth's oceans, yet remains untapped, researchers said. A new study from the University of Illinois Urbana-Champaign is the first to suggest an investment in new infrastructure capable of harvesting oceanic water vapour as a solution to limited supplies of freshwater in various locations around the world. The study, led by civil and environmental engineering professor and Prairie Research Institute executive director Praveen Kumar, evaluated 14 water-stressed locations across the globe for the feasibility of a hypothetical structure capable of capturing water vapour from above the ocean and condensing it into freshwater—and do so in a manner that will remain feasible in the face of continued climate change.

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

Palau's Rock Islands Harbour Heat-Resistant Corals

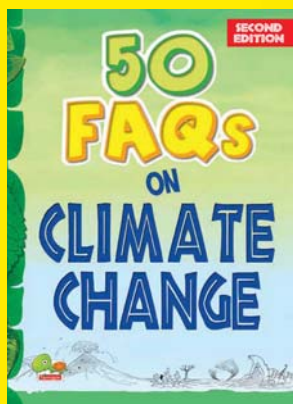
Now, scientists studying reefs in Palau, an archipelago in the western tropical Pacific, have identified genetic subgroups of a common coral species that exhibit remarkable tolerance to the extreme heat associated with marine heatwaves. Further, the scientists found evidence that larvae from these corals are travelling from their birthing grounds deep in Palau's lagoons, to the outer reef, where they survive and grow, and maintain their heat tolerance.

Understanding both the underlying mechanisms that facilitate heat tolerance of these corals, as well as the dispersal capabilities of their larvae will go a long way toward enhancing coral reef conservation and restoration efforts in the 21st century ocean, according to scientists at the Woods Hole Oceanographic Institution (WHOI) who led the research. In Palau's main lagoon, a network of very ancient, fossilized reefs has been uplifted to form a series of mountains known as the Rock Islands. These formations slow water flow in and around them, creating localized environments in which the water temperatures are consistently higher than other areas of Palau's reefs.

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



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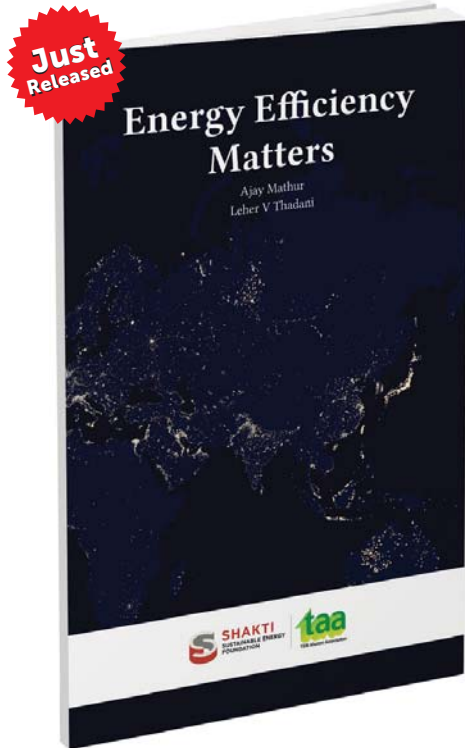
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Swati Prabhu

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Scientists Discover the Menu of the First Dinosaurs

Findings, Published Recently in *Science Advances*

The earliest dinosaurs included carnivorous, omnivorous and herbivorous species, according to a team of University of Bristol palaeobiologists.

By looking at the tooth shapes of the earliest dinosaurs and simulating their tooth function with computational modelling, experts were able to compare them to living reptiles and their diets. Their findings, published recently in *Science Advances*, show that many groups of plant-eating dinosaurs were ancestrally omnivorous and that the ancestors of our famous long-necked herbivores, such as *Diplodocus*, ate meat. This ability to diversify their diets early in their evolution likely explains their evolutionary and ecological success.

The earliest dinosaurs are enigmatic: they were much smaller than their later relatives and for most of the Triassic they were in the shadow of the crocodile-like reptiles. It is unknown how diverse they were in terms of diets and ecology, but scientists know something must have happened in the Triassic that allowed dinosaurs to endure the Triassic-Jurassic mass extinction and adapt in its aftermath, becoming the dominant group for the rest of the Mesozoic.

Lead author Dr Antonio Ballell from the University of Bristol, said "Soon after their origin, dinosaurs start to show an interesting diversity of skull and tooth shapes. For decades, this has made palaeontologists suspect that different species were already experimenting with different kinds of diets. They have compared them to modern lizard species and tried to infer what they ate based on the similarities in their teeth.



We investigated this by applying a set of computational methods to quantify the shape and function of the teeth of early dinosaurs and compare them to living reptiles that have different diets. This included mathematically modelling their tooth shapes and simulating their mechanical responses to biting forces with engineering software."

Professor Mike Benton, co-author of the study, said "With this battery of methods, we were able to numerically quantify how similar early dinosaurs were to modern animals, providing solid evidence for our inferences of diets. Theropod dinosaurs have pointy, curved and blade-like teeth with tiny serrations, which behaved like those of modern monitor lizards. In contrast, the denticulated teeth of ornithischians and sauropodomorphs are more similar to modern omnivores and herbivores, like iguanas."

The study is also innovative in using machine learning models to classify the earliest dinosaurs in different diet categories based on their tooth shape and mechanics. For instance, *Thecodontosaurus*, the Bristol dinosaur, had teeth well adapted for a



diet of plants. Professor Emily Rayfield, senior co-author, said "Our analyses reveal that ornithischians—the group that includes many plant-eating species like the horned dinosaurs, the armoured ankylosaurs and the duck-billed

dinosaurs—started off as omnivores. And another interesting finding is that the earliest sauropodomorphs, ancestors of the veggie long-necked sauropods like *Diplodocus*, were carnivores. This shows that herbivory was not ancestral for any of these two lineages, countering traditional hypotheses, and that the diets of early dinosaurs were quite diverse."

Dr Ballell concluded, "It seems that one of the things that made the first dinosaurs special is that they evolved different diets throughout the Triassic, and we think this might have been key for their evolutionary and ecological success." Dinosaurs dominated the land during the Mesozoic era until their extinction 66 million years ago. They included giant veggie groups like the long-necked sauropods and meat-eating species like *Tyrannosaurus rex* and its relatives. However, their origins were much humbler and date back to the Triassic period, with the first definitive dinosaurs appearing approximately 235 million years ago. ■

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



Skills to Stay

Social Processes in Agricultural Skill Acquisition

The Government of India launched broad reforms under the Skill India Mission in 2015 to train 400 million Indians by 2022. However, little is known about the social processes of skill acquisition, especially within the agricultural sector in rural India. In 2020–2021, **Prof. Nitya Rao**, co-led a study with **Dr Soundarya Iyer**, which was published recently in the journal *Third World Quarterly*. They conducted work-life course interviews with men and women between the ages of 18–65 in a village in southern Karnataka to better understand the informal and non-formal processes of skill acquisition in agriculture and allied activities. Their study shows that formal skilling opportunities are geared towards leaving agriculture, and the next generation of agriculturists depend on informal and non-formal mechanisms which are filtered through the intersecting identities of gender, generation, caste, and class, and are central in shaping farming futures.

A new research from University of East Anglia shows that Indian women in agriculture lack skills training opportunities. The research titled 'Skills to stay: Social processes in agricultural skill acquisition in rural Karnataka', was published on November 16, 2022 in the journal *Third World Quarterly*. Despite 54.6 per cent of Indian workers engaged in agriculture, of which 20.26% are women, skill trainings

are targeted primarily at those leaving agriculture and seeking to engage with industry or services, skewing it in favour of men.

While informal modes of skilling dominate within agriculture, newer skills and technologies are increasingly gained via non-formal learning that are filtered through gendered mechanisms that further invisibilize women's work. Young rural women in India are increasingly

working in agriculture, but this new research from the University of East Anglia (UEA) and RV University Bengaluru shows they're the least likely to gain training to upgrade their skills or work in a different sector.

Given the absence of decent jobs, more young people—particularly women—are staying in or returning to farming and agricultural livelihoods, at least part-time, to secure their futures. Most skilling opportunities in agriculture are either informal learning by doing, or non-formal skill acquisition, learning in a semi-structured environment such as a training programme run by an NGO or a government department, without certification.

Prof. Nitya Rao, Professor of Gender and Development in UEA's School of Global Development, co-led the study with Dr Soundarya Iyer, Assistant Professor of RV University Bengaluru. The study was funded by a small grant from the Azim Premji University research funding programme. The research was conducted in 2020–21 through interviews with 66 men and women between the ages of 18–65 in a village in southern Karnataka.





Prof. Nitya Rao said: "Education and training for employment transitions are mediated strongly by social expectations of gender, caste, and class. "While informal modes of skilling dominate within agriculture, newer skills and technologies are increasingly gained via non-formal learning. These skills are filtered through gendered mechanisms that further invisibilize women's work."

One example of this is use of the internet, including YouTube and Google, to investigate newer ventures such as apiculture, and get information on crop prices. Women have less access to smartphones and the internet. Many young men also use migration as a stepping-stone to earn capital, which can be invested in 'modernizing' their farming work through acquisition of new skills and technologies. While both men and women acquire agricultural

skills intergenerationally, men expand their social networks and learn new skills through other channels as well, including via peer learning, while skill acquisition by dominant caste women and girls is confined to the domestic sphere.

Dairy farming in particular is strongly gendered and seen as an extension of women's household work. Milking is a feminized process where mothers teach young girls how to milk the buffaloes, a physically demanding task that causes intense pain in the thumbs. The research revealed that families gave up dairying during phases when the household lacked a female member.

Dr Soundarya Iyer said: "Despite the crucial role that women play in agriculture and allied activities, their work is seen as help and habitual practice, and is invisibilized in society." Skill development is considered to be

critically important for the eradication of poverty and social inclusion in the Global South. The Indian government launched broad reforms under the Skill India Mission in 2015 to train 400 million Indians by 2022.

Prof. Nitya Rao said: "Formal skilling opportunities are geared towards leaving agriculture, and the next generation of agriculturists depend on informal and non-formal mechanisms that are filtered through the intersecting identities of gender, generation, caste, and class. "Understanding how agricultural skills are acquired is critical to understand the future sustainability of our agriculture and food systems." ■

Prof. Nitya Rao is Professor of Gender and Development in UEA's School of Global Development and Dr Soundarya Iyer is Assistant Professor of RV University, Bengaluru.

Art from Pine Needles

Protecting Environment and Skilling Students in HP

In this article, **Sarita Brara** apprises about the pioneering initiative by NGO Karvan in Himachal Pradesh where sacks full of the dry pine needles that are considered a major cause of forest fire in Himachal Pradesh were collected by the students with the twin objective of protecting the forests and environment and skilling the children in the art of making worthy products made from pine needles.

In May 2022, clouds of smoke from a massive fire that broke out in a pine forest in Tutikandi area in Shimla forced the authorities to temporarily move the children of a Balika Ashram in the vicinity to a safe place. Things could have gone worse if days before the incident students from a nearby government senior secondary had not collected heaps and heaps of highly combustible dry pine needles from the forest. Sacks full of the dry pine needles that are considered a major cause of forest fire in Himachal Pradesh were collected by the

students under a project with the twin objective of protecting the forests and environment and skilling the children in the art of making products made from pine needles. The NGO Karvan, which had successfully carried out the programme with women Self-Help Groups, had for the first time initiated the programme in a school—the Tutikandi Government Senior Secondary School. Over 60 students of the school were trained during a five-day training camp in making products like flower vases, fruit baskets, roti container, trays, pen stands

and pen holders, and other products. The products created during the workshop were sold and students such as Dinesh and Khushboo earned between INR 2500 and 3000.

Tutikandi Government Senior Secondary School is located near pine forests and the students in the schools are mostly children of daily wagers or from Balika ashram and that is one of the reasons for the selection of the school for the project. Khushboo, a tenth class student and one of the 63 students who were in this art workshop, says she





would make a dash to the forests right after school before it got dark to collect pine needles. She did so for almost ten days at a stretch. Khushboo who loves drawing and playing with colours says she enjoyed making products from the pine needles. Her trainer and teacher says she has excelled in the art.

"Uska haath bahut saaf hai" (her hands are deft in creating products), says Ishu Thakur the Karvan Founder. "I used my imagination as well as the guidance of the trainer for my pine needle creations." Khushboo got the first earning of INR 500 from selling a tray and a flower vase. Daughter of a daily wager Khushboo knows the value of money, so instead of wasting her earnings she gave the whole amount to her mother to save for her.

Nitin, a tenth class student sold ten of his products earning INR 1500 and continues to make products even after the workshop is over. He loves spending time in the jungles away from city noise, collecting pine needles from the forest. "It was great fun sledging and sliding on huge bundles of pine needles we would collect every day," he says. "I was able to see a number of birds I had never seen earlier," adding that he spotted a blue bird and red bird, although he could not identify these two birds.

What pained him, says Nitin, was the felling of the trees at some places. "I would like to be in the police department to stop crimes like illegal felling of trees." He has even planted saplings of some of the trees near his house.

Son of a carpenter, Dinesh a plus one student who also participated in the training camp is good at making wooden stands required for the some of the pine needle handicraft. It was easy for him as the tools required for making

these were available at home. "It is a back-up skill that I can use any time for earning money," he says. In fact, the NGO is keen to rope Dinesh for making these wooden stands for this project being implemented elsewhere. Dinesh is not averse to the idea of making handicraft products for a living.

The then Vocational coordinator in the school Seema says that although children enjoyed collecting pine needle from the forests, it was quite a challenge,





making the children sit for hours together in a room working diligently on their products. The task of creating products was exhausting and required concentration. "We used motivational stories, entertainment, and exercises and even offered snacks to get them hooked to the job of working on these products."

Amit Thakur who teaches Retail says the challenge for him has been to continue to engage the children in this vocational art after the workshop. Some of the students, in fact, are making money by selling pine needle items made at home during their spare time. Out of the 63 children trained, eventually ten students were selected for advanced



training. Ishu Thakur says these students can also be roped in the project as trainers. They can earn INR 8000 for giving training to students from other schools. Eager students like Nitin are awaiting the opportunity.

Thakur says the marketing of products is not limited to taking these creations to handicraft fairs but also display and sell them at hundreds of 'homestays' in the state where tourists from all over country and abroad can buy the products. The NGO is keen to implement the project in the schools in villages in the interior and near the forests where the trainees get easy access to pine needles.

"The idea is to provide a skill to the students from marginalized families so that they are able to earn some extra bucks or even use it as the main livelihood option later in life." Earn while you learn and at the same time protect the environment is what he aims for students. Dry pine needles, glycerine, thread, deadwood and colours are all that is required for making the products. Rakhis made from pine needles were a big hit when the women SHGs took up the project and so the students can be roped into making rakhis and thus earn some money. Thakur says the NGO will try to take the project to other interested educational institutes.

Next on the scheme of things in addition to the pine needle venture says Thakur is to see how the mid-day meal waste material is used to prepare manure. Money can be earned from selling manure required by people for growing flowers or have kitchen gardens, etc.

The Principal of the school Nitika Sharma says the project is a good example of green economy. "It is heartening to see the bonding the children have developed with nature and commitment to protect the environment that students like Nitin have articulated." This was for the first time that a workshop of this kind was conducted in the school.

More than 300 women have already been trained in the art. According to Ishu Thakur, they were able to earn over INR 80 lakh in a four-year period starting 2017 with an average of INR 12 lakh per woman. More importantly, the incidents of fires have come down by nearly six per cent in the Kandaghat area, where the project was first implemented.

The project which started with funding from ADB in Mahi Panchayat was implemented in several panchayats across Shimla district was handed over to Karvan in 2021.

Pine needles are highly inflammable and destroy plantations, timber, resin and wildlife and other biodiversity worth crore of rupees very year in states like Himachal Pradesh. According to a study, over 151,000 tonnes of the pine needles are shed every year. In addition to causing fire, felled pine needles also prevent undergrowth and ground vegetation and even obstruct underground water recharge. The pine needles, which make the ground slippery, can cause injury to animals and human beings. The HP Forest department has been offering incentives to encouraging the pine needle-based industries to start their ventures. Daily wagers are also paid to collect pine needles from the forests. ■

Sarita Brara is a Delhi-based senior journalist.

Whales could be a Valuable Carbon Sink

Say Scientists

Nature-based solutions to fight climate change take a holistic approach that promotes biodiversity and ecosystem preservation. While many efforts have focused on planting trees or restoring wetlands, researchers now also advocate for the importance of understanding the carbon sequestration potential of the planet's largest animals—whales. Researchers explore how these marine giants can influence the amount of carbon in our air and waters and potentially contribute to the overall reduction of atmospheric carbon dioxide.

Nature-based solutions to fight climate change take a holistic approach that promotes biodiversity and ecosystem preservation. While many efforts have focused on

planting trees or restoring wetlands, researchers publishing in *Trends in Ecology and Evolution* recently advocate for the importance of understanding the carbon sequestration potential of

the planet's largest animals—whales. In their paper, the researchers explore how these marine giants can influence the amount of carbon in our air and waters and potentially contribute to the overall





reduction of atmospheric carbon dioxide.

“Understanding the role of whales in the carbon cycle is a dynamic and emerging field that may benefit both marine conservation and climate-change strategies,” write the authors, led by Heidi Pearson, a biologist from the University of Alaska Southeast. “This will require interdisciplinary collaboration between marine ecologists, oceanographers, biogeochemists, carbon-cycle modellers, and economists.”

Whales can weigh up to 150 tonnes, live over 100 years, and be the size of large airplanes. Like all living things, their hefty biomass is composed largely of carbon and they make up one of the largest living carbon pools in the pelagic ocean, part of the marine system that is responsible for storing 22 per cent of Earth’s total carbon.

“Their size and longevity allow whales

to exert strong effects on the carbon cycle by storing carbon more effectively than small animals, ingesting extreme quantities of prey, and producing large volumes of waste products,” write the authors. “Considering that baleen whales have some of the longest migrations on the planet, they potentially influence nutrient dynamics and carbon cycling over ocean-basin scales.”

Whales consume up to 4 per cent of their massive body weight in krill and photosynthetic plankton every day. For the blue whale, this equates to nearly 8000 pounds. When they finish digesting their food, their excrement is rich in important nutrients that help these krill and plankton flourish, aiding in increased photosynthesis and carbon storage from the atmosphere.

A blue whale can live up to 90 years. When they die and their bodies fall to

the seafloor, the carbon they contain is transferred to the deep sea as they decay. This supplements the biological carbon pump, where nutrients and chemicals are exchanged between the ocean and the atmosphere through complex biogeochemical pathways. Commercial hunting, the largest source of population decline, has decreased whale populations by 81 per cent, with unknown effects on biological carbon pump.

“Whale recovery has the potential for long-term self-sustained enhancement of the ocean carbon sink,” the authors write. “The full carbon dioxide reduction role of great whales (and other organisms) will only be realized through robust conservation and management interventions that directly promote population increases.” ■

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