

TerraGreen

₹70



Subscriber's copy

VOLUME 15 | ISSUE 6 | September 2022

India's Women Farmers

The Unimagined Mass

SPECIAL HIGHLIGHTS

From Waste to Décor
Making India a Sustainable Superpower

TERRA YOUTH

GREEN Quiz

IN CONVERSATION

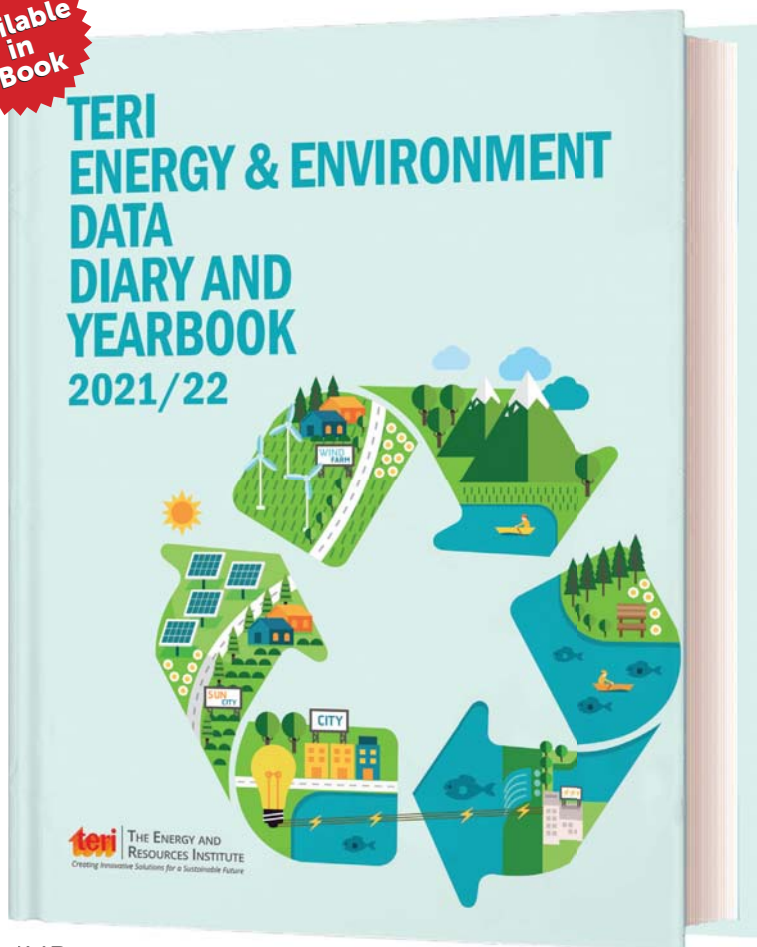
Lokesh Krishnan,
Founder & CEO, Potful



teri

The Most Comprehensive Annual Data Diary and Yearbook on **India's Energy Sector and its Impact on Environment**

Available
in
eBook



Order Now
& Save
30%
on eBook

- TEDDY is an annual publication brought out by The Energy and Resources Institute (TERI) since 1986, which presents state of art information on energy supply, energy demand and environment.
- It seeks to support policy research and decision-making by providing policymakers and researchers with the facts and data which can further be used to develop actionable solutions warranted by rigorous analysis.
- Each edition of TEDDY contains India's commercial energy balances that provide comprehensive information on energy flows within different sectors in the economy.

INR 1995

- Institutional orders limited to 10 copies
- Special e-package for corporate users

Offer valid till 30th November, 2022

Web: <http://teriin.org/projects/teddy>

Place your order at teripress@teri.res.in



EDITORIAL



“ Bringing the focus back to Indian agriculture, our cover story for this issue helps highlight the role that women play in this sector. ”

Indian farmers start harvesting their summer-sown crops, such as rice, soybean, cotton, pulses and vegetables usually in mid-September. This year, however, uncharacteristic rainfall has deeply damaged the harvest, risking food inflation in India. While this is an obvious threat, along with others such as flooding due to rainfall, we should be able to spot the latent warning in all these events about the worsening of climate conditions. This unusual rainfall and vice versa—lack of rain—is an obvious manifestation of climate change. Indian Summer Monsoon is the most significant rainfall system—along with the West African Monsoon—and disruptions in this system are, thus, seen as a tipping point in the climate system.

Bringing the focus back to Indian agriculture, our cover story for this issue helps highlight the role that women play in this sector. Women's contributions to agriculture are largely underestimated and generally overlooked. Although deeper studies may be able to efficiently point out the immensity of women's work in agriculture, when it comes to common perceptions and depictions, women are yet to be given their due. The popular representations, or rather misrepresentations, in media and culture lead to an erasure of women from this field— which in turn dilutes or negates the issue that farmer may be facing as a whole. It leads to an inaccurate assessment of the sector. This lack of women's voices, especially in the forefront of the agriculture sector, is symptomatic of the gender problem that we are facing in other sectors as well. It underscores the fact that on-ground technical advancements need to be accompanied with societal awareness as well. Our cover story is a bid to change the stereotype associated with the image of 'a farmer' and make it more gender inclusive.

The special feature for this issue also tackles a pertinent environmental issue that is typical of the Indian states—stubble burning. Many researchers and think tanks have shifted their focus towards finding a solution to prevent stubble burning. We are now seeing innovations that help farmers to better deal with the crop residues. A sustainable, profitable and accessible solution for dealing with crop residues is highlighted in the special feature. Hopefully, more such innovative resolutions will follow in the near future.

We must join our efforts and hopes to nurture the dwindling health of our planet; our home, ensuring that a happier healthier future is visible on the horizon.

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

Vibha Dhawan
Director-General, TERI



I read the August 2022 issue of *TerraGreen* and found the articles very interesting and succinct. The article on MSW Management is a good read. Solid Waste Management may be defined as the discipline associated with the control of generation, collection, storage, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and other environmental considerations. During the recent years, NGOs (non-governmental organizations) have taken up initiatives to work with local residents to improve sanitation. They have been playing an active role in organizing surveys and studies in specified disciplines of social and technological sciences. In the field of garbage management, such studies are useful in identifying areas of commercial potentials to attract private entrepreneurs. They can play an important role in segregation of waste,

its collection, and handling over to local authorities. They are all successfully creating awareness among the citizens about their rights and responsibilities towards solid waste and the cleanliness of their city. These organizations promote environmental education and awareness in schools and involve communities in the management of solid waste.

Nikita Sahwney
Mumbai, Maharashtra

I liked reading the article on emerging water contaminants published in the August 2022 issue of *TerraGreen*. A new concern about surface water quality is the occurrence of emerging contaminants that have being recognized as a new class of water contaminants such as antibiotics, hormones, pesticides, personal care products, and pharmaceutical products. The occurrence of these contaminants in the aquatic environment and especially in surface water is a serious concern because this is usually the source of water for drinking water treatment plants (DWTP). As a consequence of increasing industrial activities, concern over new emerging contaminants has increased, for instance, from hydraulic fracturing in which millions of gallons of water and additionally surfactants, sand and chemicals (including biocides) are injected by high pressure deep into the ground to fracture shales and extract gas into horizontally drilled wells.

Harish Salve
Bengaluru, Karnataka

Editor-in-chief
Ajay Mathur

Editorial Board
K Ramanathan
S K Sarkar
Suneel Pandey

Publishing Head
Anupama Jauhry

Editorial Team
Abhas Mukherjee
Sachin Bhardwaj
Shreya Mago

Design & Illustration
Santosh Gautam
Vijay Nipane

Production
Aman Sachdeva

Marketing, Sales & Distribution
Sanjeev Sharma
Nand Kumar Yadav

Head office
TERI
Darbari Seth Block, IHC Complex
Lodhi Road, New Delhi – 110 003
Tel. +91 (11) 2468 2100 or 7110 2100
Fax +91 (11) 2468 2144 or 2468 2145

Regional centres
Southern Regional Centre
TERI, CA Site No. 2, 4th Main, 2nd Stage
Domlur, Bangalore–560 071
Email: terisrc@teri.res.in

North-Eastern Regional Centre
Chachal Hengrabari, Express Highway
Guwahati- 781 036
Tel: 0361-2334790, Fax: 0361-2334869
Email: terine@teri.res.in

Western Regional Centre
House No. 233/GH-2, Vasudha Housing Colony,
Alto-St Cruz, Tiswadi, Goa-403 202
Tel: 0832-2459306, 2459328
Email: teriwrcc@teri.res.in

Overseas representation
TERI Japan
C/o IGES
Nippon Press Centre Building (8th Floor)
2-2-1, Uchisaiwai-cho, Chiyodi-ku
Tokyo, Japan - 100-0011, E-mail: teris@igesor.jp

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

© The Energy and Resources Institute. All rights reserved.



<http://www.terragreen.teriin.org>

Contents

VOLUME 15 • ISSUE 6 • SEPTEMBER 2022

4	NEWS	30	SPECIAL REPORT
8	TERI ANALYSIS		From Waste to Décor
	Cleaning Musi River	34	GREEN CHALLENGES
10	ENVIRONMENTAL RESEARCH		Sacred Groves
	Butterfly Ecology and Conservation	37	TERRA YOUTH
12	FEATURE	46	WILDLIFE
	Making India a Sustainable Superpower		Greater One-horned Rhino Estimation
18	IN CONVERSATION	50	PIONEER
	Lokesh Krishnan Founder & CEO, Potful	53	SPECIAL FEATURE
22	COVER STORY	56	GREEN EVENTS
	India's Women Farmers		

12
FEATURE



30
SPECIAL REPORT



10 ENVIRONMENTAL RESEARCH



37 TERRA YOUTH



22 COVER STORY





Revamped Crop Insurance Scheme from 2023–24 Season

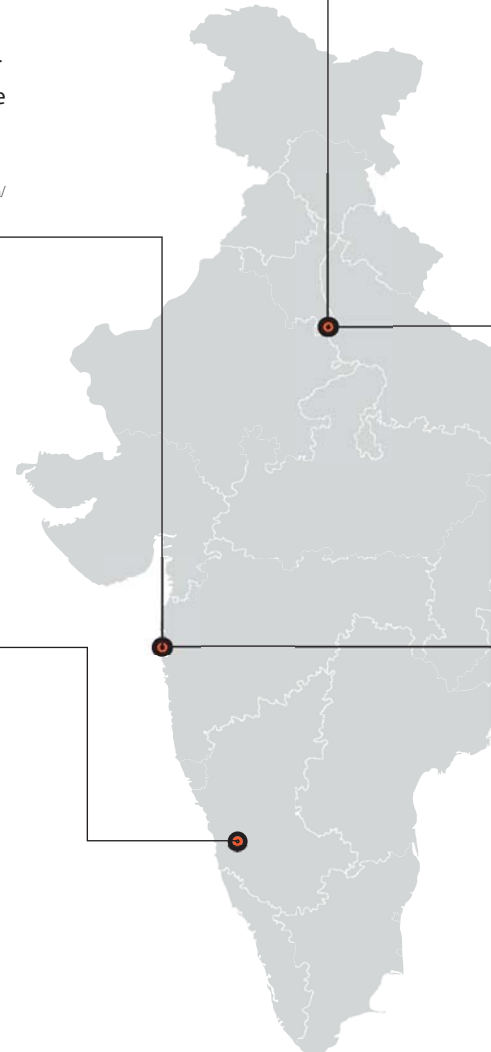
The government is considering a slew of proposals to revamp the Pradhan Mantri Fasal Bima Yojana (PMFBY) from crop year 23–24, following a sharp drop in claims to premium ratio, rise in premium rates pushing the subsidy liability of the government. To revamp the PMFBY, the agriculture ministry had set up three expert panels, of which two groups have already submitted their reports.

Source: <https://epaper.financialexpress.com/>

NGT Directs Maharashtra Authority to Make Action Plan for Scientific Handling of Waste

The National Green Tribunal (NGT) has directed the Maharashtra Coastal Zone Management Authority (MCZMA) to prepare a time-bound action plan and to issue directions for the scientific handling of waste against damage to the environment in Mumbai city near the coastal road. The Tribunal directions have come on September 28, 2022, while hearing a plea seeking direction for remedial action against damage to the environment in Mumbai city near the coastal road at Wadala to Mahul, close to Chembur to CST freeway by adding debris on the salt pan, making an island out of it and encroaching the same, affecting the mangroves which are important for Mumbai city.

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



Intense Rainfall in Kerala and Karnataka

Three months of the four-month-long Southwest monsoon season are over, but Kerala's seasonal rainfall only reached the 'normal' mark in recent days. In contrast, Bengaluru and southern Karnataka districts have witnessed a wet season since June. Despite the large variations in the quantum of rainfall, Kerala and Karnataka have both been hit by landslides and inundated roads, with the Bengaluru-Mysuru highway submerged. At present, the monsoon currents are weak as the monsoon is in its break phase. The position of monsoon trough—a major contributory factor for the rainfall—is favouring rainfall over these states.

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



Jyotiraditya Scindia Promises to Make 90 Airports Carbon Neutral by 2030

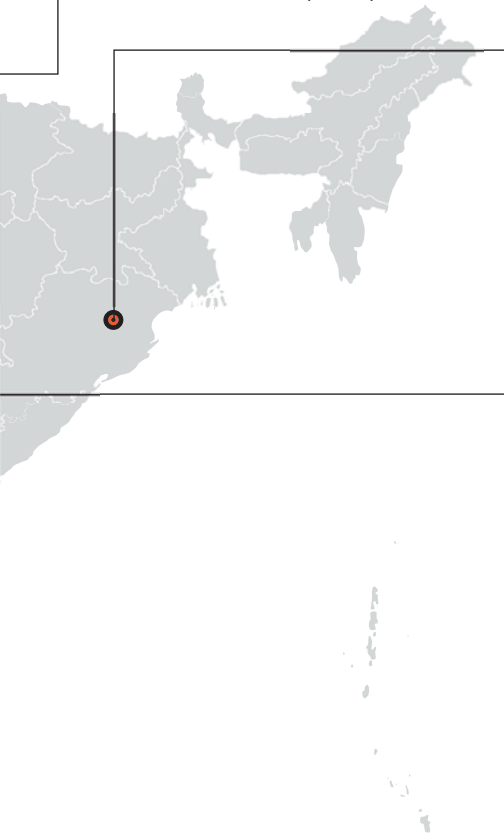
Working in the direction to make the aviation sector environment friendly, the Union Minister for Civil Aviation Jyotiraditya Scindia has informed that by 2024 more than 90 airports in the country will be carbon neutral. The minister also added that the number of airports will also be increased from the current strength of 141 to 220 by next year. "One of the first things that I did when I took over as the aviation minister was to put a carbon mapping profile of our airports. Two of our airports, Delhi and Kochi, are already carbon-neutral and India will have 92–93 carbon-neutral airports by 2024," Scindia said at the All India Management Association national convention.

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

Disaster Management Capacity in Odisha Gets INR 400 Crore Boost

In view of the changing climate conditions, the government has recently decided to further strengthen the disaster management capacity of the State by extending latest equipment and intensive training to the frontline organizations like ODRAF and fire service units. The State executive committee under Disaster Management Act which met here under the Chairmanship of Chief Secretary Suresh Chandra Mahapatra was informed that around INR 400 crore will be required for further improvement of the disaster management system, and empowering the frontline unit engaged in mitigating impact of the disasters. The proposal for Post Disaster Needs Assessment (PDNA) was discussed in the meeting.

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



Tenders Worth INR 2100 Crore to Improve Mithi Water Quality

As a part of its four-stage plan for the Mithi River water quality improvement project, Brihanmumbai Municipal Corporation (BMC) has decided to intercept sewage flow into the river—at Mahim Causeway and Prem Nagar outfall—and channel it into the municipal sewer system, and take up extensive improvement and beautification of the river. It has floated two tenders worth nearly INR 2100 crore for these works between CST Bridge and Prem Nagar outfall, and CST Bridge to Mahim Causeway. This will also add an 8.5 kilometre-long promenade along the river. The first tender aims at sewage interception and diversion, training of the river and beautification works at a cost of approximately INR 1100 crore between CST Bridge and Prem Nagar outfall in Kurla, including Vakola River.

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



5.3 Billion Cell Phones to Become Waste in 2022: Report

More than five billion of the estimated 16 billion mobile phones possessed worldwide will likely be discarded or stashed away in 2022, experts said recently, calling for more recycling of the often hazardous materials they contain. Stacked flat on top of each other, that many disused phones would rise 50,000 kilometres (30,000 miles), more than a hundred times higher than the International Space Station, the WEEE research consortium found. Despite containing valuable gold, copper, silver, palladium and other recyclable components, almost all these unwanted devices will be hoarded, dumped or incinerated, causing significant health and environmental harm.

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



Billions in Climate Deal Funding Could Help Protect US Coastal Cities

A marine biologist, Claire Arre's project aims to combat climate change using nature instead of human-engineered construction, and it is one of many across the nation's 254 coastal counties that is eligible for billions in federal funding from the Inflation Reduction Act, the sprawling climate, health care and tax bill signed recently by the US President Joe Biden. Officials from coast to coast have long sought funding to restore natural habitats that are essential to beach communities, as floods wreak havoc in the East and rising sea levels increasingly threaten the West. By 2050, sea levels are expected to rise by 1 foot or more on average, increasing as much in that time as they have in the past century.

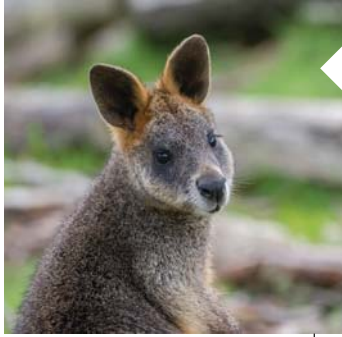
Source: <https://indianexpress.com/>

East Mediterranean, Middle East Warming up Twice as Fast as Global Average

East Mediterranean and Middle East region could see an overall warming of up to 5°C or more by the end of the century on a business-as-usual scenario, a report prepared by the Cyprus Institute said. That temperature spike was almost twice that anticipated in other areas of the planet, and faster than any other inhabited parts of the world, it said. The report, prepared under the auspices of the Max Planck Institute for Chemistry and the Climate and Atmosphere Research Center of The Cyprus Institute, will be submitted at the United Nations Climate Change Conference (COP27) taking place in Egypt in November this year. A combination of reduced rainfall and weather warming will contribute to severe droughts, compromising water and food security, with many countries unprepared for rising sea levels.

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

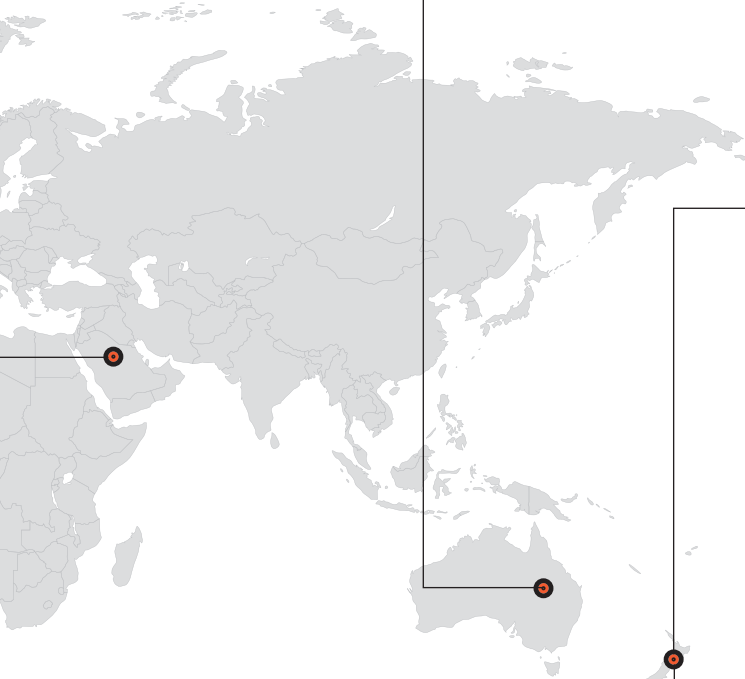




Australia Lists Small Wallaby among New Endangered Species

Australia listed a small wallaby and the grey snake among 15 new threatened species recently as it launched a zero-extinction plan for its unique wildlife. Many of Australia's species are clinging to existence, their habitats shrinking from human activity and extreme events such as the 2019–2020 Black Summer bushfires, wildlife groups say. The government announced a new 10-year scheme to try and halt the slide into extinction of 110 'priority species' and shield 20 'priority places' from further degradation. It aims to prevent any new extinctions of plants and animals while conserving at least 30 per cent of Australia's land mass.

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



Over 200 Stranded Pilot Whales Die on Pacific Ocean's Remote Pitt Island

New Zealand's conservation office has said all 240 pilot whales stranded on the remote Pitt Island have died, just days after 215 whales died on a beach on nearby Chatham Island. Dave Lundquist, marine technical advisor at the Department of Conservation, in an email said a technical team had assessed the situation and euthanized the surviving whales. "This decision is never taken lightly, but in cases like this it is the kindest option," Lundquist said. The conservation department does not try to refloat whales in the area due to the risk of shark attack to both humans and whales, he said.

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

New Zealand Zoo More Than Doubles its Population of Endangered Lemurs

New Zealand's Wellington Zoo has more than doubled its population of endangered ring-tailed lemurs after its four females gave birth to twins. Ring-tailed lemurs, endemic to Madagascar, are on the endangered list. Wellington Zoo has only had ring-tailed lemurs for 18 months and got Zeus, their male, at the beginning of 2022 with the hope they might be able to add to their population. The population of ring-tailed lemurs, made famous by King Julien in the 2005 movie *Madagascar*, is declining in the wild. One of the challenges is female ring-tailed lemurs are only sexually receptive for one or two days a year.

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



Cleaning Musi River

Learning from International Examples

This insightful article by **Sonia Grover** and **Charu Bhanot** is an outcome of literature survey done for a project for two basins—Yamuna and Musi rivers. In the earlier article, they discussed about Yamuna River. This article is particularly on Musi River and talks about the challenges and reflections from best practices at international scale that could be used as learning to improve water quality of the basins.

In India, the Musi River flows through Telangana state as a tributary of the Krishna River on the Deccan Plateau and is a perennial river. The River meanders through Hyderabad city, dividing the ancient city from the modern city. The River is listed under Priority-I of CPCB Classification and “34 most polluted river stretches” of India. The river had previously become a dumping ground for untreated industrial and residential trash from Hyderabad due to haphazard development and an inadequate planning. The Greater

Hyderabad Municipal Corporation disposes 94 per cent of sewage water drains into the Musi River coming from 54 main Nalas. The state of Musi River is quite deplorable. The key challenges attributing to this state are presented here.

Water Treatment Gap: The sewerage generation for 2021 of Hyderabad city was 1960 MLD and existing treatment capacity 772.3 MLD. There is a wide gap of 1187.7 MLD. During NGT hearing on Musi River pollution, there was a proposal for 31 sewage treatment plants

(STPs) and 17 STPs with capacity of 376.6 MLD that were sanctioned under a decentralized hybrid annuity mode.

Encroachments of River Floodplain: Musi River has observed major floods with an annual rainfall of 800 mm in the year 2000 and 2008 and 460 mm in 2020. As per the irrigation data received on a petition in NGT in 2021, Musi River does not have a demarcated flood plain and state government will initiate the process. There have been several recommendations on removal of encroachments, broadening of



sewers and creation of buffer zone around the major nalas by Kirloskar Committee after the August 2000 floods, Musi Monitoring Committee by NGT post the 2020 floods. The Municipal Administration & Urban Development in March 2022 had indicated rehabilitation of 10,000 encroachments alongside the Musi River in stretches of Chaderghat, Malakpet, and Amberpet.

Shrinking Water Bodies: During the period 2001–2016, Hyderabad's water bodies decreased from 2.28 per cent to 1.64 per cent. Between the years 2001 and 2015, it was observed that 84.16 ha land has been encroached annually.

Institutional Gaps: There have been several initiatives by the government in the past such as construction of Himayat Sagar and Osman Sagar reservoirs in the year 1920. The government also launched the Nandavanam Project focusing on beautification of the Musi River. During the course of the project, 20 m wide flood control channel was built on the Northern and Southern Banks along the river. These channels became obsolete after the 1999 floods. During the Legislative Assembly in the year 2000, the then Chief Minister declared the project invalid. Post 1999 floods, Musi Bachao Andolan was initiated by the masses living along the Musi River, where they commenced dialogues through civil societies and environmentalists. In the year 2005, Abatement of Pollution of Musi River project under the National River Conservation Plan was launched with combined efforts from National River Conservation Directorate (NRCD), Greater Hyderabad Municipal Corporation (GHMC), and Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB). The construction work was delayed by 30 months for creating sewerage infrastructures under the project. In 2006, Save Musi Project was initiated to rejuvenate Musi River. Aesthetically redeveloped zones were planned for the Musi riverfront. Several new sewers



and sewer treatment plants were to be built for prevention of the sewage from flowing into the river. However, the acquisition of property for this project sparked complaints from the people of Ramanthapur hamlet, and a lawsuit ensued. The Save Musi campaign had been plagued by several setbacks and missed deadlines, and little had changed as a consequence. In 2009, although it was not originally part of the Musi River Revitalization Project's vision, the GHMC built rubber dams, to provide a stretch for boating and water entertainment. Rubber dams at Attapur were rendered inoperable, and downstream STPs were rendered ineffective further resulting in delay of upstream STP. The dams haven't been utilized since a transitory test run in 2010 due to non-operational Attapur STP. In the most recent development, government created a Special Purpose Vehicle named as Musi Riverfront Development Corporation Limited (MRDCL) in an order issued on March 25, 2017. The duties of preparing and implementation of comprehensive plan on pollution abatement along with riverfront development of the Musi. The MRDCL has a multi-faceted strategy for rejuvenation, beautification and development of Musi River under the Musi Riverfront Development Project at an estimated cost of INR 16,634 crore.

Recently, during the torrential rains in 2020 washed away its attempts to revitalize Musi River Front, the MRDCL put the project on hold after spending INR 2 crore.

Water resources in Hyderabad city have been ignored to the disadvantage of long-term water security for the inhabitants, as was evident during the examination of challenges. The city's water supplies are under tremendous pressure due to the lack of enforcement of environmental rules and the haphazard planning and expansion of the metropolis. There is a lack of a robust institutional framework for Musi River pollution abatement and riverfront development. In order to solve these for Musi River in Hyderabad, we need to take a multifaceted strategy. The city requires basin level management choices and the article refers to relevant enlisted international cases from where key lessons could be drawn to facilitate better management of Musi River. ■

To be continued...

Note: This analysis is part of the project titled: 'Developing integrated river pollution management framework' supported by the Prince Albert II of Monaco Foundation.

Sonia Grover, Fellow and Area Convenor, WRPM, TERI and Charu Bhanot, Research Associate, WRPM, TERI, New Delhi.

Butterfly Ecology and Conservation

A Review

In this article, **Onam Vaid** throws light on the fact that butterflies play an important role in the ecosystem as they are pollinators and components of the food chain. Butterflies help scientists in ascertaining the health of environment. But, the research studies on butterflies are very limited. Further research should be conducted to obtain details and documentation on butterfly diversity for their conservation.

Butterflies are a beautiful creation of God. Butterflies are wonderfully diverse in shape, size, and colour. The life span of butterflies is approximately 12 months. They are found everywhere around the world and are also good indicators of climatic conditions, seasonal and ecological changes; butterflies can also serve in formulating strategies for conservation. However, butterflies have largely been ignored by conservation biologists and policymakers as well. Hence, butterflies play a prominent role in ecosystem and co-evolutionary relationship between them and plants as well as their lives are interlinked. The research studies on butterflies are very limited. Further research could be conducted to obtain details and documentation on butterfly diversity for the conservation and butterfly parks.

India harboured total 1504 of butterfly species, which accounted for 8.74 per cent of the world's butterfly and 285 species found in Southern India. The Peninsular India and Western Ghats have 351 and 334 species, respectively.¹

1 Abdullahi M, Larkin A, Kumar A, Kumar H, and Idris A L. 2019. A study on Butterfly diversity in Prayagraj District of Uttar Pradesh, India. International Journal of Advanced Research in Biological Sciences 6 (8). Details available at <https://ijarbs.com/pdfcopy/2019/aug2019/ijarbs16.pdf>



Butterflies provide many vital and economically important services within terrestrial ecosystems such as nutrients recycling, soil formation, food resources, and pollination.

Butterflies are arguably the world's most popular insects but in many parts of the world butterfly faunas are suffering strong declines in diversity and abundance. Studies on butterfly ecology and behaviour have provided us with myriad insights into life histories, adaptation, defense, migration, evolution, and host-plant relationships.

These studies have in turn provided information critical to the development of plans and strategies needed for conservation of threatened butterfly species.

Urban expansion is threatening biodiversity globally by destroying the natural and semi-natural habitats and increasing the levels of anthropogenic disturbance. Urbanization in cities has generated many fragmented and concrete lands at a rapid pace while very few places have been recreated as green areas for the conservation of biodiversity of local flora and fauna.² Butterflies being poikilotherms respond to such environmental changes sharply with a decline in their population diversity and hence are considered as an important section of biodiversity because they have considerable resonance with both the general public and policy-decision makers. While greenery in urban areas may reduce the impact of urbanization in biodiversity, it is often over-managed and ends up in small fragmented patches, which

2 Paul M and Sultana A. 2020. Studies on Butterfly (Insecta: Lepidoptera) diversity across urban landscapes of Delhi, India. Current Science 118 (5):819–827. Details available at https://www.researchgate.net/publication/339843725_Studies_on_butterfly_Insecta_Lepidoptera_diversity_across_different_urban_landscapes_of_Delhi_India

may be isolated. Effective management strategies for different urban landscapes require proper understanding of the ecology and habitat requirements of all relevant taxa. Yet, little is known of how invertebrates and in particular lepidopteran assemblages utilize urban landscapes despite their common occurrence. Butterflies provide the best rapid indicators of habitat equality being sensitive indicators of climate change. Delhi reported a total of 115 butterflies in 2017 from all over Delhi region, which is a positive sign for the ecological health of the city. The climate of Delhi varies with extreme temperature ranges. According to the study, the occurrence of butterfly species was highest during the monsoon months (July–September) and sharply declined in winter while the temperature was low and butterflies being poikilotherms prefer diapause. Spring arrives in February–March in Delhi; hence flower bloom acts as an attractant for the nectar-loving butterflies. In the latter pre-monsoon months (April–mid June) when the summer heat is high, butterflies tend to go into hiding inside the bushes or their larval host plants—therefore, leading to the fewer sightings. Overall, seasonal trend exhibits that there is a dual peak in the butterfly diversity throughout the year. The first rise is seen during the months of February and March and second peak is observed during early monsoon months to the end of the rainy season. The reason being for such a trend is that during these seasons there are the factors which influence the growth of nectar plants, which have a direct impact on the butterfly population. Urbanization affects the diets of butterflies. A new study (2016) reveals that most tropical butterflies feed on a variety of flower types but those that are ‘picky’ about their flower diets tend to prefer native plants and are more dependent on forests.³ These ‘picky’

butterflies also have wings that are more conspicuous and shorter proboscis. The reduction in native plants due to urbanization affects the diet of such butterflies and researchers suggest that intervention may be needed to manage their preferred flower resources. Studies of butterflies demonstrate that a population can become extinct if its habitat is disrupted and offer clues about how habitat protection can prevent many species from becoming endangered. With the Big Butterfly Month celebrated every year, the focus is on setting up more butterfly hotspots within a distance of a few kilometres to provide a conducive habitat for increasing the population of the winged insects. The steps are also being taken to strengthen the butterfly corridor and to help butterflies travel across the city. So far, 67 butterfly habitats have been created in Delhi-NCR and over 50 host species have been planted at various sites. Experts say the population of butterflies is on the decline due to threats such as use of pesticides, dweeding and ornamental gardens, and hence it is necessary to create butterfly hotspots. In an ongoing project, Bombay Natural History Society (BNHS) has been creating a corridor for butterflies by planting a variety of host plants at parks and gardens in various areas of Delhi-NCR to attract butterflies. During the entire month, the census of butterflies is also conducted. “The methodology is to collect data on species and record them on an annual basis to correctly identify gaps in the corridor and apply effective interventions. “The interventions done are planting of host plants to facilitate egg laying of butterflies, augmented by already existing seasonal flowers plantation done by various civic agencies and declaration of small wild patches left in these set locations across the corridor,” said Sohail Madan from BNHS. Data is also being collected on specific species and their ability to cross urban barriers like flyovers and six-lane roads present at some gap points. “We have observed that



some bigger species of butterflies are able to cross flyovers and six-lane roads,” remarked Sohail Madan. Of the total 67 butterfly habitats developed, 10 butterfly parks are in schools and colleges while 17 butterfly parks have been established in public parks. The remaining 40 butterfly habitats have been prepared in home gardens and terrace gardens. Experts suggested locals could attract butterflies in their garden at home by planting some common host species such as kadipatta, aak or madar, vajradanti, chulai, lemon, arandi, patharchatta, and senna. Anil Kapur, a member of BNHS who created a butterfly habitat in the garden of his colony said “We first covered the muck present in the garden with sand and soil. We planted the host species and after some months, we sighted many butterfly species.” Red Pierrot, Plain Tiger, Lemon Pansy, Common Grass Yellow, Mottled Emigrant, and Common Emigrant are the common butterfly species which were sighted in 2020.

Experts say butterflies play an important role in the ecosystem as they are pollinators and components of the food chain. Butterflies help scientists in ascertaining the health of environment. ■

Onam Vaid is a writer at India International Centre, New Delhi. Previously, she has worked as German Lecturer at prominent institutions, including University of Delhi. She was also Visiting German Faculty at various schools in Delhi, such as Modern School, Vasant Vihar.

³ The Biology of Butterflies (2016–2018): Popular Coverage of Butterfly Research. Details available at <https://www.biologyofbutterflies.org/popular-butterfly-stories>





Making India a Sustainable Superpower

Leveraging Culture and Social Inclusion

Sustainable development has four pillars; culture, social inclusion, environment, and economy.

Any country can become a sustainable superpower by focusing on all the four pillars.

Ram Ramprasad expounds if we need to build a sustainable ecosystem, then culture needs to enliven the pearls of wisdom in the ancient cultural practices of India, and unite them with the sustainable technological innovations occurring all over the world. This union can propel India to become a sustainable economic superpower. While the article focuses on India, concepts are applicable to other countries as appropriate.



Sustainability Embedded in the Ancient Culture of India

Assume a ladder with ten rungs; the top rung representing a perfect circular economy and the bottom rung representing the complete opposite. India over the years fell down from the top rung to the bottom rung by adopting an economy built on climate exacerbating products such as fossil fuels, plastics, cement, steel, etc. Unfortunately, every country in the world followed this model. Thus, the world is now paying the price of extreme climate-related disasters and loss of biodiversity.

Sustainability and a circular economy was the DNA of our culture. In India, most people eat food with their hand, they believe that each of the five fingers represent the five elements of the earth energy, and when brought together aid digestion. These cultural practices help

save the planet from the use of plastic knives, spoons, and forks including the cutting down of trees to make dining tables. In ancient India, hygiene practices were also sustainable. People brushed their teeth with tree twigs of medicinal value thus saving the planet from the disposal of plastic toothbrushes. Bathing was with herbal shampoo and soap. Dishes were scrubbed with coconut husk. Natural cleaning agents were used to wash floors, utensils or clothing. Water systems were never polluted with chemicals. In short, sustainable



development was a bottom-up rather than a top-down approach. The carbon footprint of individuals in ancient India was significantly lower compared to the modern man.

Leveraging Cultural Practices for Sustainable Growth

While it is difficult to turn the clock back on some of the ancient cultural practices, it is possible to revive some in a modern context. India needs to develop entrepreneurs that can transform the global business landscape from a 'consumption oriented model' to a 'conservation oriented model.' Such a transformative model would require stellar marketing. For example, in rural India, when families have babies, it is a common practice to make a crib for the baby by using a cotton saree as a hammock, it is passed through a single hook on the ceiling, this low cost crib has

a womb like appearance—a biomimicry concept. India has an opportunity to market the saree-crib product globally. Marketers need to convince the public on its cost saving, carbon footprint, and better safety and sleep compared to a wooden crib.

India imports a lot of throw away clothing from overseas to make blankets for disaster relief zones, the same material could be used to make ropes, mops, and even mattresses. India used earthen pots for cooking since it made the food more alkaline and tasty. Jute mattresses were used for sleeping. Lemon grass oil with other natural ingredients was used for cleaning. These cultural practices can be embraced globally with better marketing. Global consumers feel they are a victim of the current unsustainable system as they don't have a choice to buy low carbon footprint products. India can turn this tide by leveraging culture to build low carbon footprint products, and champion the need for a carbon footprint index on every product similar to a nutrition facts label. Businesses maybe missing the undercurrents of such a trend.

Old imported cruise ships can be converted to water desalination plants cum power generating stations with windmills and organic photovoltaics. Apartment complexes can generate their own cooking gas and power. Home Biogas in Israel has made some success in this area. Opportunities to import waste and transform them to wealth are enormous. Shigeru Ban in Japan makes paper tubes from waste paper and builds houses in disaster zones for less than \$200. Can India emulate such models to rebuild its slums? MINT Innovation in Australia uses microbes to extract precious metals from used computers, cell phones and other electronic gadgets. Most gadgets use about 60–70 per cent of the elements listed in the periodic table. Today, most of these gadgets are ending up in landfills.

In ancient India, millets accounted for 40 per cent of the grain consumption, it

was a staple food. A diverse amount of fruits and vegetables were an important part of the diet. A good proportion of the food was consumed raw or semi-raw to maintain the integrity of protein and vitamins. Today, it is well known that rice production emits methane because of the way it is grown. However, the disproportionate consumption of rice compared to other wholesome grains is deleterious to our health. Dr Khader Valli, nicknamed as the millet man of India has demonstrated the several health benefits of millets including several case studies in treating diabetes, cardiovascular diseases, auto immune diseases, etc. Millets grow in extreme hot or cold temperatures, require less water and do not produce methane, and enrich the soil. Ancient cultures understood what is good for the body is also good for the environment. The same analogy applies to meat grown for food. Meat consumes enormous amount of land and water. If the world converted to a plant based diet, farmers could have used this freed up resource to grow more fruit bearing trees or be suppliers to a green composites industry that could replace all plastics, steel, iron, and even cement. Unfortunately, less than five per cent of farmers' children want to take up farming



because the average farmer owns a small piece of land of about 1–2 acres that demands high capital and is subject to the vagaries of climate.

Pablo Van dear Lugt, PhD in his book, *Booming Bamboo* advocates for fast growing resources such as bamboo to substitute carbon intensive, high performance materials such as steel, PVC, hardwood, and concrete. Bamboo can be grown on degraded land and helps reforestation schemes. The ancient pongamia tree too can be grown on degraded land and offers a multitude of benefits with its protein and oil rich legumes. Terviva in the USA imported the pongamia tree from India and grows them on degraded land in Florida. India has a plan to restore 26 million hectares of degraded land by 2030. Prof. Nanditha Krishna, in her book, *Sacred Plants of India* advocates for a revival of these plants.



Historically, these trees contributed to the richness of our environment, cultural heritage, and economic growth.

Some people in India fast on the eleventh day of the moon cycle when cosmic energy is considered to be the highest. Such practices save energy, keep food prices in check, spread food equity across the country, and promote good health. Several research studies now show intermittent or a full day fast is beneficial for health. Also, people who follow Ayurveda use a herbal preparation to cleanse their bowels at least twice a year, this preparation is similar to the current medicine taken before a colonoscopy. India needs to figure out how to market such preparations.

Social Inclusion and Transforming Vocational Education

Social inclusion with respect to sustainability implies viewing every human as an asset including all other forms of life. Every occupation needs to be given equal respect. We need to break down barriers of colour, faith, caste, and creed. Opportunities for all types' education will fortify the social inclusion pillar. Let us evaluate some of the fault lines in education.

According to the Standing Committee on Skills Development about 47 per cent of the seats are vacant in the popular vocational training institutes such as the ITIs. Research indicates that getting such an education is considered inferior, only 5 per cent of the people between the ages of 19 and 24 receive vocational training compared to 52 per cent in the US, 75 per cent in Germany, and 96 per cent in South Korea (Reimagining Vocational Education, June 3, 2022, *Times of India*). ITIs and polytechnic institutes can transform their education by offering both conventional and non-conventional courses drawn from the ancient wisdom of India. Categorize skill-based training based on the five elements; air, water, soil, fire/energy, and space. For example, a non-conventional course on soil can teach 'panchagavya' an organic fertilizer preparation proven as a great elixir for soil. Kautilya's *Arthashastra* discusses how to dress seeds with organic materials. Similarly, a non-conventional course on water can train people on Vedic technologies to restore dead water bodies. Vocational education should be a top national priority. For example, if we don't restore the health of our soil, the nutritional quality of our foods and our Ayurvedic medicines will be compromised. A healthy soil should have

at least 3–5 per cent soil organic carbon. India and the world need to focus on soil health rather than on onerous and expensive organic certifications.

Materials science as elaborated in 'Vastu Vidya' can build houses that do not need air conditioning, battery technology as elaborated in 'Dhaatu Urja Vidya'. When complemented with western technology on polypeptide biodegradable batteries for electric vehicles, it is possible we can make the technology commercially viable or lower its cost. Startups all over the world are using microbes to grow several products in a lab; meat cotton, coffee, leather, bricks, cement, diamonds, etc. When such high resource intensive products move to the lab, it not only frees up land and water but also creates several decentralized small and medium enterprises—a golden opportunity for India to triple its women labour force participation from current 21 per cent to at least 60 per cent. India needs to train an army of women and men 'hands-on microbiologists' in order to run these new age manufacturing labs.

Social Inclusion, Faith, and Sustainability

To promote social inclusion, India in its history books needs to teach rich cultural history and how it created a sustainable economy rather than a focus on wars and subjugation. For example, Saint Luther Burbank the famous horticulturist created several new varieties of plants, he is known for creating the thornless cactus plant simply by talking and showing his love to the plant. There are numerous examples of people restoring ecosystems. Each story is full of wisdom and inspiration. History and media need to enliven such examples of restoration, holistic innovations, peace, love, and harmony. Mahatma Gandhi's philosophy of winning wars with non-violence needs to resonate in the foreign policy of all countries. Social inclusion must strive for friendship and unity among all nations by burying our bombs and planting more



trees—the easiest and fastest solution to climate change.

Social Inclusion— Corporations and Government

Corporations and governments are key to leveraging the social inclusion pillar. Publicly traded companies that only seek to create shareholder wealth may need to think more broadly about increasing wealth of all stakeholders including its customers and the environment. Models of employee-owned companies offer more promise in this regard. Many companies are embracing ESG (Environment, Social, and Governance) initiatives. Some companies are creating sustainability officer positions; such a concept still needs to be embraced more broadly in India. Individuals within a company should establish sustainability clubs; companies must provide incentives to employees who create a circular economy within the company. Ellen Mac Arthur Foundation has a mission to convert all companies all over the world to a circular economy. They provide resources that people can access for free. Companies need to collaborate with startups that are creating sustainable business models rather than collaborating with companies that are stuck in linear models of take, make, and waste. Indian industrialists should invest in more sustainable startups. For example, Bill Gates established, Breakthrough Ventures that invests in highly disruptive sustainable companies. Foreign direct investment must be encouraged in companies that aim to create a circular economy.

National, State and local governments must implement an ESG initiative. ESG metrics must be made open to the public for greater social inclusion. People must be allowed to offer innovative ideas on the website. Governments must be made accountable for their ESG initiatives. The “E” in the ESG must show metrics by soil, water, air, and energy. Each Indian State



must have a goal to increase its forest cover by 50 per cent in the next 10–15 years. If a small country like Costa Rica increased its green cover to 65 per cent from about 25 per cent in a period of forty years, and achieved 100 per cent renewable energy—every State of India needs an ambitious goal. Every State government, corporation, and every citizen of India must develop its own ESG standard, only then can India become a sustainable superpower.

Leveraging the Environment and Economy Pillars

Several top notch experts have provided expert advice on energy policy and the environment. While the focus today is on renewables, we have to move towards a more diverse strategy. For example, nuclear technology has advanced significantly making it a safe zero emission option; compared to solar it occupies less land and uses less resources. With two-thirds of our energy still coming from coal, it is imperative we focus on nuclear too. Also, wind mill technology needs to explore micro windmills within wall-like structures. Current windmills have killed many birds, owls, and bats.

With respect to the economy, all economic planning needs to focus

individually on each of the five elements holistically, that is, soil, water, air, fire/energy, and space in this order of importance. For example, if we focus on ‘water’—let us think sustainably on washing clothes with liquid CO₂ to save billions of gallons of water, permeable materials on roads to recharge groundwater, miniature robots to detect underground water leaks, new membrane separation technology that exploits chemical difference between fresh versus sea water to produce massive energy, etc. Thinking by category helps focused debate and execution.

Conclusion

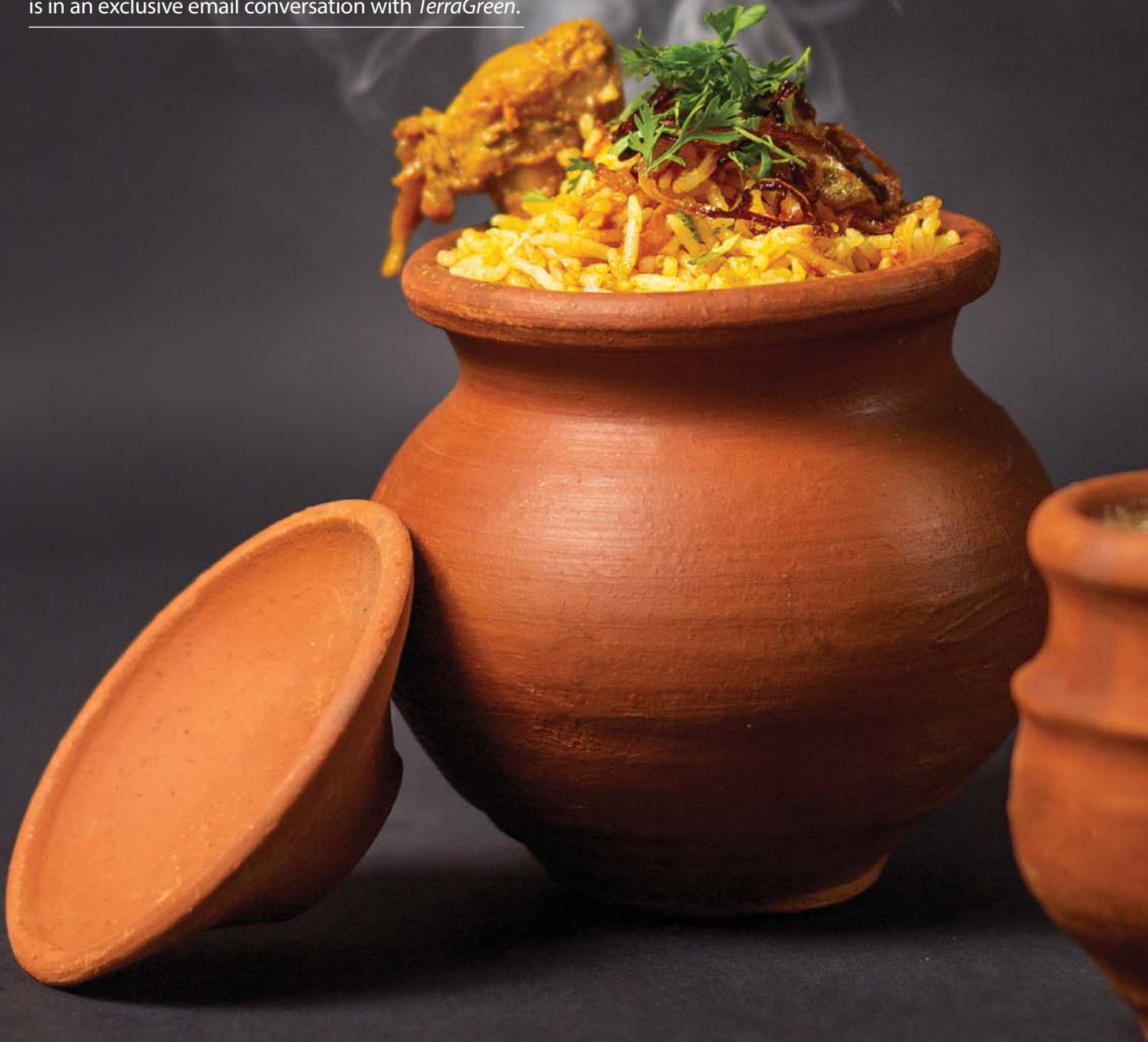
Nature-based innovations are key to sustainable development and holistic growth. Focus must primarily be in the rural areas and then in the urban areas. Proper implementation of the above ideas may arrest the flow of people from rural to the urban. Therefore, the need to build new smart cities may not arise. Growth will be equitable and will create enduring wealth while combating climate change. ■

Ram Ramprasad is a frequent contributor to TerraGreen. He worked as a Global Marketing Director for a Fortune 100 company in the USA prior to his retirement. He has graduate degrees from Yale University, USA, and Madras University, India.

Potful

Serving Biryani in an Environment-friendly Way

Lokesh Krishnan is Founder & CEO, Potful. Here, he is in an exclusive email conversation with *TerraGreen*.





Potful family (artisans)

From where did the Potful initiative begin? What are the skillsets being taught to the villagers?

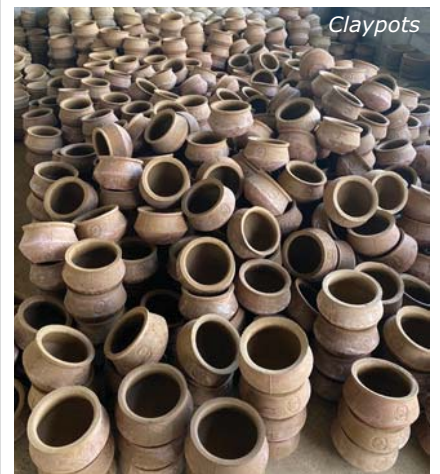
Potful Biryani started with the proposition of using earthen pots to prepare and deliver biryani to our customers. That is how Biryani had been prepared traditionally and we intended on ensuring that the entire experience of eating a biryani was as authentic as possible. We needed locally sourced earthenware to fulfill the high demand we were expecting, and that is when we came across this village—Chinnandhall, near Hoskote in rural Bengaluru, that was entirely dependent on this specific skill for its livelihood. The families in this village had been honing their craftsmanship across generations; however, due to a lack of demand and inconsistent income, most households in the community had ceased creating pottery.

With the incentive of providing stable incomes and reviving the art of making clay pots, we partnered with the villagers. To begin with, we gave a fixed monthly volume of business, which required them to make clay pots for our business. We started this project with one family but as our business progressed, more families became a part of this initiative. Today,

close to 100 people are being engaged in this initiative and this number is growing steadily with each passing month. As more people are expressing interest in enrolling with us, we have started providing the necessary training and machinery to operate more efficiently.

What are the benefits of this initiative?

This initiative by Potful works on many levels. At the base level, we provide a steady source of income to these households by only sourcing our sustainable earthenware from this village. We have also ensured that these households upskill themselves with





Representative Image



Representative Image



the help of training modules and give them machinery that will increase their output to match our increasing demands. Our overall objective is to improve the quality of life for these villagers as well as continue our sustainable business operations. We are all aware of the indiscriminate use of plastic in the food delivery chain. Potful aims to be as sustainable as possible in our value chain and build our community at the same time. We also send plant seeds along with every biryani handi to encourage our customers to re-use the handi at home. A lot of our customers also use handis for home décor and regifting.

What are your expansion plans?

The group of craftsmen we currently partnered with can meet our needs in Bengaluru City, and we anticipate enrolling at least 10–12 more families for our Bengaluru supplies in the upcoming months. So, approximately 25 families will supply our pots to the Bengaluru market, resulting in the empowerment of over 200 people. As we expand into Hyderabad, Chennai, Mumbai, Pune, the NCR, Kolkata, etc., we intend to strengthen the local artisan communities in each major city. We anticipate empowering at least 2,000+ people directly or indirectly over the course of the next three years. As we expand, we will continue to invest in new equipment

and environmentally friendly baking techniques that will increase output and, ultimately, revenue.

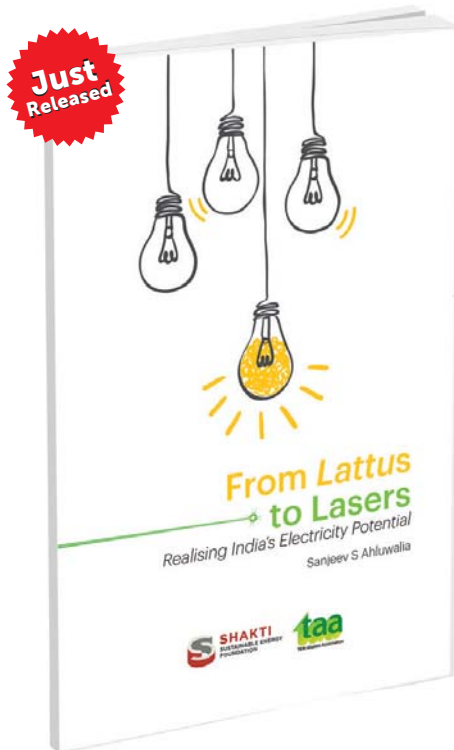
What are the impacts of the initiative on the lives of the villagers?

Today, every household earns a minimum of INR 2.0 lakh per month. The only costs they have are for the land, a small amount of power, and wood for baking. Compared to farming or a traditional ceramic job, this is perhaps a more lucrative source of revenue. According to our estimates, the monthly income levels of villagers have increased by at least 10 times compared to the year 2017. Villagers who formerly lived in mud homes have erected homes with concrete roofs, and they are sending their kids to better schools now than they did in the past. In the near future, we will also give them health insurance coverage worth INR 5 lakh per household. A scholarship scheme for the children in the village is now being developed.

How much money has been invested in this initiative by the company?

We have already invested more than INR 25 lakh and will continue to do so while also spending an additional INR 25 lakh on both new and existing potters in the same village. We, therefore, estimate an investment of about INR 50–60 lakh in each city we enter. ■

HISTORY AND EVOLUTION OF THE ELECTRICITY SECTOR IN INDIA



Major topics covered:

- Democratizing electricity supply
- The return of private investment
- The outcomes of reforms
- Planned electricity development
- Unresolved issues in electricity supply
- Trends favouring India

- ISBN: 9789394657021
- Print / eBook Subscription Price: ₹299 ₹270 (with free shipping in India)
- Avail special 15% discount on order of more than 10 copies
- Perpetual Price: on request

The history of electricity in India traces an inverted arc – like a smiley – which starts in the colonial period with private electricity capacity leading, regresses to a mode of near complete public sector monopoly by the 1980s and then traces the upward incline to a near 50% share for private electricity suppliers – not a full smiley but a slightly lop-sided one. The half-smile – like Mona Lisa's – masks long periods of misallocation of public capital, unabashed populism, and careless adherence to 'path dependencies' which plagues bureaucracies the world over. This book asks a few inconvenient questions and provides some out-of-the-box solutions with the intention of enlarging the public debate around how the electricity sector should be regulated and developed going forward.

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.

For any query or to avail bulk purchase discounts please write to us at:

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100
Fax: 2468 2144
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: <http://bookstore.teri.res.in>

Bank details for NEFT:
The Energy and Resources Institute
Bank: State Bank of India
A/c Number: 62002345487
IFSC Code: SBIN0020511

India's Women Farmers

The Unimagined Mass

India is known for its agricultural produce, but what we do not know, or perhaps tend to overlook, is the contribution of women in the growth of this sector. In this article, **Himanshu Kumar** and **Vivek Kumar** enlighten us about the role of women in the agriculture sector and some of the problems they face.

*Planting new harvest
of rice at farm field,
Thanjavur, Tamil Nadu*





India is a country that is endowed with enormous natural resources, different climates, variety of agricultural landscapes and boasts a distinct environmental and cultural diversity. We have grown up hearing that India is predominantly an agrarian state—which is true in a way, because even now roughly 55 per cent of the country's population is dependent on agriculture and allied sectors for their primary livelihood according to the 2011 census. So are all of us, who doesn't need bread and butter in the morning to reach their offices and tirelessly work from 9 to 5 to get their pay cheques. Maybe sometimes relish on some chicken biryani, but that too comes from agriculture and animal husbandry.



Women work the tea plantations in the Kanna Devan Hills

People often do not understand how significant this sector is, but let us get this straight: India ranks second in world agriculture production; India is the largest milk producer; ranks second in vegetables and fruits; third in fish, egg and poultry production in the world; India is the world's largest producer of spices, pulses, milk, tea, cashew and jute; and the second-largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oilseeds.¹ India is also currently the world's 4th largest producer of agrochemicals, has the largest livestock population of around 535.8 million—which translated to approximately 31 per cent of the world's livestock population in 2019. Additionally, India has the largest land area under irrigation globally.¹

Thanks to a combination of social, natural, and economic capital of the country, we are now the world's second largest food producer country. India is blessed with land, light, water, and labour and Indian companies now produce everything required for agriculture, from seeds, fertilizers, and irrigation equipment to farm machinery and plant health technologies, making this sector a truly *aatmanirbhar* one. Diversification into high-value crops (fruits and vegetables) and milk, aided by continuous improvements in communication, infrastructure, and innovative techniques, have transformed the agriculture sector into a dynamic enterprise.²

Indian agriculture thus, is a vast arena with a significant global footprint. We need to ask ourselves

this fundamental question: what makes this agricultural ecosystem such a strong one? There is no need for us to dig deeper as the answer is quite apparent; farmers form the backbone of this sector and have invested generations in making India a country that is now self-reliant and aims to reduce its food imports.

The task of feeding 130 billion people and another few million (in the form of exports), thus, resides on the shoulders of the Indian farmers. However, it is not easy to understand the Indian farmer and farming system; it is a complex set of constants and variables that together form the development we now observe in Indian agriculture.

Upon imagining an Indian farmer, one will only think of a man, old and impoverished, wearing a dhoti kurta and a pagri, with dark skin wearing, standing against a barren/dry landscape, and looking with hope and despair, having incurred losses, and bearing the wrath of climate extremes. Thanks to the popular media, movies, and others for painting this grim picture of the Indian farmer. Often, it is the man who represents this sector and women seldom find a place in popular media or imaginations even after forming the core of this sector and investing an equivalent amount of blood and sweat to bring food to our tables.

Let us now understand some facts that have the potential to amuse and completely redraw this picture of an Indian farmer.



*Smt. Sunita Raju Valvi,
Nandurbar, Maharashtra
Photo Credit: Himanshu Kumar*



Literature now highly acknowledges the role of women in the Indian agriculture system and their contribution to the rural economies.³ *Down to Earth*⁴ magazine reported that around 80 per cent of farm work is undertaken by women in India, which is astonishing and goes against the popular narrative of farmers being largely men. Strange as it may seem, women constitute over 42 per cent of agricultural labour in the country but own less than two per cent of farmland, which could be attributed to several social norms and rights-related issues. This is an alarming figure and raises several questions on the land rights and social inequalities persisting in rural India. Women are not given their share of recognition in the Indian farm sector and, therefore, have limited entitlements. While recognition is a key issue, another crucial matter of concern is that of control. Even if a woman owns the land, she does not have control over it; instead, it will be in the hands of a male—her husband or father.

The Panchayati Raj Act of 1993 aimed to empower local governance and quite inclusively provided adequate space for women to lead, but ground realities seem quite different today, a reasonable number of proxy sarpanches or sarpanchpatis is visible on the ground as observed in Madhya Pradesh and West Bengal, defying the constitutional provisions for the women to lead local government bodies. Since recognition and rights form an integral relationship with the exercise of power it is essential to understand the power dynamics and correct the historical wrongdoings. Power without access to rights and decision-making is as good as a book with a thousand blank pages: heavy but contributes nothing to the reader.

Smt. Sunita Raju Valvi, from Aslipara village, Navapur Taluk, district Nandurbar, Maharashtra works in an agricultural field. Harvesting rice under the clear blue sky with the sun shining bright, her picture was taken on a field visit to the Nandurbar district in Maharashtra, organized by the Centre for Rural Development and Technology, IIT Delhi in November 2021. A closer observation will change the conventional narrative about the Indian farmer; she belongs to a tribal family and apart from performing the daily household chores she dedicates a substantial amount of her time to agriculture.

In our brief interaction with her, she said that women in and around her village perform all the agricultural activities, starting from seed production, sowing, reaping/harvesting, conversion of primary produce to secondary products, to selling the crop in the market. The whole agricultural life cycle, thus, can be performed by women, which establishes the fact that women have a crucial role in the agriculture sector and possess the knowledge and skills to run the agriculture system by themselves.

Women contribute a lot to the sector and face numerous challenges in the process. It is high time that we hear them out, understand their perceptions and address their challenges. Our discussion with Smt. Valvi enlightens us on her life and the challenges faced by a woman farmer.

What tasks do you perform on your fields?

I can perform all the activities from seed production to sowing, harvesting, developing secondary products, and selling the product to market. I have been doing these activities for many years and have a deep understanding about the agriculture sector.

Has agriculture changed in your village since the last couple of decades?

Well, a lot has changed over the last couple of decades; we are tribal people and have a maximum population in our village. The nearby villages belong to the Bhil and Konkani tribe. Previously, there was an abundance of forests in our area and there was a huge dependence on the forest-based products and resources, but gradually the population expanded and forests were cut to create space for humans. This led to the forest area being converted to agriculture fields and this became a primary source of livelihood for the people of Nandurbar.

Do you think there has been a change in temperature and rainfall over the last few decades?

Yes, there has been a significant change in the temperature and rainfall in the village and nearby areas. This is



Cutting the sugarcane field by hands for harvesting near Burhanpur, Madhya Pradesh



precisely due to the reckless destruction of the forests. The water availability in the area has reduced due to shorter monsoons; rains now arrive later in the month of June and there is a very short span of monsoon that lasts only for a handful of days. I recall the monsoons some decades ago, we couldn't even step out our house even to buy essentials, the monsoon season would last for at least three to four months, and we could reap good harvests, but now the situation is difficult. And yes, temperatures are also soaring now, we usually didn't experience temperature extremes, but now the gods seem to be angry on us.

Do you think agriculture is a painful job? Don't you wish to switch to another job with less pain and drudgery?

Agriculture for us is not as painful as it looks to you, it has now become a way of life for us. Indeed, it is physically laborious, but we have now accepted it. We have been

Indian woman harvesting cotton in a cotton field, Maharashtra



doing this job for decades now, we enjoy doing this and there is no chance of switching to an entirely different profession. Me and my husband work together and share equal responsibilities; sometimes I work a bit extra, sometimes he does and that's how the cycle of our life goes on.

Are you given the due credit for your hard work by your family and the society as a whole?

I believe that hard work is always appreciated; my husband is highly supportive and works equally hard with me. It is because of this, we have been able to raise a family and make a house for ourselves. We live in a community of tribal people, here, you will find less discrimination and bias, you will find numerous women in and around our village who work hard and are highly appreciated by their families and the community.

Do you want your daughters to practice agriculture when they grow up?

I don't think anyone would wish for that, looking at the harsh situation and uncertainties that the farmers must bear, that is the reason our children are studying hard, they wish to make a better future for themselves, and I think that is good as well. It is for them to choose if they want to do farming or not.

We were informed that the Krishi Vigyan Kendra, Nandurbar, and Dr Hedgewar Sewa Samiti had played



an instrumental role in the holistic development of the village community and especially women—through various initiatives and interventions for agriculture, water conservation, alternative livelihood generation, training and capacity building, establishing institutions and empowering women through bottom-up approaches. One fundamental intervention being improvisation of the traditional sickle used to harvest rice, developed by the Mahatma Fule Krishi Vidyapeeth Rahuri. The Laxmi and Vaibhav sickles were provided to the farmers which possessed serrated blades, hence didn't require to be whetted repeatedly. Additionally, sickles were also developed specifically for the left-handed farmers (a small but inclusive approach), this not only reduced their drudgery but also chances of getting hurt. Women play a vital role in agriculture and form an essential component of society; therefore, it is high time we give them their rightful share and recognition in all the sectors, including agriculture. We need to make them the face of the Indian agriculture system, ensuring that when the next generations imagine farmers, they paint the portrait of a woman. ■

References

1. Pathak H, Mishra J P, and Mohapatra T. (2022). Indian Agriculture after Independence. Indian Council of Agricultural Research, New Delhi 110 001, pp. 426.
2. Dev S M (2018). Transformation of Indian agriculture: Growth, inclusiveness, and sustainability. In Presidential Address at the 78th Annual Conference of the Indian Society of Agricultural Economics, November (pp. 1-3).
3. Pattnaik I and Lahiri-Dutt K. (2020). What determines women's agricultural participation? A comparative study of landholding households in rural India. *Journal of Rural Studies* 76: 25–39.
4. Pachauri S. (2019). The invisibility of gender in Indian agriculture. *Down To Earth*. Retrieved from <https://www.downtoearth.org.in/blog/agriculture/the-invisibility-of-gender-in-indian-agriculture-63290>

Vivek Kumar is a professor at the Centre for Rural Development and Technology, IIT Delhi. Himanshu Kumar is a Ph.D. scholar at the Centre for Rural Development and Technology, IIT Delhi, working under the supervision of Prof. Vivek Kumar.

The authors would like to acknowledge the support and cooperation received from YOJAK Center For Research and Strategic Planning for Sustainable Development and KVK Nandurbar. The authors also highly appreciate the love bestowed upon them by the beautiful tribal people of Nandurbar.

LET FOOD BE THY MEDICINE AND MEDICINE BE THY FOOD



Major topics covered:

- Food is medicine
- Nutraceuticals: an umbrella term
- What is in our food supplements
- How to read a label
- Current market space
- Restorative concluding remarks
- Challenges for nutraceuticals

- ISBN: 9789394657052
- Print / eBook Subscription Price: ₹299 ₹270 (with free shipping in India)
- Avail special 15% discount on order of more than 10 copies
- Perpetual Price: on request

Nutraceuticals in Human Health describes what nutraceuticals are made up of, how they differ from pharmaceuticals (drug), and why the Food Safety and Standards Authority of India has stepped in to regulate the industry. This little book even shows you how to read the label pasted on a bottle of medicine and answers a number of frequently asked questions on consuming nutraceuticals.

This book also describe the current scenario in terms of the expanding market, global trends that drive the industry at present, and the challenges it faces. The concluding section returns to the individual with some remarks on an individual-centric approach to nutraceuticals.

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

For any query or to avail bulk purchase discounts please write us at:

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100
Fax: 2468 2144
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: <http://bookstore.teri.res.in>

Bank details for NEFT:
The Energy and Resources Institute
A/c Number: 62002345487
IFSC Code: SBIN0020511

From Waste to Décor

Recycling Crop Waste into Pulp and Board

From being a major political and environmental issue, to becoming a characteristic of Indian winters: stubble burning and the subsequent pollution it causes has been a matter of concern since the last decade. In this article, **Dr Rina Mukherji** talks about CRASTE—a start - up with the potential to solve this issue. By recycling crop waste, CRASTE helps the farmers better deal with the same, as well as creates employment opportunities in India's rural areas.

Stubble burning has been posing a major problem in India, especially around the Delhi- National Capital Region (NCR) during the winter months. It is not as if farmers do not burn stubble following their harvests. But in the winter months, following the major winter harvest around January, the heavy winter

fog causes the smoke to settle in. Owing to the winds from Haryana, Punjab and Western Uttar Pradesh areas blowing into Delhi, smoke from stubble burning in the adjoining agriculturally-rich region wreaks havoc on the air in Delhi-NCR. This, combined with vehicular pollution, has been known to produce a noxious



Shubham Singh and Himansha Singh





An engineered board from crop residue at the CRASTE lab



A side table made of engineered board

cocktail that has played with public health and human lives—especially that of the children and the elderly.

But then, stubble burning, or rather, burning of crop residue is not just confined to the regions around Delhi-NCR alone. It is a nationwide phenomenon affecting every state in India. In recent years, farmers have been resorting to stubble burning due to the shortage of farm labour. In a demand and supply scenario, this shortage has resulted in high rates for farm work, making it economically unfeasible for farmers to manually clean up farms prior to the next planting season. Under such circumstances, burning of crop stubble is seen as the fastest and cheapest option to clean up farms and prepare them for the next harvest.

According to the Ministry of New and Renewable Energy (MNRE), Government of India, India generates an average of 500 million tonnes of crop residue every year. The major portion of it is used as fodder and fuel. Yet, it leaves behind a surplus of 140 million tonnes: of which 92 million tonnes is burnt every year. As per statistics furnished by the National Policy for Management of Crop Residues (NPMCR), Uttar Pradesh generates the highest amount of crop residue (60 million tonnes), followed by Punjab (51 million tonnes), and Maharashtra (46 million tonnes). Each of these states, witnesses widespread stubble burning during the post-harvest season; which in turn, ends up choking the population and accounts for rising respiratory ailments. Incidentally, burning of crop



CRASTE pulp bags and board

residue is not just the cause of toxicity in the air we breathe. Burning of crop residue also results in the loss of micronutrients from the soil, and hence, is most undesirable.

It was this state of affairs that Shubham Singh desired to correct when he returned to India in 2017, following his Masters in Advanced Chemical Engineering from Imperial College, London. As luck would have it, he was one of four fellows who were awarded the Social Innovation Challenge Immersion Fellowship by the Biotechnology Industry Research Assistance Council (BIRAC)—Department of Biotechnology (DBT). “The Fellowship saw us visit several parts of India. Since I was interested in doing something about

food waste, I visited breweries, farms and industries to study waste generation during food production. Ultimately, I decided to tackle crop waste.”

As a BIRAC-DBT fellow, Shubham Singh was assisted in incubating his start-up: CRASTE, at the National Chemical Laboratories (NCL) Innovation Park in Pune, which helped to access funds. In 2018, he was joined by his sister, Dr Himansha Singh, who—with a Doctorate in Pharmacology from Cambridge University and ongoing involvement in vaccine research as a Post-doctoral Raman Fellow at the Indian Institute of Science (IISc)—shared a common interest in improved public health.

In 2019, the sustainable technology used by CRASTE received

acknowledgement and a Stanley + Techstars international incubator grant. This, along with INR 1.5 crore in government grants, helped CRASTE move full steam ahead in its endeavour.

There are two types of crop waste. One is the waste generated post-harvest. The second is the waste generated during processing the crop. “We tackle both kinds of waste” explains Singh. “Post-harvest waste generated by farmers include rice, wheat, barley and millet waste; while crop processing waste includes by-products like sugarcane bagasse generated by sugar factories. CRASTE sources rice waste from farmers in and around from Sus in rural Pune, barley waste from Rajasthan and Madhya Pradesh, and sugarcane bagasse from



Hydraulic press with a board in the lab



sugar factories in Uttar Pradesh, buying the crop waste at INR 6 per kg.

The crop waste is bought by quantity and then dried in a convection oven to remove all moisture content. The straws are then cut evenly using a pulveriser and vibratory screener. This separates and prepares the crop straw for being mixed in a blender. The resulting mass is then treated with a chemical resin. The

resination process smoothens the mass and prepares it through compression using a hydraulic press, into a mat.

The mat is then hardened to form an engineered particle board for use in furniture and other products. For every 500 kg of crop waste, CRASTE produces 15 boards, each weighing 33 kg.

A similar process is used to convert crop waste into pulp. This pulp is then

smoothened to prepare paper. The paper, Singh emphasizes, can be obtained in a variety of thicknesses, and utilized for a wide variety of applications, ranging from writing pads, to attractive carry bags for merchandise.

At the moment, CRASTE manufactures its products through a third party in pilot mode. However, it intends to start manufacturing soon at its own unit in Morena, Madhya Pradesh.

CRASTE is keen to use its products as social innovations that can better the lot of farmers, while empowering women. "We intend to teach women in the interiors to use crop residue paper to make attractive bags. That is why we set up our factory in Morena, which is one of the most backward districts of Madhya Pradesh," explains Singh. At the same time, Singh seeks to wean farmers away from stubble burning, which is a major cause of air pollution. "My home town, Gwalior, was found to fare the worst in its air quality index," Singh says. Recycling crop residue, he believes, will wean farmers away from stubble burning, while bringing down air pollution. ■

Dr Rina Mukherji is an independent journalist with more than 27 years of experience. She holds a doctorate in African Studies and has several media and academic awards to her credit.



A farmer burns the remains of his sugarcane crop

Sacred Groves

Cultural and Environmental Significance

Sacred groves are forest fragments of varying sizes, which are protected, and which usually have a significant religious connotation for the protecting community. Hunting and logging are usually strictly prohibited within these areas. In this article, **Shakti Bishnoi** and **A S Bishnoi** discuss about the cultural and ecological significance of sacred groves in Indian culture.

Sacred groves are a piece of natural vegetation protected by various communities due to religious reasons. Local communities take responsibility to protect and nurture the area. It could be only a few trees or an entire forest. Sacred grove can be a forest of single native plant or variety of native plants of that region.

Traditionally, the sacred groves were a repository for various Ayurvedic medicines, fruits, deadwood, and honey. Every household knew the uses of herbs needed for basic diseases. Herbs were daily used in food for healthy life.

The motive of our ancestors was to make ecological balance a way of life.

Being home to very diverse and strong religious practices, India contains many sacred groves. Before the Mughals and British rulers arrived, the entire country was covered by sacred groves. One of the many benefits is the ether content from the groves, which keeps our body, mind, and spirit healthy. As a result, our forefathers led a blissful life. Our values and principles were based on sustainable lifestyle. Our ancestors intelligently imbibed those practices as part of their daily chores.

Shipin is the largest deodar grove in Himachal Pradesh and contains trees that are hundreds of years old. Energy in sacred groves is 700 times more than a usual forest. The Military Institute of Technology (MILIT) planted the first sacred grove of Pune City at Naval jetty of MILIT. Under the able guidance of Mr Raghunath Dhole (The Tree man of India), MILIT was able to plant the sacred grove. Dhole gives saplings for free. He is working towards planting 75 sacred groves in our country this year, as we have completed 75 years of independence on August 15, 2022. It was





his 33rd sacred grove plantation and he has planted 35 sacred groves so far.

Meghalaya has some of the richest sacred groves in the country; Khasi hills in Meghalaya have a grove called *Law Kyntang* in almost every village. The popular myth dictates that anyone damaging the plants and trees of the grove will be killed by the forest

spirit. This myth has kept people from destroying the area and thus, it is best preserved.

Devara Kadu (in Karnataka) are a binding force between families and different communities of Kodagu district. Of late, encroachments are depleting this forest cover also. Devara Kadu fall under the protected forests, they are treated as

sacrosanct by the people resulting in the prohibition of felling, lopping or clearing of trees and even weeds. Light, water, air, earth, wind—the five elements—are glorified at these abodes of nature and are revered and celebrated once a year at these groves. ‘Kadu Aiyappa’ is one of the ancient deities worshiped at Devara Kadu. “He (Kadu Aiyappa) chose solitude and a simplistic life in the wild, which is why he is still worshiped amidst the virgin forests,” explains historian Bacharaniyanda Appanna. Bhadrakali, Bhagavathi, Naga, Aiyappa, Eshwara, and Ajappa are the common deities worshipped in Devara Kadu and each deity has a folk story connecting them closely to the villagers. The folk deities are revered as protectors and guardians of villages they are nestled at.

The authors’ recent visit to Kodagu was full of enriching experience. Most of their time was spent near Devara Kadu and near river bed just enjoying the flow of Kaveri, Harangi reservoir and feeding Mahaseer (fish)—the protected species. Currently, as per records 1214 Devara Kadus are in Kodagu covering an area of 4614 hectares and 18 native communities are involved in worshipping 165 folk deities. Devara Kadu have been





reduced to less than 9000 acres from the original 15,000 acres, according to a survey on Devara Kadu. Even though Kodagu has one sacred grove for every 300 acres, the highest in the state, the groves are still depleting. The pressure of economic returns from plantations has resulted in their depletion. Yet, to some extent, the spiritual connections with these ecological havens are keeping them alive.

Felling, lopping, clearing of fallen branches, plucking of weeds, pruning or burning of trees is prohibited in Devara Kadus. It is believed that offenders will



be punished with death by the folk deity. Sacred groves were a part of most agrarian cultures around the world, in South America, Africa, Australia, Europe and most Asian countries. Nature worship is the foundation of Indian culture and sacred groves are protected in different states as ‘Sarana’ in Bengal and Bihar, ‘Varaan’ in Rajasthan, ‘Devvari’ in Maharashtra, ‘Kavu’ in Kerala, ‘Kovil Kadu’ in Tamil Nadu and in Karnataka, ‘Kanas’ of Uttara Kannada, ‘Nagabanas’ of Dakshina Kannada, and ‘Devakad’ of Kodagu. It is reported that there are 4125 sacred groves covering 39,063 hectares in India. Kodagu district in the state of Karnataka is one the greenest regions not only in India, but in the world.¹

Indian sacred groves are often associated with temples, monasteries, shrines or with burial grounds. Our ancestors were very innovative in their ways to protect nature and enlighten us to live a meaningful life. They offered prayers in temples with sacred groves. Historically, sacred groves find mention

¹ A technical paper on The sacred groves ‘Devarakadu’ of Kodagu in Karnataka: Diversity, integrated conservation and significance by Vivek C G, Bhoomika U shall provide better insight on sacred grove. Details available at <http://journalstd.com/gallery/63-may2021.pdf>

in Hindu, Jain, and Buddhist texts. Numerous nature spirits and guardians are associated with Hindu, Jain, and Buddhist deities. Such nature spirits are known as yakshas, nagas (serpent guardians) and guardian tutelary deities (like *ayyanar* and *amman*). There is countless folklore on forest spirits, guardians and nagas, which has been part of our childhood.

Planting and nurturing of trees has been a highly evolved practice in ancient India. Attaining ‘moksha’ is very simple. If you plant native saplings and look after them, you not only clear your karma but also your ancestor’s karma. Your entire lineage will attain moksha. You can confirm it in our ancient texts. Vrukshayurveda, the science of plant life, indicates how mystical beliefs and conservation of ecology was interconnected. For example, if one plants kisirini, dadimi, rambha, priyala, and panasa, one experiences no affliction for seven births. Every native plant has something to offer to the person who plants it. The Hindu tradition considers forests to be of three types—tapovan, mahavan, and sreevan. Tapovan are forests associated with penance (tapas), and are inhabited by saints and rishis. Mahavan refers to the grand natural forests. Tapovan and mahavan are considered to be a raksha (sanctuary) for flora and fauna as ordinary human beings are not allowed to enter in these forests. Sreevan, which means, ‘forests of prosperity’ consists of dense forests and are open for ordinary citizens with rules. Panchvati, or a cluster of five tree species represented the five elements of Earth, Water, Fire, Air, and Space. If we observe, everything will make sense. ■

To be continued...

Mrs Shakti Bishnoi is a counsellor, ornithologist, botanist, wildlife photographer, and marathon runner. She strives to increase the green cover by planting native trees. Mr A S Bishnoi is an entomologist and qualified ornithologist. He planted Pune’s first sacred grove and has also planted 1215 native saplings around his Pune home.



Terra Youth



Joining Hands
for a Greener
Tomorrow

Home to Stay?

India Translocates Eight Cheetahs from Namibia to Kuno National Park

As we write, an unusual-looking aircraft, with the face of a big cat painted on its snout, is on its way from Namibia in Africa, to India. Its passengers are exotic, gorgeous and much-awaited. Eight cheetahs are on that flight. **Benita Sen** follows their news.

The cheetah disappeared from India about 70 years ago. Some years thereafter, in 1952, the cheetah was officially declared extinct by the Government of India. The close relationship between humans and an animal depicted in cave paintings dating back to the Neolithic age was thus severed. The magnificent animal is believed to have got its name from the Sanskrit word *chitraka*. The word means spotted or patterned.

The Asiatic cheetah that once roamed the forests of India, is now found only in small numbers in Iran. The biggest reasons behind the disappearance from India were hunting and the destruction

of its habitat by human beings who cleared forests and grasslands for their own habitat, agriculture, and infrastructure like roads. Before that, it prowled through parts of India, just as tigers, lions and leopards still do. The world's fastest land animal lost its race in India soon after the country got independence.

The reintroduction of the cheetah is being done along the guidelines set down by the International Union for Conservation of Nature (IUCN). A wild animal from a foreign country, a climate that is different to ours cannot be released immediately into the wilderness.

Welcome to Kuno National Park

Kuno is a healthy biodiverse habitat. They say, the National Park resembles the shape of a leaf. The Kuno River flows down its middle. The cheetahs will share space there with the leopard, dhole or Indian wild dog, sloth bear, Indian wolf, Bengal fox, striped hyena, and other predators. Among the possible prey for predatory animals there are the nilgai, blackbuck, chital, and sambar deer. Smaller animals include the mongoose, langur, hare, and honey badger. Enjoying the waters and the muddy banks are reptiles like the gharial, Bengal monitor,





Did you know?

- The cheetah touches a speed of 110 to 120 kmph (kilometres per hour). That makes it the fastest land animal. If life in the wilderness was a race, the leopard, at about 56 kmph, would be left far behind. The tiger can make a dash of up to 64 kmph.
- The cheetah is not just super-swift. It is known to be less aggressive than other big cats. So, they were used by erstwhile royalty to hunt for them. That is why you see them in some paintings from earlier times. Mughal emperor Akbar is believed to have been the proud owner of a thousand cheetahs that were used to hunt other animals. 'Akbar Hunting with Cheetahs' is a famous painting from the Manuscript of the *Akbarnama*.
- The last time cheetahs were spotted in India was in 1947. The Maharaja of Korla in Madhya Pradesh, Ramanuj Pratap Singh Deo had a photograph of himself clicked with three cheetahs that he shot dead. Did he know that he had virtually wiped out an important species from the face of India? No cheetah was ever seen in India after that.
- This is not the first time cheetahs are being brought to India from Africa. According to a report in National Geographic, even in the nineteenth century, when the population of cheetahs fell in India, they were brought in from Africa to help keen hunters.
- Cheetahs are known to attack cattle and livestock, so their owners often retaliate and kill cheetahs. This has been an important reason for the decline in the number of cheetahs.

and the crocodile. The forests of Kuno play gracious host to more than a hundred species of birds including winter visitors like the crane.

By October 10, a dozen more cheetahs are to land in their new home, India. This coalition—yes, that is the collective noun for cheetahs! — will be from South Africa. If you look at the larger picture, this relocation may bring some hope for the overall population of the cheetah. If you took a bird's eye view of the cheetahs across the world in the wild, you would find barely 7100 are left. That is not a very robust number. So, some naturalists are hoping that, perhaps, spreading them across a larger canvas will help increase their numbers.

The newly introduced cheetahs are being given tracking collars so that they can be monitored round the clock. Will it be possible, as we have heard plans, to monitor their well-being 24 x 7? That way, some scientists hope that they will be able to save the cheetah from human anger if they stray into populated territory. But will it be so easy to nudge them back into the forest? The people around the Park are being educated and sensitized about the cheetah so that they can help in the conservation of this gorgeous animal. They have been told also that if the cheetah lives and prospers, tourists will flock to see them. That means more earnings for the locals from the tourists.

Future Tense

One fallout of the new arrivals may be an increase in ecotourism in the regions where the cheetahs have been introduced. Also, to ensure that the cheetah remains healthy, it is expected that the authorities will look closely at the ecosystems where they live. This should help other forms of life in the region.

In spite of the excitement, there is niggling concern. Were the cheetahs moved out of their original habitat because there were too many there? Will the newly introduced cheetahs, considered Vulnerable under the IUCN Red List of Threatened Species, get on well with the others they share that habitat with, especially the leopard, tiger and the hyena, which the cheetah is known to be apprehensive of? Will the weather conditions in Kuno National Park suit them? Will this lead to more human-animal conflict because the region is heavily populated by humans? After all, according to recent estimates, there are about 360 people per square kilometre. Will the cheetah find substantial amount of food? Will a new species create new problems for environmentalists? Only time will tell. ■

Article by Benita Sen. She is a renowned author and regularly contributes articles for TerraGreen.



GREEN Quiz



GREEN Olympiad Secretariat welcomes you to GREEN Quiz Section! Thank you for registering for GREEN Olympiad 2022. We have received an overwhelming response and we hope we meet your expectations in the coming months.

Through this section, the Secretariat aims to reach out to student readers to avail an opportunity to prepare for GREEN Olympiad examination scheduled for October/ November 2022.

1. Weather refers to 'conditions of the atmosphere over a short period of time', and climate is 'how the atmosphere behaves over relatively long periods of time'. Hence, the difference between weather and climate is essentially a measure of _____.
 - a. place
 - b. time
 - c. temperature
 - d. atmospheric conditions
2. In the Earth's atmosphere, there are certain types of gases that absorb energy and prevent the loss of heat back into space. These gases act like a blanket making the planet much warmer and liveable. What is this effect known to be as?
 - a. Blanket effect
 - b. Weather effect
 - c. Atmospheric effect
 - d. Greenhouse effect
3. Which of the following statements hold true with respect to climate change? (1) Natural causes such as volcanic eruptions and changes in solar energy are mainly responsible for the climate change that occurred prior to the Industrial Revolution (2) Most of the observed recent global warming results from human activities.
 - a. Only 1
 - b. Only 2
 - c. Both 1 and 2
 - d. None of the above

4. Carbon sinks are like a storehouse of carbon/carbon compound, and thus prevent it from being in the atmosphere. Name a natural carbon sink from below:
- An agricultural farm
 - An industrial factory
 - An urbanized city
 - A forest
5. Soils are a mix of minerals, water, air, organic matter and are made up of layers. What is the layer found just below the O Horizon (which contains mostly leaf litter and hummus) called?
- Sub soil
 - Bedrock
 - Top soil
 - Regolith
6. Any item/material can be called a resource when its _____ has been identified.
- character
 - composition
 - utility
 - availability
7. Biomass refers to any organic matter such as plant material/animal waste that is used as a source of fuel. Pick the correct example of a biomass from the options provided below:
- Wind
 - Water
 - Trees
 - Electricity
8. Which of the following is NOT a petroleum product?
- Wax crayons
 - Kerosene
 - Cement
 - Plastic
9. Springs are an example of:
- Rain water
 - Surface water
 - Ground water
 - All of the above
10. Antarctica is considered to be the highest, driest, coldest and the most remote continent. It is also known as the _____.
- Dark Continent
 - Island Continent
 - Greenland
 - White Continent

Answer key:
1. (b); 2. (d); 3. (c); 4. (d); 5. (c); 6. (c); 7. (c); 8. (c); 9. (b); 10. (d)

Netafim's Irrigation Project

For Higher Crop Productivity

Netafim India, a leading smart irrigation solution provider, along with global agronomist Ityel Eviatar, has commenced a four-month-long training programme for farmers of Singataluru Lift Irrigation Project (package 1 and 3) in Gadag, Karnataka. This farmer education programme aims to reach thousands of growers of onion, maize, chilly, cotton, groundnut, red gram, and marigold, in the project area and empower them with the knowledge of Good Agriculture Practices.

Singataluru Lift Irrigation Project endeavours to bring the entire farming community together through Community Drip Irrigation Project—to establish systematic and sustainable irrigation practices. The ongoing phase 1 of the project plans to bring 10,080 hectares of agricultural land under drip irrigation connecting 13 villages and 7800 farmers in this season under various crops and majority of the farmers have started taking the benefit.

The training programme is scheduled from August 2022 to November 2022, with multiple on-field demonstrations, workshops, individual and cluster farmer meetings, and capacity

building initiatives. The education programme focuses on drip irrigation, fertigation, nutrient diagnostic kits, farm mechanization, and crop bed preparation. During the field training, farmers are empowered with knowledge on various topics, such as: different methods to grow crops under diverse soil, land preparation, sowing method, fertigation, irrigation frequency, optimum growing condition for the plants, tackling biotic and abiotic stress conditions, transplantation in agriculture, and more.

Global Agronomist, Ityel Eviatar said, "The concept of a grower's community managing their irrigation scheduling

through water association, is a combination of social, agronomical and technical scopes. The primary goal of such training and demonstrations is to increase farming productivity, help them cope with climate variability, and make farming profitable by encouraging them to adopt appropriate crop management practices".

Mr Eviatar is closely working with water user cooperative associations of the project area. He is an Israeli agronomist with more than four decades of worldwide experience in surveys, feasibility studies, project planning, extension programmes and crop and farm management. He has successfully





conducted multi-dimensional agriculture training and studies across the USA, Africa, Israel, Switzerland, Fiji, China, Panama, and Sri Lanka, to name a few, and published many research papers on Soil and water management. He specializes in farm management for vegetable and horticulture crops and irrigation and holds a PhD in soil physics and an MSc in plant nutrition.

Many farmers across the project have already participated in the training programme and are receptive to the suggestive methods. Poojar Kabeerdaas, a farmer from Mundargi taluka, said, "We saw the demonstration of different agronomic technologies and we have found them very useful. From what

we have seen in the field, there is a significant impact in the application of fertilizer using drip irrigation system." Another farmer from Mundargi taluka, Muttappa Kantikalla Lakshmaiva, said, "During the field training I saw many technologies. I have learned that frequently removing the side suckers helps avoid competition and how drip irrigation can be successfully used for my crops".

Agronomist Umesha M C, Netafim India, said, "We aim to empower Singataluru Lift Irrigation project farmers with modern agriculture practices and crop management techniques that help to increase crop yield and substantially increase their income. We, at Netafim,

have always been farmers' cultural anthropologist and believe when farmers improve the quality and yields of their high-value crops, the impact can be transformative. The training programme focuses on promoting the adoption of broad-based innovations used by countries across the globe."

About Netafim India

Netafim India is a wholly owned subsidiary of Netafim, the global leader in smart irrigation solutions for sustainable productivity. Established in 1997, Netafim India offers a wide range of micro-irrigation, greenhouse, digital farming solutions and community irrigation projects. Netafim India—with 3 manufacturing plants, over 1000 employees and an exclusive network of over 2500 dealers across all the major states—have provided an irrigation system for over 10 lakh hectares of land over the years, covering a wide range of crops. The company has successfully offered extensive agronomic, design, after-sales support, and agri-extension services to ensure sustainable prosperity to over 9.5 lakh farming families to date. Netafim India is an active partner in several government projects such as GGRC, APMIP and TANHODA as well. ■





Scientists Unravel Mystery Surrounding One of Nature’s Most Incredible Journeys

Every year, eels leave European rivers to travel in an epic migration to the Sargasso Sea in the North Atlantic to breed for a single time, then die. Although this final destination has long been suspected, until now there has been no direct evidence. By fitting eels with satellite tags, researchers have tracked the creatures on the final leg of the route. And they say the information will help in the conservation of the critically endangered species. “This is the first time we’ve been able to track eels to the Sargasso Sea and we are delighted we have the first direct evidence of adult European eels reaching their spawning area,” said Ros Wright of the Environment Agency, who led the research.

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

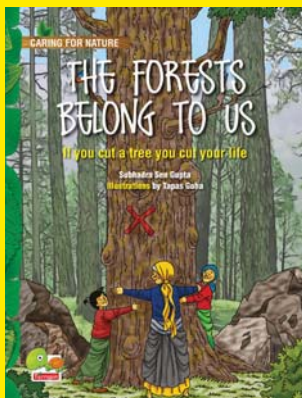
Zimbabwe Moves 2500 Wild Animals Because of Climate Change

Zimbabwe has begun moving more than 2500 wild animals from a southern reserve to one in the country’s north to rescue them from drought, as the ravages of climate change replace poaching as the biggest threat to wildlife. About 400 elephants, 2000 impalas, 70 giraffes, 50 buffaloes, 50 wildebeest, 50 zebras, 50 elands, 10 lions and a pack of 10 wild dogs are among the animals being moved from Zimbabwe’s Save Valley Conservancy to three conservancies in the north—Sapi, Matusadonha and Chizarira—in one of southern Africa’s biggest live animal capture and translocation exercises. It’s the first time in 60 years that Zimbabwe has embarked on such a mass internal movement of wildlife. Between 1958 and 1964, when the country was white-minority-ruled Rhodesia, more than 5000 animals were moved in what was called ‘Operation Noah.’

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



To know more... Read



CARING FOR NATURE: THE FORESTS BELONG TO US (THE STORY OF THE CHIPKO ANDOLAN)

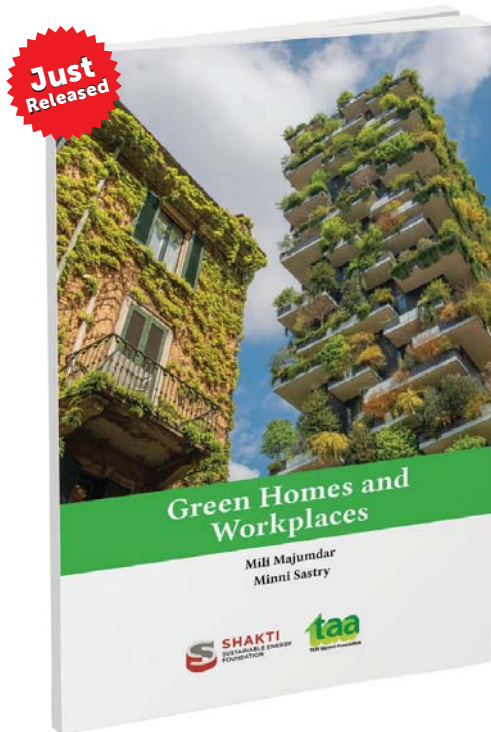
Subhadra Sen Gupta

Manjari sat under a tree, lost in her thoughtful world, enjoying the breeze past noon. But something unusual caught her attention – a sinister-looking bus was silently lumbering up the slope on the path that steered to the forest. Lately, other strange and worrying things had been happening in her village including auctioning of her favourite oak tree by the Forest Department. Alarmed, Manjari ran towards the village and to alert. What happened next was most unusual. Was Manjari able to save the oak tree? Who were the passengers in the bus? Why was the forest department hell bent on cutting the trees that kept the village safe from floods? The Forests Belong to Us tells you how women and children by most peaceful means, by hugging the trees, saved the guardians of nature. This small incident planted the seeds of the first people’s movement to save trees, called the Chipko Andolan.

ISBN: 9788179933626

Available at: [amazon.in](https://www.amazon.in) [flipkart.com](https://www.flipkart.com) [amazon kindle](https://www.amazon.com/kindle) [Google play](https://play.google.com/store/books/details?id=9788179933626) [teri bookstore](https://www.teribookstore.com)

EXPLAINS EFFICIENT RESOURCE UTILIZATION IN HOMES AND WORKPLACES THROUGH SIMPLE WAYS AND MEANS



Major topics covered:

- Energy-efficiency measures
- Measures to save water
- Cooling techniques
- Climate-responsive design
- Waste Management
- The 6 R's of sustainability
- Waste treatment technologies

- ISBN: 9788195077649
- Print / eBook Subscription Price: ₹299 ₹270 (with free shipping in India)
- Avail special 15% discount on order of more than 10 copies
- Perpetual Price: on request

Green Homes and Workplaces is simple and clear explanations of fundamentals and liberal use of illustrations. The authors aim to demystify the concepts and empower everyone to think and live green. For example, are you worried about polluted air indoors? Try a couple of houseplants. Living on the top floor? Try a reflective paint that can lower the inside temperature by at least a couple of degrees.

Although meant to be a guide to the concerned citizen, the book also has a more profound message: as green-buildings practitioners on the frontline of market transformation in India, the authors believe that our homes, buildings, and communities must move from not just doing less harm to becoming truly regenerative.

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

For any query or to avail bulk purchase discounts please write us at:

The Energy and Resources Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100
Fax: 2468 2144
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Web: <http://bookstore.teri.res.in>

Bank details for NEFT:
The Energy and Resources Institute
A/c Number: 62002345487
IFSC Code: SBIN0020511

Greater One-horned Rhino Estimation

The Successful Completion of the One-Horned Rhino Estimation in Assam

Implementation to preserve and promote an endangered species is important; so is mapping the progress of our plans to know how far we've come and how must we proceed. This article, by **Amit Sharma** and **Somreet Bhattacharya**, shares the successful account of estimation of the Greater one-horned Rhino population in the national parks and sanctuaries of Assam. Amid varying challenges, the WWF India team with support from the Govt. and Forest officials of Assam, undertook this task and came back with favourable results and a hope for the future of these animals.

The Greater one-horned Rhino is considered the most amphibious of all the rhino species. To count its numbers at home is no easy task. But the forest department of Assam and naturalists from WWF India undertook

this month-long exercise. While factors such as the weather or when the area is teeming other wild animal species made the task time-consuming, it was accomplished successfully. Interestingly, drones were used for the verification

count for the first time.

A rhino count requires boots on the ground throughout the process, during which the teams have to tread through the grasslands and forest counting individual rhinos carefully.



Adult Indian rhinoceros crossing a safari trail at Kaziranga National Park, Assam



Counting rhino numbers is a massive exercise that is executed after detailed planning and arrangements.

Counting rhino numbers involves the entire Protected Area to be divided into enumeration blocks; the ground conditions determine the sizes and shapes of the blocks. For analysing the performance of the population over the years, the blocks are kept uniformly. Each enumeration block is traversed in a forward-moving pattern and each rhino individual encountered is recorded in a pre-designed format. It is done in a zig-zag path to maximise the coverage of the area in an attempt not to miss any individual and avoid a double count of a single individual.

The enumeration team is not only made up of people from the forest department, but an opportunity is also provided to people from conservation NGOs, researchers and naturalists to make the exercise an inclusive one.

For the WWF India team from the Brahmaputra Landscape, the estimation exercise began early – after a series of meetings with the forest officials for planning the estimation exercise. While tracks were covered on the elephant's back, a part of the area was negotiated on foot.

In a trial run for the year 2022, the double count method was successfully executed for Orang National Park and Pobitora WLS to make the numbers more

accurate. The numbers for Kaziranga National Park and Manas National Park were revealed based on the traditionally followed single count method.

Over the third weekend of March 2022, Orang National Park became the first Protected Area where the count began. The process indicated that the entire protected Areas was divided into 16 census blocks that were covered by the enumeration team. On the first day, the enumeration team covered the blocks from point A to B, and on the following day, the blocks were covered from point B to A to ensure a double count process. Two different enumerators ideally did this for the two days. The analysis revealed the existence of 125

rhino individuals distributed in almost the entire park (as recorded during the count) which indicated the growth of 24 rhinos over four years. This is an indicator of a healthy park population.

Globally, the population of the Kaziranga National Park is the highest. For the enumeration process, the park area was divided into two distinct sections with 84 census blocks. The enumeration teams covered the census blocks mostly on elephant back for over two days. On the third day, a sample count covering 30% of the census blocks selected randomly over the park was completed as a verification exercise. A complete double count was not possible as the area of this protected area is quite big. The terrain in Kaziranga was challenging with the additional risk of the presence of wild animals; therefore, the results were declared based on a single count. This park recorded 2613 individual rhinos. A healthy increase of 200 individuals over four years was distributed over the park.

Next, the count was executed in Pobitora Wildlife Sanctuary. As the terrain is relatively friendly, the double count method was adopted. The entire area



Forest guards patrol at Pobitora Wildlife Sanctuary

of 38.81sq. km was divided into nine census blocks, where counting occurred for over two days early in the morning. Here, the new numbers obtained were 107, which is a marginal increase from the last count. These were located in all the census blocks of the protected area.

The team's excitement rose while counting numbers in Manas National Park as the rhino population was reintroduced under the Indian Rhino

Vision 2020 and the rehabilitation programs. This park offers a lot of challenges as it is large, and the terrain is very challenging. This time the challenges increased manifold due to inclement weather conditions and continuous rains, making enumerators negotiate even while they are knee-deep water and leeches. The protected area was divided into 71 census blocks, where the enumeration team could count 40



Forest guards patrol at Pobitora Wildlife Sanctuary following flooding in the low-lying area

Female rhinoceros with calf in Dudhwa.
Photo courtesy Narendra Upadhya



rhino individuals only occupying 19 of the blocks. "The count in Manas was not quite satisfying as the exercise got highly affected by rains and waterlogging. In addition, the non-availability of sufficient elephants to cover all parts of the park was also a hindrance", says Amit Sharma, the lead of WWF India's Rhino Programmes. However, as the park maintains a regular monitoring for the rhinos the estimated figures has been recorded to be 50. The count was successfully concluded for the

14th time in the state, revealing a total population of 2895, with about 90% concentrated only within Kaziranga National Park. The operation is relatively intensive and involves precise planning and careful execution. Dedicated efforts in the estimation exercise, negotiating all challenges have led to this highly applauded success.

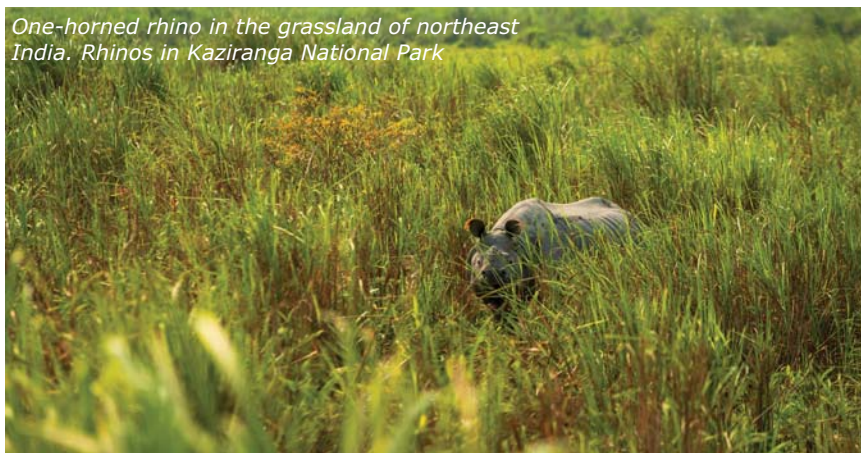
The efforts made by the Government and the Assam Forest Department in working with all its partners and providing the space to the local

communities to contribute has helped achieve this success in rhino conservation.

We understand that rhinos exist in numbers of six or more in a square kilometer, in certain pockets. Some of its preferred habitats are getting deteriorated in quality and there is an increase in the population of associated herbivores competing for space, in addition to the pressure from livestock. The rising population also requires space management to be better planned and also maintain the food quality and water availability in the prime areas. There is minimal scope to increase space in the existing rhino bearing areas. As such, it will be necessary to find new areas and reintroduce rhinos, both inside and outside of Assam, to secure the future of the population.

We conclude after undertaking the estimated count that the future can be only be brighter for the species if this collaborative and inclusive model of conservation is sustained and strengthened. ■

One-horned rhino in the grassland of northeast India. Rhinos in Kaziranga National Park



RWAs and Sustainability

How RWAs Promote a Sustainable Urban Environment

"Good governance is putting people at the centre of development process."

– Narendra Modi

A resident welfare association (RWA) is essentially a group housing system in a layout spread over an area or built into floors of apartments in a building. Resident Welfare Associations (RWAs) are typically registered under the Societies Registration Act, 1860. They are entirely self-financed and self-managed. RWAs are the finest expression of civil society consensus; an answer to urban problems; a tool for community building and for self-management and direct democracy. An urban resident is endowed with intensive communication skills, fast transport and uninhibited relations with other human beings. They can play a vital role in building up a

knowledge-based society.

Unfortunately, urban residents are under-represented in all tiers of governance, namely, the Central, State and Local. The RWAs should, therefore, form a fourth tier of grass-root, self-governing micro-urban communities with participatory functions.

One encouraging trend in all major cities, since 1990s, is the formation of Resident Welfare Associations (RWAs). The Municipal Corporations, the Election Commission of India and other constitutional bodies have also started recognizing RWAs as partners for fair and equitable delivery of services to the public, without political and partisan



Encouraging cloth bags

considerations. Active RWAs now exist in almost all major cities of our country.

In this article, we describe, as a case study the efforts made by the Andhra Pradesh Federation of RWAs (APFERWAS), Visakhapatnam, in promoting a sustainable urban environment in the city through a well-established organizational structure.

APFERWAS

The Andhra Pradesh Federation of Resident Welfare Associations (APFERWAS) was founded in November, 2016 – with the main objective of

promoting a sustainable urban environment through active participation of the Resident Welfare Associations (RWAs). It was inaugurated by the then Hon'ble Minister of Urban Development, Sri M Venkaiah Naidu, at Visakhapatnam. The APFERWAS is affiliated to the Confederation of RWAs (CoRWA), which is the pan India apex Body of RWAs in the country.

Over the last 6 years, the Federation has made significant progress in several aspects of urban environment, like greenery development, rainwater harvesting, plastic-free society, pollution, etc.

It has about 130-150 RWAs under its umbrella in the city of Visakhapatnam. The Federation's activities are now spread to other cities of Andhra Pradesh, like Vijayawada, Kakinada, Nellore, Ongole, etc.

Organizational structure

The Federation has a solid organizational structure. For example, the 130-150 RWAs in the area covering the city of Visakhapatnam, from Madhurawada in the north to Kurmannapalem in the south, of are divided into 6 zones – with a Zonal Coordinator for each Zone, who guides the RWAs. Each Zone has a WhatsApp group for easy communication with individual RWAs. Each RWA (or a colony), as the basic unit, also has a Committee with a



WhatsApp group. The Federation as a whole has an Executive Committee and Core Committee to plan, guide and implement the activities and it has a website (www.apferwas.org) as well. This is how a perfect organizational set up is established for easy communication and effective implementation of the Federation's activities.

Activities of RWAs

The main activities of the RWAs under the Federation are: Clean and Green Programs, Solid waste management, Rainwater Harvesting, Ban of single use plastics, Awareness programs on different aspects of Swachh Bharat, Organization

of Ralleys on important aspects of urban environment, Seminars and Conferences on relevant topics of Swachh Bharat, Publication of research papers, articles, booklets, videos on aspects like rainwater harvesting, solid waste management, plastic pollution, etc., participation in the National Conferences of RWAs (NCRWAs). The RWAs of APFERWAS have received National Recognition for their contribution in Rainwater Harvesting, Green Environment, Solid Waste Management, etc.

Coordination with Greater Visakhapatnam Municipal Corporation (GVMC)

A streamlined method of coordination with GVMC was established in 2017. Though it was a bit affected by the Covid pandemic during the last two years; this method comprised of quarterly meeting of Zonal Coordinators of APFERWAS and Zonal Commissioners of GVMC, along with the representatives of RWAs of that particular Zone, to review the civic issues in their colonies and the steps to be taken to effectively solve them. In addition to these zonal committee meetings, half yearly meetings were



held in the office of the Commissioner, GVMC to review the progress at each Zonal level. Sometimes these meetings are followed by field visits to certain sites by the Commissioner and his officials, to take stock of the ground situation.

This is how a perfect coordination was maintained between GVMC and APFERWAS. In addition, RWAs of different Zones actively coordinate with GVMC officials during the times of Swachh Survekshan (urban sanitation and cleanliness survey), by participating in rallies, door to door campaign for citizen feedback, etc.

APFERWAS donated an amount of INR 4lakh to the GVMC, towards relief to Covid victims of 2020-2021. It has also felicitated sanitary workers and health care providers, for their noble services.

Workshops/Seminars/Conferences/Rallies

During the last 6 years, several programs were organized by APFERWAS on topics like solid waste management, rain water harvesting, Real Estate Regulation Act (RERA), Beach Development, etc. Rallies were organized on events like World Environment Day, National RWA Day, etc. Beach cleaning and other activities were also taken up on such occasions. Medical Awareness Programs were organized

during the time of Covid, for guiding the public on Covid precautions. Along with this, relief camps were also organized for Covid victims.

Knowledge sharing

Dissemination of information through pamphlets, videos, you tube links, booklets, articles/research publications in reputed environmental journals was carried out for the last 5 years. As many as 7 articles, 3 booklets on topics like rainwater harvesting, RWA Mission, disaster management, and other such topics were published in magazines.

Achievements

Some individual RWAs established parks, communication halls, libraries, with their own funds and with the help of GVMC.

- Most of their RWAs could establish rainwater harvesting pits, waste composting pits in their colonies.
- Greenery development of RWAS is significant.
- Most of the RWAs attained reasonably good progress in sanitation, ban on single use plastics, pollution-free environment and other aspects.
- RWAS made their presence felt in the crucial period of the Covid pandemic by their active participation in relief operations.



Awards

- Some RWAs received state level as well as national level recognition for their over all performance, in projects like rainwater harvesting, greenery development, etc.
- A RWA receiving National Award in Rainwater Harvesting.
- Individual Members of RWAs received "Best Performance" at National level.
- APFERWAS has honoured the as best performing RWAs of the city of Visakhapatnam. ■

Dr K S R Murthy is the associate President of The Andhra Pradesh Federation of Resident Welfare Associations, Visakhapatnam.

Drones in Agriculture

Harnessing the Power of Drones for Sustainable Agriculture

In this article, **Rajesh Aggarwal** talks about the future of drones in Sustainable Agriculture and the many benefits that they can bring to the table. The increasing popularity of drones is opening up new possibilities in a lot of sectors. Their application in agricultural practices reveals unforeseen advantages that can hugely benefit the farmers.

Following the liberalization of drone restrictions in 2021, the industry received a huge boost with the announcement in this year's Union Budget of Drone Shakti: a new integrated office in the Ministry of Civil Aviation to allow speedier growth, coordination, and approvals for drones. The government is currently supporting a number of drone entrepreneurs in order to increase their use across industries. Kisan Drones are already being utilized for crop assessments, land records, and insecticide spraying, and are projected to usher in a new era of technology in agriculture and farming. Drones with Artificial Intelligence (AI), Machine Learning (ML), and remote sensing

capabilities are becoming increasingly popular due to their numerous benefits.

Use of Drones in Agriculture

Drone technology has received the greatest attention due to its versatility and is seen as the agrarian sector's future. Drones not only improve overall performance, but they also help farmers to overcome a variety of other obstacles and get several benefits from precision agriculture. The goal of implementing drone technology is to eliminate any uncertainty or guesswork and instead focus on accurate and dependable data. They fill the void left by human mistake



and inefficiency in traditional farming practices; with the market for agricultural drones expected to reach \$5.7 billion by 2025, growing at a 35.9 per cent CAGR.

A farmer can use an agriculture drone to adapt to different settings and make informed decisions. Crop health, crop treatment, crop scouting, irrigation, field soil analysis, and crop damage assessments are all aided by the information obtained via drone surveys. They help farmers increase agricultural yields while reducing time and costs.

Role of Drones in Crop Protection and Productivity Enhancement

Spraying of agrochemicals

Drones are already being tested for use in the cotton-growing region of the country for spraying pesticides - to reduce pests that would otherwise be handled by agricultural labourers, which is very time consuming and is also not uniform. Drones not only lessen the



risk of unintended fume inhalation, but also expedite pest management by covering more areas in less time. The primary advantage of using a drone is that it will consume less insecticide and provide greater precision throughout the application process.

Controlling the locust swarm

The majority of countries fighting locust swarms rely heavily on organophosphate insecticides. In India, drones have been stationed in Rajasthan to ensure that the spraying is done efficiently. Drones can spray insecticides across a 2.5-acre area in under 15 minutes. The use of drones to battle locust swarms is a quick, safe, and practical solution.

Crop health surveillance and monitoring

Tracking the health of the vegetation and spotting bacterial or fungal diseases early on is critical. Plants that reflect various quantities of green light and Near-Infrared Spectroscopy (NIRS) light can be identified by agricultural drones. This information is used to create multispectral images that can be used to track crop health. Crops can be saved if they are monitored closely and any faults are discovered quickly. In the event of crop failure, the farmer can document the losses in order to file proper insurance claims. Agricultural drones equipped with multispectral and RGB sensors can

also identify weeds, diseases, and pests in farm regions. The exact amounts of chemicals required to combat these infestations are known as a result of this research, which reduces the farmer's costs as well.

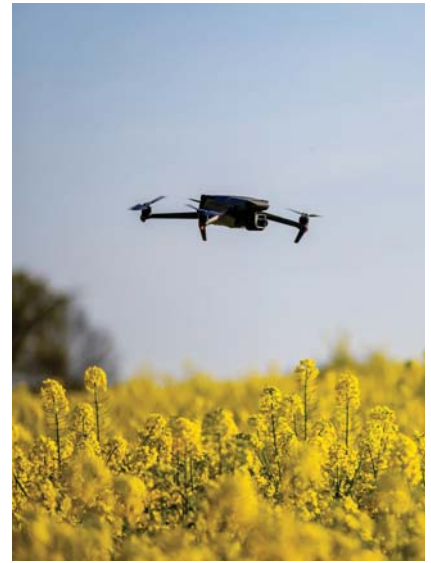
Monitoring of irrigation

Drones with hyperspectral, thermal, or multispectral sensors detect areas that are too dry or require the farmer's attention. Irrigation monitoring yields calculations of the vegetation index to help realize the health of crops and emitted heat/energy. Along with that, Drone surveys aid in bettering water usage and uncovering irrigation problems.

Soil analysis in the field

Farmers can use the drone survey to learn more about the soil conditions on their land. Multispectral sensors capture data that can be used for seed planting patterns, field soil analysis, irrigation, and nitrogen management. Farmers can thoroughly examine their soil conditions using precise photogrammetry/ 3D mapping.

Drone-planting systems have already been developed that allow drones to shoot pods, seeds, and essential nutrients into the soil. Not only does this technique cut expenses by over 85%, but it also improves consistency and efficiency.



Tracking livestock

Farmers can use the drone survey to keep track of not only their crops, but also their cattle's movements. Thermal sensor technology aids in the recovery of missing animals and the detection of injury or illness. Drones are capable of performing this duty well, and this contributes significantly to the development of vegetation.

The Future of Agriculture

Seeing the manifold benefits that drones bring to the field of agriculture, they are surely going to be the next big thing in this sector. Drone not only reduce the toil of manual labour (that till date is seen as characteristic of agricultural activities), but they also help farmers in better mitigating with uncertainties of this business. Coupled with these benefits, development in drone technology, as well as increasing support and acceptance by governmental policies further cements the fact that drone have the capacity to change the future of sustainable agriculture. ■

Mr Rajesh Aggarwal is the Managing Director of Insecticides(India) Limited, which is an Indian agrochemicals manufacturing company that has emerged as a front-line performer in India's crop care market in the last few years.



SUBSCRIBE

TerraGreen

INDIA'S LEADING MONTHLY ENVIRONMENTAL MAGAZINE

<http://terragreen.teriin.org>



TerraGreen promotes the concept of sustainable development. Launched in June 2004, this magazine from TERI is an effort to bring forth information and knowledge in the fields of energy, environment, and sustainable development. The magazine is in keeping with our mission to expand the base of environmentally conscious readers and popularize sustainability issues at the local level. TerraGreen aims to provide the readers with the necessary inputs to enable them to be a part of the process of change. The magazine stays away from all jargon, so that the educated, informed, yet lay readers are updated on all that happens around them everyday.

Tick one	Term (yrs)	No. of issues	Cover price		You pay		You save	
			₹	US\$	₹	US\$	₹	US\$
	1	12	840	122	800	116	40	6
	2	24	1680	234	1510	211	170	21
	3	36	2520	302	2270	272	250	30

*Name of the Customer (IN BLOCK LETTERS).....

Designation..... Company / Organization.....

City..... State..... PIN..... Country.....

Email.....

PAYMENT PROCEDURE

Enclosed a Cheque/Draft number.....drawn in favour of 'TERI' payable at New Delhi for

₹/.....for 1/2/3/ year subscription of TerraGreen.

To SUBSCRIBE or make online payment, visit: <http://bookstore.teri.res.in/TerraGreen>

For subscription related queries,
contact: +91 11 2468 2100 / 7110 2100
Email: teripress@teri.res.in

THE ENERGY AND RESOURCES INSTITUTE
Darbari Seth Block, IHC Complex, Lodhi Road, New Delhi – 110 003
Tel. 2468 2100 or 7110 2100, Fax 2468 2144 or 2468 2145, India +91 • Delhi (0) 11
<http://terragreen.teriin.org>



Green events

OCTOBER-
NOVEMBER
2022

International Conference on Renewable, Environment and Agriculture

October 23, 2022

Kolkata, India

Website: <https://10times.com/>

ADIPEC

October 31–November 3, 2022

Abu Dhabi, UAE

Website: <https://www.adipec.com/>

Workshop on Net Zero Roadmap - Carbon Footprint and Mitigation

November 3–4, 2022

Virtual Platform

Website: <https://www.cii.in/>

Electric Vehicle and Renewable Energy Expo

November 4–6, 2022

Bengaluru, India

Website: <https://evexpoinc.com/>

National Conference on Smart Energy Systems

November 6, 2022

Hyderabad, India

Website: <https://10times.com/>



FEEDBACK FORM

PLEASE TICK YOUR CHOICE.

1. Which section(s) did you find the most interesting?

- TERI Analysis Environmental Research Feature
 In Conversation (Interview) Cover Story Special Report
 Green Challenges Terra Youth Review

2. In your opinion, which section(s) need(s) improvement?

- TERI Analysis Environmental Research Feature
 In Conversation (interview) Cover Story Special Report
 Green Challenges Terra Youth Review

3. What do you think about the look and feel of TerraGreen?

- Brilliant Design is not a priority, content is
 Average Needs improvement

4. In your opinion, what aspect(s) of TerraGreen need(s) improvement?

- Choice of stories Handling of issues Language
 Design Presentation

5. Please rate TerraGreen on a scale of 1–5 (5 being the best).

- 1 2 3 4 5

6. What issues would you like TerraGreen to cover?

.....
.....

7. Which other environmental magazine(s) do you read?

..... None

8. Any further suggestions?

.....
.....

YOUR DETAILS

Name:

Profession:

Tel.:

E-mail:

The most innovative suggestion will get a surprise gift.

The Energy and Resources
Institute
Attn: TERI Press
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi – 110 003/India

Tel. 2468 2100 or 7110 2100
Fax: 2468 2144 or 2468 2145
India +91 • Delhi (0)11
Email: teripress@teri.res.in
Submit online: <http://bookstore.teri.res.in/terragreen>



ADVERTISE IN...

TERRAGREEN

Circulation information

Industries, Ministries, PSUs, Corporates, Multi and Bilateral Agencies, Universities, Educational Institutions, and Research professionals. Readership of 40,000

General information

- Monthly
- All colour
- Matte paper
- Number of pages: 56



Technical specifications

Finished size: 20.5 cm × 26.5 cm
 Non-bleed ad size: 17.5 cm × 23.5 cm
 Half page ad size: 17.5 cm × 11.75 cm
 Bleed size (3 mm bleed on all sides): 21 cm × 27.5 cm
 Artwork preference: Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)

Position	Card rate for single issue(INR)	quarter contract (3 issues) (INR)	bi-annual contract (6 issues) (INR)	annual contract (12 issues) (INR)
Advertorial (per page)	100,000	255,000	480,000	900,000
Back Cover	100,000	255,000	480,000	900,000
Inside Back Cover	75,000	191,250	360,000	675,000
Inside Front cover	75,000	191,250	360,000	675,000
Inside Full Page	50,000	127,500	240,000	450,000
Inside Half page	30,000	76,500	144,000	270,000

GST & taxes additional as applicable

Subscription

One year ₹840 / \$122 • Two years ₹1680 / \$234 • Three years ₹2520 / \$302

ENERGY FUTURE

Circulation information

Industries, Ministries, PSUs, Corporates, Multi and Bilateral Agencies, Universities, Educational Institutions, and Research professionals. Readership of 25,000.

General information

- Quarterly
- All colour
- Matte paper
- Number of pages: 96



Technical specifications

Finished size: 20.5 cm × 26.5 cm
 Non-bleed ad size: 17.5 cm × 23.5 cm
 Half page ad size: 17.5 cm × 11.75 cm
 Bleed size (3 mm bleed on all sides): 21 cm × 27.5 cm
 Artwork preference: Print ready, minimum 300 dpi (tiff, eps, pdf, or cdr) files with all fonts with high quality print proofs and progressives for colour reference.

Advertisement tariffs (₹)*

Ad location	Back cover	Inside back cover	Inside front cover	Inside full page	Inside half page	Inside quarter page	One-sixth page
Single issue	60,000	50,000	50,000	40,000	20,000	12,000	7,000
Two issues	114,000	95,000	95,000	76,000	38,000	22,800	13,300
Three issues	171,000	142,500	142,500	114,000	57,000	34,200	19,950
Four issues	228,000	190,000	190,000	151,000	76,000	45,600	26,600

Subscription

One year ₹800 / \$80 • Two years ₹1600 / \$160 • Three years ₹2400 / \$240

Contact details

Sanjeev Sharma

Email: sanjeev.sharma@teri.res.in
 <Extn 2579>

Bank details for NEFT:

The Energy and Resources Institute
 Bank: State Bank of India
 A/c Number: 62002345487
 IFSC Code: SBIN0020511

Website: <http://bookstore.teri.res.in/TerraGreen>



The Energy and Resources Institute

Darbari Seth Block, IHC Complex
 Lodhi Road, New Delhi - 110 003
 Tel: 011 2468 2100 / 7110 2100
 Fax: 011 2468 2144 / 2468 2145
 Website: <http://bookstore.teri.res.in>

OPEN YOURSELF TO A WHOLE NEW WORLD OF ENVIRONMENT INTELLIGENCE!

PRESERVE • CONSERVE
INSPIRE • LEARN

**ORDER
YOUR COPY
TODAY**

ENVIRONMENT STUDIES AND SUSTAINABLE DEVELOPMENT

- SUSTAINABILITY OF BUSINESS IN THE CONTEXT OF ENVIRONMENTAL MANAGEMENT
- LOCKDOWN TIGER - ANJANA BASU
- Green, Reliable and Viable

ECOLOGY, ENVIRONMENT, AND FORESTRY

- AGROFORESTRY WITH COMMERCIAL CLONAL PLANTATIONS IN INDIA

SUSTAINABLE ARCHITECTURE

- GRIHA Version 2019 & VOLUME SET

LIFE SCIENCES

- Plant Biotechnology

ENVIRONMENTAL ENGINEERING

- A TEXTBOOK OF MUNICIPAL SOLID WASTE ANALYSIS
- ECOLOGICAL MELTDOWN - Second edition

ENERGY

- Coal: phase down or phase out
- Sun Through the Roof

CHILDREN BOOKS

- LET'S SAVE THE RAIN
- Reclaiming the Blue Earth
- Pollution Solutions

CLIMATE

TERI publications also available at



For more information, log on to <http://bookstore.teri.res.in>