

TerraGreen

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VOLUME 15 | ISSUE 5 | August 2022

MSW Management

The pitiable situation of Municipal
Solid Waste Management

IN CONVERSATION

Dr Kåre Helge Karstensen
Chief Scientist and Programme Manager at SINTEF

SPECIAL HIGHLIGHTS

Inherent Risks of 'Natural' Foods
Utility Bidder's Renewable Ready Index

TERRA YOUTH

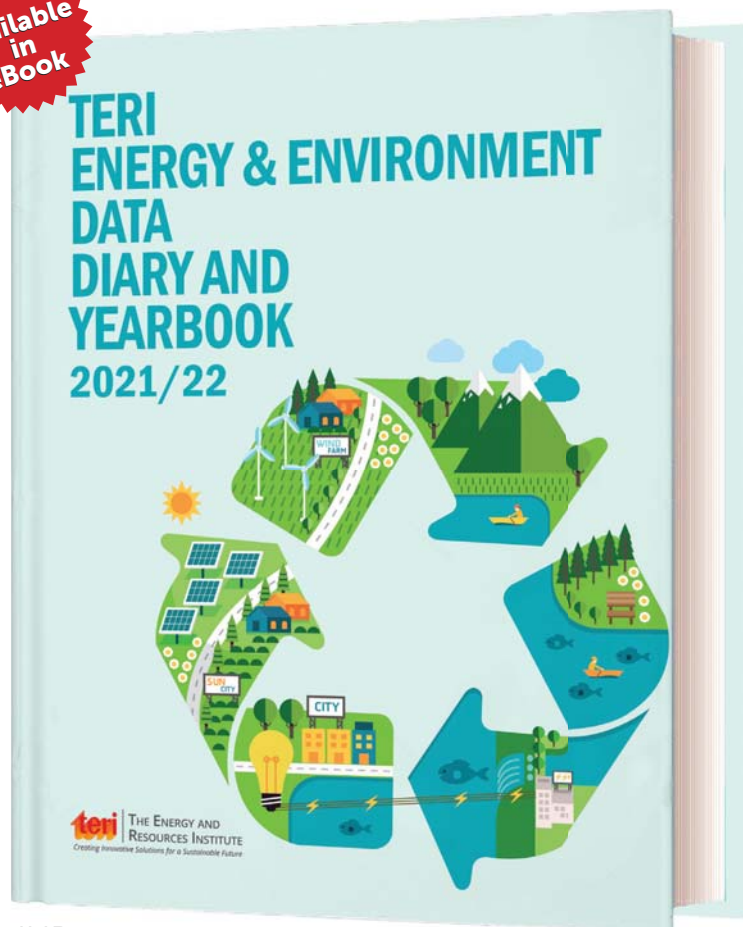
GREEN Quiz



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EDITORIAL



“ We should be aligning any step we take – whether it is as small as segregating the waste at home, or as big as formulating policy changes – with the goal of protecting, preserving and nurturing our environment ”

There is a sharp rise in extreme weather events of flooding, landslides, and droughts across the world. It is worrying that the spate of extreme weather events witnessed in the past few months alone cannot be chalked up to be a rare coincidence. Rather, it indicates how rapidly the health of our planet is degenerating. These happenings serve as a reminder that there is an urgent need for action, to reassess the current scenario, map a preventive course and speedily implement the necessary steps to preserve the planet's future. It is necessary to change our outlook towards climate change and climate action by realizing the immediacy that characterizes the situation.

At the G20 Summit in Indonesia, Union Environment Minister Mr Bhupender Yadav emphasized this fact. “There is an urgent need to mobilize resources to stimulate the economy in a manner that makes it more resilient and sustainable”, he said, asserting the need for sustainability and climate action to be part and parcel of any developmental effort. We should be aligning any step we take – whether it is as small as segregating the waste at home, or as big as formulating policy changes – with the goal of protecting, preserving and nurturing our environment and curbing the impact of climate change.

This month, our cover story ‘The Pitiabale Situation of Municipal Solid Waste Management’ throws light on the challenges in dealing with Municipal Solid Waste (MSW), and the need to mitigate risks, particularly to health and environment, involved in the process. While efficient MSW management is integral to ensure cleanliness and avoid littering, it is also an area of concern when it comes to air pollution. Proper policy implementation, as laid out by the government in the Solid Waste Management Rules 2016, is required to control the release of hazardous pollutants via incinerators. It is important to use new technologies for dealing with MSW and even improving the traditionally used incinerators. Improvements and upgradation in the sector will contribute to creating job opportunities and also to better resources management.

The cover story also explores a subject that can potentially create jobs in the future - energy storage, an integral facet to positive climate action. With many countries setting Net Zero emissions goals for 2050 or later, an assessment of how they fare will provide a realistic picture of what we can hope in the future. Unlike most countries, India aims to reach Net Zero by 2070 and recent assessments have shown that this is an appropriate timeline for the country. Given the recent boost in the energy sector (particularly with Green Hydrogen) India's Net Zero target seems more within reach.

To make sure that this favourable vision doesn't falter; it is imperative to combine our energies to ensure that climate action goals are successfully achieved.

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

Vibha Dhawan
Director-General, TERI



I do agree with the author of the cover story published in the July issue of TerraGreen about Green Hydrogen being a solution for meeting the Net Zero Emission goals of various countries. The MNRE policies discussed in the story help highlight and assess India's position and how successfully India is transitioning from fossil fuel-based energy to cheap and clean/renewable energy system. In terms of renewables, our country has ample local supplies. For instance, with an extensive deployment of solar and wind farms we can not only meet our Net Zero goals, but also solve the unemployment problem currently plaguing our youth.

Vishak Vijyan
Kozhikode, Kerela

I liked reading the July 2022 issue of TerraGreen. I especially enjoyed the feature article on Wetlands and how they can play a pivotal role in tackling Climate Change and Biodiversity Loss. This is a topic that is largely ignored, especially

in mainstream discussions. The article was an insightful read – I had not read about high altitude wetlands before this, let alone why it is important to conserve them. I hope we are able to rejuvenate our wetlands with the collective efforts of the government, research organizations and the people.

Reshma Samuels
Jaipur, Rajasthan

The TerraYouth section really gives the magazine its edge – making it informative and valuable for young and adult readers alike. As an educator, I particularly liked the green quiz section. The story on “Hamara Gaon Project” by Aequs Foundation, which focused on imparting education through experiential learning and developmental activities, was very inspiring as well. Integrating the community in educational activities in such a manner, in my opinion, will help in furthering a temperament for literacy. It will also help women in broadening their traditional duties as primary caregivers; uplifting them in the process of educating their children. I look forward to reading about more such initiatives in the upcoming issues of TerraGreen.

Monica Khanna,
Delhi

Editor-in-chief
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Editorial Board
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Abhas Mukherjee
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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: teriwrc@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@iges.or.jp

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COVER STORY



Delhi's air, surface temperatures above baseline avg, study finds

The study, "Urban Heat Stress in major cities of India: Delhi" found that the Capital's average air temperature from March to May (considered the pre-monsoon period) this year was 30.03°C, higher than the 30-year baseline (1981-2010) of 28.25°C, while the average land surface temperature was 1.95°C than its baseline. At the same time, Delhi's heat index (also known as the 'real feel' of the weather) was 30.53°C, higher than the baseline figure of 28.89°C.

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

Explained: Why fisherfolk in Kerala are protesting Adani's under-construction Vizhinjam port

The week-long ongoing protests against the construction of the Adani Group's Vizhinjam International Transshipment Deepwater Multipurpose Seaport in Kerala's capital Thiruvananthapuram intensified on Monday (August 22), with fisherfolk laying siege to the port from the sea and land. The community has also put forward six other demands: (i) rehabilitation of families who lost their homes to sea erosion, (ii) effective steps to mitigate coastal erosion, (iii) financial assistance to fisherfolk on days weather warnings are issued, (iv) compensation to families of those who lose their lives in fishing accidents, (v) subsidised kerosene, and (vi) a mechanism to dredge the Muthalappozhi fishing harbour in Anchuthengu in Thiruvananthapuram district.

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



10 villages get community forest resource rights in Chhattisgarh

Chhattisgarh Chief Minister, Bhupesh Baghel, has distributed titles for community forest resource rights to 10 villages in core and buffer areas of two tiger reserves under the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. Community forest resources include traditional grazing grounds; areas for collection of roots, tubers, fodder, wild edible fruits and minor forest produce, sources of water for human or livestock use; medicinal plant collection territories of herbal practitioners. On the occasion of World Indigenous People's Day (August 9), Baghel gave the titles to five gram sabhas each of Achanakmar Tiger Reserve and Sitanadi-Udanti Tiger Reserve respectively.

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



18 Indian cities in 20 worst PM2.5 list, says US report

The analysts of the report used data from 2010 to 2019 from over 7,000 cities across the globe and focussed on two of the most harmful pollutants; fine particulate matter (PM2.5) and nitrogen dioxide (NO2). PM2.5 refers to fine particles (measuring 2.5 µm or less in diameter) that penetrate deep into the body and fuel inflammation in the lungs and respiratory tract, leading to the risk of having cardiovascular and respiratory problems, including a weak immune system. "Of the 50 cities with the increase in PM2.5, 41 are in India and 9 are in Indonesia. On the other hand, of the 20 cities with the greatest decrease in PM2.5 pollution from 2010 to 2019, all are located in China," said the analysts.

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

500 Cities Declare Mechanized Sanitation: All Indian Cities to be SafaiMitra Surakshit by March 2024

Today, Urban India has recommitted itself towards ensuring the safety, dignity, and security of all sanitation workers (SafaiMitras). For the first time, 500 cities across India have declared themselves as 'SafaiMitra Surakshit Shehar'. In doing so, they have established that the cities are able to achieve adequacy in terms of institutional capacity, manpower and equipment norms as stipulated by MoHUA and are providing safe working conditions for SafaiMitras. The 'SafaiMitra Surakshit Shehar' declaration done by 500 cities aligns with Swachh Bharat Mission-Urban's longstanding goal of promoting sustainable sanitation practices and acting as a catalyst for the transformation of every 'manhole' into a 'machine hole'.

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



Plastic pollution-free school

St Joseph's Sr Sec School, Sector 44-D, Chandigarh, has been felicitated with the most coveted award, 'The Plastic Pollution-Free School Award' for the STOP (Students Take On Plastic) campaign at the special award ceremony organised by the Environment Department of Chandigarh in association with Yuvsatta. The 45 day-STOP campaign was launched on the Earth Day and had continued up to the World Environment Day for which the Josephians stepped up the drive to get rid of the disposable plastic completely.

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



Explained: The new U.S. Bill on climate action

On August 7, the U.S. Senate approved a Bill titled the Inflation Reduction Act (IRA) 2022, with a simple majority of 51 to 50. Vice President Kamala Harris cast her tie-breaking vote to aid the approval after the Senate was evenly divided. Even though all Republicans opposed the bill, the Democrats pushed through after a long debate taking advantage of the budget reconciliation process. The bill is a scaled-down version of President Biden's Build Back Better Act (BBBA), which failed to get approval from the Senate. The IRA has a special focus on climate, healthcare, and tax provisions to address inflation. The Bill marks the largest American investment aimed toward making the U.S. a leader in clean energy. It includes packages worth \$369 billion for the clean energy transition.

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



Europe declares drought as heat dries up rivers, kills fish, shrivels crops

Once, a river ran through it. Now, white dust and thousands of dead fish cover the wide trench that winds amid rows of trees in France's Burgundy region in what was the Tille River in the village of Lux. From dry and cracked reservoirs in Spain to falling water levels on major arteries like the Danube, the Rhine and the Po, an unprecedented drought is afflicting nearly half of Europe. Europe isn't alone in the crisis, with drought conditions also reported in East Africa, the western United States and northern Mexico.

Source: [Source: https://www.hindustantimes.com/](https://www.hindustantimes.com/)

UN chief taps Grenada's Simon Stiell as new climate chief for agency

Secretary-General Antonio Guterres announced the appointment Monday of Simon Stiell from the Caribbean island nation of Grenada as the new UN climate chief, calling him, a true champion of creative approaches to tackling the global climate crisis. In recent years Stiell has been among a handful of prominent figures from vulnerable nations demanding that rich countries step up their efforts to combat climate change and help those around the world who are most vulnerable.

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

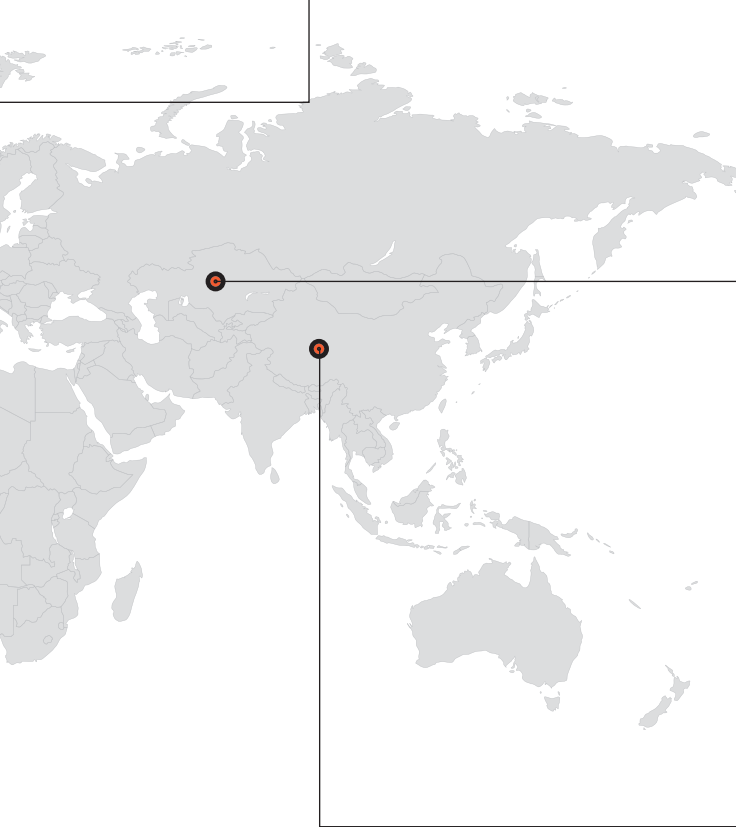




China and US spar over climate policy on Twitter

The world's two biggest emitters of greenhouse gases are sparring on Twitter over climate policy, with China asking if the U.S. can deliver on the landmark climate legislation signed into law by President Joe Biden this week. After Congress passed the bill last Friday, U.S. Ambassador to China Nicholas Burns took to Twitter on Sunday to say the U.S. was acting on climate change with its largest investment ever — and that China should follow. The exchange, part of a longer back and forth on Twitter on the issue, is emblematic of a broader worry: U.S.-China cooperation is widely considered vital to the success of global efforts to limit rising temperatures.

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



'50% infectious diseases aggravated by climatic hazards'

As the world continues to battle the rising cases of Covid-19 caused by zoonotic virus, a study by a team of researchers has found that over 50 per cent (that is, 218 out of 375) of infectious diseases, from common waterborne pathogen to life-threatening diseases like plague have been at some point aggravated by climatic hazards. The team of environment and health scientists had reviewed decades of scientific papers on all known pathogenic disease to create a map of the human risks aggravated by climate-related hazards.

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

China issues first drought alert, battles to save crops in extreme heatwave

China has issued its first national drought alert of the year as authorities battle forest fires and mobilize specialist teams to protect crops from scorching temperatures across the Yangtze river basin. The national 'yellow alert', issued late on Thursday, comes after regions from Sichuan in the southwest to Shanghai in the Yangtze delta have experienced weeks of extreme heat, with government officials repeatedly citing global climate change as the cause. The alert is two notches short of the most serious warning on Beijing's scale.

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



Iron and Steel Industry

Situation and prospects of water conservation

The process of steel making is energy intensive and requires extensive volumes of water. In this regard, the steel sector a responsibility to be transparent about its environmental liability. In this article, **Mohammad Imroz** and **Charu Bhanot**, talk about the challenges and reflections from the best practices that could be utilized for improving water consumptions of the industry.

Recent studies have established steel as a significant factor in India's development, also highlighting its promising potentials from the future perspective. The Indian steel industry has the ability to boost country's economic growth. India currently produces more than 100 million tonnes of crude steel annually, making it the world's second-largest producer after China. Steel production contributes nearly 2% to India's GDP.

The process of steel making is energy intensive, also requires extensive volumes of water. Wastewater discharged from the iron and steel sector has a profound effect on aquatic ecosystems in the surrounding area. Many harmful substances, such as dissolved metals for instance, cadmium, petroleum by-products, 32 types of volatile phenol,

arsenic are contained in wastewater. Consequently, the iron and steel sector confronts a substantial risk related to water due to its extensive influence on local, regional, and global water supplies. Commonly used indicators in the iron and steel business nowadays include freshwater consumption (FWC) per tonne of steel and water consumption (WC) per tonne of steel.

Water Challenges in Steel Production

There is a finite amount of water on Earth. The oceans are reservoirs of vast quantities of water, however, only 3% of this water is actually exploitable while another 2% exists in locked, frozen form at the Poles. Freshwater accounts for less than 1% of all water available on Earth—both beneath and above ground. This

implies that water is a precious resource and hence should be utilized judiciously. Figure 1 depicts the consumption of water by major steel plants in India. Major players of the Indian steel and metal manufacturing such as JSW Steel Limited and Tata Steel Limited, and Vedanta Limited have raised concern over the future availability of water.

In the light of stated facts, it can be established that lack of water is a hindrance that the country must overcome, if it eyes to increase its steel production. The production of steel relies heavily on water. Water is the common prerequisite for accomplishment of the steps, involved in steel manufacturing such as ore/coal washing, coke quenching, cooling hot shells, granulating slag, cooling rolls and slabs during hot rolling, and power plant cooling. An example can facilitate understanding—preparation of the raw material through the coke oven plant, known as the quenching process, requires about 1130 litres of water per million gallons of coke produced. The average intake of water for the electric arc furnace route is 28.1 m³ per tonne of steel, while the average discharge is 26.5 m³. On an average, each production step utilizes 4–5 tonnes of input material, which further requires 25–60 m³ of water, to manufacture one tonne of steel.

Water consumption by Steel Plants of India (in Cubic meters)

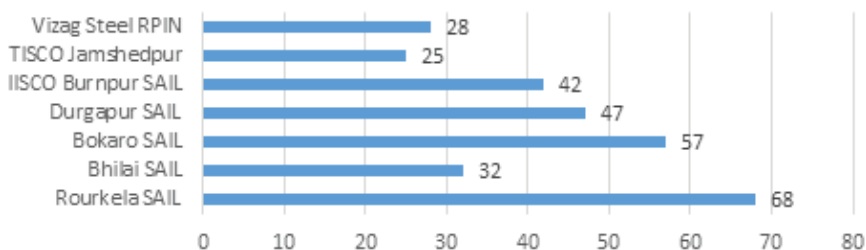


Figure 1 Water consumption by major steel manufacturers in India

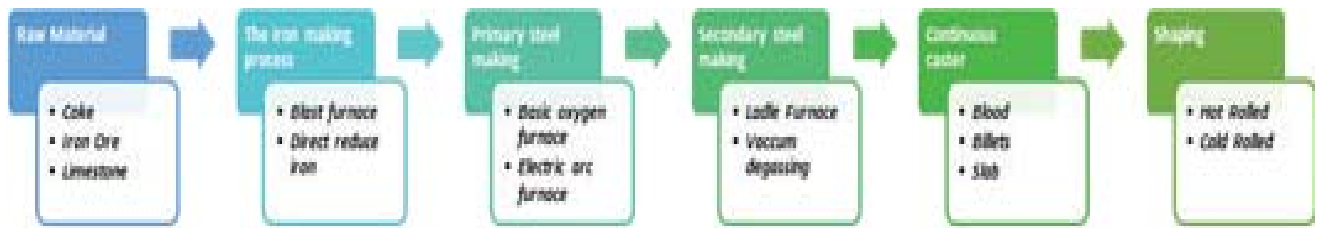


Figure 2 Steps involved in steel- and iron-manufacturing process

Current water use

Existing steel facilities consume large amounts of water—for both plant and township community. Some Indian units' water consumption rates, when compared to those of international best practises, show that using 2 m³ of water per tonne of cast steel produced (without a power plant) is optimal. While taking township's water use in account, this amount rises to 5 m³ per tonne of cast steel. On average, an Indian steel plant uses 11.3 m³ of water per tonne of cast steel. On the contrary, a facility in the United States has an average water usage of 3.5 m³ per tonne of cast steel. This pinpoints to the urgency of improving the current water management procedures in the steel industry of India.

Water Reduction, Reuse and Recycling are the Future

Cooling: Since once-through cooling systems require the most water switching to recirculating cooling systems that could store part or almost all of the water for multiple cooling cycles, may be beneficial.

Process water: Facilities can collect spent process water streams and employ appropriate separation technologies to remove contaminants and bring the water to an acceptable quality range, either for reuse in subsequent process applications or recycling it for other uses within the facility.

Boiler feed water: It is employed to produce the process steam needed to power various steel production processes. For powering both heating

and cooling systems boilers are required. Through adequate treatment, water can be conserved and recycled for boiler feed water.

Reuse water: In zero-liquid discharge (ZLD) method of water treatment, all wastewater is cleaned and recycled, thus, leaving no discharge at the end of the treatment cycle. The zero-liquid discharge is a cutting-edge approach to wastewater treatment that combines fractional electro de-ionization, evaporation/crystallization, reverse osmosis, and ultrafiltration.

Coke dry quenching (CDQ): is an energy-saving process used during the production of coke in the coke oven battery. Dry quenching has multiple benefits, for instance it minimizes water use (0.5–1.0 m³/tonne of gross coke), reduces water pollution, and offers the possibility of recovering waste heat (0.286 G Cal/tonne of gross coke). As of 2009–10, only two integrated plants in India had installed CDQ facilities—Vizag Steel (for all four batteries) and Neelachal Ispat Nigam Limited (for one battery). On the global scale, steel-manufacturing plants in regions/continents such as East Asia, Central Asia, South America, and Europe are equipped with CDQ facilities.

Dry gas cleaning: Around 0.4–8 m³/thm (per tonne of hot metal produce) of freshwater is needed during wet gas cleaning. This causes large-scale wastewater generation, thus increasing the load on the treatment facilities. The most recent gas cleaning method uses a completely dry gas cleaning method, which reduces both wastewater production and freshwater consumption. Bhushan Power and Steel, Sambalpur, is the only plant in India equipped with

dry gas cleaning technology to its blast furnace. It is worth mentioning, dry gas cleaning is a common fitment in blast furnaces of Chinese and Japanese origin.

Policy on Corporate Water Consumption Disclosure

The steel and iron industry has a responsibility to be transparent about its environmental liability. The present trend of reporting the ESG for corporates around the world has shown that the actions of corporates have a direct influence on the natural world. The recent analysis of environmental disclosures in the annual reports of the steel industry shows that companies do not provide enough transparency to meet the informational demands of the stakeholders. Nonetheless, the current trend of more transparency is encouraging news for the environment. As a result, the research lends credence to the idea that a sufficient framework for water consumption and reduction disclosure is necessary. In addition, more robust institutional and policy regimes are needed to meet the issues in India's water –dependent industries. The end outcome must be an evidence-based management and enforcement system.

***Note:** This study was conducted on secondary literature, by Mohammad Imroz and Charu Bhanot, for the water conservation of industries engaged in manufacturing iron and steel in India. ■

Mohammad Imroz is an M. Tech student under the Water Resource Engineering and Management at TERI SAS. Charu Bhanot works as Research Associate for Water Resources Policy and Management, TERI, New Delhi.

Honey Bee, the Pollinator

An ancient fossil reveals the earliest panda to survive solely on bamboo and the evolutionary history of panda's false thumbs.

As biodiversity is fast depleting, the Global Assessment Report recently (April, 2019) compiled by a UN agency – the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES), has indicated that at present at least 1 million species are at the risk of extinction. Accordingly, today the extinction of global species is accelerating alarmingly, occurring at a rate 1000 times higher than the average rate over recorded history. Although the toll it is taking on ecology and agriculture is beyond calculation, the loss of some of these extinctions has been evaluated. For example, the IPBES has indicated that the loss of pollinators caused by intensive farming has been putting between \$235 to \$577 million worth of crop output at risk (Table-1) annually.

Table-1: Percentage decline in selected global insect population over the past decade (2008-2018)

Insect	% of decline
Coddesflies	68
Butterflies	53
Beetles	49
Bees	46
Mayflies	37
Dragonflies	37
Stoneflies	35

Bees constitute a majority of the pollinating insects. According to the Green Peace, 70 out of the top 100

food crops, which supply 90% of the world's nutrition, are pollinated by them. Therefore, a significant decline in their population (especially that of the honey bees) that has become glaring in the recent years, is a matter of great concern.

Bees are insects of the order *Hymenoptera*. They belong to 7 different families consisting of about 20,000 species. However, the most common among those, having visible influence on our ecology in general and agriculture in particular are the honey bees (*Apis mellifera* L.) and some others, like the bumblebees (*Bombus* sp.), the large carpenter bees (*Xylocopa* sp.), the sweat bees (*Lasioglossum melachurum*) etc., ordinarily together known as native bees or common bees. All of them are very important pollinators and protect many plant species from going extinct. One of the glaring examples is angiosperms, which have such highly modified flowers that those can be entered only by a single or a few species of insects like bees. So when those particular species are absent, the pollination does not occur and that may lead to the extinction of such plant species. The native bees do not build combs as do the honey bees and usually live solitarily or in groups in soil, cavities of wood, leaf lined nests etc. Since they are less known to us (as compared to the honey bees) their importance for the eco-system and agriculture is less appreciated.

On the other hand, there are several

species of honey bees, which make hives almost everywhere – from the forests to



our gardens and even on house tops – in which they store honey that is useful in traditional medicine and our nutrition. However, their greater service to us is the important role they play as pollinators, and therefore, ensure our food security. The National Audit Office of the UK has estimated the economic value of pollination effected by honey bees to be worth 200 million pounds a year. Similarly, in the US, honey bee pollination has been calculated to be adding more than \$15 billion in value to crops every year. In India, although similar evaluations have not been made, one can imagine the extent from the size and the varieties of crops that are grown here.

Of the several species of honey bees, those which are dominant in the Indian sub-continent include *Apis cerana*, *Apis dorsata*, *Apis florea* and *Apis mellifera*. It has been observed that honey bees

from a typical hive visit about 225,000 flowers in a day and pollinate those. Approximately, 16% of the global flowering plants and 400 types of agricultural crops are pollinated by these insects. Those include 87 of the 115 most important food crops grown around the world and produce fruits, nuts and seeds which account for a third of the \$ 3 trillion worth of agricultural products sold every year. Such crops provide 35% of the calories and most of the vitamins (50% of vitamin C), minerals and antioxidants that we need. The increase of the crop output of some crops has been given in Table-2.

Table - 2: Increase in crop yield due to bee pollination.

Crop	% increase in crop-yield
Capsicum	227
Tomato	160
Pigeon pea	157
Chick pea	79.5
Mustard	75
Mango	68
Banana	63
Papaya	60
Jawar	33
Brinjal	31

The necessary number of bee hives per acre to achieve saturated pollination differs from crop to crop. As an example, it has been estimated that while 2.5 acres of kiwi fruit can be most successfully pollinated by bees from 8 hives, 3 or 4 hives are necessary for an acre of blueberry. Therefore, the business of honey bee pollination services has developed in many parts of the world, where a bee keeper rents colonies of bees (hives) to a farmer for a bloom season, which is usually 4 weeks long. In the US alone, there are about 2.4 million such colonies.

It has been calculated that the economic benefits of the farmers

growing crops with borrowed bee colonies are far greater than the bee-keepers. As for example in a blueberry crop, the fruit yield can be increased by as much as 50% by using honey bee pollination, which needs 6 hives per acre, at a cost of \$450. On the other hand, about \$5,000 more can be expected from the additional fruit yield. In a survey conducted in the year 2000, it was found that the direct contribution of such honey bee pollination to the US agriculture was more than \$14.6 billion, which increased to nearly \$20 billion in



2018. Worldwide it may be closed to \$90 billion. In India, although apiculture has been encouraged, its objective has mostly remained confined to the production of honey and wax, but its use in agriculture to enhance pollination is gradually picking up.

For the last half a century, soon after the introduction of the organo-chloride pesticides (like DDT) in agriculture, the population of honeybee has been alarmingly declining. The other factors that contribute to the trend include: the loss of natural habitats, widespread parasite and pathogen infections that are becoming more virulent in recent years, lack of genetic variability, stress due to seasonal movement of hives for pollinating fruit and vegetable crops, toxic pesticide residues in pollen and nectar, poor nutritional value of agro-landscapes dominated by mono-culture and the harsher climatic conditions of the recent decades (Table-3).

These are leading to “**colony collapse disorder**”. That is why all the species of honey bees, along with the so-called

native bees, have been included in the list of “**threatened species**” by the International Union on Conservation of Nature (IUCN). At present two third of the American beekeepers are losing about 40% of their colonies every year. Similarly, the annual losses reported from Europe, South Africa and China, the major beekeeping countries, have been 30%, 29% and 13% respectively.

Table- 3: The major factors responsible for the decline of honey bee population.

Factor	% of decline
Intensive agriculture	23.9
Pesticides	12.6
Ecological traits	12.6
Urbanization	10.7
Fertilizers	10.1
Deforestation	8.8
Wetlands/rivers alteration	6.3
Warming	5.0
Other pollutants	3.1
Pathogens	1.9
Fires	1.9
Introduced species	1.9
Genetic	1.3

Therefore, immediate steps must be taken to save and increase the population of these wonderful insects, so essential for our food and nutritional security, as well as, the ecological balance. It can be achieved by adopting extensive afforestation with native species of plants, organic farming and giving importance to apiculture, while keeping mind to preserve the diversity of their species. ■

Dr Ramesh Chandra Parida is a retired Professor of Chemistry, who taught at Odisha University of Agriculture and Technology. Dr Pranab Kumar Ghosh works as an Assistant Director with the Centre for Innovations and Appropriate Technologies for Skills & Jobs, National Institute of Rural Development & Panchayati Raj, Hyderabad.

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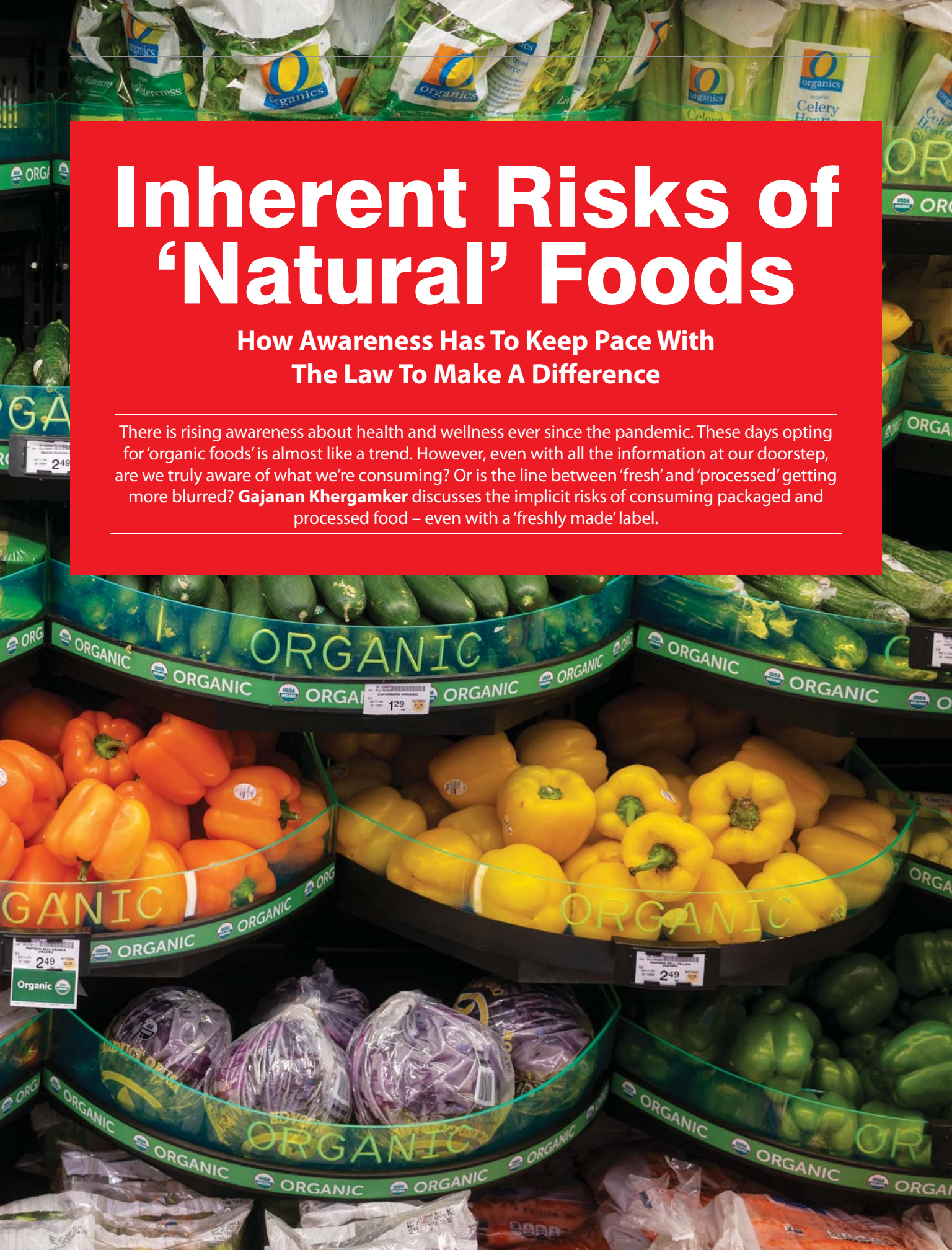
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Inherent Risks of 'Natural' Foods

How Awareness Has To Keep Pace With The Law To Make A Difference

There is rising awareness about health and wellness ever since the pandemic. These days opting for 'organic foods' is almost like a trend. However, even with all the information at our doorstep, are we truly aware of what we're consuming? Or is the line between 'fresh' and 'processed' getting more blurred? **Gajanan Khergamker** discusses the implicit risks of consuming packaged and processed food – even with a 'freshly made' label.





When Western Russia Sarov's Saint Seraphim, one of the most renowned Russian saints and venerated in the Eastern Orthodox Church also generally considered 'the greatest of the 18th-century startsy', had said, "Drink water from the spring where horses drink. The horse will never drink bad water. Lay your bed where the cat sleeps. Eat the fruit that has been touched by a worm. Boldly pick the mushroom on which the insects sit. Plant the tree where the mole digs."

Back home, when Lord Rama chose to visit Shabari's hut, now in Shivrinarayan, Chhattisgarh, and consumed her half-eaten berries (*bers*), despite brother Laxman's disapproval, even when Ram could have opted for other fresh food, speaks reams of the merits of truly 'natural' food otherwise looked down by modern society.

'Freshness' Needs To Be Preserved

Today, to ensure that food remains 'fresh' and 'natural', as sought after by most consumers by dint of habit and

education, paradoxically two kinds of 'permitted' preservatives are added. The first being antioxidants used in the food-processing industry to deter oxidation and concurrently enhance flavour, aroma, and colour. Oxidation of food products comprises adding an oxygen atom or deduction of a hydrogen atom from the molecules in the food.

A simpler understanding of the process lies in the examination of a half-eaten apple that turns brown swiftly owing to a process, known as enzymatic browning. Of antioxidants, there are reducing agents such as ascorbic acid (vitamin C) and agents that inactivate the enzymes, such as citric acid. Now, citric acid is used throughout the dairy industry, especially for cheese processing and production, as an excellent stabiliser.

And then there are antimicrobials used primarily to prevent and inhibit pathogenic microorganisms from growing. In products with a low pH, organic acids such as acetic, benzoic, propionic, and sorbic acid are used against microorganisms.

It is known that in the dairy industry, milk products such as yogurts, cheeses,

yogurt drinks, etc., primarily are produced with preservatives to avoid spoilage.

Sodium benzoate and/or potassium sorbate are preservatives that inhibit mold growth and keep products fresh. Sodium Benzoate, while not being carcinogenic in itself, when mixed with ascorbic acid turns into benzene a known carcinogenic and, by itself, triggers violent side-effects that include high blood pressure, seizures, blood clotting disorders and severe organ failures.

Role of Milk In PCOS: Controversial

Now, while the research on the effect of preservatives on health is ongoing and debatably controversial, the role of milk, dairy products and processed food in the trigger of polycystic ovarian syndrome or disorder (PCOS/PCOD) among young girls is overwhelming. It's time, the authorities ensure food manufacturers are held accountable for the same.

It is a known fact that the PCOS diet focuses on high-fiber whole foods, lean proteins, complex carbohydrates, and

healthy fats and advocates the avoidance of refined sugars, red meat, full-fat dairy, and processed foods.

Now, refined carbohydrates, such as pastries, white bread and white rice are foods to avoid when you are suffering from PCOS. These increase the production of insulin that make managing PCOS symptoms more difficult and can lead to increased risk of diabetes. Women with PCOS are significantly more likely to develop diabetes than other women.

Fried foods, such as fast food, high in saturated fats and trans-fats increase the risk of inflammation, cancer risks, weight gain and have the same effects as foods high in sugar. Also, the consumption of sugary beverages, such as sodas and energy drinks insidiously impact PCOS. Like refined carbohydrates, sugar in foods triggers insulin release, which helps sugar enter cells. As with refined carbohydrates and sugars, this process can lead to too much sugar being stored as fat.

Women need to avoid sugary drinks



to prevent insulin spikes and stop their bodies from overproducing the male hormones like testosterone. Processed meats contain nitrites and high levels of sodium besides being inflammatory. Unhealthy fats that include margarine, shortening used in pastries, and lard used in cooking and baking are avoidable.

Gluten and Soy need to be kept

in strict check by PCOS sufferers. Also, alcohol that increases levels of testosterone leading to an imbalance with estrogen and stimulates the release of excessive amounts of luteinizing hormone (LH) and follicle-stimulating hormone (FSH), two hormones that control ovulation in women, can trigger serious problems.

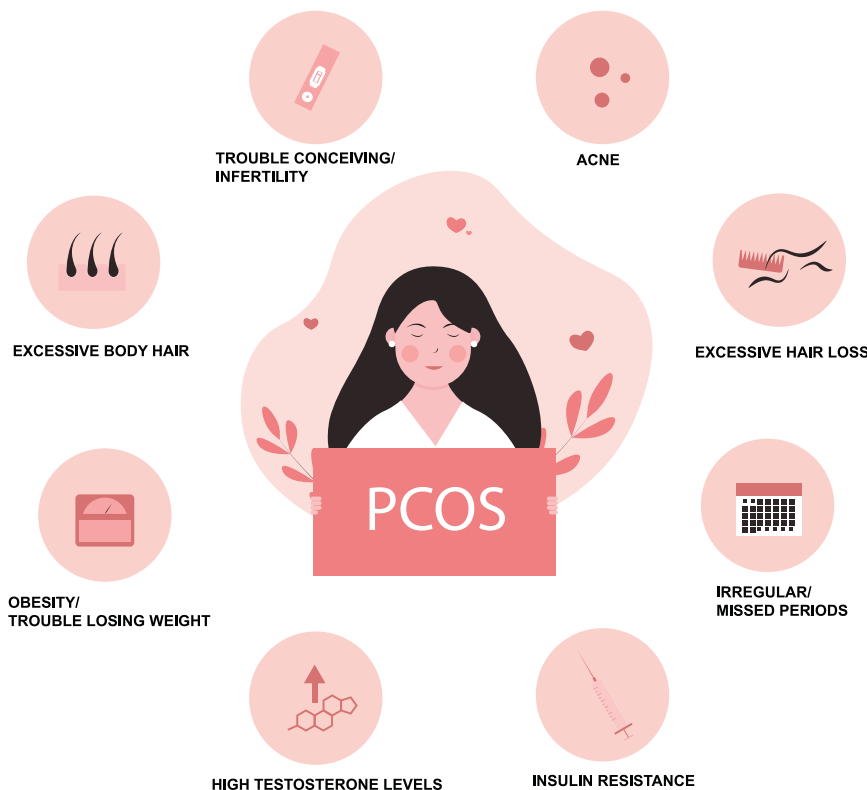
However, the sneakiest culprit among them all is Dairy, like milk and processed cheeses owing to the hormones it contains. A hormone called insulin-like growth factor, IGF-I, increases androgen production in women with PCOS when they consume foods containing dairy like milk or ice cream.

Many dairy products are also high in secret sugars and, as discussed above, women with PCOS should also avoid foods that have added sugar to them such as frozen yogurt and ice cream because of their impact on insulin levels.

Now, where fresh food is concerned, there's little by way of alternative and, of those available, it's mostly nomenclature and jargon that is, more often than not, lost on the end consumer.

FSSAI Notification Regulates Narrowly

Applicable here is a notification issued by the Food Safety and Standards Authority India (FSSAI) on 19 November 2018 that



details Regulation No: 9 on Conditional Claims.

Accordingly

1) a claim may be made where a food is by its nature high or low or free of a specific nutrient provided the name of the nutrient or substance is preceded by the words 'natural or naturally' in the claim statement.

Explanation: "a naturally low (naming a nutrient or substance) food" or "a naturally (naming the nutrient or the substance) free food"

2) claims containing adjectives such as "natural", "fresh", "pure", "original", "traditional", "Authentic", "Genuine", "Real", etc., when used, shall be in accordance with conditions laid down in Schedule V and the claims containing words or phrases like "home-made", "home cooked", etc., which may give an erroneous impression to the consumer shall not be used.

Also, in Schedule 5, the word 'Natural' may be used to describe:

- a) A single food, derived from a recognised source viz., plant, animal, micro-organism or mineral and to which nothing has been added and which have been subjected only to such processing which would only render it suitable for human consumption like:
 - i) Smoking without chemicals, cooking processes such as roasting, blanching and dehydration and physical refining;
 - ii) Freezing, concentration, pasteurization, sterilisation and fermentation; and
 - iii) Packaging done without chemicals and preservatives.
- b) Permitted food additives that are obtained from natural sources by appropriate physical processing.
- c) Composite foods shall not themselves be described directly or by implication

as "natural" but such foods may be described as "made from natural ingredients" if all the ingredients or food additives meet the criteria in (a) and (b) above: Provided that, the above principles shall also apply to use of other words or expressions such as "real", "genuine", when used in place of "natural" in such a way as to imply similar benefits. Provided further that the, claims such as "natural goodness", "naturally better", "nature's way" shall not be used.

Fresh

- a) The term "fresh" shall only be used on products which have not been processed in any manner except, washed, peeled, chilled, trimmed or cut, irradiated by ionizing radiation not exceeding 1kGy or other processing necessary for making the product safe for consumption without altering its basic characteristics in any manner. If such processing also leads to extension in the shelf-life of the product the term "fresh" shall not be used.
- b) The term "fresh" or "freshly" shall have no other connotation than the immediacy of the action being described. A food containing additives or subjected to packaging, storing or any other supply chain processes that control freshness shall not be termed as "freshly stored", "freshly packed", etc.: Provided that "Fresh" may be permitted to be used along with "frozen" if it is clear from the context. - "Frozen from fresh" "fresh frozen" "Freshly frozen"- which would indicate that the food was quickly frozen while still fresh.

Pure

- a) The term "pure" shall only be used to describe a single ingredient food to which nothing has been added and which is free from avoidable contamination and the levels of unavoidable contaminants shall need to be below the levels prescribed in the Food Safety and Standards





(Contaminants, Toxins and Residues) Regulations, 2011 or in any other standard given under Food Safety and Standards Act, Rules and Regulations thereof.

- b) *Compound foods shall not generally be described, directly or by implication, as "pure" but such foods may be described as "made with pure ingredients" if all the ingredients meet the criteria in (a) above.*
- c) *"Pure" shall not be included in any brand or fancy names, nor in coined or meaningless phrases, in such a way as to imply that a food that does not meet the criteria above is pure or made from pure ingredients.*

Natural Foods Not Truly Natural

A range of foods, considered, since time immemorial to be 'natural', 'pure' and 'fresh' when procured, stored, packaged and sold are almost always not made available in the form or manner they've been procured at the onset. Like 'low fat' milk is stripped of all fat then added

externally in controlled quantities to qualify for the 'skimmed fat' levels.

The abstinence of use of the said 'words' in the packaging itself is expected to imply that the end-consumer is aware that the product is not, indeed, fresh, pure, real, natural or traditional and concurrently make an informed decision to buy and consume or refuse to buy and consume the product. And, in that lies the fault.

Since time immemorial, certain products have been sold, promoted, and consumed for their 'benefits' to health and this as passed down generations by word of mouth or, simply, innocuous-seeming propaganda, irrespective of overwhelming evidence to the contrary.

Now, whether that evidence affects the decision of the end-consumer or not may be debatable but that the evidence must be made available to him/her each time s/he chooses to buy or consume the product is imperative in order to ensure the opinion to buy, promote or consume is an 'informed' one or else the contract fails the test of 'free consent'.

Food Labels Must Specify 'Not Natural'

The least that must be ensured, by law, is the publication, and in bold and with significant visibility, that the product is "not pure", "not fresh", "not real", "not natural" or "not traditional" as the case may be, if it has been procured, stored, preserved, processed or tampered with in any manner other than what's popularly perceived.

The popular bias, in favour of consumption of certain foods, like milk and associated products, not procured or sold in original formats, is overwhelming and likely to perpetuate more damage than good should such caveats not be made the order of the day.

The acts of Saint Seraphin and Lord Ram were modelled on facts and with good reason to top it. ■

(Gajanan Khergamker is a solicitor, editor and documentary film-maker who heads media-legal think tank DraftCraft International and has initiated The Public Health Project that generates media to spread awareness on issues such as PCOS and works to initiate food laws for consumers to address inherent health risks. Visit publichealth.draftcraft.org)



Replacing coal with wastes

A win-win opportunity for reducing use of fossil fuel and greenhouse gas emissions

Dr Kåre Helge Karstensen is the Chief Scientist and Programme Manager at SINTEF. He is regarded to be one of the pioneers in Co-processing & treatment of wastes in resource and energy intensive industry and has published crucial R&D findings on the possibilities and limitations of co-processing in key scientific and technical journals the last 25 years. Here we are in conversation with him for TerraGreen magazine.



You have recently published a book, Sustainable Management of Waste through Co Processing, which is “the first comprehensive book on co processing”. Why did you and your co-authors think of creating this book and how do you think it adds to the existing body of literature?

This book is an attempt at building capacity, distilling years of experiences of the authors and documenting the international best practices covering different aspects of co-processing. The book will serve as an important reference

to students, researchers, practitioners and policy makers. It gives a framework and guidance on co-processing for cement plants initiating and ramping up co-processing, such as in India, as well as for plants which are matured and aiming for even higher substitution of coal with wastes such as many countries in Europe.

When it comes to Co processing practices in the Asian context, what are some distinctive qualities (problems, advantages, revelations) that you have noticed, and perhaps learned from,



owing to your extensive experience in Asia?

The developing countries in Asia have some of the highest waste releases. Relatively small quantities are handled in an environmentally sound way. These countries also have the highest industrial production of cement, steel, and electric power, using huge amounts of coal and contribute to a large chunk of the world's CO₂ emissions. Replacing parts of the coal with wastes constitute a win-win opportunity reducing the need for large amounts of fossil coal and indirectly

reducing greenhouse gas emissions by avoiding building new incinerators or landfills.

You have had a long association with SINTEF and now work as their Chief Scientist. Are there any upcoming SINTEF projects in the Waste management space that you would like to share about?

SINTEF is conducting a regional project called Ocean Plastic Turned into an Opportunity in Circular Economy (or OPTOCE), which will showcase how the cement industry can be involved and increase the treatment capacity for Non-Recyclable Plastic Wastes in China, India, Myanmar, Thailand and Vietnam and thereby contribute to reduce the release of plastics to the Sea. The OPTOCE project is part of the Norwegian Development Programme to Combat Marine Litter and Microplastics. SINTEF also has other ongoing projects in India on Hazardous Wastes and C&D Wastes.

Your book ends with an assessment of “the growth of Co processing in India”. According to you what are some of the unique problems and advantages that India has?

India has the second largest cement industry in the world with many progressive companies and several BAT plants. On an average the Indian cement industry achieves a Thermal Substitution Rate (TSR) of 4-5%, compared to >40% for EU 27 and > 70% in Norway. However, cement industry has invested tens of millions of USD in installing pre-processing and co-processing facilities and conducted >80 pilot demonstration trials. The leading companies aspire to achieve net-zero before 2070. Primary concerns expressed by the industry in some of our stakeholders' discussions have been on implementing the 'polluters pay principle', creating a level playing field vis-à-vis waste-to-energy incineration plants, and demonstrating a feasible and scalable business model for priority wastes (for example, RDF).



What are your hopes for the future of the Indo-Norwegian collaboration on Co-processing?

My future hope is that the capacity and capability of Indian cement industry will continue to improve and that the cement industry will be able to achieve 25% TSR before 2030. The lessons from India, through regional outreach, can be replicated in neighbouring countries such as Nepal, Bangladesh, Bhutan, and Sri Lanka.

How do you propose the problem of plastic waste can be dealt with in the context of Co processing?

An estimated 9.3 billion tons of virgin plastics was produced globally up to 2019. Out of this, around 6.3 billion tonnes have ended up being plastic waste; of this, only 9% has been recycled, 12% incinerated and 79% dumped. If current production and waste management trends continue, roughly 12 billion tonnes of plastic waste will be in landfills or in the natural environment by 2050.

It is estimated that more than 80% of marine debris comes from land-based sources and Asian countries are among the top contributors to marine litter and microplastics. Studies has also shown that most of the plastic that ends up in the oceans is low quality plastic that is hard to recycle. Our OPTOCE project is expected to uncover an untapped potential to remove, treat and beneficially utilise 'non-recyclable plastic wastes' by the private sector.



Cement kilns have proven to be effective means of recovering value from waste materials and co-processing in cement kilns is now an integral component in the spectrum of viable options for treating several waste

categories, practised in developed countries for the last four decades. What is considered waste in one sector becomes a resource in another. This concept represents circular economy in practice and incorporates waste treatment with existing industrial production, which is also preferred to Incineration and Landfilling in the internationally accepted Waste Management Hierarchy.

and beach clean-up are important for creating a social cohesion and for creating awareness amongst citizens – especially on demerits of littering and unsustainable waste management. Advocate Afroz Shah in Mumbai has been doing excellent work towards this.

There is a need to develop curriculum for students in schools on sustainable waste management. Young people are important agents of change. There are some specific courses at Bachelors and Masters level, but only few universities in India are offering it today; many more colleges/universities should make it a part of their curriculum. More books should be written on sustainable waste management documenting the local context, success cases and successful business-operations models for priority waste streams. ■

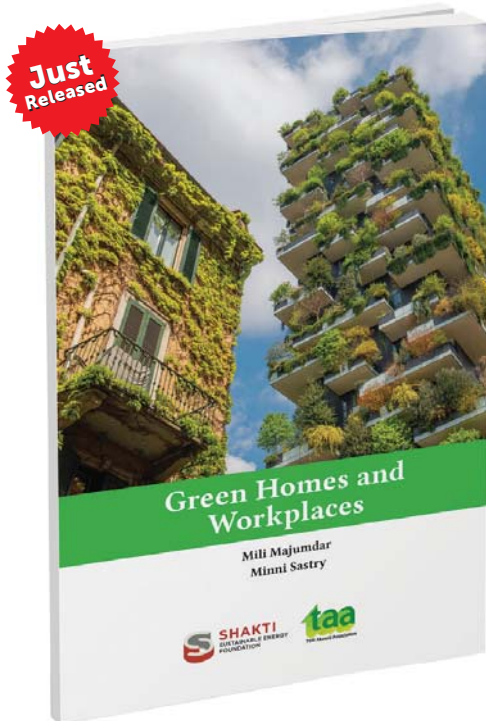
Are there any suggestions that you can share with the general public, to make them active participants in the sustainable management of wastes?

Waste segregation at the household level is a crucial step for effective downstream treatment of municipal solid wastes and everyone has a role to play.

Regular community level clean-up



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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

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MSW Management

The pitiable situation of Municipal Solid Waste Management

With the fast pace of urbanization, especially in metro cities, the issue of sustainable management and disposal of Municipal solid waste (MSW) deserves the attention of all stakeholders of society. This can be achieved by following the globally established business rules of MSW management. In this paper **Dr. Anil Kumar Agnihotri** discusses how MSW is a serious issue in India needing immediate attention for managing it sustainably and for making Bharat Swachh and healthy.







In India, policy planners have never considered waste management in general—and municipal solid waste (MSW) management in particular—to be a part of development and urbanization process: landing us in the present crisis of MSW management.

The Swachh Bharat Mission launched by the Hon'ble Prime Minister of India in 2014 is a silver lining in this regard. Recently, an important announcement regarding the *Swachh Bharat Mission 2.0* was made by the Hon'ble Prime Minister of India on 1st October 2021, in which he said that the aim of this phase was to make our cities garbage-free. The second phase of Swachh Bharat aims at sewage and safety management: making our cities water-secure and ensuring that dirty *nallahs* (sewers) don't merge into rivers. This needs immediate attention of the top policymakers to bring out an explicit policy-based programme backed by sound policy regime and political will. Until 2000, we did not even have any law specifically on how to deal with MSW. Environment related legislation, such as Water (Prevention & Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; and Environment Protection Act, 1986; was introduced but, the subject of MSW was largely neglected legislatively. Certain rules like Hazardous Wastes (Management and Handling) Rules, 1989 and Biomedical Waste (Management and Handling) Rules, 1998 dealt with the subject only tangentially. This glaring oversight was compounded by the cash-

strapped status and general indifference of the civic bodies towards maintaining a functional MSW disposal system.

Recently, the collection of MSW has significantly improved, but there are still issues in its final disposal. The reason behind this is that the technology being used is not suitable for Indian garbage. This is because the inherent calorific content of MSW is not sufficient for its incineration. Besides, incineration is an unsafe method of disposal. The other issue is that utility companies handling the disposal of MSW are not honouring the prevailing MSW Rules.

Municipal Solid Wastes (Management and Handling) Rules, 2000

MSW Rules, 2000, were applicable on 'every municipal authority responsible for the collection, segregation, storage, transportation, processing, and disposal of municipal solid wastes'. It fixed certain responsibilities for monitoring and ensuring eco-friendly compliance and submitting Annual Reports on municipal authorities, State Governments and UT Administrations, as well as Central Pollution Control Board and the State Board; or the Committees in infrastructure development that were setting up landfills and other waste processing and disposal facilities.

Current Status

With the ever-increasing population and urbanization in India, waste management has become a major challenge, especially in the urban setup. Over the years, there has been a stark increase in the quantity of waste generated and it is only expected to increase further in the coming years. The characteristics of waste being disposed have also undergone a transformation, especially with the increased use of electronic gadgets and equipment.

Currently, as per government estimates, about 65 million tons of waste is generated annually in India, and over 62 million tons of it is MSW (organic waste, recyclables like paper, plastic, wood, glass, etc.). Only about 75-80% of the municipal waste gets collected; out of this only 22-28% is processed and treated. The remaining MSW is deposited at dump yards. By 2031, MSW generation is projected to increase to 165 million ton, and further up to 436 million ton by 2050. The waste collection efficiency needs to catch up with the increasing quantity of waste generated in India. It ranges from 70 to 90% in major metro cities and is below 50% in many smaller cities as of now.

Issues regarding management of MSW:

The 'Position Paper on MSW' (2009) of the Government of India raises important issues regarding the management of MSW.

- There are serious barriers to private sector participation in urban infrastructure as the financial status of ULBs, except for a minority, is precarious. Urban sector is seen as a high-risk sector also because of institutional complexity, due to the multiplicity of agencies involved in service delivery.
- Further, there is lack of regulatory or policy enabling framework for PPPs (Public-Private Partnership),



barring a few exceptions, along with a lack of bankable and financially sustainable projects, considering the opportunities and risks involved.

- Lack of commitment by municipal authorities to ensure compliance of source segregation of MSW. This is an important for safe disposal of MSW and for successfully structuring its treatment on a PPP model. Achieving this will ensure proper treatment of MSW and success of PPP.

Apart from the aforementioned problems, the most important issue regarding MSW management is that these projects should be planned on the basis of negative pricing. A negative pricing/ externality occurs when an individual or firm making a choice does not have to pay the full cost of the choice. If any good has a negative externality, then the cost to the society is greater than the actual cost paid by the consumer. A common example of a negative externality is pollution. For example, a polluting industry might pump pollutants into the air. While the industry has to pay for electricity, materials, etc., the individuals living around the industry will pay for the pollution at the cost of their well-being, because it will affect them adversely. They would have higher medical expenses, poorer quality of life, reduced aesthetic appeal of the air and so on—a cost that the industry does not pay.

However, when disposed at proper the dump site, MSW is a state asset. Hence, this is the sole responsibility of the state to collect and dispose it of in a scientific and sustainable manner.

On the bright side, MSW Rules, 2016 have just come into effect and contain beneficial provisions, like:

- Dairy waste, which is major polluter of rivers, has been covered under the said legislation.
- For the first time, bio-methanation has been emphasized for treatment of segregated organic part of MSW – because the waste generated in

our country is high in organic content, with high moisture and low calorific content. Bio-methanation is a proven technology that can treat freshly segregated organic fractions of MSW, and hence, there is no need to dump the entire garbage in landfills. Only the non-organic matter will go to landfill and even this can be recycled by further segregation to paper, plastics, glass, etc.

Solid Waste Management Rules, 2016

- A major overhaul of environmental policies was introduced in the 2000 Rules. The scope of application of MSW rules has been expanded by including under its ambit: places of pilgrimage, airports, special economic zones, ports and harbours, defence establishments and every domestic, institutional, commercial and any other non-residential solid waste generator.
- These Rules, for the first time, prescribe the duty of a MSW generator. A Central Monitoring Committee is to be constituted for monitoring implementation. Criteria for land filling and waste-to-energy plants are also provided.
- Moreover, the Rules moreover prescribe the duties of Ministries and Departments other than Ministry of Environment & Forests. Ministry of Housing and Urban Affairs (Ministry of Urban Development in the Rules) will issue technical guidelines and the National Policy on MSW; in addition to providing training and financing as well as promoting R&D.
- Departments of Fertilizers & Chemicals (presently divided between the Department of Chemicals and Petrochemicals and the Department of Fertilisers; also put under the Ministry of Chemicals and Fertilizers) will aid market development for city compost. The Ministry of Agriculture will propagate



Municipal solid waste at Gazipur Landfill site, New Delhi

- utilization of compost on farm land. Whereas, the Ministry of Power will have to compulsorily purchase power generated from waste-to-energy plants.
- Central Pollution Control Board will have to coordinate with the State Pollution Control Boards, review environmental standards, monitor implementation, publish guidelines and prepare an annual report on implementation.
- Duties are also assigned to Secretary-in-charge of Urban Development in the States and Union territories, District Magistrate, Village Panchayats and manufacturers or brand owners of disposable products, sanitary napkins and diapers.

Technologies are available for managing MSW of all sorts of composition. Pertinent to mention at this juncture that we have to revisit the practice we have followed so far, in the so called waste-to-energy plants. These plants at Hyderabad and New Delhi, flagrantly violate the MSW Rules, 2016.



Waste Incinerator (Photo source: Internet)

As per a paper published by the **Global Anti-Incinerator Alliance & Global Alliance for Incinerator Alternatives** in 2003 the problems of waste incineration are:

“pollutant releases, both to air other media; economic costs and employment costs; energy loss; un-sustainability and incompatibility with other waste management systems. It also deals with problems specific to Southern countries.”

The paper, titled **“Waste Incineration: A Dying Technology”**, goes on about “Dioxins” which “are the most notorious pollutant associated with incinerators”. Along with causing a wide range of health problems (cancer, immune system damage, reproductive and developmental problems) Dioxins also bio magnify, meaning they are passed up the food chain from prey

to predator.

The author of this paper, Neil Tangri, points to incinerators as the primary source of dioxins worldwide. He also points to incinerators as a major source of mercury pollution and of other heavy metal pollutants such as lead, cadmium, arsenic, and chromium. Mercury is a powerful neurotoxin, impairing motor, sensory and cognitive functions.

Other concerning pollutants include other (non-dioxin) halogenated Hydrocarbons; acid gases (precursors of acid rain); particulates which impair lung function; and greenhouse gases. Even with these, the characterization of incinerator pollutant releases is still incomplete; there are many unidentified compounds present in air emissions and ashes.

The paper continues to showcase how:

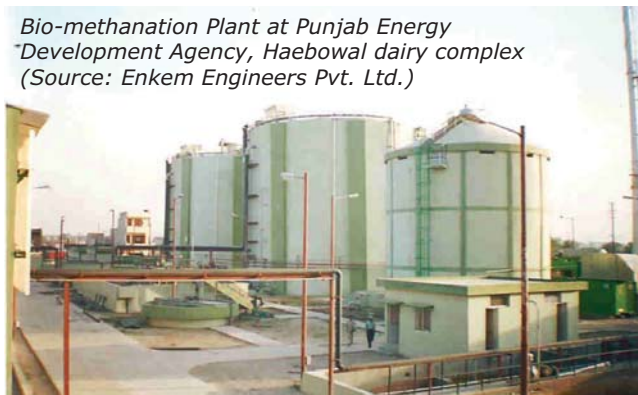
“Incinerator operators often claim that air emissions are “under control,” but evidence indicates that this is not the case. First, for many pollutants, such as dioxins, any additional emissions are unacceptable. Second, emissions monitoring is uneven and deeply flawed, so even current emission levels are not truly known. Third, the data that do exist indicate that incinerators are incapable of meeting even the current regulatory standards.”

With incinerators being unsustainable and obsolete, innovative practices for sustainably managing waste are being adopted around the world. In our country, during the last few years, a number of incinerators have been put up which are of a primitive type without proper emission control arrangements; these plants are flagrantly violating environmental norms as per MSW Rules, 2016.

*As per the **Solid Waste Management Rules, 2016** (as amended) under section 21: Criteria for waste to energy process –*

1. *Non recyclable waste having calorific value of 1500 K cal /kg or more shall not be disposed of on landfills and*

Bio-methanation Plant at Punjab Energy Development Agency, Haebowal dairy complex (Source: Enkem Engineers Pvt. Ltd.)



shall only be utilised for generating energy either or through refuse derived fuel or by giving away as feed stock for preparing refuse derived fuel.

2. *High calorific wastes shall be used for co-processing in cement or thermal power plants.*
3. *The local body or an operator of facility or an agency designated by them proposing to set up waste to energy plant of more than five tons per day processing capacity shall submit an application in Form-I to the State Pollution Control Board or Pollution Control Committee, as the case may be, for authorisation.*
4. *The State Pollution Control Board or Pollution Control Committee, on receiving such application for setting up waste to energy facility, shall examine the same and grant permission within sixty days*

Suggestions:

1. For MSW management and disposal projects, economic evaluation should be done on negative pricing mode.
2. We should not forget that the garbage produced in our country has a very different composition as compared to developed nations; Indian garbage is high in organics and moisture content and has very low calorific contents while the garbage from developed countries has reverse values, therefore, the prevailing technologies for MSW management in the developed world cannot be justified to be applicable in India.
3. Looking at the hazards involved in this sector and with the burgeoning population and stress on per capita availability of urban space, finding finances should not be an issue. In India there are a number of subsidized services, such as, postal, water, energy, transportation, food and health, etc., therefore, subsidy could be given in MSW sector as well. In addition, if we conduct a proper economic analysis

of the industry, the payback will be very fast with the added advantage of India being on the path of becoming a healthier and cleaner nation.

4. The fiscal aspect of this sector is a very vital issue. These projects need huge investments and regular operations (utility, etc.) require capital expenses; if such incentives are provided to operators, these projects are bound to run successfully.

The salient suggestions/recommendations of the **Position Paper, 2009** of Government of India are:

Given the lack of in-house capabilities of municipal authorities and paucity of resources, it is desirable to outsource certain services and resort to PPP/NGO participation in providing Solid Waste Management services. The private sector has been involved in door-to-door collection of solid waste, street sweeping (in a limited way), secondary storage and transportation, and for treatment and disposal of waste.

Municipal Corporations and city governments create and maintain assets with funds provided by Central and State grants, funds internally generated by local governments through taxes and tariffs, capital markets, etc. The Central Government should take up the role of a regulator by addressing the financial sector and related regulatory issues.

State Governments should also respond by enacting Model Municipal Laws to enable PPPs, setting up regulatory authorities and creating cadre of professionals at ULBs and state level.

Thus, it is imperative that while framing the policy the mind-set of the people at large is kept in view. This sector should be run in the public-private partnership (PPP) mode only, and there should be bare minimum intervention from government agencies – except identification of the right entrepreneurs for waste collection and of utility operators to dispose the MSW in the most scientifically without affecting the ecosystem.

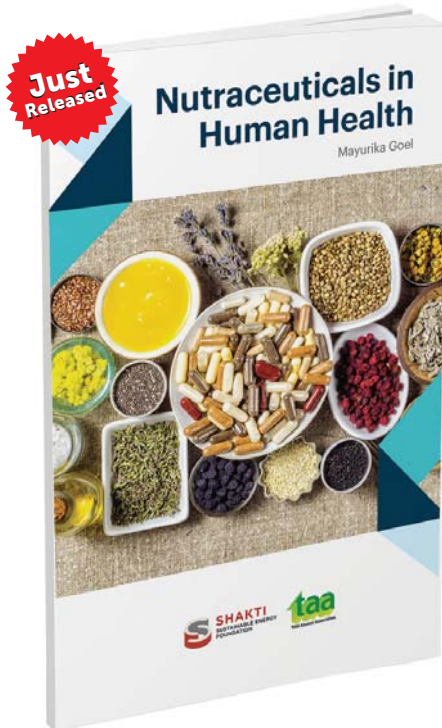


The Way Forward

- Ensuring financial commitment based on the present data on MSW
- Opening this sector to private sector with strict compliance of **MSW Rules, 2016**. Inviting an expression of interest by the respective agencies for MSW collection and its scientific disposal, keeping in mind the concept of negative pricing – which is prevalent all over the world in such projects – and ensuring that it conforms to the prevalent statutory standards.
- Developing various concessional agreements pertaining to such projects with implicit roles and responsibilities of each stakeholder, along with relevant administrative mechanisms to ensure effective implementation of these agreements with clear provisions for administrative accountability.
- Provisioning for performance guarantee and strict monitoring of these projects; right from construction to implementation.
- Provisioning for stakeholder participation and encouraging them to visit to ensure that due care of the environment is taken by the project executor.
- Giving importance to decentralised, integrated MSW facilities where-in the MSW components should be segregated, i.e., construction and demolition waste, road side dust, biodegradable and non-biodegradable waste, because segregation of MSW at source has not been successful so far.
- Biomethanation may be preferred option for ultimate sustainable disposal of MSW, because Indian MSW is very rich in organic content and moisture content along with low calorific content. The remaining inert and recyclables can be gainfully utilised. ■

Dr. Anil Kumar Agnihotri is a Waste management Consultant at The Energy and Resources Institute and also contributes as an Energy Efficiency expert at Solutions for Clean and Healthy Environment foundation.

LET FOOD BE THY MEDICINE AND MEDICINE BE THY FOOD



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- Restorative concluding remarks
- Challenges for nutraceuticals

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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

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Utility Bidder's Renewable Ready Index

In this report, experts at **Utility Bidder** examine the potential of countries to fulfil their Net Zero goals. This evaluation is carried out using a 'Renewable Ready Index', which assesses the performance of the countries based on the current and past condition, as well as the upcoming plans of their energy industries.

World's climate crisis

In recent years, the world has been seeing record temperatures being reached, seeing sea levels rise whilst the ice caps and glaciers deplete - but why? Greenhouse gas and carbon emissions are the main factors contributing to this increasing global warming and have detrimental effects on the health

of the planet and those who inhabit it. As individuals, we can be told what we can do to make a difference. Still, it is essential to acknowledge that it will not be until the large corporations and country-based actions are implemented that change will become positive and beneficial, leading to a healthier planet with a life span to outlive generations

to come. This is why Utility Bidder has developed the renewable ready index, to allow for the world's biggest polluters to be revealed, alongside those who are most net-zero ready.

What is Net Zero?

The term 'net zero' refers to the goal of reducing overall greenhouse gas





emissions caused by humans to as close to zero as possible. Achievement of net zero emissions can be seen when overall emissions are either reduced or balanced out by carbon removal, such as from re-absorption via forests or the ocean. Therefore, by reducing the usage of fossil fuels, and replacing them with renewable sources, the levels of carbon emissions will dramatically decrease and the path to net zero will become clearer. Fossil fuels include coal, gas and oil, whereas renewable sources refer to hydropower, solar power and wind power for generating electricity.

The goal for over 70 countries is to reach net-zero emissions by 2050 – this will mean that their current emissions must be reduced by 45% by 2030 for this goal to be achieved.

The importance of Net Zero commitments

The commitments to net zero emissions can be seen through the Paris Climate Agreement, 2015. This agreement required countries to declare their climate change goals. Examples of the

pledges made by different countries include, but aren't limited to, the following: the UK pledged to cut emissions by 68% by 2030, the EU aims to reduce their emissions by 55% by 2030, and Australia aims to cut their emissions to 43% below 2005 level by 2030.

India has also pledged net zero commitments, taking a crucial step in tackling the climate crisis. The first aspect of these commitments is the 2030 target which is comprised of the following elements: reducing emission intensity to 45% below 2005 levels; increasing non-fossil capacity in power generation to 500GW, with 50% of energy requirements being generated from renewable sources; and finally, reducing emissions by 1 billion tonnes by 2030 – which, in reference to CO₂ emissions, will bring India's total emissions down to 1.44 billion tonnes. The second aspect of the commitment was the overall net-zero target of India: the hope to achieve this goal by 2070. This is later than many of the other countries involved in the agreement, who have set their goal to be 2050. However, from a recent review

of these targets, India's goals have been moved from 'highly insufficient', to 'insufficient' and are, therefore, moving in the right direction.

The world's largest sources of electricity

It is estimated that the world generates over 27,000 TWh of electricity every year. Around 17,000 TWh of this is generated using fossil fuels, whereas only 7,700 TWh is from renewable energy sources.

Coal is the world's main source of energy generation, with over 10,000 TWh of electricity being produced from this source every year – 36% of the world's total electricity production. Following coal, is gas, with over 6,000 TWh being generated using this source annually (22% of global electricity production). Finishing the top three is hydro-power, the largest renewable energy source, generating over 4,000 TWh of electricity per year – 15.28% of the world's total electricity production. These sources are followed by nuclear power, wind power, solar power and oil.

India's main source of electricity is

coal, with 1,250 TWh of yearly electricity production being generated from this source. This is however followed by hydropower in second place, which generates 171.3 TWh of the country's annual electricity. Despite being considerably lower than coal, having a renewable energy source as the second largest generator of electricity is a promising sign for the future of achieving net-zero emissions. However, as a whole, India uses fossil fuels to generate 1,313.4 TWh, but only 339.8 TWh of electricity is generated through renewable energy sources. With almost a 1000 TWh difference between these sources, we can see how much change is needed to truly make a difference amid the climate crisis.

Fossil fuel reliance & CO₂ emissions

With two of the three main sources of electricity in the world being fossil

fuels, these are bound to be the chief source for generating electricity in many countries. Therefore, Utility Bidder was sure to calculate which countries rely the most on fossil fuels. In first place was China, with over 67% of their electricity being generated from this source; 33.33% of the world's total fossil fuel sourced electricity production is from China, with the main source being coal. In second place was the United States, with over 60% of their electricity being generated via fossil fuels. India placed third in this list, using fossil fuels for 77% of their yearly electricity production, over three times the amount of electricity produced via renewable sources (20.4%) in the country.

Fossil fuel reliance and CO₂ emissions appear to go hand in hand – with China, the United States and India taking the top three spots once again. China emits over 30% of the globe's total emissions,

producing 10.67 billion tonnes of CO₂ annually. The United States follows in second place; however, producing less than half of what China produces, with 4.71 billion tonnes of CO₂ being emitted by the US each year. India once again follows in the third position, producing 2.44 billion tonnes of CO₂ annually - 7.01% of global emissions.

What is energy storage and why is it important?

Energy storage is vital in the movement toward net-zero emissions. The term 'energy storage' refers to the ability to save energy at one time to use the same at a later date and that any fluctuation in energy from renewable sources is accounted for. An example of this can be seen in solar power, one day might see large production of electricity generated from the sun, while another day might



be overcast and not produce as much. Therefore, having the ability to store the excess power generated on the brighter day will ensure that on days where this production is limited, access to electricity is still available.

Utility Bidder has revealed the top three countries adding to the world's energy storage market in 2021. China added 1.6 GW of energy storage capacity, followed by the United States with 1.5 GW added, and then the whole of Europe with an addition of 0.8 GW of storage.

The world needs to see nearly 600 GW of battery storage capacity in place by 2030, to be on track for the goal of 2050's net zero emissions. The total currently stands at 17 GW; therefore, needing an additional 583 GW to be added in order to achieve this.

Which countries are most on track for achieving Net Zero by 2050?

By analysing 10 indicators of net-zero preparedness, KPMG has investigated 32 countries to reveal which of these are the most on track for achieving net-zero by 2050. These indicators include

the country's national preparedness, its past decarbonisation performance and the country's enabling environment for decarbonisation (e.g. industry, agriculture, etc.).

The title of the most net-zero-ready country was awarded to Norway, with the findings predicting that the country will reach net-zero emissions by 2030 – 20 years earlier than planned. The United Kingdom came in second place, with its legally-backed targets, the country appears promising in its route to net-zero emissions. And in third place came Sweden; with high ambition and climate advocacy, the country is moving in the right direction. However, their reliance on exports and imports is negatively impacting their emission levels.

A summary of India's current position as a result of the renewable ready index.

Where India is currently standing in relation to net-zero emissions is not ideal. However, acknowledging the need for change is the first step toward enacting that change. As we have seen, India is one of the greatest producers of CO₂ emissions in the world, alongside their



reliance on fossil fuels. However, the clear link between the two provides a good focus on what needs to be done to improve the country's position during this crisis. We have also seen India declare in the Paris Climate Agreement that they aim to achieve net-zero emissions by 2070. Despite this being significantly behind other countries, the end goal remains the same.

The effects of climate change cannot be ignored. Human race is destroying the world, and if we want a home for future generations, changes need to be made as soon as possible. ■

*Op-ed by experts at Utility Bidder
Utility Bidder are a price comparison site,
comparing business energy prices from all the
major suppliers to help find you find the best deal
for your business.*



Emerging water contaminants

Major health and environmental threats

Water is not only one of our most vital resources, but is a source of life for all species. Naturally, attention needs to be paid on maintaining the quality and wellness of this resource. Biotechnology and environmental engineering are becoming increasingly popular, allowing for new approaches to water remediation.

Soniya Ashok Ranveer and **Phool Singh Hindoriya** focus on a general overview of new sources of pollutants, detection methods, and treatment approaches in this article. Adsorption as a treatment method for developing pollutants, as well as more complex and cost-effective approaches to treating emerging contaminants, are all part of this review's focus.

Introduction

Water that has been contaminated must be treated before it may be sent to other rivers and lakes in order to avoid additional groundwater contamination. Pesticides, endocrine disruptors (EDs), hormones and toxins, synthetic dyes and dye-containing hazardous pollutants have been studied extensively over the last decade, but the new contaminants are predominantly those generated by

micro pollutants and EDs. In most cases, there were no recognized standards for new contaminants, but even at low concentrations, they might have negative impacts on aquatic life and humans. There has been a lot of effort put into improving cleanup procedures or establishing better methods of detecting and quantifying samples, in order to tackle the above environmental risks.

Because of rising standards of living and greater demand from customers,

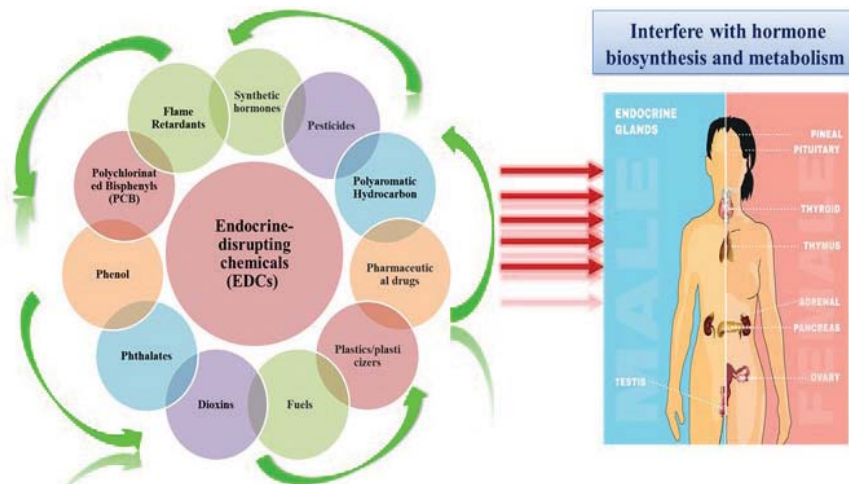
pollution has emerged as a major environmental issue. Toxic waste disposal, pesticide distribution, the use of non-biodegradable materials, fertiliser use, harmful greenhouse gas emissions, sludge disposal, and other hazardous chemical waste, are just a few of the countless environmental dangers that pose a major threat to our planet. Emerging contaminants (ECs) refer to a wide range of human-made compounds that are found in water on a regular basis but have just recently been identified as serious water contaminants. Cosmetics, pesticides, personal care items, pharmaceuticals, and steroid hormones are only a few of the synthetic compounds that are crucial in today's world. According to current estimates, global emissions of these pollutants are on track to rise from a current annual production of 1 million to 500 million tonnes. However, these ECs (i.e., environmental contaminants) were found to have a negative influence on human health and the ecosystem. Endocrine disruptors (EDs) have also been identified as interfering with the body's endocrine function, resulting in adverse effects on human and animal reproductive and neurodevelopmental,



as well as immunological and neurological, functions. Despite their widespread distribution, they are most frequently found in wastewaters. The vast range of EDs shown in Figure:1 is among the most extensively studied compounds. It has been found that anti-inflammatory medicines (such as naproxen and diclofenac) can affect the health of biofilm stream organisms, according to a study published in 2014. Toxicological consequences for humans and the environment remain unknown for many new pollutants like musk smells, but they have been found in adipose tissue, breast milk and blood.

An existential dilemma has arisen in this situation and wastewater management must be improved in order to counteract environmental degradation. However, the World Health Organization (WHO) gave high priority to the detection and prevention of emerging risks in wastewater, drinking water and surface and groundwater during their research; they published an exclusive report detailing the presence of medicines in drinking water and groundwater, as well as the associated risks to health and environment (WHO, 2011). Even while environmental contaminants, such as hydrocarbons and dangerous substances in wastewater, have been extensively studied by scientists, there have been few systematic investigations on the incidence of ECs and the documentation of viable remediation procedures. Therefore, water purification from EC contamination is a constant issue (Gogoi *et al.*, 2018).

Environmentally appropriate and evidence-based measures should be put in place to limit potential dangers to persons as well as the ecosystem, before the harmful effects of climate change force communities to reuse water without adequate protection. A primary concern for researchers and ecologists is to find new technologies and fill knowledge gaps regarding how to remove emerging toxins from water, so that the general population can



have access to safe drinking water. It is, therefore, essential to identify new contaminants and evaluate process treatment methods for their elimination – in order to avoid potential health risks for people and other creatures (Kumar *et al.*, 2022).

Emerging contaminants

Emerging contaminant is a term used to describe environmental dangers caused by novel contaminants – whose effects are not yet known, but which have the potential to cause considerable harm. Additionally, the development of new methods for analysing new and emerging pollutants has made significant progress in detecting organic contaminants from industrial effluent.

Disruptive endocrine chemicals are a type of EC that has recently gained a lot of interest (EDCs). EDCs are defined by the Endocrine Society as “an exogenous (non-natural) molecule, or a mixture of chemicals, that interferes with any component of hormone action.” These compounds have a variety of effects on the body’s hormonal balance; they can impair hormone production, mimic hormones, influence the development of hormone receptors, act as hormone antagonists, or modify hormone binding. Pharmaceuticals and personal care products (PPCPs), synthetic chemicals used as industrial solvents/lubricants and

their by-products, plastics [bisphenol A (BPA), polybrominated biphenyls (PBBs), dioxins], plasticizers – are all examples of endocrine disruptors (phthalates) (Khan *et al.*, 2022).

ECs and their consequences, as well as present challenges

Emerging pollutants, whether naturally occurring or synthetic, have been connected to demonstrated or anticipated negative impacts on health and the environment. However, due to a scarcity of data on their impacts, clarifying and detecting the environmental and health issues posed by hazardous chemicals is difficult. Regardless, understanding their mobility, tracking and fate provides



a detailed picture of their impact on the ecology and aquatic species. Since medications are water-soluble, it is impossible to separate them in a solution to a significant degree. Because medications are designed to perform several physiological and biochemical functions, they are able to pass through biological barriers and remain stable within the human body. The tendency of pharmacologically active chemicals to accumulate and cause harm to species (other than those intended for use) raises grave concerns (Taheran *et al.*, 2018).

ECs treatment technologies

Non-conventional water treatment technologies have advanced throughout time as new ways have been created. The principal treatment technologies are classified as follows: phase-changing methods, advanced oxidation methods and biological treatment methods. In order to get rid of ECs, biological treatment methods have mostly exploited the biodegradation pathway. Large molecular weight ECs are broken down into smaller molecules by microbes like bacteria, algae, and fungi, and they can even be bio-mineralized into straightforward inorganic components like water and carbon dioxide. This process is known as biodegradation. In order to find suitable finishing methods to further reduce ECs, chemical treatment techniques must be looked

at as replacements. Oxidation reactions have primarily been used to complement traditional setups rather than replace them and to improve the removal of EC. To remove ECs from wastewater, it is necessary to use chemicals such as chlorine, hydrogen peroxide, and ozone as well as to combine these oxidants with catalysts based on metal oxides and transition metals.

Conclusion

ECs, pesticides, polycyclic aromatic hydrocarbons, dioxins and biphenyl polychlorinated ECs, dye pollutants, personal care products, and other emergent derivatives, as well as pharmaceuticals, are among the harmful chemicals and emergent derivatives found in the environment or aquatic systems that must be eliminated. Recently, a lot of work has been put into developing new treatment methods for eliminating new contaminants from aqueous solutions, but it is not sufficient. Traditional wastewater treatment methods are insufficient for totally removing ECs from water. Therefore, physical, chemical, and biological treatment procedures are necessary to ensure that all ECs are entirely removed from the water. Chemical treatment techniques (activated sludge, activated carbon, membrane bioreactors (MBRs), and treatment based on microorganisms) have removed from wastewater (with

high removal efficiencies) ECs such as EDCs, PPCPs, surfactants, and pesticides analgesics, antibiotics, beta-blockers, and pharmaceuticals. Advanced oxidation techniques are exceptionally effective at treating wastewater. The membrane technology can remove particles as small as 10 m and colloidal particles. It can be eliminated by up to 99 percent using MBR and treatment technologies, such as reverse osmosis, ultrafiltration and Nanofiltration at concentrations up to 5 g/l.

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 Soniya Ashok Ranveer is a scholar at the Dairy Microbiology Division, ICAR-National Dairy Research Institute, Karnal, Haryana. Phool Singh Hindoriya is a scholar in the Agronomy Section, ICAR-National Dairy Research Institute, Karnal, Haryana.





Terra Youth



Joining Hands
for a Greener
Tomorrow

STEAM education

Creating lifelong learners

The world is changing at a faster pace than ever; why then should our education not mirror this change? Inculcating this spirit of the new, **Neha and Pragya Gaur** highlights the need for STEAM education in this article. STEAM education not only provides a well-rounded growth to our children but also better equips them for the new and ever-changing job market of the future. “sab ka saath sab ka vikas! aao karen apne baccho ko sashakt aur karen unka bhavishya surakshit!”

We live in a fast-paced technological era in which work, education and life change in the blink of an eye. There have been far more technological changes in COVID-19 than in the previous years. Drone deliveries, touchless transactions, driverless cars, cashless transactions, cryptocurrency, virtual reality, augmented reality, and a slew of other AI-powered technologies were introduced to us during the pandemic and are now on a steep rise.

Looking at the current situation, it can be said with no doubt that

exponential technological development is unavoidable; shortly, a drastic change in the way we work and the types of jobs we do should be/can be expected.

According to a World Economic Forum report, by 2025, there will be a shift in the division of labour between humans and machines. People with skills in areas such as: AI, data analysts, process automation specialists, ‘internet of things’ specialists, and other technologies, will be in higher demand. These jobs require a strong foundation in science, mathematics, engineering, and technology, as well as 21st-century skills like critical

thinking, creativity, collaboration and communication.

The question remains, are we preparing ourselves and our children for future jobs (that will require adequate skills) and are we preparing them to be lifelong learners – capable of adapting and succeeding in an ever-changing world?

“There is no more powerful transformative force than education—

Growing Job demand:

1. Data Analysts and Scientists
2. AI and Machine Learning Specialists
3. Big Data Specialists
4. Digital Marketing and Strategy Specialists
5. Process Automation Specialists
6. Business Development Professionals
7. Digital Transformation Specialists
8. Information Security Analysts
9. Software and Applications Developers
10. Internet of Things Specialists

Jobs for 2025: Future of Job Reports, World Economic Forum



to promote human rights and dignity, to eradicate poverty and deepen sustainability, to build a better future for all, based on equal rights and social justice, respect for cultural diversity, international solidarity, and shared responsibility, all of which are fundamental aspects of our shared humanity.” IRINA BOKOVA, Former UNESCO Director-General

A transition from pedagogy to heutagogy, which is self-determined and student-centred way of learning, is required. The question then is: how do we support and assist today’s children and adults in acquiring the necessary 21st Century skills and other technological skills?

STEAM education, or Science, Technology, Engineering, Art, and Math, appears appropriate and vital for making children versatile, flexible, adaptive, inquisitive, observant, and problem-solvers. Some may argue that STEAM necessitates extensive labs and equipment; schools cannot support STEAM for everyone. This is where we must reconsider the various aspects of our lives and our living environment.

STEAM starts at home –most parents who cook at home use STEAM components (Science, Technology, Engineering, Art and Math). Other activities requiring STEAM components include gardening, changing light bulbs, repairing water pipes, caring for a fish tank, and constructing a pet shelter. STEAM is about understanding and solving real-world problems, not working in laboratories with expensive equipment. The world will require an increasing number of people who can identify issues and design solutions.

By engaging learners in exploring concepts, practices and phenomena, we prepare them for the future by fostering questioning, curiosity, creativity, excitement, and innovation. The need is to create and teach programmes that combine technological tools with children’s imaginations to allow for self-expression, while also teaching problem-

solving skills. Learners will pursue their understanding by conducting investigations and experiments. Some may question whether art is necessary for students to develop the required skills, given that most future jobs appear to be based on AI, machine learning, and other STEM fields.

Interdisciplinary studies and cross-connect and cross-cutting concepts across various areas are suggested by **National Education Policy 2020**, as well as other curricula worldwide, as a new normal. The World Economic Forum has identified 15 critical skills for 2025.

Table 1.1 Skills for the Future

1	Analytical thinking and innovation
2	Active learning and learning strategies
3	Complex problem solving
4	Critical thinking and analysis
5	Leadership and social influence
6	Technology use monitoring and control
7	Technology design and programming
9	Resilience, stress tolerance, and flexibility
10	Reasoning, problem-solving, and ideation
11	Emotional intelligence
12	Troubleshooting and user experience
13	Service orientation
14	Systems analysis and evaluation
15	Persuasion and negotiation
*Skills for 2025: World Economic Forum	

Are we providing our students with the World Economic Forum’s list of skills? How do we develop these abilities? **Table 1.1** contains a mix of technology, design,

and soft skills required for success in life and work. STEAM is the best approach because it encourages collaboration to understand a STEM concept. STEAM has gained recognition in the professional world because it integrates arts concepts and practises; it contributes to a better understanding of science, math, and technology. STEAM employs tools, such as visualisation or fine art visuals, which are essential for gaming, simulations and training.

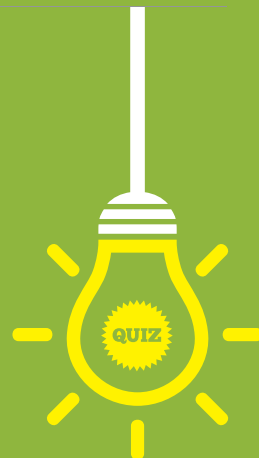
According to studies, creative skills and knowledge of the arts (for example, design, writing, and history) help STEM employees solve problems more innovatively. Furthermore, learners with diverse skills have greater flexibility, adaptability and a broader range of skills that may be helpful in the future, aligning with **Skills Outlook 2021: Learning for Life**.

So, how do we begin to integrate teaching to better prepare students for the future? Parents play an essential role in their children’s education. Parents should encourage their children to develop 21st-century skills by exploring and encouraging them to consider the STEAM aspect of everything they do daily. By creating a ‘learner-centred’ environment, that supports students in defining their learning path and equips students with skills to help them transition into the workforce, schools and educational institutes, should foster a culture of encouraging learning through exploration, observation, and experimentation. Think tanks, research institutes, corporates and other agencies should help the educational institutes and educational boards – by providing them sufficient resources and information for creating a STEAM environment for integrating adopting flexible, creative and multidisciplinary studies. ■

Neha is a Senior Fellow and Area Convenor, Environment Education and Awareness Area, at The Energy and Resource Institute, New Delhi. Pragya Gaur is a curriculum and content design specialist.



GREEN Quiz



GREEN Olympiad Secretariat welcomes you to GREEN Quiz Section! Through this section, the Secretariat aims to reach out to student readers to avail an opportunity to register for the program and prepare for GREEN Olympiad examination scheduled for October / November 2022. Happy Quizzing!

1. As an environment conscious and responsible citizen, you contribute towards reducing your carbon footprint, by:
 - a) Walking to school, which is just 500 m from your home
 - b) Leaving windows of the room open for natural air and switching off the AC when not required
 - c) Defrosting the refrigerator at regular intervals
 - d) All of the above
2. Ozone is a gas. Its molecular formula is:
 - a) O
 - b) O₂
 - c) O₃
 - d) O₄
3. Vitamin B-12 is an important vitamin, needed for nerve tissue health, brain function, and production of red blood cells. Deficiency of this vitamin causes:
 - a) Anaemia
 - b) Night blindness
 - c) Beri Beri
 - d) Biotin
4. Most of the minerals in Earth's crust are found in which layer?
 - a) Crust
 - b) Mantel
 - c) Inner crust
 - d) Core
5. Antarctica at the South Pole has about 90% of the world's ice and is extremely

- vulnerable to impact of climate change. Of the animals found here, which is endangered due to climatic changes affecting this fragile zone?
- Penguins
 - Whales
 - Seals
 - Southern Fulmar
6. Which of the following types of forests can be found in India?
- Moist tropical forests
 - Dry tropical forests
 - Montane temperate forests
 - All of the above
7. What is the flow of water from high tides to low tides in oceans called?
- Flood tides
 - Ebb tides
 - Neap tides
 - None of the above
8. In India, where can mangroves be found?
- West Bengal
 - Gujarat
 - Andaman & Nicobar Islands
 - All of the above
9. Name the only continent that does not have glaciers?
- Africa
 - Australia
 - South America
 - None of the above
10. Most of the oil that we use is imported into our country from other nations. The oil is carried in huge sea going tankers. Sometimes, these tankers get damaged and the oil leaks into the oceans and seas. What is such an accidental discharge of oil into water bodies called?
- Water pollution
 - Oil leak
 - Oil spill
 - Tanker leak

Month of August is dedicated to welcoming student community for GREEN Olympiad Registrations. Hence make the most out of the opportunity and register for the current edition through our website- www.teriin.org/olympiad or <https://terigreenolympiad.com>

ENGIE to provide clean drinking water to the villages in Tamil Nadu

ENGIE Foundation, in partnership with Pavilion Water, has pledged to provide clean drinking water to a village in Tamil Nadu.

On 18th August, 2022, a leader in low-carbon energy solutions, ENGIE committed to provide clean drinking water to the families of drought hit Mattiyarendal district and surrounding villages in state of Tamil Nadu. This was the first village identified by the Rotary Club of Manama for the water purification project. More than one thousand families will benefit from this

project which is a collaborative effort by ENGIE and Pavilion Water.

Talking about the initiative, **Amit Jain**, Country Manager of **India & COO Renewables AMEA**, shared that “Delivering clean and sustainable water resonates with ENGIE’s purpose and is also fully supported by the goals and mission of the ENGIE Foundation, i.e., to support innovative, philanthropic

projects related to renewable and sustainable energy solutions.” The water purification system will clean up to 500,000 litres of contaminated water per day, using only wind or solar energy, at a very low maintenance cost of \$100 per year. The system is deployed to serve the communities that face challenges to access clean drinking water. Through reduced energy demands and low waste





output, the system can be monitored and controlled remotely, ensuring its efficiency in serving the community.

Globally, ENGIE has partnered with the Pavilion Water and Rotary Club of Manama in the Kingdom of Bahrain, for the initiative. The objective of this project is to convert contaminated ground water into potable drinking water in accordance with the WHO and Indian standards, whilst alleviating the increasing water scarcity issues the communities are experiencing in India.

About Pavilion Renewables

Pavilion Renewables is a regional leader in providing energy, water, waste management, organic agriculture and

decarbonization solutions through its subsidiaries, most notably Pavilion Energy and Pavilion Water. Originating in 1988, Pavilion Renewables established its headquarters and main manufacturing operations in the Kingdom of Bahrain, in 2018. Pavilion aims to create a positive impact, environmentally and socially, by reducing the global carbon footprint and providing access to clean, reliable, cost-efficient power and water with zero emissions.

About ENGIE

ENGIE group is a global reference in low-carbon energy and services. Together with their 170,000 employees, customers, partners and stakeholders, they are committed to accelerate the transition

towards a carbon-neutral world, through reduced energy consumption and more environmentally friendly solutions.

Inspired by the purpose “raison d’être”, ENGIE reconciles economic performance with a positive impact on people and the planet – building on their key businesses (gas, renewable energy, services) to offer competitive solutions to their clients.

ENGIE’s purpose is to act to accelerate the transition towards a carbon-neutral economy, through reduced energy consumption and more environmentally-friendly solutions. The purpose brings together the company, its employees, its clients and its shareholders, and reconciles economic performance with a positive impact on people and the planet. ■



MOXIE experiment reliably produces oxygen on Mars

The MIT-led Mars Oxygen In-Situ Resource Utilization Experiment, or MOXIE, has been successfully making oxygen from the Red Planet's carbon-dioxide-rich atmosphere since February 2021, when it touched down on the Martian surface as part of NASA's Perseverance rover mission. Researchers envision that a scaled-up version of MOXIE could be sent to Mars ahead of a human mission, to continuously produce oxygen at the rate of several hundred trees. At that capacity, the system should generate enough oxygen to both sustain humans once they arrive, and fuel a rocket for returning astronauts back to Earth. So far, MOXIE's steady output is a promising first step toward that goal.

Source: www.sciencedaily.com

Dolphins form largest alliance network outside humans, study finds

The scientists, with colleagues from the University of Zurich and University of Massachusetts, analysed association and consortship data to model the structure of alliances between 121 adult male Indo-Pacific bottlenose dolphins at Shark Bay in Western Australia. Male bottlenose dolphins in Shark Bay form first-order alliances of two-three males to cooperatively pursue consortships with individual females. Second-order alliances of four-14 unrelated males compete with other alliances over access to female dolphins and third-order alliances occur between cooperating second-order alliances. Co-lead author Dr Stephanie King, Associate Professor from Bristol's School of Biological Sciences explained: "Cooperation between allies is widespread in human societies and one of the hallmarks of our success. Our capacity to build strategic, cooperative relationships at multiple social levels, such as trade or military alliances both nationally and internationally, was once thought unique to our species."

Source: www.sciencedaily.com



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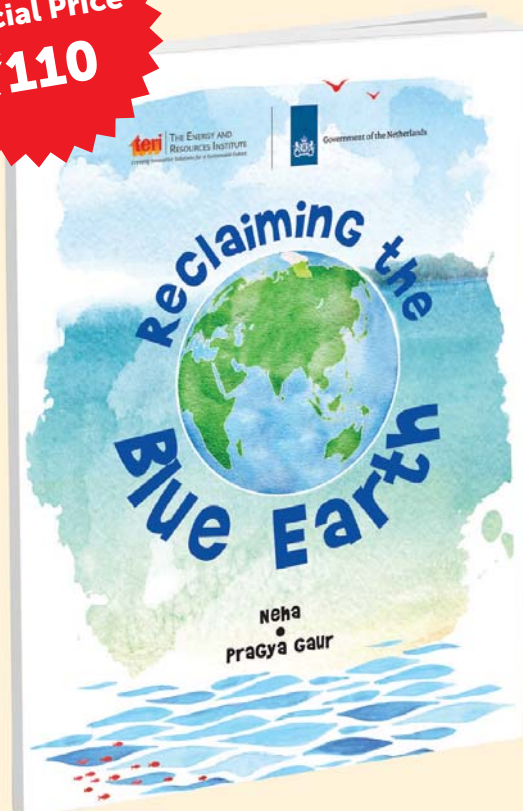
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The Deccan Trotters

A chronological narrative of colonizing elephants and ensuing conflicts

Elephants hold a special importance symbolic importance in the Indian subcontinent. Owing to this sentiment they are welcomed and even revered in most communities. However, the interactions between humans and elephants aren't always as favourable as depicted in our fables. In this article, **Avinash Krishnan** and **Maria Anjum** examine the reasons of HEC (Human-elephant conflict) on both the species and suggest some means to solve this problem.

In India, the Asian elephant population is distributed over 23 states; in the southern region, their range spreads across 9670 km² in Kerala, 8976 km² in Karnataka, 7935 km² in Tamil Nadu and 357 km² in Andhra Pradesh. Until the early 1980s, when a small herd of elephants moved into the Kuppam and

Palamaner forests of Chittoor district in Andhra Pradesh, the state was not known to host elephants. The year-round availability of palatable crops in Andhra Pradesh and drought in their normal distribution range of Hosur and Dharmapuri forests of Tamil Nadu (60 km southwest of Chittoor), had seemingly

forced them to move. It was thought that they would return to their natal range during the next harvest season; however, this was not to be. Instead, during 1986, more elephants dispersed into this area from Bannerghatta National Park, Karnataka, which adjoins the Hosur-Dharmapuri



The research team interacting with local forest officials on the status of HEC at Thoppannahalli IB Source: © Manigandan K / A Rocha India.



forests. Some of the elephants later dispersed northwards into the Sri Venkateswara National Park, Andhra Pradesh, and southwards to the Jawadhu Hills, Tamil Nadu. Owing to religious sentiments and ignorance of potential problems, these elephants were initially welcomed by the locals; the narrative changed with increased incidences of human-elephant conflict (HEC). When repeated attempts to drive them back into the Hosur-Dharmapuri forests were unsuccessful, the Andhra Pradesh Forest Department accepted their presence and declared an area of 357 km² in the Kuppam and Palamaner forest areas as the Koundinya Wildlife Sanctuary (KWS). However, this did not help in improving the situation; agricultural loss and human and elephant casualties remained high.

The Kolar forest division is located in south-eastern Karnataka with a total forest cover of 508.34 km². It consists of five ranges - Kolar, Malur, Bangarpet, Mulbagal, and Srinivaspura. On receiving news of a conflict caused by a few bulls in surrounding areas, on 16th August 2021,

we traveled from Bannerghatta National Park to North Cauvery Wildlife Sanctuary via Hosur Forest Division, finally reaching the Bangarpet range.

At the dimly lit Thoppanahalli inspection bungalow, founded in 1913, now covered with dense creepers, we interacted with the local forest officials to understand the case at hand. According to them, a single bull colonized the Bangarpet range in 2008, staying there for 2-3 months at a time and most likely returning to Hosur afterward. Acting as a scout, it expanded its herd and 17 elephants were frequenting this range by 2015; as of 2021, 5 of them remain active. This residual population of 3 adults and 2 sub-adult bulls continue to move from Hosur in the south-east towards Kolar in Karnataka, Krishnagiri in Tamil Nadu, and Chittoor in Andhra Pradesh. In the process, they cross the busy NH7 (formerly NH 44) that connects major cities across India, including Bengaluru and Chennai. This situation has resulted in a drive gone wrong: instead of sending them back to Hosur, the elephants were

driven into the forests of Andhra Pradesh because of their closer proximity. The stretch where the elephants are currently stationed is a part of an elephant movement trajectory that spreads from Jowlagiri in Tamil Nadu to Chittoor in Andhra Pradesh via Bangarpet, and KGF regions in the Kolar district of Karnataka. As these elephants are not allowed to pass through the Ramakuppam forests of Andhra Pradesh, they are compelled to take a detour of 35-40 km cutting through villages and farms, thus increasing cases of HEC. Fascinatingly, these bulls take refuge in the forests of Tamil Nadu during the day and raid crop farms of Karnataka in the night, a tactful way of evading detection.

The following morning, much like the five marauding elephants, we crossed the invisible line demarcating Karnataka and Tamil Nadu on the foothills of Malappana Betta. With a small peak at 900 MSL and a temple right on the top, it could roughly be divided into three - the west belonged to Andhra Pradesh, and the east was divided between Karnataka

Yargol Dam in Budikottai village which serves as a transit between Karnataka and Tamil Nadu for the herd Source: © Avinash Krishnan / A Rocha India



and Tamil Nadu. Konganapalli Road, connecting Kuppam in Andhra Pradesh and Yapnahalli in Tamil Nadu, cuts across the tri-junction and is used by the herd to move into Tamil Nadu from Andhra Pradesh.

The surrounding dry deciduous forests with a sparsity of *Albizia amara*, *Dendrocalamus strictus*, and *Wrightia tinctoria* had very little in terms of elephant fodder. It was evident why the herd used these forests only as temporary refuge and preferred raiding crop fields of neighboring villages. Consisting of guava, groundnuts, paddy, lentils and ragi, the cropping patterns of these agricultural fields are much more diverse and palatable. The damage was extensive in two villages – Chattaguttahalli where a paddy field had been raided by a tusker and Bodapatti where groundnut, banana and guava plantations had been raided. Apart from

a hanging solar fence that ran in parts of 3 km and 5 km along the forest, there was no other sign of proactive mitigation. Meager ex-gratia granted by the forest department would not be sufficient to mitigate the conflict.

HEC in the Bangarpet range began in 2008-2009; since 2015 these conflicts have become more severe and frequent. A tusker is known to frequent Deva Gutta in Andhra Pradesh; another raids crops in Bethalahalli, Karnataka; while three others raid farms in Kalamanagudi quite often. According to a 2015 news report, 10 people have been killed in Kolar district since the beginning of HEC in 2011 – Bangarpet recorded the highest number of casualties. 5 people were killed in 2013 and 2 in 2012. In 2021 there have been 3 recorded deaths. Alongside, there has been one elephant death – that of a calf – in 2019. The farmers are marginalized and an increase in HEC

compromises their food security. The unequal pace of conflict mitigation and crop-raiding in these areas has emanated a skeptical view of elephant conservation among the inhabitants and strained relationships with local agencies. Being faced with a novel situation, the forest officials of these areas are inexperienced in managing elephants. What ensues is buck-passing among the forest department of the three states.

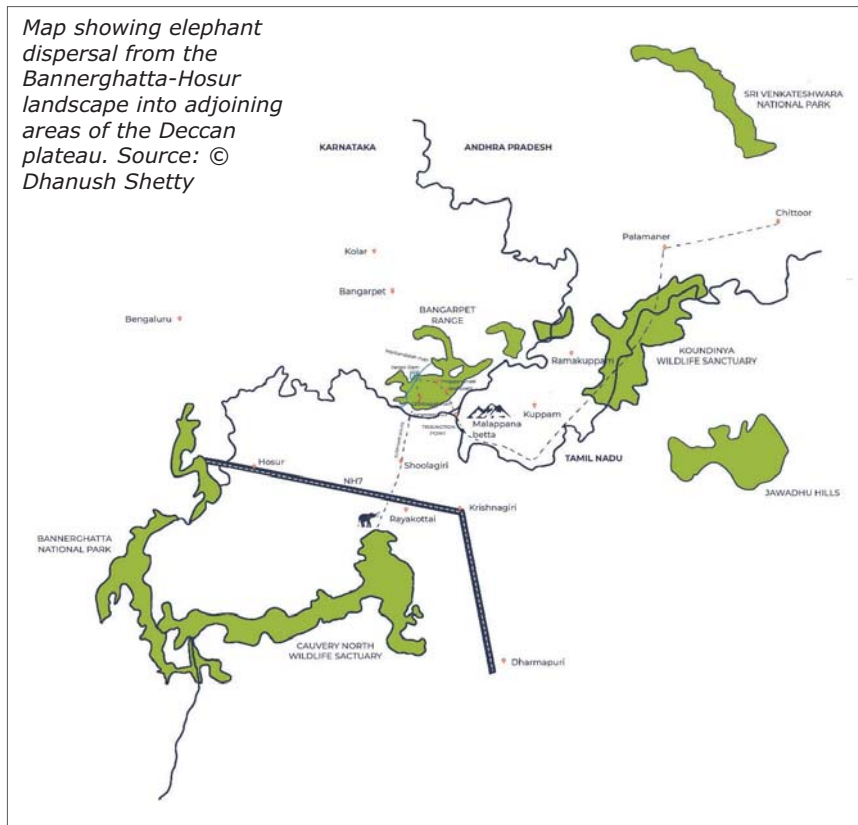
One potential and major threat to the survival of this herd is the Yargol Dam at Budikottai village, which is being built by the Karnataka Government, on the Markandaiah river. The dam in itself is a controversial figure as there have been several disputes between Tamil Nadu and Karnataka with regards to freshwater accessibility. Now on the last leg of construction, it will improve irrigation in and around the Kolar district. The farmers who are victims of crop-raiding

grow seasonal fruits and vegetables; with the dam in place, this will most likely expand farming throughout the year. Consequently, there will be an increase in the frequency of crop-raiding and in turn increasing number of human and elephant casualties. The dam, being used by the herd as a transit point between Karnataka and Tamil Nadu, could also lead to elephant casualties because of the high current in it.

Conserving this seemingly doomed elephant population in their current habitat is infeasible because of the degraded state of the habitat, increasing anthropogenic pressures and absence of connectivity. Taking into account the problems of habitat, population, HEC, and long-term conservation gains, this population should ideally be translocated.

- Effective elephant-proof barriers could also be put in place to prevent the herd from crossing the NH7 and to restrict their movement within the elephant forests of Hosur.
- Besides curtailing the spread of HEC to distant places, this will also reduce the risk of elephant casualties due to road kills.
- However, before being translocated to their native forests of Hosur-Dharmapuri-Bannerghatta, these forests will first have to be restored, being extremely prone to habitat loss,

Map showing elephant dispersal from the Bannerghatta-Hosur landscape into adjoining areas of the Deccan plateau. Source: © Dhanush Shetty



- degradation and HEC.
- If they are to be translocated to better habitats, then these areas need to be evaluated and restored wherever necessary. Effective management plans should also be implemented to minimize HEC along with a strategy to contain the elephants in the new area.
- In areas devoid of forest cover,

monoculture plantations act as crucial refuges for elephants in terms of shelter and food. If forest cover cannot be increased or forest fragments cannot be connected, then a landscape-level management strategy should be employed in which there is a deeper understanding of land use patterns and communal needs.

- In this case, monoculture refuges should be protected and retained, failing which conflict incidents may increase and spread afar. Bringing these elephants into captivity should not be the first resort as it fails to address the larger question of dealing with all dispersing elephants, especially bulls whose numbers are gradually diminishing in all elephant ranges. ■

Avinash Krishnan is the Director (Conservation Science) & CEO of A Rocha India and Maria Anjum is an Intern at A Rocha India and a post-graduate student of Wildlife Biology and Conservation at National Centre for Biological Sciences.



Gather to Garden (G2G)

Case study of a project on Terrace Gardening as micro enterprise

“If you’ve never experienced the joy of accomplishing more than you can imagine, plant a garden.”

– Robert Brault

Gather 2 Garden (G2G) was started in Madurai, Tamilnadu by an environmentalist, Mr Nambirajan, popularly known as ‘Nambi’ (which means ‘Trust’ in Tamil), in the year 2016. Besides his engagement in SELCO, the solar promotion company, ‘Nambi’ promotes micro enterprises for people who are around poverty line in their communities as prototypes, with scope for incubation into models with inclusion, mainstreaming, replicability, growth and sustainability. Dr R. Mohanraj, a freelance Organization Development (OD) practitioner provided management consultancy for the project.

The project began in plot No.10, Bharathiyarnagar, Nagamalai Pudukottai, Madurai, Tamil Nadu – which is the residence of ‘Nambi’ and his family. By 2019, the project growth spread all over Madurai City and sporadically in other towns and cities of Tamil Nadu.

It started with 20 homemakers with common profiles. The income for the family is the salary or wage earnings of the head of the family, invariably the man; the woman is the homemaker. These families have the average size of 5: the couple in income earning age, 1-2 children below 18 years or dependant youth, one dependant senior citizen

invariably parent or a relative. The family budget has an average 30% deficit, managed through neighborhood borrowing and micro-credit of women in Self Help Groups (SHGs). About 40% of the houses have concrete roofing provided under the Government housing scheme. There are a few plants in pots along with micro scale backyard farming – with a curry leaf plant, mint, few chilly plants and vegetables. There are also one or two banana trees and few chickens in few backyards and wastewater from the house used for the plants.

Goal

G2G aims to be a home based micro enterprise for household based environmental concerns and provide a second income earning to eliminate family budget deficit. The project also seeks an Annual growth of a minimum of 20%. **Following is a ‘Strategic plan’ for achievement of the goal:**

- To develop a ‘terrace garden’ with 20 pots of Rose, Jasmine, Chrysanthemum and Hibiscus in ‘Nambi’s’ terrace.
- To be self reliant for the consumption needs of flowers of the household and to sell excess flowers to neighbors and local vendors.
- Learning and educational inputs for children; inculcating nature science



- projects in terrace gardening.
- The present monthly average expenditure of ₹300/- on buying flowers is to be stopped from the 3rd month of the project.
- To add 20 pots more on the terrace and open spaces for adding vegetable production: Chilies, Mint, Brinjal, and creepers like Bottle and Snake gourd and Pumpkin, from 6-9 months of the project. The optimal production from the 40 plants is to achieve self-sufficiency in the family's requirement of flowers and vegetables; saving Rs 600 per month on buying these.
- Through saving on expenditure and income earning in selling of excess flowers and vegetables, the homemaker can make up to an average daily income of ₹100 to ₹150, which is the livelihood earning of a local vendor in the area, in 2016.

Children love nature: they love playing in mud and water, hence, their involvement can begin as play and fun time



Project implementation Strategy

The first model was built in 'Nambi's terrace itself and the neighbors were



invited to the house on festival days. Complimentary flowers were given to them in order to **demonstrate** how the model works **and motivate** people to join. This led to the formation of the first group of 7 members, expanded to 20 within 3 months as the 'Gather 2 Garden' (G2G) Group. The first **objective** of G2G was, 'flower self-reliance for worship and domestic consumption'. This objective was based on the consensus of all the members in the household – in all households. Following this, economic objectives of saving on expenditure and income value on productivity were decided on Individual plans, costing and budgets were developed for every individual member; these plans included measurables and indicators. As a means of **providing a support system for its members**, 'Half day' trainings and capacity building support, contributed to the achievement of targets, was provided in: Product development, Productivity, Value chain management and Development of 'supply and delivery' linkages. These were also occasions for socialization, relationship building and 'interest group formation'. The project also followed a **'One to one' strategy for growth**, by using 'word of the mouth' to propagate the idea to extended families, friends, colleagues and associates.

Demonstrative and motivation model is very effective! In Nambi's Terrace Garden, his children Deepesh and Deepthi, harvesting this giant

pumpkin was a milestone motivation for neighbors, particularly children

'Seeing is believing' promotion of Terrace Gardening: the first set of pots in Nambi's terrace for growing of flowers

Operational methodology

A **Logical Framework Approach (LFA)** was used for project planning and individual plans. **Setting targets and indicators** provided the measurability for monitoring the individual and total project performance and growth. The **money** value involved in the project, in the form of savings and earnings, was the **core motivation for replicability and growth**. It allowed the homemakers in becoming second income earners for their families. Now, the members first fix the amount of income that the project should earn and choose the products, services and business strategies for it.

Over the 4 years, from 2016-2019, about 25% of the members have developed extension enterprises in areas such as – organic manure production, supply of pots, seeds and saplings; and services such as: repotting and marketing of the process, as well as finished products. The capital requirement for enterprise promotion comes from the micro-credit membership in Self Help Groups (SHGs), or directly from Banks in about 30% of membership

Stakeholder matrix

Primary	Secondary	Tertiary
Homemakers who desire to become enterprise holders	Local vendors, local institutions and organizations, SHGs, family tree and associates of households	Solidarity and network organizations in 'environment and empowerment' area, NGOs, Sections of market and information society (MAIS)

Timeline

Because of COVID, an estimation of the project cycle over 4 years (i.e., 2016-2019) is provided below –

- **2016:** Piloting and prototyping of the project – Formation (3 months); Formalization (6-9 months); Consolidation (9-12 months)
- **2017:** Individual plans, training and skills development for the homemakers. Access to the average ₹6000 credit, from SHG (microcredit) for enterprise promotion
- **2018:** Five times growth, or replicability, by reaching up to 100 members and 60% optimization on individual productivity. Individual income established for the homemakers and self-reliance of flowers and vegetables for the household, along with ₹30 to ₹50 daily income from sale of excess products
- **2019 (Pre COVID optimization of the project performance):** The planned targets have been achieved with ten times replicability and growth in the form of 200 members, 80% optimization on individual productivity. Individual income established for the homemakers and self-reliance of flowers and vegetables for the household, along with Rs 100 to Rs 150 cash income from sale of excess products. This income is at par with local vendors; the deficit in family budget eliminated. the second income by homemakers is utilized for improvement of health, nutrition and education of children
- **2020-2021 (COVID LOCKDOWN):** With unforeseen risk affecting the

project about 40% of the members are able to continue their enterprise in its minimal form. Balance 60% of the projects are at different stages of the 'status Quo'. They are in the process of reorganizing their enterprises in 2022

Costing and budget: At an average, ₹6000 is required as the capital investment at the starting of a project for gaining productivity in 20 pots. SHGs are the source of this micro-credit. Therefore, the capital value of the Project can be calculated as: ₹600 avg. x 200 = ₹12,00,000.

Nambi has also promoted satellite environmental programs such as Farm School in which he provides integrated inputs on knowledge and skill to children, parents and all other possible beneficiaries of environmental productivity

Objectively Verifiable Indicators (OVI), Means of Verification (MOV) and 4 years

Objectively Verifiable Indicators (OVI)	Means of Verification (MOV)	4 years project output
A home based micro model with replicability, growth and sustainability	Replicability, growth and sustainability	10 times replicability of membership, 80% optimization of productivity and 40% of individual enterprises survived the COVID LOCKDOWN in project cycle from 2016-2019. 25% enterprise expansion for inclusion and mainstreaming of products and services
Homemaker as enterprise holder	Second income earning for family	Income earning at par with local vendors, Deficit in family budget eliminated. Additional income for improvement in health, nutrition and education of children



project output

Sushmitha, who is also a member of the Farm School Program with her prod display of radish harvest; her mother does Terrace Gardening.

Logical assumptions: Risk factors

The project is based on the Logical assumption that the following 3 factors will be consistent over the project period of 2016-2020, as well as a minimum of 2 years post the project period:

1. Structure and systems of the families,
2. Motivation of the homemakers,
3. Flower and vegetable sectors of market and information society (MAIS).

Any changes in the above are risk factors, is likely to affect the project performance. While factors 1 and 2 maintained the required consistency, the market was affected because of the unexpected COVID situation and the subsequent lockdowns. ■

Dr R. Mohanraj is a freelance Organization Development practitioner.

Innovative Ideas towards Circular Economy in eWaste

As the third largest producer of eWaste in the world, India needs quick solutions to deal with the environmental hazard that is eWaste disposal. In this article, Raj Kumar presents the idea of creating a Circular economy for better managing eWaste. In fact, inventive policy and ingenious strategies for processing eWaste can not only mitigate the climate risks involved, but also provide benefits in terms of optimal use of the present resources.

The disposal of eWaste is a severe environmental issue that affects the entire planet. When we buy an Electrical and electronic equipment (EEE), we rarely consider what materials are used or where they came from. We dispose off the product when it gets obsolete or replace it with newer technology.

An increase in eWaste in the landfills is adversely affecting the climate and contributing to climate change. As a result of environmental consciousness, we are now witnessing a global shift from sequential manufacturing to a cyclic manufacturing paradigm. This is especially important in the recycling of

electronics, where the circular economy for e-Waste has already been applied.

The Importance of a Circular Economy in E-Waste Management

Circular economy is a viable alternative to the existing linear economy, which is built on the use-and-throw idea. It replaces the concept of 'end-of-life' with regeneration and restoration, along with advancing the EEE product design to enable prolonged product life. India emphasized on the need for a sustainable ecosystem at COP21, when



the Paris Agreement was reached in 2015, with Prime Minister Narendra Modi underlining **Mission Circular Economy** last year. Following this, the Niti Aayog has constructed circular economy action plans for 11 waste categories.

In the case of electronics, this includes all eWaste generated by EEE items, lithium-ion batteries, solar panels and so on. After China and the United States, India is the third-largest producer of eWaste. The informal sector handles more than 95% of this waste. According to a report by the Central Pollution Control Board, India generated 1,014,961.2 tonnes of eWaste for 21 different types of electrical and electronic equipment in 2019-20. The eWaste stream contains a wide range of materials, including toxic compounds – like lead, polychlorinated biphenyls (PCB), mercury, and others – as well as



valuable materials like iron, steel, copper, aluminum and plastics. These require special handling and cannot be disposed off in landfills.

Although, most electronic manufacturers claim to produce long-lasting products that are 'resistant to wear and tear'; it is anticipated that the consumers replace these on a regular basis, rather than opting for improvements that could extend the product's life-cycle. As a result, there is a massive '**Right to Repair**' movement taking place all across the world. In India, a 'Right to Repair' policy is desperately needed. A circular economy relies on extending the life of technological items. For a country like India, the 'Right to Repair' would mean decreased ownership costs and the creation of millions of tiny repair shops – resulting in tremendous job opportunities.

5 Innovative Methods towards creating a Circular Economy

- **Reduction** can be defined as an action that minimizes the use of resources by incorporating technologies into the product's

manufacturing processes. The garbage that we generate after usage can be treated in a way so that the potentially useful materials can be removed, reconditioned and reused. In addition, the reduction of the waste generated can assist in the optimization of resource utilization.

- **Reuse** the existing products; the term "reuse" refers to the repeated use of extracted resources for re-utilization. For instance, metal and other related reusable items have significant opportunity for re-use during manufacture. Moreover, when resources are used optimally, it inturn leads to a reduction in eWaste.
- **Recycling** is performed on objects that cannot be repurposed as a resource. These goods that are discarded, yet have the potential for re-utility can be recycled, giving rise to resource development or birth once more.
- In addition to the foregoing, **leasing a product** rather than selling it can provide greater value. Upon purchasing a new product, the consumer pays a deposit and receives a reimbursement when returning the used product. The reimbursement

would be less than the deposit; thus, the system would be funded. The benefits of this financial mechanism include encouraging consumers to return products to the supplier. Furthermore, it fosters product scavenging.

- Moving ahead, the components, elements, or products that have become such that they cannot be used in any way – have only the option of removal or disposal. The **removal or destruction** of obsolete EEE products is a highly specialized job that necessitates the use of modern technology. In a broader sense, the main goal is resource recovery, which is sometimes referred to as the **recovery chain**.

Digital waste, in particular, and the threat posed by them are hot topics these days. The scarcity of resources is becoming a threat to humanity. Sharing and recovery of resources will create a situation in which greater and more output will be possible. The evolution of technology toward a greener, more sustainable environment and a risk-free society through reusable efforts is visible and rapidly becoming unavoidable.

The Future Roadmap

The resources at our disposal are not limitless and have a finite lifespan. Different factors will be used progressively in conventional and sustainable eWaste management, with the incorporation of developing technology. The necessity for a regulatory framework and unified approach in dealing with the situation has been established. The globe must unite its efforts to achieve a sustainable and circular economy. ■

Raj Kumar is the founder and CEO of Deshwal waste Management which functions for reducing the impact of hazardous waste on the environment and its components. – through their monitored operations, efficient waste management solutions, state-of-art infrastructural upgrades and cutting-edge technology.



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We all can fight coronavirus together by following these measures:

- Wash your hands with soap and water frequently for 20 seconds or use alcohol-based hand rub. Do not touch your eyes, nose, or mouth if your hands are not clean.
- Cover your nose and mouth with a disposable tissue or flexed elbow when you cough or sneeze.
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- Avoid mass gathering and crowded places.
- Get yourself and family members vaccinated at the earliest.



Sneeze inside the corner of elbow



Stay at least 6 feet from others



Use alcohol-based hand sanitizers



Wash hands frequently with soap



Wear face mask outside



Avoid social gatherings

TerraGreen



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?

.....

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Contact details

Sanjeev Sharma

Email: sanjeev.sharma@teri.res.in
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