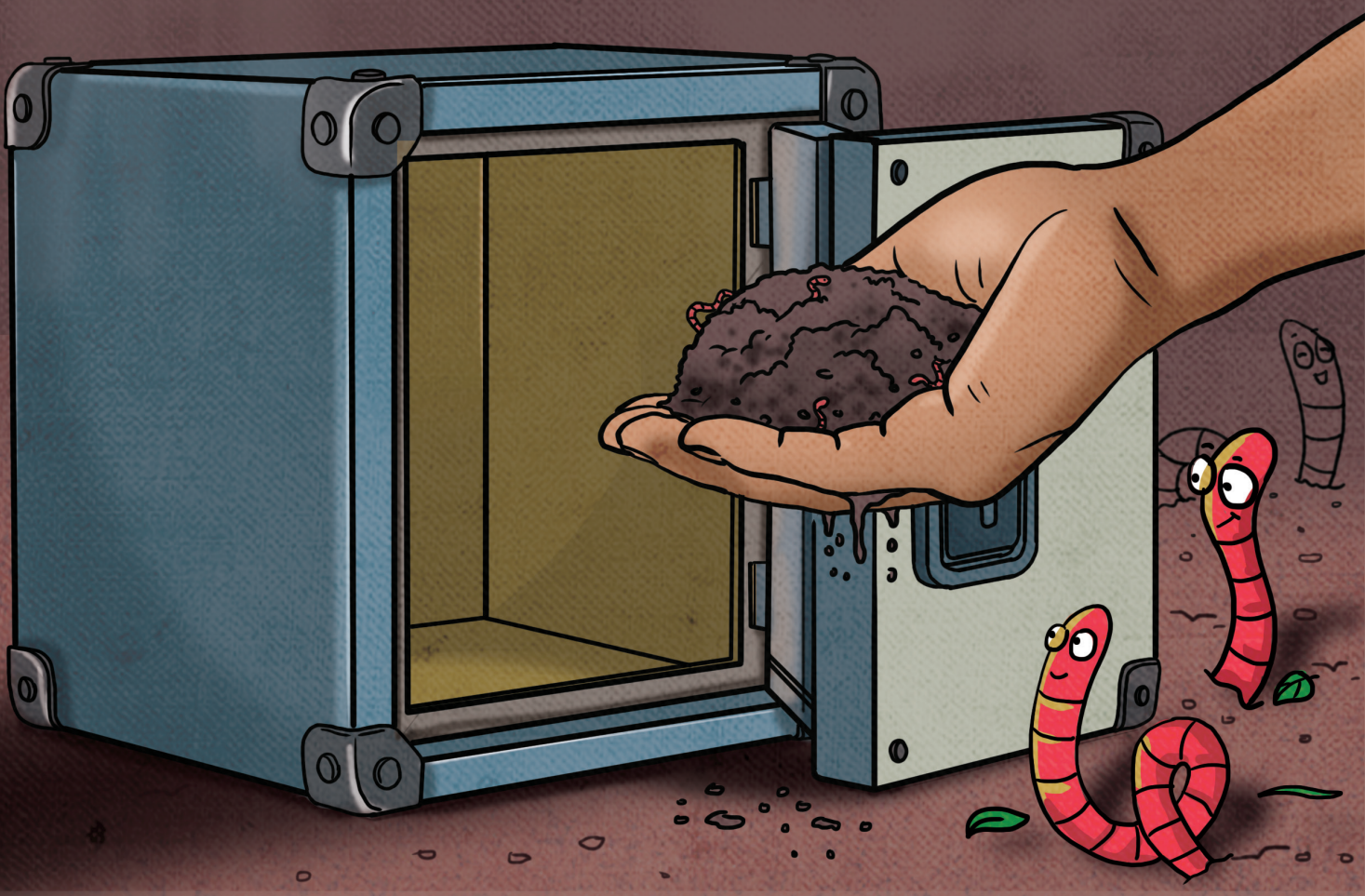
gobar times

Issue no. 282, November 1–30, 2025

A DOWN TO EARTH SUPPLEMENT FOR THE YOUNG AND CURIOUS

SECRETS OF THE SOIL

Discovering soil's hidden powers and the life-saving work plants do for our planet



Cover Story

Be a Soil Steward and Discover Soil's Magic

Discover how soil keeps our food growing, our climate stable, and our planet alive—and how small actions by YOU can help save it.

Anwesha Mandal

Uttam Kumar Mandal

Biswapati Mandal

Supplement Editor: Souparno Banerjee **Senior Creative Director:** Ajit Bajaj **Supplement Editorial Coordinator:** Anubhuti Sharma
Design: Ritika Bohra **Illustrations:** Yogendra Anand **Cover Design:** Ritika Bohra **Production:** Rakesh Srivastava, Surender Singh
Email: young@downtoearth.org.in **Snail Mail:** 41, Tughlakabad Institutional Area, New Delhi–110062

If we die, we are buried in soil. If soil dies...?... Can you visualize the fallouts?

Soil, 'the thin skin of the earth' is indeed a wonderful gift of nature to humankind. It holds and filters water, helps plants to grow—not only food-giving but also medicinal—and homes myriad organisms. About 95 per cent of the foods we eat and antibiotics we use/consume originate in the ground underneath! Soil also inactivates pollutants and plays a central role in regulating climate change.

If you look at the Sustainable Development Goals (SDGs) set by the United Nations (UN), soil impacts them significantly. FYI: SDGs are nothing but some global goals aiming to achieve peace and prosperity for people and the planet. Out of the total seventeen SDGs, eight are dependent upon good soil.

- **SDG-1 No Poverty:** Soil helps in growing food that you can sell and earn money, or it can help you in something as basic as letting you build your shop!
- **SDG-2 Zero Hunger:** A healthy soil can not only produce nutritious foods but achieve food security for all.
- **SDG-3 Good Health and Well-being:** Did you know running on mud is far better than any of your artificial tracks?
- **SDG-6 Clean Water and Sanitation:** Soil absorbs moisture which enables life on land. What more can be told about it!
- **SDG-12 Responsible Consumption and Production:** To ensure sustainable use of any item, say your pencil and eraser that are made from plants, you first need soil!

Every five seconds globally, soil from land equivalent to a soccer pitch gets denuded! This equals about 36 billion tonnes of soil lost annually worldwide.

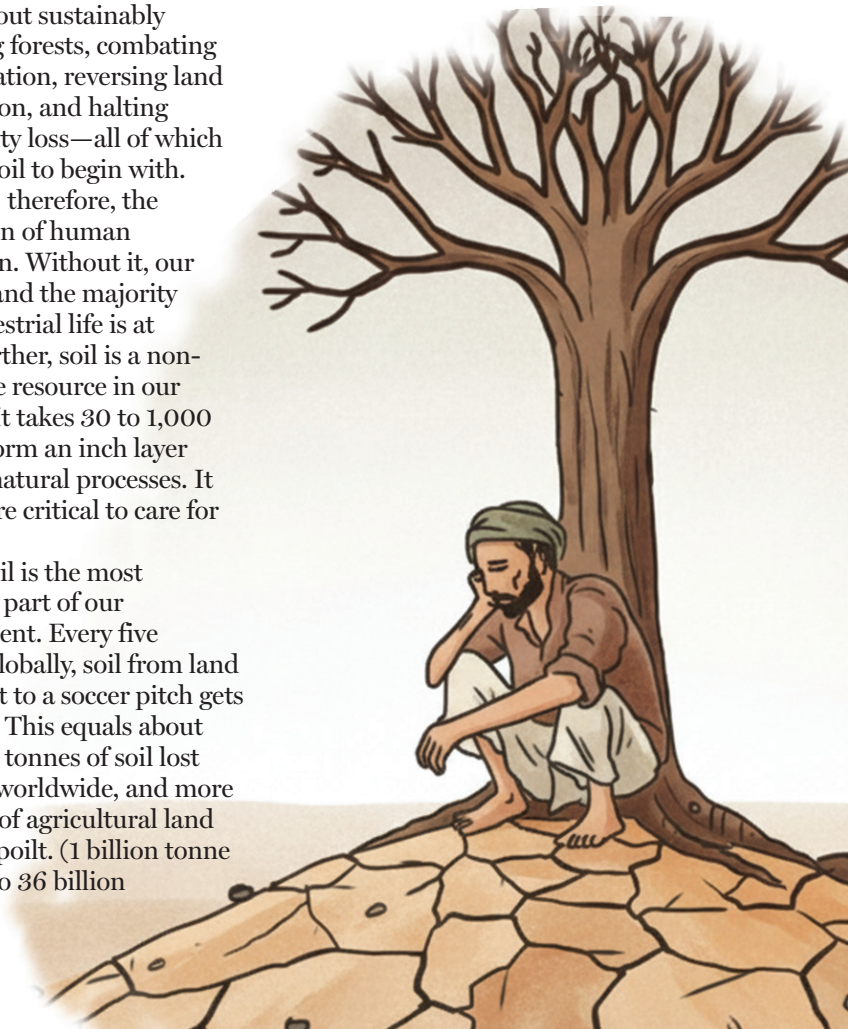
- **SDG-13 Climate Action:** Soil is the biggest storehouse of carbon on earth.
- **SDG-14 Life Below Water:** Underwater soil is home to incredible aquatic creatures and resources.
- **SDG-15 Life on Land:** This goal is about sustainably managing forests, combating desertification, reversing land degradation, and halting biodiversity loss—all of which involves soil to begin with.

Soil is, therefore, the foundation of human civilization. Without it, our survival, and the majority of all terrestrial life is at stake. Further, soil is a non-renewable resource in our lifespan. It takes 30 to 1,000 years to form an inch layer through natural processes. It is therefore critical to care for the soil.

But soil is the most neglected part of our environment. Every five seconds globally, soil from land equivalent to a soccer pitch gets denuded! This equals about 36 billion tonnes of soil lost annually worldwide, and more than half of agricultural land severely spoilt. (1 billion tonne = 10^9 kg so 36 billion tonne = 36,00,00,00,000 kg of soil gone bad!)

The Food and Agriculture Organization of the UN recently reported that over a billion farmers around the world have suffered with poor crop yields due to land degradation caused by human activities! In India, the situation is worse. The extent of erosion here is quite high. About 70 per cent of the total land cultivated in our country is spoiled in one form or the other—basically, 122 out of 182 million hectares (1 million = 10^6)—causing an estimated loss of about 5 billion tonnes every year.

To salvage the situation, the Government of India has committed to rehabilitate soil by 2030 but that is for



Note the degradation of soil and nearby land caused by human activities

only 26 m ha of the degraded land. This is notwithstanding the gospel, "The nation that destroys its soil, destroys itself" by the famous US President Franklin D. Roosevelt in the 20th century.

Among the various spoilers, water-led erosion is predominant. This is conspicuous if you visit any river bank during monsoon. You'll find muddy water flowing alongside the coast, which results from frequent landslides triggered due to cloudbursts. Owing to severe depletion and ruination, our soil's capacity for resilience is under serious threat.

Low organic carbon content of our soils (mostly < 0.5 per cent) is another major reason for such deterioration. This organic carbon maintains the integrity of soil—keeps it living and helps it offer various 'ecosystem services' to us. However, improving Soil Organic Carbon (SOC) is a herculean task in India. That's because our country is located under tropical, subtropical, arid and semi-arid climatic regions where a good amount of SOC gets oxidized. Just read that as a loss of SOC!

How does soil impact climate change and vice-versa?

Now-a-days we frequently hear of 'climate change'. It is driven by long-term shifts in temperature, precipitation, and atmospheric conditions wherein we experience summers getting hotter, monsoons become erratic, and winters becoming colder than before. Unusually long dry spell and heavier rains, greatly disrupts our agricultural and food production activities.

The main reason for climate change is the increase in greenhouse gases (GHGs) in air such as carbon dioxide (CO_2), methane, nitrous oxide, water vapour, and chlorofluorocarbons. Since the Industrial Revolution in the 18th century till now, CO_2 levels have risen from about 270 parts per million (ppm) to more than 430 ppm—about 60 per cent rise in about 150 years! These GHGs trap heat in the atmosphere, making our planet warmer leading to uncertain and disturbed monsoons.

Can soil be a natural ally to mitigate this change for humans' and others' well-being? If yes, how?

Firstly, soil and climate change are no good cousins. They have a two-way relationship: climate change negatively impacts soil, while soil can either worsen or mitigate climate change depending on how we manage it. This is because soil is both a source and sink of carbon. It holds around 2,400 gigaton (1gigaton = 10^{12} kg) of carbon in its belly. This amount is ~3 times higher than what is there in the entire atmosphere and 4.5 times of that in all vegetation on earth. Just imagine, if soil gets angry and releases its entire carbon into the atmosphere, what will be our fate! OMG.

Fortunately, not all soil carbon behaves alike. A good part of this carbon is sensitive to any disturbances caused to the soil while the other part is stubborn and stays stable. However, the sensitive part keeps the soil healthy for cropping while the stubborn part maintains Earth's integrity.

Whenever there is any disturbance caused to the soil, like during farming, it causes the SOC to oxidize (resulting into GHG emissions). Thus, soil feels the carbon deficit perpetually. Therefore, any addition of carbon to it, causes the soil to hold it fondly. This balances the net loss and gain of SOC in soil and maintains the 'carbon cycle' in nature. But this yearning for carbon varies from one soil type to the other.

Carbon addition through cropping or any extra efforts, like crop residue, farmyard manure, compost, etc. could increase SOC. Selection of the right crop, the right cropping system, and the right soil could also enrich the carbon content. The right cropping system could mean leaving a good amount of plant roots hidden in the soil, and doing minimum tilling.

Carbon thus fixed in soil by right cropping is now called 'carbon farming'. This keeps the soil healthy and productive, yielding more crops. Promoting this practice among farmers is the need of the hour.

However, improving the relationship between soil and climate change alone will not conserve soil. At an individual level, we need to change some societal behaviors like, improve dietary habits, shift towards plant-based protein, and reduce food wastage.

What could our young friends do to salvage the situation?

- **Say a big NO to food waste:** Food is raised using soil, water, energy and human efforts; if you require less food, less land needs to be tilled, less soil be disturbed, and less carbon be released. So take only as much food as you need;
- **Plant at least one tree annually:** Through photosynthesis plants absorb CO_2, protect soil from erosion, and add organic matter to it;
- **Be a 'soil steward':** Create awareness about the sciences of soil to save it for your children's children;
- **Promote regenerative agriculture:** Adopt zero or minimum tillage farming in your family and neighborhood. Practice crop rotation, and add crop residue to soil for carbon addition and ensure low carbon emission from it.
- **Join soil health camp:** Visit a Soil Testing Laboratory and get ideas on advanced technologies, balanced fertilizer use, nutrient management, etc. to curb soil and nutrient losses.

Following lines from Atharva Veda (around 900 BC) capture the message of this story.

Upon this handful of soil, our survival depends. Husband it and it will grow—our food, fiber, and fuel—and surround us with beauty. Abuse it, the soil will degrade and collapse, taking mankind with it.

Dr Anwesha Mandal is the Assistant Professor, GD Goenka University, Gurugram, Haryana. Dr Uttam Kumar Mandal is the Principal Scientist at ICAR-Central Soil Salinity Research Institute, Regional Research Station, Canning Town, West Bengal. Dr Biswapati Mandal is the Former Pro-Vice Chancellor of the Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia district, West Bengal.

Readers Writers

Jyoti Chaprana

Air-Purifying Plants
Your Indoor Superheroes

Against hidden indoor toxins are mighty air-cleaning plants—explore how nature helps us breathe better and why every home needs these green helpers.

Indoor air pollution is usually 2.5 times greater than outdoor pollution and, at its extreme, can be a hundred times worse! The deterioration of interior air quality caused by dangerous substances and materials is known as indoor air pollution. It claims about 4.1 per cent of global deaths annually.

Important indoor air pollutants are CO, NO_2, SO_2, Particulate Matter, ozone, and other Volatile Organic Compounds (VOCs). VOCs include benzene, ethyl benzene, toluene, and xylene. All these are emitted from cooking, wall paint, fabrics, mosquito repellants, deodorants, or even human breath.

To purify indoor air: reduce off-gassing from building materials and furnishings before they are installed. Air filtration, ionisation, activated carbon absorption, ozonation, and photocatalysis are other measures. But all these require some specifics and are energy-intensive.

At an individual level our best defense must be to avoid any introduction of pollutants in the first place. Take prevention by ensuring ventilation in your rooms; and smoking restricted to outdoors-only be it of cigarette, vape, or any other product. Use combustion appliances safely and minimize using air fresheners or strongly scented products.

Since our majority time in spent inside our houses, offices, and schools, there is an urgent need to look for solutions. Given how critical human interaction is with plants and microbes, any attempts to live in sealed buildings or remain absolutely cut off from this ecological system could have fatal consequences.

Scientists are already aware of the ghastly impacts of impure air but our country still lacks the standard protocol for measuring Indoor Air Quality. This makes it difficult to implement any strict remedial actions.

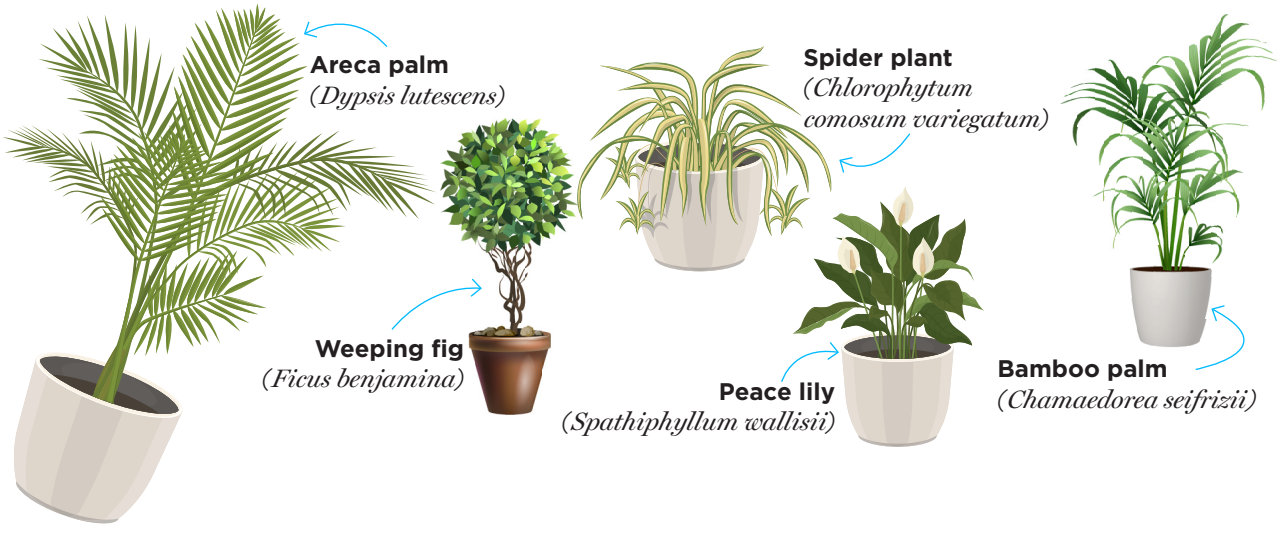
But this problem has an obvious answer: humans must bring nature's life support system—the plants—indoors and coexist with them for their survival.

Indoor plants are not only good for our health but also enhance the looks and aesthetics of our rooms. They undertake a variety of techniques which reduce pollution, like: stomata uptake, phytoremediation, and adsorption and absorption.

Yoneyama et al. (2002) reviewed the absorption and metabolism of NO_2 and NH_3 in 220 species including the sun- and shade-loving plants, the latter of which can be used indoors. In the research by Sadek (2012), it was reported that *C. comosum varigatum*, *C. varigatum*, and *S. podophyllum* removed more SO_x than other plant species. He also reported that *S. wallisii*, *F. benjamina*, and *C. comosum* absorbed more NO_x than the other tested plants.

These natural tools are affordable and low-maintenance. Some of the most effective ones you can purchase are illustrated below.

The author is pursuing Ph.D. from the Department of Environmental Sciences, Gautam Buddha University, Greater Noida, Uttar Pradesh.



Readers Writers

Mangroves
Nature's Coastal Guardians

These salt-loving trees safeguard shores, store carbon, and sustain countless species—helping balance ecosystems and fight climate change.

Pranay Mane

Mangroves are a unique group of plant species that grow along coasts, particularly in muddy, marshy, and waterlogged zones that are often submerged by tidal seawater. In local dialects, mangroves are also referred to as *tattavruksha, kund, or kandalvan*. Globally, around 73 species of mangroves have been identified, out of which 46 are found in India. Major species include *Tatawar, Champa, Fugni (Murchi), Surkandal, Kandal, Sood, Meswak*, and *Marindi.*

Their dense green foliage and intricate root systems provide critical habitats for a wide variety of birds, insects, and aquatic animals. Mangrove areas are especially important for the breeding of fish, crabs, molluscs, and prawns. Their web-like roots act as natural shelters and breeding grounds, making these ecosystems hotspots for biodiversity.

Mangroves can thrive in oxygen-poor soils due to their specialised respiratory roots known as pneumatophores. These roots grow above the ground and directly absorb oxygen from the air, enabling respiration even in anaerobic conditions. The presence of aerenchyma tissues in these roots facilitates rapid exchange of gases. The outer surfaces of these roots contain structures called lenticels, through which oxygen enters the plant's internal system. These adaptations allow mangroves to survive in saline and oxygen-deficient environments.

Mangroves in the Sundarbans Biosphere Reserve use special upward-growing aerial roots to breathe.

Mangroves also hold religious and historical significance. For instance, in Chidambaram near Chennai, a mangrove tree is worshipped as the sacred *Sthala Vriksha* at the Nataraja Temple. In West Bengal's Sundarbans, the deity *Bonbibi* is revered as the protector of mangroves. The Sundarbans, one of the world's largest mangrove forests, is declared a UNESCO World Heritage Site due to its ecological and cultural importance.

The International Union for Conservation of Nature has classified many mangrove species as threatened. For example, *Avicennia marina*, *Avicennia officinalis*, and *Sonneratia apetala* are found in significant numbers around urban regions like Thane and Vashi. However, they are now classified as Endangered and Critically Endangered.

Today, rapid urbanisation, increasing population, and widespread concretisation are major threats to mangrove habitats. This loss poses serious risks to biodiversity, climate resilience, and flood control.

Several legal frameworks have been established to protect mangroves. These include the Environment Protection Act (1986), Coastal Regulation Zone Notification (2011), Maharashtra Tree Felling Regulation Act (1975), Water Pollution Control Act (1974), and Wildlife Protection Act (1972). The Maharashtra government has developed dedicated coastal management plans and formed a special Mangrove Cell to oversee conservation efforts. Acknowledging their significance, the Union Ministry of Environment has given mangroves the status of "Highly Important Plants" and integrated their protection into national laws. To raise awareness, 'International Mangrove Day' is celebrated globally on July 26, highlighting the critical role mangroves play in sustaining life and protecting coastal environments.

The author is Sr. Project Technical Assistant, Environmental Science & Engineering Department, Indian Institute of Technology Bombay, Mumbai, Maharashtra.

We know money can't buy happiness. But it can buy something else — just look at Delhi this winter! The city's 'Disastercard' is swiping us straight into smog. Industrial and vehicular emissions, low temperatures, stagnant winds, stubble burning, and festive firecrackers are turning the air toxic. And the hidden charges? Far beyond coughing or wheezing, Delhi's air is harming almost every organ — raising heart disease, worsening asthma, affecting mental health, complicating pregnancies, and stunting lung growth in children.

So, beware of this Disastercard, dear *Young Environmentalists*. Its cost is far deadlier than you think.

Ritika Bohra