Mother Earth

Volume-2 Number-1, January-March 2024

Special Issue

Future of Earth

Quarterly e-Magazine
School of Environment and Disaster Management
Ramakrishna Mission Vivekananda Educational and Research Institute
Narendrapur Campus, Kolkata: 700103

CONTENTS

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MESSAGE

The EDM (Environment & Disaster Management) Department functioning from the Narendrapur Ramakrishna Mission's approved 'Off-Campus' Centre has made a mark in this important area that is less studied field, much less researched into, by any conventional University in India and abroad. Located in an elevated and peaceful ambience at Narendrapur which has almost a century old reputation in running programmes on education, outreach and extension in agriculture, rural development and related fields, the EDM Department has come to establish itself as one the finest Centres in the State of West Bengal, if not the entire country. Albeit relatively new to higher education institutions' arena, the field of EDM is not new to Ramakrishna Mission itself which began work in this field under the name 'Relief and Rehabilitation' since its very inception 125 years ago, pioneered by Swami Vivekananda himself. To our knowledge, the postgraduate (M.Sc.) and research (Ph.D.) programmes run by School of Environment and Disaster Management and the EDM Department thereunder, are the first of its kind in India. Being highly inter-disciplinary in character, the right type of faculty and researchers in this field are difficult to come by, which is why this fields needs to be promoted in a big way so that the new generation students are made keenly aware of the subtle nuances in research in this area like environmental ethics, deep ecology, conservation and preservation of the earth's resources, global warming, climate change, environmental modelling, etc., all of which are sine qua non for actualizing United Nations Organization's Sustainable Development Goals. This e-magazine, the brain child of the Head of the EDM Department who serves also as 'Swami Vivekananda Chair Professor' in this area, saw the light of day for the first time on the occasion of the 'Earth Day' on 22 April 2023. It continues its journey with steady pace thanks to the relentless efforts of the faculty, students and scholars of the EDM Department under the continual inspiration of the Head of the EDM Department, updating the readers' knowledge on the story of in the EDM Departments' endeavour to reach further heights of excellence. May it continue its journey 'to strive, to seek, to find' newer horizons of thought in emerging areas in this field like AI intervention, etc., is the earnest prayer of Belur Math.

Swami Atmapriyananda

Belur Math'
Main campus of the University

Embracing Our Planet: Vision for a Sustainable Tomorrow

As we commemorate Earth Day, it is with a profound sense of responsibility that we present to you the special issue of 'Mother Earth,' Volume 2, Number 1. This edition, dedicated to the 'Future of Earth,' serves as a clarion call from the School of Environment and Disaster Management at Ramakrishna Mission Vivekananda Educational and Research Institute. We are at a pivotal moment in our relationship with our planet, and the choices we make today will resonate for generations to come. I urge each one of you to absorb the wisdom contained within these pages and let it inspire you to take meaningful action. May our collective efforts lead to a sustainable and thriving Earth for all.

Swami Shivapurnananda

Assistant Administrative Head
RKMVERI
Narendrapur Campus

Belur

22 April 2024

RAMAKRISHNA MISSION VIVEKANANDA EDUCATIONAL AND RESEARCH INSTITUTE
(Deemed to be University as declared by Govt. of India under Section 3 of UGC Act, 1956)
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MESSAGE

Earth Day serves as a reminder of the importance of environmental conservation and sustainability, inspiring us to work together to create a healthier planet and a brighter future. We hope to promote awareness, inspire change, and build a stronger connection to nature through a variety of activities and programmes. Let us collectively strive to conserve the Earth for current and future generations. Together, we can have a significant effect and build a more sustainable world.

The global theme for this year's Earth Day is 'Planet vs. Plastics', which acknowledges the damage plastics represent to human health and calls for a 60% reduction in plastic manufacturing by 2040. Earth Day, which began in the United States, has grown into a global event that transcends national lines. The day is significant because it changes our viewpoint, urging us to perceive ourselves as integral to nature rather than apart from it. It encourages people to make tiny adjustments in their daily lives that benefit the environment and contribute to a more sustainable future.

I congratulate the EDM department of RKMVERI for taking the effort to observe and raise awareness among students and scholars about maintaining the world free of environmental pollution and sustainable in nature in all spheres of life.

Prof. Tapash Dasgupta
Dean
RKMVERI, Narendrapur campus

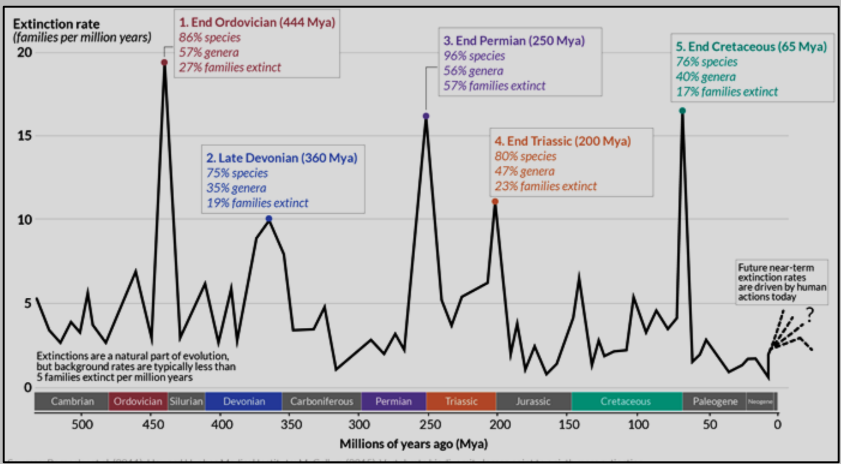
Future of Planet Earth

Dr P G Dhar Chakrabarti

Swami Vivekananda Chair Professor and Head School of Environment and Disaster Management

Planet Earth emerged some 4.5 billion years ago from the solar nebula**.** Over time as Earth cooled, solid crust formed, and liquid water appeared on the surface, creating conditions for life**.** Microbial mats of bacteria and archaea are known to be the first creatures that evolved photosynthesis, leading to oxygen buildup in the ocean and atmosphere, opening opportunities for diverse species to grow and develop. Ecosystems evolved for interconnected growth of varieties of plants, animals, micro-organisms on land, water and sky in different geo-climatic zones of the planet.

Five Big Mass Extinction of Species



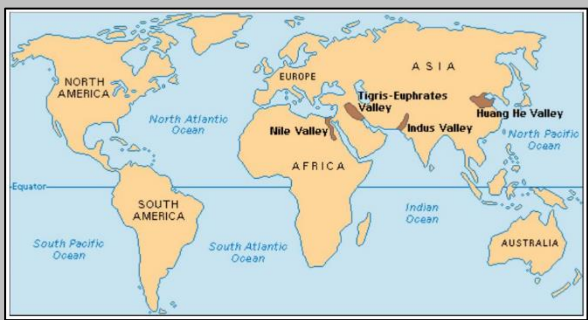
Catastrophic changes in the earth system over the trienniums, such as rapid and dramatic changes in climate, combined with significant changes in the composition of environments on land or the ocean (such as continental drifts due to tectonic activities, ocean acidification or acid rain from intense volcanic activities, and asteroid impacts).have led to mass extinction of species and regeneration and evolution of new species, in a cycle of creation- stabilization- destruction-creation, what has been described in ancient texts as *Srishti*, *Sthiti and Proloy*. There have been five such mass extinction events in Earth's history, at least since 500 million years ago, the last extinction occurring 65.5 million years ago, leading to the demise of the dinosaurs.

March of Human Civilization

Homo-Sapiens or human being evolved around 100,000 years ago in the forests of East Africa before migrating first to the Middle East and Europe and later to Asia, Africa, Americas and Australia. What made *homo sapiens* different from all other species is their large brains with cognitive abilities that enabled them to learn, create and adapt in varied environments, and their gregarious nature which helped to organize social structures and institutions.

Privatization of property started when human beings learnt to domesticate animals and institution of marriage developed when succession of property had to be determined. With private property and marriage started inequalities of income and wealth and gender discriminations that remained other two distinguishing features of the humans.

Early Civilizations



Human societies progressed from hunter-gatherer communities to agrarian economies that produced marketable surpluses, generated wealth through trade and commerce, and established civilizations. The earliest recorded human civilization flourished in the Indian sub-continent in **Indus valley** (c. 7000 to c. 600 BCE), followed by **Sumerian Civilization** in **Mesopotamia** (c. 6000-1750 BCE), **Egyptian Civilization** (c. 6000-30 BCE), **Chinese Civilization** (prehistoric Xia Dynasty, c. 2070-1600 BCE) developed along the Yellow River and subsequently the **Greek civilization of the city states** (c. 1500 BCE -500 CE). Civilizations with strong economic foundations, and relative peace and prosperity for a long time, such as in India, China and Greece, became the fountainhead of knowledge and wisdom in diverse fields that enriched global civilizations.

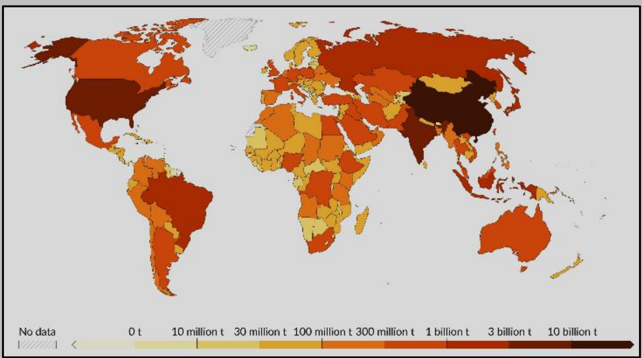
Agrarian societies learnt to protect and conserve nature, and in fact, nature was worshipped as Mother Goddess, in civilizations across continents. Geographical explorations, maritime trade, scientific discoveries and technological inventions enabled men to extract natural resources from around the world to manufacture goods and services on a large scale that was not known hitherto. Industrial revolution, staring towards the middle of eighteenth century in England

and spreading across countries in Western Europe and America with more advanced technologies, heralded an era of conquering nature and colonizing countries for producing more and more wealth that glittered the countries of the West at the cost of millions of impoverished people of the global South. Political freedom of the countries of Asia, Latin America and Africa did not end the economic domination of the west, which continued in a new form of domination of capital and technology that only shifted manufacturing and pollution to emerging economies, but the era of human domination over nature that started with industrial revolution continues unabated in more vigorous forms.

Human Domination over Nature

Human population has exploded from less than a billion in pre-industrial age to more than 8 billion today and is not expected to stabilize before it reaches 10 billion by 2058. This has put tremendous pressure on both renewable and non-renewable natural resources of the earth. Forest areas have been denuded at an alarming rate of 40 million hectares every year since 1900. Surface water resources like floodplains of rivers, wetlands and other water bodies have been encroached. Ground water resources have been depleted in many places. Pollution load on air, water and soil has multiplied, resulting in alarming rate of increase in global burden of diseases. Mineral resources of the earth are also depleting fast with oil and gas reserve to last 50-60 years, coal less than 200 years.

Global Greenhouse Gas Emission 2022



Anthropogenic greenhouse emission has increased consistently over the past hundred and fifty years with average global surface temperature of earth reaching dangerously close to + 1.5^0 C compared to pre-industrial age. GHG emission has expanded from the countries of the west to emerging economies of the global South. Scientists have warned that with the present rate of emission, it may be less than a decade when the tipping point is reached when it will be difficult to adapt to the changing climate in many productive sectors like agriculture, horticulture and fisheries with devastating consequences on global food and nutritional security. Already more than 27% population of the world is suffering from moderate food and nutritional insecurity including 900 million that is facing hunger.

Glacial deposits on the mountains, the poles and the permafrost have started melting, leading to sea level rise that have threatened small island countries and coastal regions that include many coastal mega cities of the world. Thermal expansion of oceans and sharp rise in ocean temperature is changing the weather pattern with increasing frequencies and intensities of extreme climatic events like tropical cyclones, floods, droughts and forest fires.

Epoch of Anthropocene

The pressures humans exert on the planet have become so great that scientists are considering whether the Earth has entered an entirely new geological epoch, the **Anthropocene** or the age of the humans, suggesting that we are now living in an age that is defined more by human activities than by natural forces. In this age the dominant risk to our survival is ourselves. The Anthropocene Working Group (AWG) of the International Commission on Stratigraphy deliberated on a proposal that Anthropocene should be considered as a formal unit of geological epoch, starting either from 1750 (start of industrial revolution) or 1945 (explosion of atom bomb). After prolonged deliberations over several years the AWG formally recommended in August 2016 that 1950 be used as the starting point of the Anthropocene Epoch within the traditional Chronostratigraphic chart. Athropocene may be regarded as the ultimate triumph of humans over nature on the Planet Earth, or as the beginning of the end of the Planet Earth itself.

Anthropocene Epoch in Chronostratigraphic Chart 2023

Eonothem/ Eon	Erathem/ Era	System/ Period	Series/ Epoch	Stage/ Age	millions of years ago
Phanerozoic	Cenozoic	Quaternary	Anthropocene		1950 CE
			Holocene		0.0117
			Pleistocene	Upper	0.126
				Middle	0.781
				Calabrian	1.806
				Gelasian	2.588

Future of Planet Earth

Scientists have deliberated on various plausible futures of Planet Earth. Astronomers have discussed the probabilities of cosmic supernova that would strike our planet with intense sterilizing radiation, or close gamma-ray burst could spell the end of life on our planet. Less likely risks could come from antimatter or a very low-mass black hole passing into the planet. Powerful geomagnetic storm or huge coronal mass ejection from the Sun may also cause a doom of the earth. These are all in the realm of conjectures that may or may not happen in time span of millions of years.

What is more real is the day to day destruction of Planet Earth. Humans have altered about 70 percent of Earth's land surface and ocean. Wetlands have lost 85 percent of their natural area; tropical forests have lost 40 percent; the ocean's large predatory fish are two-thirds gone; coral reefs have lost half their living mass. Agriculture has halved the weight of living vegetation on land, driving a diversity loss of 20 percent; 40 percent of extant plants are currently endangered. Farmed animals and humans now constitute 96 percent of all land vertebrates; only around 5 percent are wild, free-living animals. The world's wild populations of birds, mammals, fishes, reptiles, and amphibians have declined by an average of nearly 70 percent in just the last 50 years, a breathtaking plummet. More than 700 vertebrate species have gone extinct over the last 500 years, an extinction rate 15 times the natural rate. Around a million species are now threatened with total extinction, what has been described as sixth mass extinction of species or the age of Holocene that the Planet Earth is passing through.

Is it possible to save the Planet Earth from the catastrophe? If the humans have brought the earth to the present state of decay, the onus lies on the humans to find ways to save the planet. The 'ghastly futures' predicted by the ecologists and environmentalists can be averted to a large extent if there is the will and determination among people to work together for a better future. This is no longer a rhetorical slogan for scoring a debating point, but a felt need for survival that is uniting people at the grassroots across countries and continents. The most encouraging development is the upsurge of research and education on environment and ecology that is creating awareness among people who are using this knowledge for fighting against forces that are contributing to climate change and environmental degradation. There are umpteen number of grassroots level environmental movements of people in countries around the world that have forced governments including authoritarian regimes to discard their policies for commercial extraction of forest, mineral, aquatic and other resources and adopt proactive measures for protection and conservation of these resources.

The age of industrial ignorance is over. There is growing passion for preserving nature, driven by awareness and sense of responsibility for healing the wounds of Mother Earth. People are actively working to improve local environment through citizen's projects on science and environment. People are also going back to the ancient wisdoms to draw inspirations for protecting nature.

No doubt, science and technology have played an important role in facilitating the process of human domination over nature, leading to the pauperization of the Planet Earth. But it is unfair to blame the science or the scientists for this process; it is the manner in which scientific knowledge was used by the vested interests that mattered. Scientific knowledge is now bringing out all the negative impacts of such misuse of science; scientific knowledge is also providing solutions for many pressing problems of the present. Advancements in agricultural, veterinary and soil sciences and water harvesting technologies have immensely contributed to the success of green, white and blue revolutions in many countries. The world is now producing enough to feed its 8 billion people and is confident to feed another 2 billion to be added during the next three decades. If food and nutritional security is still widespread that is primarily due to the problems in supply chain, distribution and access due to a variety of reasons that go beyond environment to the realm of war, politics and diplomacy.

Scientific and technological advancements in the fields of renewable energy – solar, wind, hydrogen, bio-mass – is showing the keys to the solution of global warming and climate change. This is already ushering in a silent revolution which will surely pick up well before the world exhausts its fossil fuels. Advancements in medical science and technology are finding solution for many deadly diseases. Average life expectancy of humans has more than doubled since the industrial revolution and is likely to increase further in the coming decades despite the growing incidence of non-infectious diseases and threats of recurrence of pandemics. Explorations under the oceans and over the sky holds promises for new resources for the future.

The epoch of anthropocene has signaled the domination of human beings over nature. So far such domination has worked negatively in exploiting the resources of the planet to bring it to the verge of catastrophe; time has now come to dedicate ourselves to use such domination to let the nature auto-regenerate itself.

One with Nature One with Soul

Dr. Paromita Roy
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We confront a wonderful bonding of humans and nature in this terrestrial land inspiring man in many ways to rebuild the lost bond with nature. The oldest and simplest form of Nature-worship finds expression in Vedic texts. The ṛgveda-Saṃhitā is considered as the earliest source book of ancient human culture and civilization. In it we witness an expansion of life as boundless as nature emerging out of the fundamental conscience that life cannot be perceived in a narrow secluded way as every moment of our earthly existence is a gift of nature. The ṛgVedic seers therefore in their efforts to elevate natural objects and phenomena to the status of Gods and Goddesses exhibit a deep sense of reverence for nature in its entirety. Ordinarily looked at, the ṛgVedic Gods like Sūrya[1], Agni[2], Vāyu[3], Apa[4], Parjanya[5] etc are but the sun that we observe in the sky, the fire that plays an important role in our daily chores, the air and water indispensable for our survival, the rain-clouds that gather in the sky respectively. But behind the entire act of nature deification is a deeper philosophy of life inspiring us to come out of the narrow cocoon like existence and identifying the self with the *Self* as a whole.

Nature: The Greatest Temple on Earth

The Environmental Protection Act of 1956, highlights that "'environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property."[6] The Vedic culture depicts both the understanding of the interconnection of life and its execution through benevolence towards all

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1 विश्वमा भासि रोचनम् (१-५०-४)

2 अग्निमीळे पुरोहितं यज्ञस्य देवमृत्विजम्।
होतारं रत्नधातमम् ॥ (१।१।१)

3 आ वात वाहि भेषजं वि वात वाहि यद्रपः।
त्वं हि विश्वभेषजो देवानां दूत ईयसे॥ (१०।१३७।३)

4 आपो हि ष्ठा मयोभुवस्ता न ऊर्जे दधातन।
महे रणाय चक्षसे॥ (१०।९।१)

5 स नो यवसमिच्छतु॥ (७।१०२।१)

6 https://www.indiacode.nic.in/bitstream/123456789/6196/1/the_environment_protection_act%2C1986.pdf

components of nature. This outlook of Vedic seers towards nature quite different from the mainstream thinking[7] derives its inspiration from spiritual realization which forms the backbone of our culture. Swami Vivekananda emphasizes that “all healthy social changes are the manifestations of the spiritual forces working within, and if these are strong and well adjusted, society will arrange itself accordingly” (CWSV 5, p.417). Therefore the fundamental question that arises is highly philosophical—“How we should live?” And the answer Swami Vivekananda suggests is in the teachings of Advaita—“…realizing the ideal of the Advaita, that ideal of the oneness of all” (CWSV 3, pp.204-205). Then alone can we sincerely pray for the well-being of all and exhibit harm towards none.[8] This has been the life of our seers inspiring the modern world to tread lightly on earth. We conclude with the famous line of John Muir : “And into the forest I go, to lose my mind and find my soul.”

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Abbreviations

CWSV 3: Vivekananda, Swami 2018. *The Complete Works of Swami Vivekananda*, vol.3: ‘The Mission of The Vedānta’, 3rd edn. Mayavati: Advaita Ashrama.

CWSV 5: Vivekananda, Swami 2018. *The Complete Works of Swami Vivekananda*, vol.5: ‘Sayings and Utterances’, 3rd edn. Mayavati: Advaita Ashrama.

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[7] “Let us make man in our image and likeness to rule the fish in the sea, the birds in the sky, the cattle, all wild animals on earth and all the reptiles that crawl upon the earth. So God created them in his own image and blessed them and said to them ‘be fruitful and multiply, and fill the earth and subdue it; and have dominion over the fish of the sea and over the birds of the air and over every living thing that moves upon the earth.’” Quoted from the Genesis in *Environmental Ethics, An Introduction to Environmental Philosophy*, Second Edition, Joseph R. Des Jardins, Wadsworth Company, 1997, p.93.

[8] मधुमतीरोषधीर्द्याव आपो मधुमन्नो भवत्वन्तरिक्षम्। (४-५७-३)

मधु वाता ऋतायते मधु क्षरन्ति सिन्धवः।

माध्वीर्नः सन्त्वोषधीः॥ (१-९०-६)

मधु नक्तमुतोषसो मधुमत्पार्थिवं रजः। मधु द्यौरस्तु नः पिता॥ (१-९०-७)

मधुमान्नो वनस्पतिर्मधुमाँ अस्तु सूर्यः।

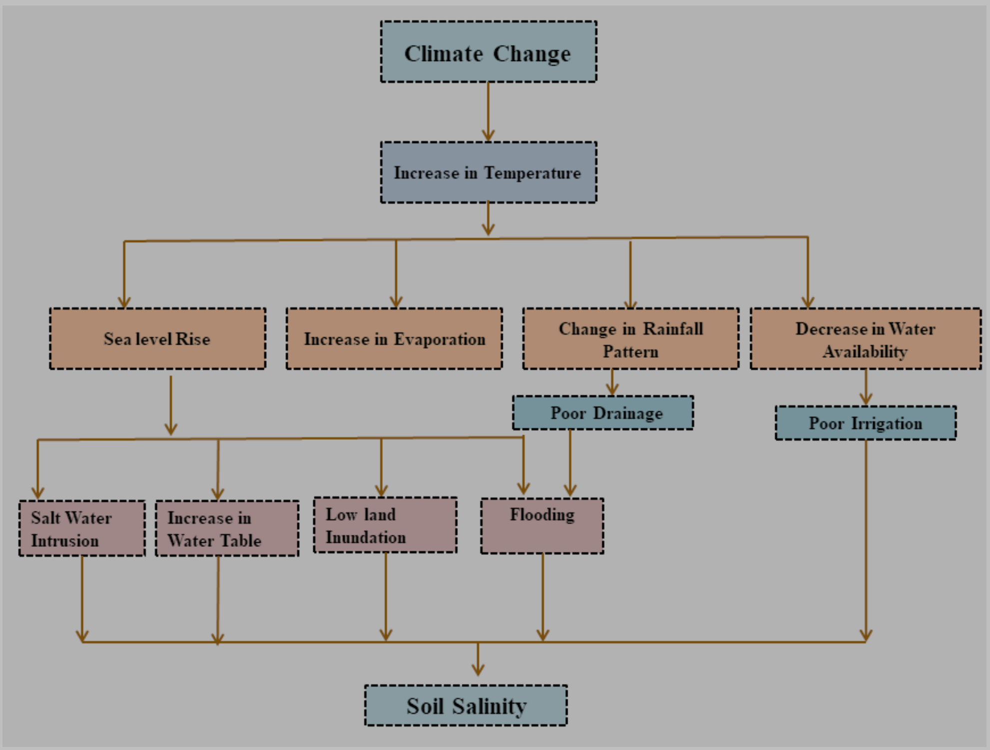
माध्वीर्गावो भवन्तु नः॥ (१-९०-८)

Climate Induced Salinization of Soil: A Looming Crisis in the Coasts

Dr. Sudipta Tripathi
Assistant Professor, School of Environment and Disaster Management, RKMVERI

Climate change is causing various effects across the globe, and one of the most pressing concerns is soil salinization in coastal regions. This phenomenon is slowly posing a threat to future food security, which is further worsened by climate change. The data shows that around 20% of the world's cultivated land is affected by soil salinity, and coastal areas are highly vulnerable due to saltwater intrusion and sea level rise. The Food and Agriculture Organization (FAO) estimates that over 1.5 billion hectares of land worldwide are impacted to some degree by salinity, which affects agricultural productivity. Soil quality degradation significantly reduces crop yields, making it difficult to meet the growing food demands. Moreover, once soil becomes saline, restoring it becomes difficult and costly. Soil salinity a slow onset phenomenon of climate change as depicted in the Figure.

Rising temperatures increase evaporation rates, which disrupt traditional rainfall patterns. This disruption upsets the delicate balance between freshwater and saltwater in coastal regions. The resulting reduction in freshwater flow worsens soil salinization, which further decreases soil quality. Sea-level rise is another critical consequence of climate change that compounds the issue. It causes coastal flooding and worsens poor drainage systems in these regions, which amplifies soil salinity and decreases soil fertility. Moreover, sea-level rise facilitates saltwater intrusion into coastal freshwater aquifers, which exacerbates the problem. Additionally, the sediment delivery shortfall caused by sea-level rise in delta regions increases vulnerability to salinization and flood hazards, as it reduces the elevation of these areas. All of these factors show the urgent need for comprehensive strategies to mitigate the impacts of climate change-induced soil salinization in coastal regions.



Coastal areas are at a greater risk of storm surges and flooding due to the intensifying effects of extreme weather events caused by climate change. These events can lead to the flooding of agricultural lands with saltwater, which increases the soil salinity levels. This change in salinity can disrupt the balance of plant and animal life, leading to a decrease in biodiversity and habitat degradation.

Various sectors of society, including fishermen, wage labourers, and farmers, rely on coastal agricultural ecosystems for sustenance. However, soil salinization poses a significant threat to their livelihoods by diminishing crop yields and jeopardizing food security. Furthermore, prolonged consumption of saline water can have detrimental health effects, such as elevated blood pressure leading to cardiovascular issues.

Addressing this pressing issue is imperative. Gypsum has emerged as a highly effective soil amendment for saline soils, while biochar has shown promise in enhancing overall soil health in such environments. Additionally, cultivating salt-tolerant crops presents a viable alternative for managing saline soil, offering resilience to adverse conditions. Furthermore, mangrove plantation stands out as a natural defence mechanism, shielding coastal ecosystems from floods, cyclones, salinization, and erosion.

Collaboration among policymakers, scientists, and local communities is essential to develop comprehensive solutions that safeguard the future of coastal ecosystems.

A Supernovaeic Explosion to End Life on Planet Earth?

Dr. Sumanta Das
Assistant Professor, School of Environment and Disaster Management, RKMVERI

In the vast expanse of the cosmos, celestial phenomena often captivate our imagination, none more so than the spectacular event of a supernovae. These cosmic explosions mark the violent demise of massive stars, unleashing immense energy and scattering heavy elements across the cosmos. While supernovae are relatively rare occurrences in the universe, their potential impact on nearby celestial bodies, including Earth, raises intriguing questions about our place in the cosmos and the nature of life itself.

Supernovae occur when massive stars reach the end of their life cycles. When nuclear fusion reactions in their cores cease, the inward force of gravity causes the star to collapse, triggering a rapid and catastrophic implosion. This collapse rebounds violently, resulting in a colossal explosion known as a supernova. The energy released during this cataclysmic event can briefly outshine entire galaxies, making supernovae some of the brightest objects in the universe.

While most supernovae occur in distant galaxies, the possibility of a nearby explosion—within our own Milky Way galaxy—has intrigued scientists and astronomers for decades. Known as near-Earth supernovae, these events could have significant implications for our planet and its inhabitants. Although the chances of a supernova occurring in our galactic neighborhood are statistically low, the potential consequences of such an event have spurred scientific inquiry and prompted efforts to better understand these cosmic phenomena.

Infrared image of a supernova near Earth. This composite uses an image of the Crab Nebula, a real supernova remnant [Source: NASA/ESA-Hubble Space Telescope]

One of the primary concerns surrounding near-Earth supernovae is their potential to cause harm to life on Earth. The intense radiation emitted during a supernova explosion could have devastating effects on the ozone layer, leading to increased levels of harmful ultraviolet radiation reaching the Earth's surface. Such an event could pose a significant threat to terrestrial life, including humans, by damaging DNA and increasing the risk of cancer. Moreover, the explosion of a nearby supernova could have profound implications for Earth's atmosphere and climate. The influx of cosmic rays and high-energy particles could trigger atmospheric ionization, leading to changes in weather patterns and potentially disrupting global climate systems. Additionally, the impact of supernova debris—such as dust and gas—on Earth's atmosphere could have long-lasting effects on the planet's climate and ecosystems.

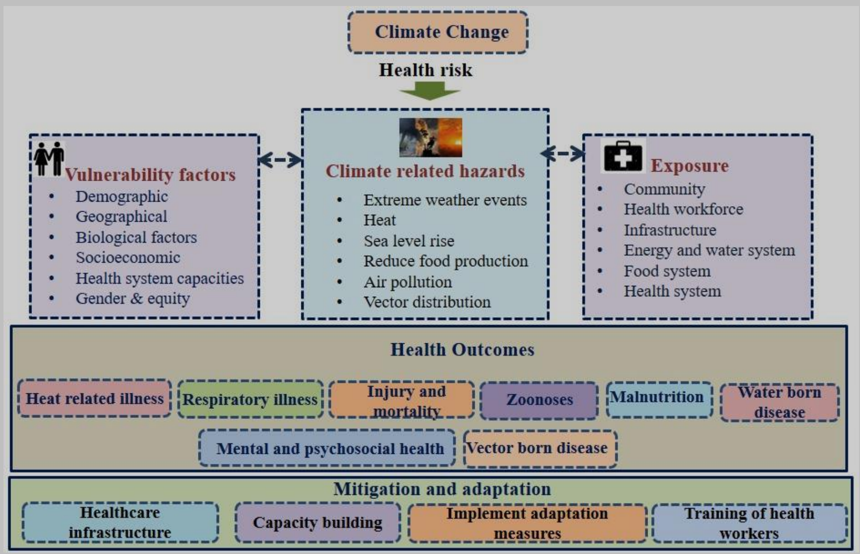
Despite these potential risks, near-Earth supernovae also present unique opportunities for scientific study and observation. By monitoring the light and radiation emitted during a nearby supernova explosion, astronomers can gain valuable insights into the processes underlying these cataclysmic events. Studying the aftermath of a supernova can also provide clues about the formation of new stars and the evolution of galaxies, shedding light on the fundamental principles that govern the cosmos. Furthermore, the detection of a near-Earth supernova could serve as an early warning system for astronomers, allowing them to prepare for and observe the event in real time.

In conclusion, near-Earth supernovae represent a captivating and potentially hazardous aspect of the cosmos. While the chances of a supernova occurring in our galactic neighborhood are rare, the consequences of such an event could be profound. By studying near-Earth supernovae, astronomers hope to unravel the mysteries of the universe while also safeguarding our planet and its inhabitants from the forces of the cosmos.

Climate Change and Human Health: A Call to Action for Global Resilience

Dr. Mahadev Bera
School of Environment and Disaster Management, RKMVERI

Climate change, a complex and multifaceted phenomenon, impacts every aspect of our lives, including our health, beyond just melting ice caps or extreme weather events. The World Health Organization (WHO) predicts that by 2030 to 2050, climate change could lead to an extra 250,000 fatalities annually due to malnutrition, malaria, diarrhea, and heat-related illnesses. This underscores the pressing importance of tackling the health risks associated with climate change worldwide. The influence of climate change on human health is profound, exacerbating current health challenges while also fostering new ones. Among its effects, increasing temperatures contribute to the proliferation of vector-borne illnesses like malaria, dengue fever, and Zika virus. Warmer climates expand the habitats of disease-carrying mosquitoes, enabling their survival in regions where they couldn't previously thrive. Additionally, shifts in rainfall patterns can create ideal conditions for these vectors to breed, substantially heightening the likelihood of disease transmission.



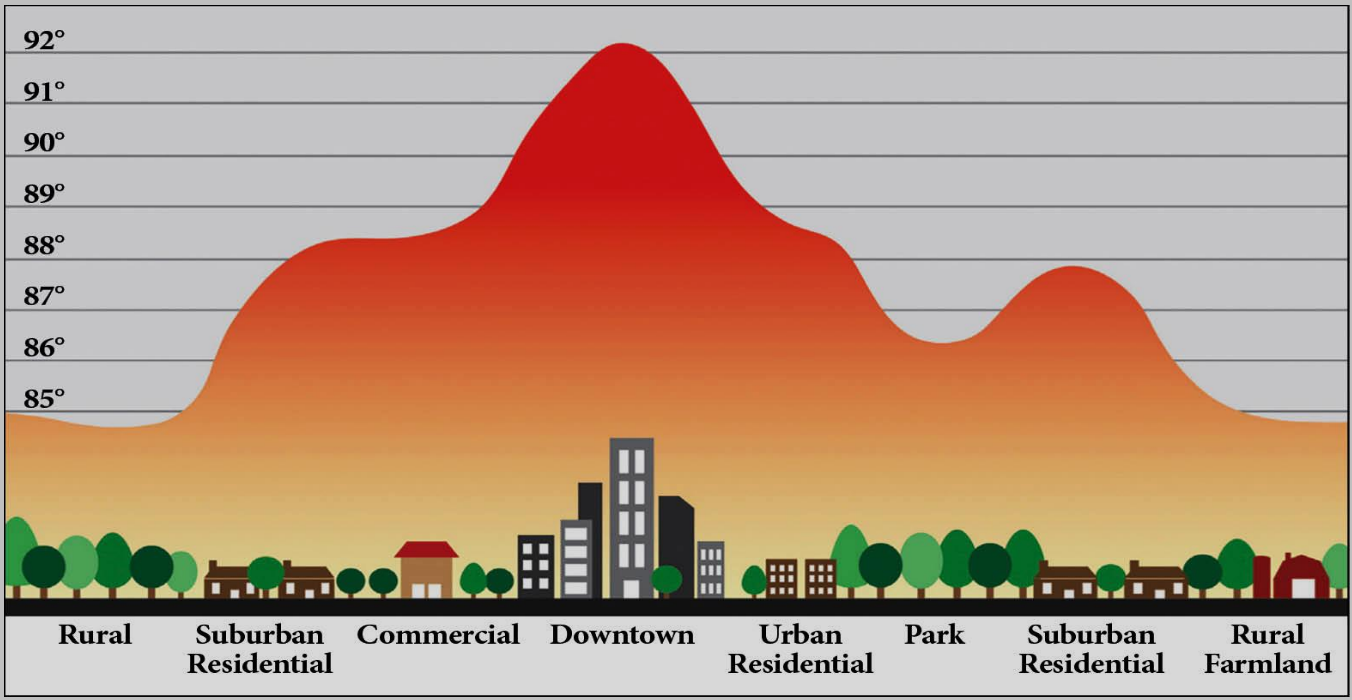
The ramifications of climate change on air quality have dire implications for respiratory well-being. Elevated air pollution levels and rising temperatures exacerbate respiratory ailments like asthma and COPD. The escalation of wildfires, a consequence of climate change, intensifies this issue by emitting harmful particulate matter and pollutants into the atmosphere. This exacerbates respiratory symptoms, leading to an increase in respiratory-related hospitalizations and deaths. Climate change also affects food and water security, affecting the health of individuals. Changes in temperature and rainfall patterns affect agricultural productivity, leading to crop failures and food shortages. This can result in malnutrition and undernourishment, especially among vulnerable populations, such as children, pregnant women, and the elderly. Flooding and extreme weather events may contaminate water sources, increasing the risk of waterborne diseases, such as cholera and dysentery, which further compromise public health. Climate-sensitive diseases do not affect all nations equally. They put a much greater burden on low- and middle-income countries (LMICs) and marginalized communities in wealthier nations. These communities often lack the necessary resources and infrastructure to handle the health consequences of climate change. They may not have access to healthcare services, proper sanitation facilities, or safe housing, making them more susceptible to climate-related health risks.

To address the challenges posed by climate change on global health, a comprehensive approach is necessary. This approach should integrate efforts toward public health, environmental conservation, and socioeconomic development. The initial phase of this strategy involves establishing robust surveillance systems capable of effectively monitoring and tracing the prevalence of climate-sensitive illnesses. This facilitates early identification and swift response to outbreaks. To achieve this, investment is necessary in healthcare infrastructure, capacity building, and the training of healthcare personnel, particularly in regions more susceptible to climate change effects. The subsequent phase entails implementing adaptation measures aimed at mitigating the health repercussions of climate change and increasing resilience. This encompasses enhancing water and sanitation infrastructure to ensure access to clean, safe drinking water, deploying early warning systems for extreme weather events, and advocating for climate-smart agricultural practices to enhance food security. Additionally, investment in resilient healthcare systems that can respond to climate-related emergencies is critical. Mitigating climate change is crucial to reducing the impact of climate-sensitive diseases in the long run. This entails transitioning to renewable energy sources, reducing greenhouse gas emissions, and enacting policies that foster sustainable development and environmental preservation. By addressing climate change, we can avert numerous health challenges linked to increasing temperatures and environmental decline. Combating climate-related illnesses necessitates collaboration among governments, policymakers, healthcare providers, researchers, and communities to prioritize health equity and sustainability. Awareness campaigns are important to generate support for climate action and encourage behavioral changes that promote better health. We must take immediate action to reduce the impact of climate change on human health and create more resilient and sustainable societies.

Emerging Urban Heat Islands: A Growing Concern

Sujan Mandal

The emerging phenomenon of Urban Heat Islands (UHIs) is a major concern in the context of climate change and its multifaceted effects on human habitats. UHIs are isolated regions in urban settings that are noticeably hotter than the surrounding semi-urban and rural areas. Although this phenomenon has been recognized for many years, current patterns suggest that more and more intense UHIs are appearing globally. Understanding this phenomenon's underlying mechanics is crucial before exploring newly discovered UHIs.



UHIs are becoming a major global issue in cities due to the consequences of both rapid urbanization and climate change. As cities grow, more people live there, paving over open areas and retaining heat. The consequences of rising temperatures and more frequent heat waves are two other ways that climate change exacerbates UHIs. Large expanses of concrete and asphalt seen in infrastructure development, such as roads, airports, and industrial zones, frequently concentrate heat, changing local microclimates and aggravating the impacts of UHI. Another aspect that leads to UHIs is social vulnerability; impoverished areas are more vulnerable to excessive heat because they have less access to cooling facilities, worse housing, and fewer green spaces.

Significant health hazards are associated with the emergence of new and intensified UHIs, including worsened heat-related illnesses, higher energy use, and environmental damage. There is a risk to vulnerable groups, including the elderly, kids, and people with underlying medical issues. Elevated temperatures exacerbate the consequences of UHI by taxing electricity networks and increasing greenhouse gas emissions. Local ecosystems are upset by UHIs, which also change the habitats of plants and animals and reduce biodiversity. Urban heat waves can potentially increase air pollution levels, endangering the environment and public health. Creating resilient and sustainable communities presents problems for urban planners, necessitating creative approaches to land use management, green infrastructure, and urban design.

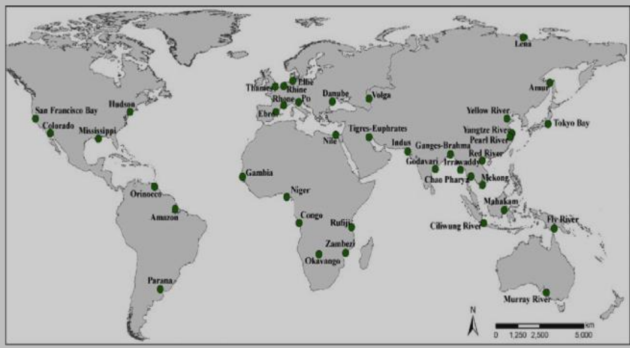
UHIs are new problems that call for a multimodal strategy involving community involvement, urban design, and climate adaptation. Parks, urban forests, and green roofs are examples of green infrastructure that can lower surface temperatures, increase evapotranspiration, and provide shade. Permeable pavements and cool roofing materials can also aid in lowering surface temperatures and heat absorption. To lessen the effects of UHI, local governments can implement laws requiring energy-efficient building practices, renewable energy consumption, and green building standards. To empower communities to adopt heat-resilient behaviors and increase understanding of the implications of UHI, community participation and education are essential. Moreover, addressing UHIs requires proactive mitigation strategies, community resilience, and sustainable urban development. By addressing UHI's root causes and implementing measures, cities can create healthier, more livable environments for future generations.

Future of the River Deltas

Abhijit Pal

River deltas are landforms, usually shaped like a triangle, by the deposition of sediment carried by rivers as they flow into slower-moving or stagnant water bodies. This occurs at a river mouth, when it enters an ocean, sea, estuary, lake, reservoir, or even another river that cannot carry away the sediment. It is so named because its triangle shape resembles the uppercase Greek letter delta.

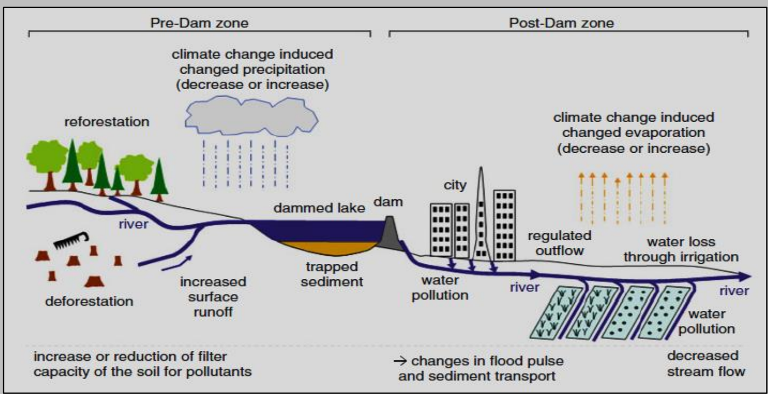
Sundarban delta at the confluence of Ganga and Brahmaputra rivers with Bay of Bengal in India and Bangladesh is the largest river delta of the world. Other large deltas of the world include Nile delta, situated in the Mediterranean Sea; the Mississippi delta in the Gulf of Mexico; the Volga delta in Russia as the river Volga empties into the Caspian Sea; the Indus delta in Pakistan where the river Indus meets the Arabian Sea; and the Mekong delta in Vietnam where river Mekong empites into sea through a network of distributories.



Largest river deltas of the world

Geologically, deltas act as carbon sinks over long periods; ecologically, these support diverse species depending on their landscape position; economically, they are major agricultural production centers that support large population; and culturally, the deltas present unique community culture of living together to survive against hazards of nature.

The deltas of the world are passing through enormous climatic and environmental challenges that threaten the delicate balance of these ecosystems. Sea level rise, a consequence of climate change, poses a significant risk to river deltas by increasing flood hazards, saltwater intrusion, and coastal erosion. Climate change increases the frequency and intensity of extreme weather events such as hurricanes, cyclones, and storm surges. These events can cause severe flooding, infrastructure damage, loss of life, and disruption to ecosystems and communities in river deltas. Changes in precipitation patterns, including shifts in the timing, intensity, and distribution of rainfall, affect river flows and sediment transport in deltas. This impacts sediment deposition, erosion rates, and the overall morphology of deltaic landscapes, influencing habitats and livelihoods. Dams, upstream reservoirs, and land-use changes can reduce the sediment supply to river deltas, leading to sediment starvation and land loss. This disrupts the natural processes of deltaic sedimentation and compromises the resilience of delta ecosystems and coastal protection systems.



Climate and environmental stressors of river deltas

Additionally, human activities such as urbanization, deforestation, agricultural intensification, and industrialization contribute to environmental degradation in river deltas, leading to reduced sedimentation, waste accumulation, land subsidence, and surface sealing. The loss of natural delta land further compounds the vulnerability of these ecosystems, impacting biodiversity and ecosystem services. Heterogeneous planning, competing sectoral responsibilities, and limited law enforcement complicate efforts to address the challenges faced by river deltas in the context of climate and environmental change.

Climate and environmental stressors threaten biodiversity in river deltas, leading to habitat loss, fragmentation, and degradation. This diminishes ecosystem resilience, reduces fisheries productivity, and undermines the provision of ecosystem services essential for human well-being and socio-economic development. Low-lying areas and coastal regions are particularly vulnerable to the adverse impacts of climate change, such as submergence, coastal flooding, and erosion due to sea-level rise susceptible to these impacts.

Addressing these climate and environmental stressors in river deltas requires integrated and adaptive approaches that consider the complex interactions between natural processes and human activities. This may include ecosystem-based adaptation, sustainable water management, coastal protection measures, and policy interventions aimed at enhancing resilience and promoting sustainable development in deltaic regions.

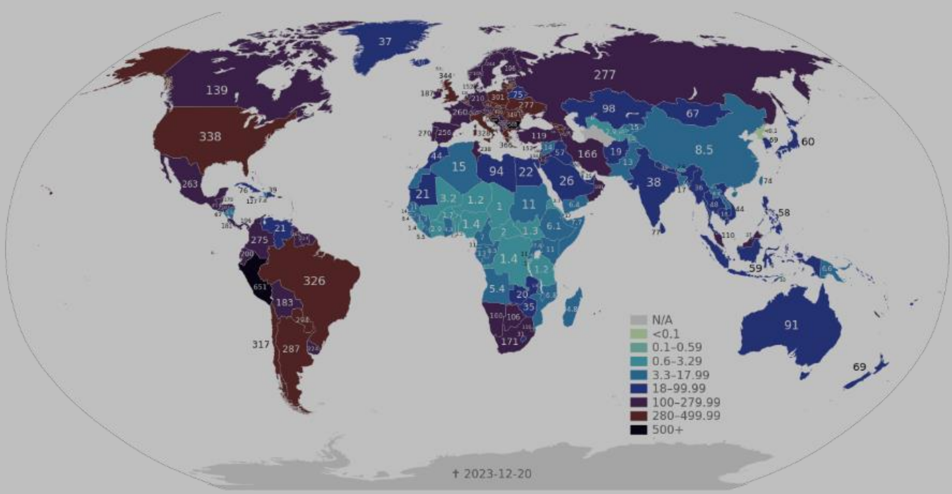
Pandemic in the Horizon

Dr. Saurabh Kole

As the world cautiously emerges from the grips of one global pandemic, the spectre of another looms ominously on the horizon, with a plethora of potential threats waiting to unleash chaos upon humanity. Despite the collective sigh of relief that accompanied the waning of the previous crisis, the harsh reality remains that infectious diseases continue to evolve and proliferate in our interconnected world. Every day, scientists and health experts tirelessly monitor the landscape for signs of the next potential threat, acutely aware that the next pandemic may already be brewing in the shadows.

The interconnectedness of our modern world, characterized by rapid globalization and unprecedented levels of travel and trade, serves as conduit for progress and potential breeding ground for contagion. As populations expand and encroach upon previously untouched ecosystems, the delicate balance of nature is disrupted, increasing the likelihood of zoonotic spillover events where pathogens make the leap from animals to humans. Climate change further exacerbates this precarious situation, altering ecosystems and potentially unleashing ancient pathogens frozen in the permafrost for millennia.

COVID-19 deaths per 100000 population



Meanwhile, antimicrobial resistance continues to erode the effectiveness of our most potent weapons against infectious diseases, rendering once-treatable infections increasingly difficult to manage. The convergence of these factors creates a perfect storm of conditions ripe for the emergence of new and deadly pathogens. From novel strains of influenza with pandemic potential to the resurgence of ancient diseases like the bubonic plague, the range of potential threats is vast and varied.

Emerging viruses such as flaviviruses, and filoviruses pose particular concerns because they can cause severe illness and spread rapidly among human populations. Moreover, the rise of synthetic biology and the potential for bioterrorism further complicate the landscape, as malicious actors seek to harness the power of biology for nefarious purposes. And yet, amidst the uncertainty and apprehension, a glimmer of hope exists.

Advances in technology and scientific understanding empower us to detect and respond to emerging threats with unprecedented speed and precision. From the rapid development of vaccines to the deployment of cutting-edge surveillance systems, humanity stands better prepared than ever before to confront the challenges that lie ahead. However, preparedness alone is not enough. As we stand on the precipice of an uncertain future, we must heed the lessons learned from past pandemics and prioritize collaboration, transparency, and equity in our collective response. The threat of a pandemic knows no borders of indiscriminately affecting rich and poor alike.

Only through global solidarity and a shared commitment to safeguarding the health and well-being of all people can we hope to navigate the turbulence of the pandemic on the horizon. The path forward will undoubtedly be fraught with challenges and obstacles, but if history has taught us anything, it is humanity possesses a remarkable resilience and capacity for adaptation in the face of adversity. As we confront the spectre of yet another pandemic, let’s draw strength from our collective resolve and unwavering determination to build a healthier, more resilient world for generations to come.

Global Conference on Environment and Disaster

(January – April 2024)
Compiled by Tazamin Sultana

60th Session of the IPCC (IPCC-60): 195 member countries had its 60th Session in Istanbul, Turkey from 16-19 January 2024 to discuss seventh assessment cycle and took important decisions about its work plan.

66th meeting of GEF Council: Washington, D.C. hosted the Council's 66th meeting from February 5–9, 2024. The GEF Council, comprised of 32 members chosen by member countries, approved a new work program for GEF Trust Fund.

14th Meeting of the Conference of the Parties to the Convention on Migratory Species of Wild Animals (CMS COP 14): The 14th Meeting of the Parties to the Convention on the Conservation of Migratory Species of Wild Animals took place in Samarkand, Uzbekistan. The conference covered a wide range of conservation priorities and new initiatives to support the implementation of the Global Biodiversity Framework.

UNEA-6 and OECPR-6: From February 26 to March 1, 2024, the UNEP headquarters in Nairobi, Kenya hosted the sixth session of the United Nations Environment Assembly, adopted 15 resolutions to promote cooperative action on the triple planetary crisis which are loss of nature, biodiversity, pollution, and waste.

10-Year Framework of Programmes for Sustainable Consumption and Production Board and SCP Partners Meeting: UN's 10YFP is a global commitment to sustainable consumption and production with 193 member states. It's the only universal cooperation framework to accelerate shift to sustainable consumption and production. The Board and Partners Meeting took place in Nairobi on 24 February 2024.

Beyond GDP through Inclusive Wealth | Tackling the planetary crisis better: This event was held on 26 February 2024 in Nairobi, Kenya. Here, the Presenters focused on natural capital and its human connections and produced capital as they talked about the lessons they had learned from creating inclusive and comprehensive wealth measures and their applicability to policymaking.

UN Plastics Treaty: Reuse - a Climate and Plastic Solution: On February 26, 2024, this event took place in Nairobi, to deliberate on the "reuse" component of the maxim "reduce, reuse, recycle". At this side event, speakers covered the opportunities and difficulties of promoting reuse systems, which have the potential to significantly reduce CO_2 emissions and reduce packaging production by 90%.

Blue Leaders High-Level Event on Biodiversity Beyond National Jurisdiction: On March 7, 2024, the Blue Leaders High-Level Event in Belgium urged countries to ratify a new treaty protecting the high seas from pollution, overfishing, and climate change. They plan to use the 2025 UN Ocean Conference to finalize the BBNJ Treaty. Nations like Nigeria, Norway, UK, Greece, Cape Verde, and Monaco participated.

39th UN-Water Meeting: 39th UN-Water Meeting in Rome on March 12–13, 2024, at IFAD headquarters, discussed the first UN system-wide water and sanitation plan, a follow-up to the 2023 UN Water Conference.

15th Meeting of the Monaco Blue Initiative: The 15th Monaco Blue Initiative, led by HSH Prince Albert II, convened on March 18, 2024, uniting ocean conservation stakeholders to address future challenges. Discussions covered past achievements, future goals, private sector involvement in ocean resilience, and fostering a sustainable blue economy.

2024 Ocean Decade Conference: On 10-12 April 2024 UN Ocean Decade Conference in Barcelona, hosted by Spain and co-organized with UNESCO. The Barcelona Statement highlights three key areas: advancing ocean knowledge, enhancing infrastructure for monitoring and observations, and embracing collaborative approaches.

Global Stocktaking on Sustainable Energy (SDG7): On April 19, 2024, the UN General Assembly sponsored an event aimed at advancing Sustainable Development Goal 7 and the Paris Climate Agreement. This event focused on fostering multi-stakeholder partnerships to promote affordable, clean energy access for all and accelerate energy transitions. It encouraged voluntary commitments like Energy Compacts to reduce the energy gap and drive sustainable energy initiatives forward.

4th Session of the Intergovernmental Negotiating Committee to Develop an International Legally Binding Instrument on Plastic Pollution, Including in the Marine Environment (INC-4): From April 23 to 29, 2024, in the Shaw Center in Ottawa, Canada, the Intergovernmental Negotiating Committee will hold its fourth session with the goal of developing an international legally binding instrument on plastic pollution, including in the marine environment (INC-4). Regional consultations are scheduled for April 21, 2024, ahead of the session.

Global Disaster Updates

(January – April 2024)

Compiled by Akash Chakraborty

Based on the global disaster database maintained by the EM-DAT, the world has witnessed 99 disasters during the first quarter of 2024, of these 77 were natural and 22 were technological disasters. As usual floods remained the most occurred disaster. Total, 1885 persons lost their lives and 12.05 million people were affected. The following is a brief overview of the most important disasters during this period-

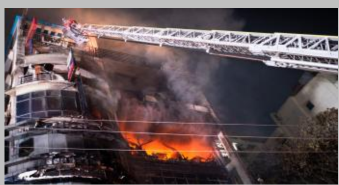
Chile Wildfire- Chile wildfire broke out in the month of February, and continued for 7 days. This affected the central and southern regions of Chile. The affected area was more than 43,000 hectares and 14,000 houses were engulfed by fire. This event took 431 lives and 27600 people were affected. This disaster was regarded as the deadliest disaster in the country since the 2010 Chile earthquake.

Japan Earthquake- On the first day of 2024, an earthquake with a magnitude of 7.5 occurred near the northern coast of the Noto Peninsula on the west coast of Honshu, Japan. The quake caused severe shaking in Nanao area, with light shaking in Tokyo. This also promoted tsunami waves of 3ft. One of the major city affected was Wajima. This disaster caused 241 deaths and 33091 affected. The estimated economic loss was $17.6 billion.

Philippines Landslide- This landslide occurred on February 6th due to heavy rainfall in Maco Municipality. An estimated 9.8 hectares of land was buried by rocks, mud and trees that slid over 700 meters down a steep mountain. The transit terminal, where the buses were parked, had been buried by the landslide. According to an official, the landslide reached a height that can "almost cover a two-story building". This event took 128 lives and 1.40 million people got affected.

Northern American Winter storm- This winter storm started to show its affect from 9th Jan, It was originated as extratropical cyclone and brought heavy snowfall and ice accumulation near coastline areas. Due to this areas that normally did not receive frozen precipitation were affected adversely. Cities like New York, Washington D.C. and Philadelphia saw their first accumulating snowfall over 2.5 cm in nearly two years. This disaster was a combination of bitterly cold and winter storm, resulted at least 92 deaths.

Indonesia Landslide- This event was triggered by heavy rainfall (300 mm in 6 hrs) in Sumatra Province from 1st March 2024. This heavy rainfall also caused flood that swept through Padang City and affected around 10,000 homes. At least 51 people lost their lives and 500012 people were affected. The reported damage was over 30,000 homes, 26 bridges, 45 buildings of worship and 25 schools. Economic loss was estimated around $23 million.



Dhaka Fire Accident- This man-made accident took place on 29th February in a restaurant on the first floor of the Green Cozy Cottage Shopping Mall in the city of Dhaka. Many survivors were rescued but at least 42 people were confirmed dead and 3 injured persons died later. 75 persons sustained burn and other injuries.

Mmamatlakala Transport Accident- This accident occurred when a passenger bus crashed near Mmamatlakala in Limpopo, the northernmost province of South Africa on 28th March. This accident happened when the driver lost control and the bus went over a bridge and then caught on fire. This accident killed 45 people and left an eight-year-old girl, who sustained serious injuries, as the sole survivor.

Liangshui Landslide- This disaster took place on 22nd January in Liangshui Village in Zhenxiong County, Yunnan Province of China. The cause of triggering this landslide is unknown but it is reported that 44 people from 18 households were buried in the landslide and 500 persons got affected.

CROSSING PLANETARY BOUNDARIES

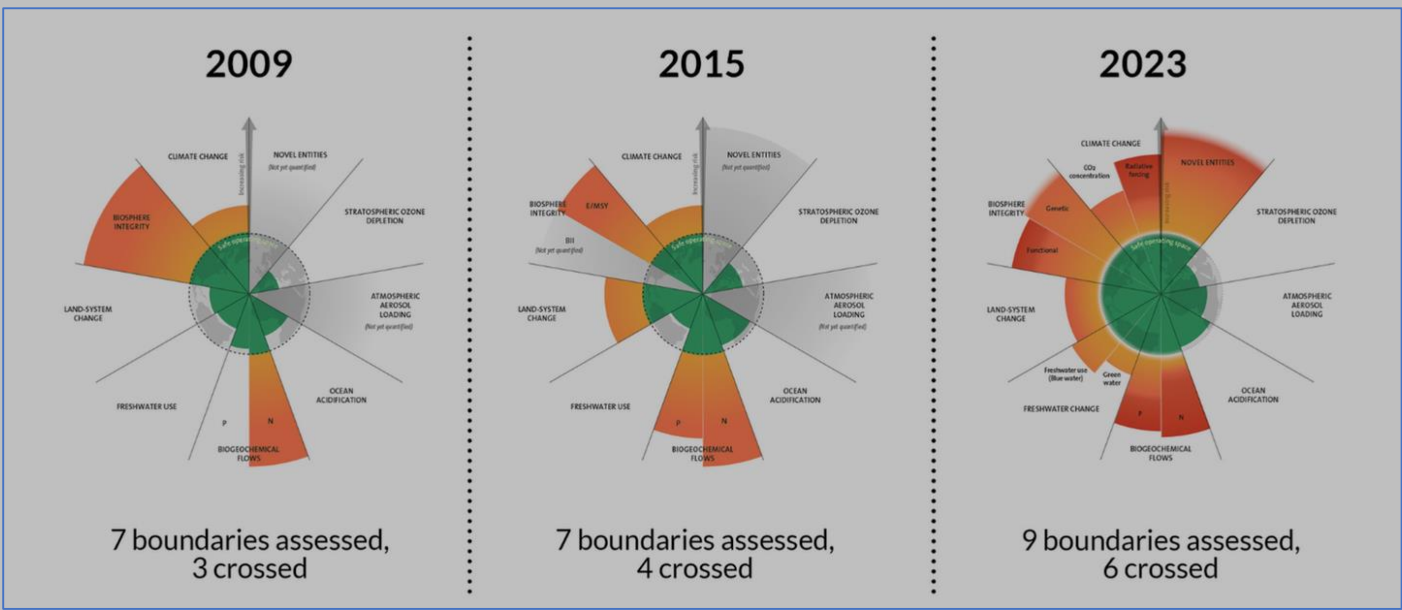
Ditsa Maity

The concept of Planetary Boundaries revolves around a set of nine boundaries of ‘safe operating space’ within which humanity can continue to develop and thrive for generations to come. These boundaries define limits of human activity within the system of planet Earth. Transgressing these limits may have devastating consequences for the system. The concept was first proposed in 2009 by a group of 28 internationally renowned scientists led by Johan Rockström, then Director of Stockholm Resilience Centre and has undergone several revisions thereafter.

The nine planetary boundaries are and the quantified limits of these boundaries are the following:

1) **Climate change** (CO_2 concentration in the atmosphere < 350 ppm and/or a maximum change of +1 W/m^2 in radiative forcing);
2) **Biogeochemical flows** in the nitrogen and phosphorus cycle (limit industrial and agricultural fixation of N_2 to 35 Tg N/yr) and phosphorus (P) cycle (annual P inflow to oceans not to exceed 10 times the natural background weathering of P);
3) **Global freshwater use** (< 4000 km^3/yr of consumptive use of runoff resources);
4) **Land system change** (< 15% of the ice-free land surface under cropland);
5) **Biosphere integrity** (an annual rate of loss of biological diversity of < 10 extinctions per million species).
6) **Chemical pollution** (introduction of novel entities in the environment);
7) **Ocean acidification** (mean surface seawater saturation state with respect to aragonite ≥ 80% of pre-industrial levels);
8) **Stratospheric ozone depletion** (less than 5% reduction in total atmospheric O_3 from a pre-industrial level of 290 Dobson Units);and
9) **Atmospheric aerosol loading**;(no quantified limit was fixed)

Scientists assessed these boundaries in 2009, 2015 and 2023 and the results are presented in the diagram below:



Hence there has been progressive deterioration in position of the boundaries. In 2009 boundaries of safe operating space were transgressed in respect of climate change, biochemical flows and bio-diversity, in 2015 land system change were added and in 2023 two more boundaries were crossed - global freshwater use and chemical pollution. Only three boundaries – ozone depletion, ocean acidification and atmospheric aerosol cooling – are still within the limits of safe operating space.

The concept of Planetary Boundaries has been criticized for its oversimplified model particularly in the context of uncertainties on projections on various parameters of earth system. The concept has also been assailed for its lack of clarity on how different planetary boundaries relate to each other. Nonetheless the concept has become influential in working out the health of earth system Follow up studies have been undertaken to work out the limits of planetary boundaries at regional and national levels. This has encouraged studies on ecological footprints.

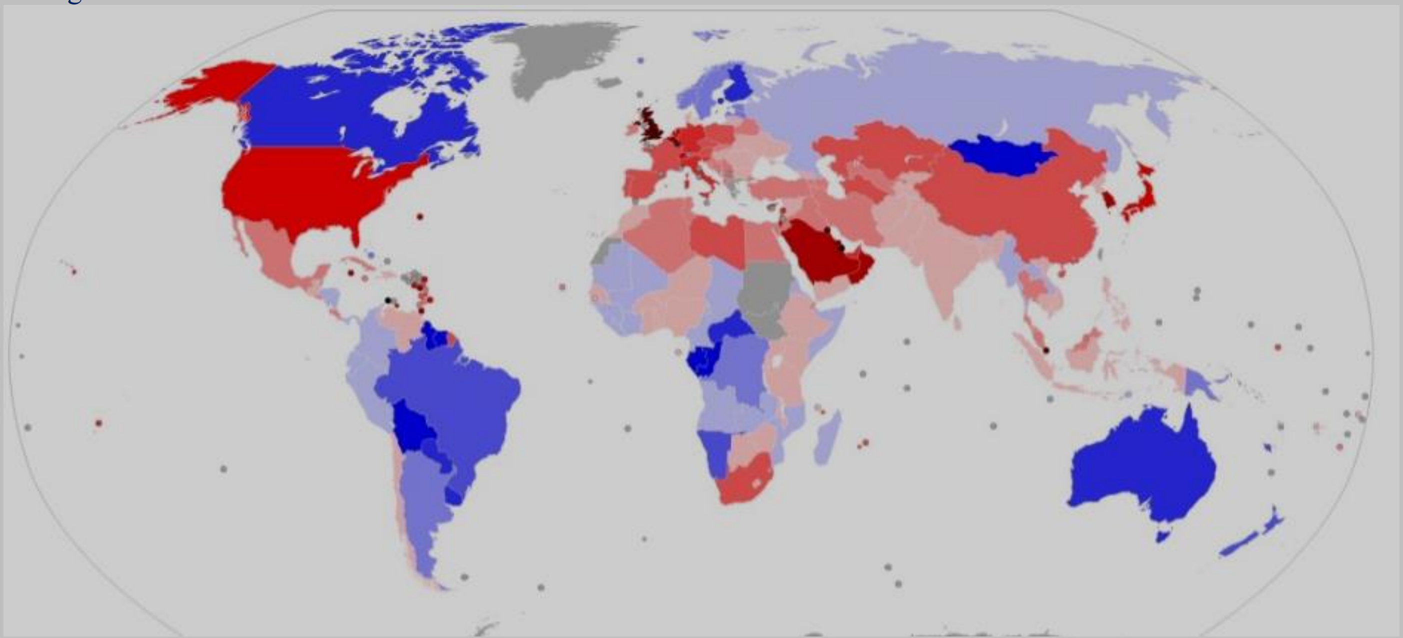
Ecological Footprint

V Rohit Kumar

Ecological Footprint is a resource accounting tool that measures human demand on natural capital i.e, the quantity of nature consumed to support people and their economies. Almost every human activity places demands on the planet's capacity, including the provision and processing of food, the construction and maintenance of housing, transportation, and the consumption of goods and services. The planet earth has its inherent capacity to regenerate. When human demands exceeds the bio-capacity of the earth to regenerate, the nature capital is stressed. When the natural capital is stressed beyond its capacity to regenerate, the ecological and environmental crisis begins. Ecological Footprint accounting can measure the extent to which human activities operate within the means of our planet. It is a central metric for sustainability.

The ecological footprint concept and calculation method was developed as the PhD dissertation of Mathis Wackernagel, in collaboration with his supervisor Prof. William Rees at the University of British Columbia in Vancouver, Canada, In 1996, Wackernagel and Rees published the book *Our Ecological Footprint: Reducing Human Impact on the Earth.*

The methodology of ecological Footprint was further revised, improved and adopted by the Global Footprint Network, a global think tank, which developed standards to make results comparable across countries and communities. Applying these standards Ecological Footprint can be compared at the individual, regional, national or global scale. At a global scale, footprint assessments show how big is humanity's demand, as compared to what Earth can renew. Global Footprint Network estimates that, as of 2022, humanity has been using natural capital 71% faster than what planet Earth can renew, which means that humanity's ecological footprint corresponds to 1.71 planet Earths. This overuse is called ecological overshoot.



National ecological footprint, surplus or deficit, is measured as country's bio-capacity minus its ecological footprint per person.

x ≤ -9 | -9 < x ≤ -8 | -8 < x ≤ -7 | -7 < x ≤ -6 | -6 < x ≤ -5 | -5 < x ≤ -4 | -4 < x ≤ -3 | -3 < x ≤ -2 | -2 < x ≤ -1 | -1 < x < 0 | 0 ≤ x < 2 | 2 ≤ x < 4 | 4 ≤ x < 6 | 6 ≤ x < 8 | 8 ≤ x | Data unavailable

Every year Earth Overshoot Day is observed on the day when humanity has exhausted nature's budget for the year. In 2014, Earth Overshoot Day was August 19, in 2015 on August 13, in 2016 on August 8 in 2016, in 2017 on August 2, and in 2020 on August 22. In 2020 the calculated overshoot day fell more than three weeks later than 2019 due to coronavirus induced lockdowns around the world. In 2023 it reversed again on August 2.

A number of national government agencies have performed collaborative or independent research to test the reliability of the ecological footprint accounting method and its results. They have largely confirmed the accounts. Such reviews include those of Switzerland, Germany, France, Ireland, the United Arab Emirates, and the European Commission. Top 10 countries with highest Ecological Footprints in GHA (Global Hectare Area) are Qatar 14.72, Luxembourg 12.79, United Arab Emirates 8.95, Bahrain 8.66, Trinidad and Tobago 8.23, Canada 8.08, Mongolia 8.05, United States 8.04, Kuwait 8.03, and Bermuda 8.00.

Beyond Boiling: The Alarming Rise in Global Temperatures

Arundhatii Aich

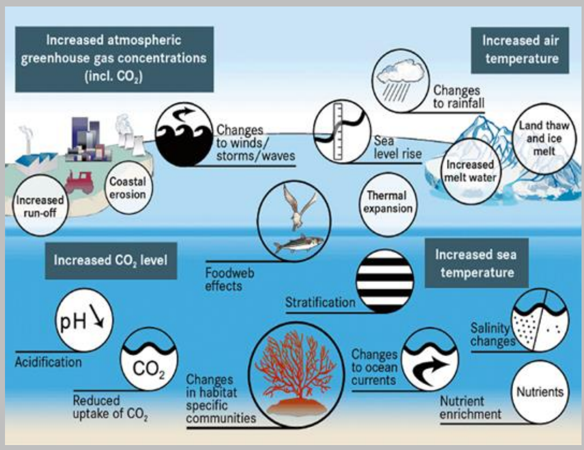
In the past few decades, the Earth has been experiencing a worrying trend: a gradual increase in temperature. This is known as global warming or climate change and is not just an environmental issue, but a crisis that affects all aspects of life on our planet. The effects of rising temperatures are becoming more apparent, from the depths of the oceans to the icy peaks of mountains, and are shaping our present and future negatively. The oceans, which are an essential element of our planet, are experiencing the negative consequences of the rise in global temperatures. The increase in sea temperatures not only disrupts marine ecosystems but also intensifies the frequency and severity of extreme weather events such as hurricanes and cyclones. Coral reefs, which are vital habitats that are teeming with biodiversity, are becoming bleached and dying due to the stress induced by warmer waters. This not only endangers marine life but also threatens the livelihoods of millions of people who depend on fisheries for sustenance. At the same time, the once-frozen expanses of polar ice caps and mountain glaciers are melting at alarming rates. This rapid ice loss contributes to rising sea levels, which poses a grave threat to coastal communities worldwide. The inundation of low-lying areas, coupled with the increased risk of flooding and land subsidence, presents a stark reality of climate refugees and displaced populations.


Environment

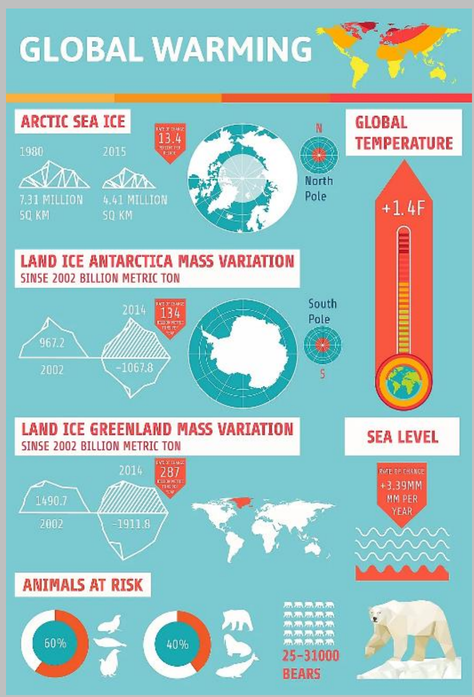
Climate change may see one in four US steel bridges collapse by 2040

By Ruby Prosser Scully

23 October 2019



The consequences of global warming go beyond what is visible. Beneath the frozen layers of permafrost, there are dormant microorganisms that could release ancient pathogens upon thawing. This could lead to the emergence of new diseases and pose a potential health crisis. Additionally, the rise in temperatures creates favorable conditions for parasites that carry diseases, posing a risk to global food security and exacerbating existing challenges of hunger and malnutrition. The warming trend also disrupts the delicate balance of seasonal cycles, leading to erratic weather patterns. Prolonged summers, reduced rainfall, and extreme winters become the new norm, disrupting ecosystems and agricultural practices. Migratory birds, finely attuned to the timing of seasons, face extinction as their habitats undergo rapid changes. Furthermore, staple crops struggle to adapt to altered growing conditions, affecting food production and necessitating changes in dietary habits. Moreover, the impact of rising temperatures extends to infrastructure, particularly those made of metals. Increased temperatures can weaken metal structures, compromising their integrity and safety. This poses significant challenges for urban areas and critical infrastructure systems such as transportation networks and energy grids.



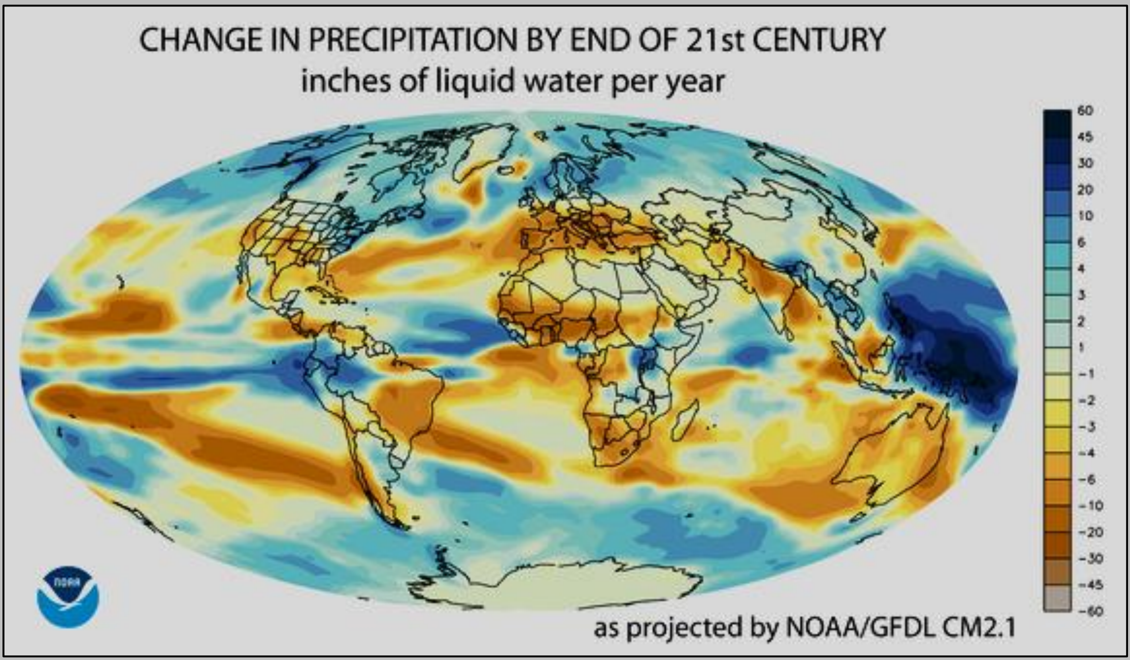
The increasing global temperature is not a distant threat; it is a pressing reality that has far-reaching consequences. It demands urgent and concerted action from individuals, communities, and governments worldwide. Mitigation measures, along with adaptation strategies, are essential to address the multifaceted challenges posed by climate change. Only through a collective effort and global cooperation can we hope to safeguard our planet and secure a sustainable future for generations to come.

Navigating Uncertain Precipitation Patterns

Pinanki Das

Weather, that ever-changing force of nature, often leaves forecasters grappling with uncertainty, particularly when it comes to precipitation. Rain, snow, sleet, and hail – the forms precipitation takes are as diverse as the atmospheric conditions that produce them. Understanding and predicting these phenomena is crucial for a multitude of sectors, from agriculture to transportation, yet the inherent unpredictability of precipitation poses significant challenges. At the heart of the matter lies the complexity of atmospheric dynamics. Weather systems are influenced by a myriad of factors, including temperature, humidity, air pressure, and wind patterns. These variables interact in intricate ways, giving rise to the unpredictable nature of precipitation events. Forecasters rely on sophisticated models and data analysis techniques to make sense of this complexity, but even the most advanced tools cannot eliminate uncertainty.

One of the primary sources of uncertainty in precipitation forecasting is the inherent variability of atmospheric conditions. Small changes in temperature or humidity can have significant effects on the type and intensity of precipitation. Additionally, the presence of atmospheric disturbances such as fronts, low-pressure systems, and atmospheric rivers adds another layer of complexity to the forecasting process. These dynamic features can rapidly alter precipitation patterns, making it challenging to provide accurate predictions. Another factor contributing to uncertainty is the limited spatial and temporal resolution of weather models. While modern forecasting techniques have vastly improved our ability to predict weather patterns, there are still limitations in our ability to capture small-scale phenomena. This is particularly evident in regions with complex terrain or microclimates, where local factors can exert a strong influence on precipitation outcomes. As a result, forecasts for these areas often carry a higher degree of uncertainty.



Furthermore, the role of climate change introduces additional challenges to precipitation forecasting. As global temperatures rise, the hydrological cycle is being disrupted, leading to shifts in precipitation patterns and intensities. Extreme weather events, such as heavy rainfall and severe storms, are becoming more frequent and unpredictable, further complicating forecasting efforts. Climate models offer valuable insights into long-term trends, but predicting the exact impacts of climate change on precipitation at a regional level remains a formidable task.

In the face of such uncertainty, meteorologists employ a range of strategies to improve the accuracy of precipitation forecasts. Ensemble forecasting, which involves running multiple simulations with slight variations in initial conditions, allows forecasters to assess the likelihood of different outcomes and quantify uncertainty. Advanced data assimilation techniques integrate observations from various sources, such as satellites, weather stations, and radar systems, into numerical models, enhancing their predictive capabilities. Machine learning algorithms are also being increasingly utilized to analyse large datasets and identify patterns that traditional methods may overlook.

Despite these advancements, uncertainty will always be a fundamental characteristic of precipitation forecasting. Weather is inherently dynamic, governed by nonlinear processes that defy complete understanding. As such, forecasters must remain vigilant, continuously refining their methods and embracing new technologies to navigate the complexities of uncertain precipitation. While we may never eliminate uncertainty, with dedication and innovation, we can strive to provide more reliable forecasts that empower individuals and communities to prepare for whatever the skies may bring.

Melting Glaciers, Ice Sheets and Permafrost

Aninda Haty

Across the planet, due to the impacts of global warming, ice is disappearing rapidly - from mountain tops, the poles, the ice seas, and the tundras. The Arctic is warming four times faster than the rest of the planet, and this means that glaciers, which sit on land, and sea ice, which floats on the ocean surface, are melting rapidly. Two-thirds of Arctic Sea ice has disappeared since 1958 when it was first measured. Between 2000 and 2019, the world's glaciers lost 267 billon tons of ice each year. Himalayan glaciers are on a trajectory to lose one-third of their ice by 2100, and Alpine glaciers are projected to lose half of theirs.

As glaciers melt, the additional water contributes a significant volume to the oceans, threatening coastal communities worldwide. Island nations and low-lying areas face potential inundation, displacing millions and forcing mass relocations. Infrastructure near coastlines, from ports to entire cities, could be submerged or require expensive upgrades to withstand rising tides.

The impact extends beyond coastlines. Glaciers act as natural reservoirs, storing freshwater and releasing it gradually throughout the year. With accelerated melting, this vital source of freshwater for rivers and irrigation systems could vanish much faster, leading to water scarcity and impacting agriculture in many regions. This, coupled with changing weather patterns caused by climate change, could lead to food insecurity and conflict over limited resources.

Ecosystems dependent on glacial melt water will also be severely disrupted. From the mighty rivers fed by Himalayan glaciers to the delicate Arctic tundra, the loss of this freshwater source will affect a vast array of plant and animal life. Species depending on seasonal meltwater for migration or breeding could face extinction. In turn, these changes will disrupt entire food webs, further jeopardizing biodiversity.

Global warming is also causing the thawing of permafrost—ground that remains frozen for two or more consecutive years - at high latitudes and high altitudes, mainly in Siberia, the Tibetan Plateau, Alaska, Northern Canada, Greenland, parts of Scandinavia and Russia. Permafrost, some of which has been frozen for tens or hundreds of thousands of years, stores the carbon-based remains of plants and animals that froze before they could decompose. Scientists estimate that the world's permafrost holds 1,500 billion tons of carbon, almost double the amount of carbon currently in the atmosphere. As permafrost thaws, the microbes within consume the frozen organic matter and release carbon dioxide and methane into the atmosphere. This accelerates warming, precipitating even more permafrost thaw in an irreversible cycle. Scientists project that two-thirds of the Arctic's near-surface permafrost could be gone by 2100.

The future, however, isn't entirely bleak. Melting glaciers opens up new opportunities. New shipping routes opened by melting ice in the Arctic could reduce the travel time between Asia and Europe substantially. The Arctic routes are 30 to 50 percent shorter than the Suez Canal and Panama Canal routes and can cut travel time by 14 to 20 days. Ships will thus be able to reduce their greenhouse gas emissions by 24 percent, while saving money on fuel and ship wear and tear. New mining opportunities in previously inaccessible areas and in the deep sea will make it possible to obtain the quantities of rare and precious metals needed to transition to a clean energy economy.

As the planet warms, some countries and regions will benefit, for example, Siberia will likely become a huge wheat producer, and Canada a major wine producer, but ultimately, these relatively small potential benefits of a few countries cannot outweigh the enormous negative impacts climate change will have on most of the countries and communities around the planet earth.

The melting glaciers are a stark reminder of the consequences of decades of inaction for reducing emission of greenhouse gases. They serve as a call for effective and sustained global action to protect our planet. By implementing innovative solutions and taking decisive action to curb climate change, we can chart a course towards a future where these majestic ice giants in the poles and mountains continue to grace our landscapes and provide life-sustaining resources for generations to come.

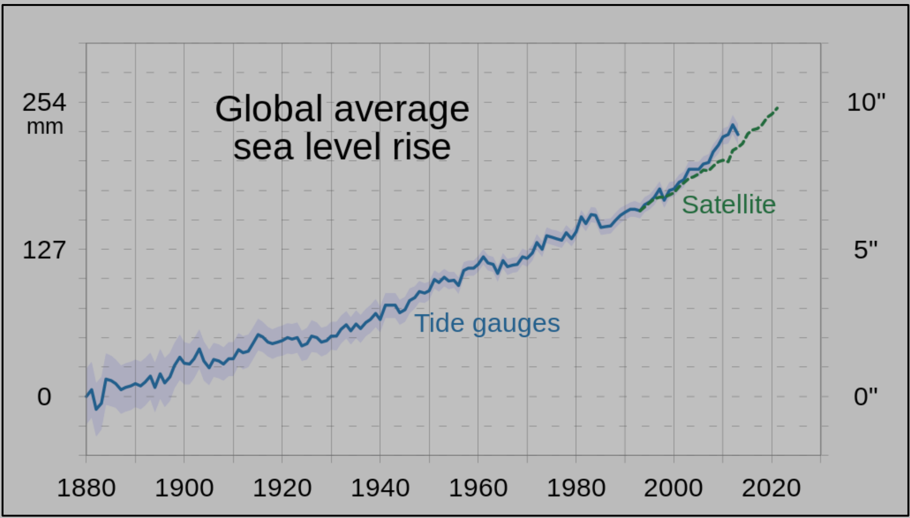
Sea Level Rise

Rasmoni Karak

There has not been any significant rise in sea level during the two millennia of recorded history of the pre-industrial age. During the past hundred years, the average rise in sea level in different oceanic systems has been increasing steadily. Tide gauges and altimetry observations show that between 1901 and 2018, Global Mean Sea Level (GMSL) rose by 15–25 cm (6–10 in), an average of 1–2 mm (0.039–0.079 in) per year. This rate accelerated to 4.62 mm (0.182 in)/yr for the decade 2013–2022. In 2022, GMSL was 101.2 millimetres (4 inches) above 1993 levels, making it the highest annual average in the satellite record.

The global mean water level in the ocean rose by 0.14 inches (3.6 millimeters) per year from 2006–2015, which was 2.5 times the average rate of 0.06 inches (1.4 millimeters) per year throughout most of the twentieth century. By the end of the century, global mean sea level is likely to rise at least one foot (0.3 meters) above 2000 levels, even if greenhouse gas emissions follow a relatively low pathway in coming decades.

In some ocean basins, sea level has risen as much as 6-8 inches (15-20 centimeters) since the start of the satellite record. Regional differences exist because of natural variability in the strength of winds and ocean currents, which influence how much and where the deeper layers of the ocean store heat.



According to the IPCC, rise in sea level rise lags behind changes in the Earth's temperature, and sea level rise will therefore continue to accelerate between now and 2050 in response to warming that has already happened. What happens after that depends on human greenhouse gas emissions. Sea level rise would slow down between 2050 and 2100 if there are very deep cuts in emissions. It could then reach slightly over 30 cm (1 ft) from now by 2100. With high emissions it would accelerate. It could rise by 1.01 m (3+⅓ ft) or even 1.6 m (5+⅓ ft) by then. In the long run, sea level rise would amount to 2–3 m (7–10 ft) over the next 2000 years if warming amounts to 1.5 °C (2.7 °F). It would be 19–22 metres (62–72 ft) if warming peaks at 5 °C (9.0 °F).

Global warming is causing GMSL to rise in two ways. First, glaciers and ice sheets worldwide are melting and adding water to the ocean. Second, the volume of the ocean is expanding as the water warms. A third, much smaller contributor to sea level rise is a decline in the amount of liquid water on land - aquifers, lakes and reservoirs, rivers, soil moisture. This shift of liquid water from land to ocean is largely due to people depleting ground water. Between 1993 and 2018, thermal expansion of water accounted for 42% of sea level rise. Melting temperate glaciers accounted for 21%, while polar glaciers in Greenland accounted for 15% and those in Antarctica for 8%.

Many low-lying coastal cities, small islands and river deltas on confluence with seas at most latitude will experience extreme climatic events (tropical cyclones, flooding, erosion, and salinity intrusion) and by 2050 it will most certainly submerge many low-lying islands and coastal areas, many small island territory of several countries have already submerged. Kiribati is the first small island state in the Pacific Ocean that will be submerged. More than half of the Ghoramara Island in West Bengal has gotten submerged, and just like this, many more islands are battling for survival. Anthropogenic non-climatic drivers will magnify the exposure and vulnerability of coastal communities to future sea level rise. This would force vulnerable communities to migrate to highlands, across regional and national borders as climate refugees.

Coastal ecosystems will be affected adversely in multiple ways, such as habitat contraction, loss of functionality, loss of bio-diversity and loss of mangroves. Salt water ingress into soil and sub-soil, and surface and sub-surface water, will affect agriculture, inland fisheries, and supply of potable water, challenging food and nutritional security.

Adapting to sea level rise in the coasts, small islands, and river deltas at the confluence of seas will be a challenging and daunting task in the years and decades ahead.

Extinction of Species

Tazmin Sultana

Extinction of species has become a major concern nowadays. It happens when the last individual of a particular species dies, and no new offspring are left. There can be various reasons for extinction, such as poor health, aging, a shortage of individuals, or other factors. This not only affects biodiversity and ecosystems but also has an impact on human societies. Extinct species are quite common, and fossils of extinct species are found frequently. Scientists believe that at least 99.9% of all plant and animal species that have existed are now extinct. There are four types of extinction: biological extinction, ecological extinction, mass extinction, and local extinction. Biological extinction is the first stage of irreversible extinction of a species. Ecological extinction is a situation where the population of a species drops to an extremely low level. Mass extinction occurs when a species disappears much more quickly than it is replaced. Local extinction is when a species of plant or animal disappears from a particular research location, while still present elsewhere.

Mass extinction is a rare phenomenon that occurs only when a major catastrophe happens. It is defined as a time when the pace of extinction is significantly higher than usual. Both magnitude and rate serve to define it. The magnitude is the fraction of extinct species, whereas the rate is the speed at which things take place. Only five mass extinctions have occurred on Earth, which are as follows:

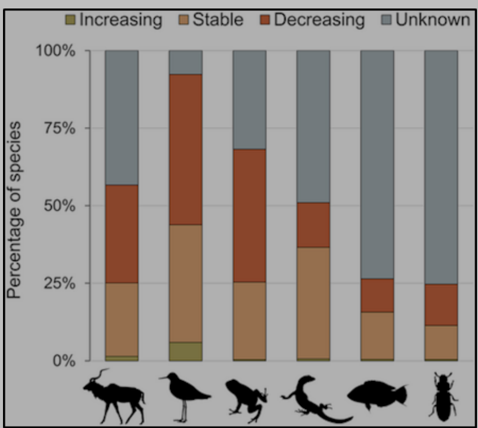
- *Ordovician-Silurian (444 million years ago):* Killed many marine creatures and wiped out 85% of species on Earth.
- *Devonian (365 million years ago):* Killed many marine invertebrates and wiped out 75% of species on Earth.
- *Permian-Triassic (250 million years ago):* The largest mass extinction event in Earth's history affected a range of species. Over 95% of species on Earth died in what was either a volcanic explosion or asteroid striking the Earth.
- *Triassic-Jurassic (210 million years ago):* Killed many types of dinosaurs and wiped out 80% of species on Earth.
- *Cretaceous-Tertiary (65 million years ago):* Killed the remaining dinosaurs and wiped out 78% of species on Earth. Dinosaurs went extinct about 65 million years ago in that phase.

At present, we are witnessing the sixth extinction, which is primarily caused by human activities including human-induced climate change. Jacquelyn Gill, a paleoecologist at the University of Maine, states that this is a geologically unprecedented event and we are trying to understand it as it unfolds. Professor Stuart Pimm, from Duke University, adds that we are on the verge of something that has never happened before. We are facing the largest extinction of species since the Dianosaur age. Several factors have combined to result such unprecedented kind of extinction. These include loss of habitats, climate change, and overexploitation of natural resources, pollution, invasive species, and disease.

To sum up, the extinction of species is a serious problem that needs immediate attention from everyone. We have to take action now to preserve biodiversity and safeguard the naturally occurring balance of ecosystems. By implementing changes in laws that promote conservation, modifying land use patterns, and reducing greenhouse gas emissions to combat climate change, we can slow down the rate of extinction. However, we need to act quickly because there isn't much time for these changes to have an effect.

Extinction species over the time (1690-2004)

1690 Dodo bird	extinct from predation by introduced pigs and cats
1768 Stellar's sea cow	extinct from hunting for fur and oil extinct from hunting for fur and oil
1870 Labrador duck	extinct from human competition for mussels and other shellfish
1900 Rocky mountain locust	extinct from habitat conversion to farmland
1936 Thylacine (Tasmanian tiger or wolf)	extinct from hunting, habitat loss, and competition with dogs
1952 Deepwater cisco fish	extinct from competition and predation by introduced fishes
1962 Hawaii chaff flower	extinct from habitat conversion to military installations
1989 Golden toad	extinct from climate change or other impacts
2004 St. Helena olive tree	extinct from logging and plantations



The given data sourced from IUCN Red List shows the percentage of species in different taxonomic groups that have decreasing, stable, increasing, unknown or population trends. The groups are represented by silhouettes from left to right, namely mammals (N= 5969), birds (N=11162), amphibians (N =7316), reptiles (N = 10150), fishes (N = 24356), and insects (N = 12161). Every homo sapien has the moral responsibility to prevent the sixth extinction of species.

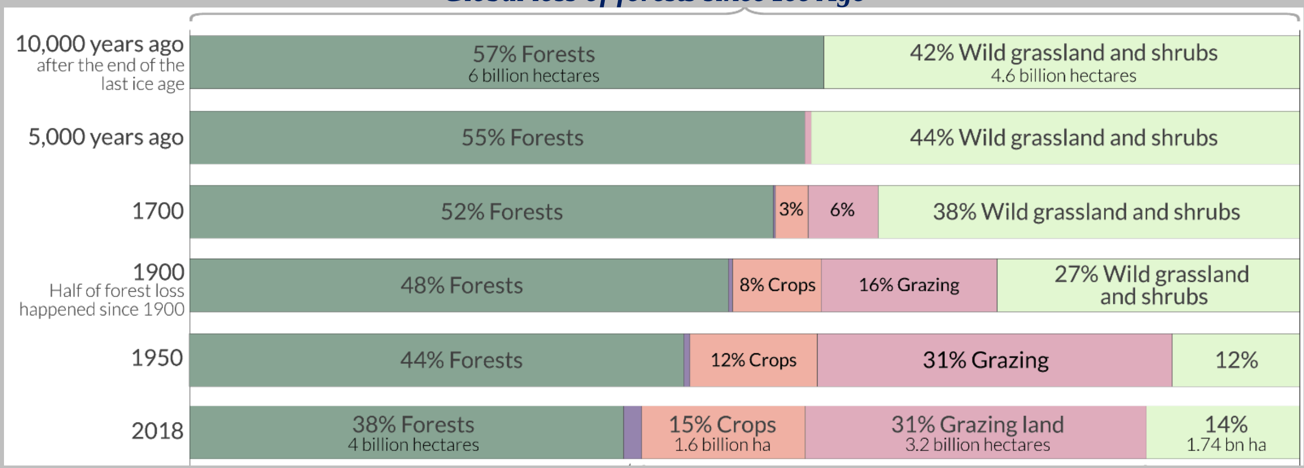
The Fading Green: An Alarming Rate of Forests Loss

Akash Chakraborty

Forests, often referred to as the lungs of the Earth, stand as magnificent havens teeming with diverse life. They serve as sanctuaries for a plethora of species, from the tiniest ants to the most majestic elephants. Forests play a pivotal role in maintaining ecological equilibrium - fostering biodiversity, protecting soils, conserving water, sinking carbon, producing oxygen's and combating climate change. Hosting more than 80% of terrestrial species, forests provide sustenance for over 1.6 billion people, with approximately 70 million indigenous people who are forest dwellers. Their importance is immeasurable and vast. Deforestation involves the wholesale clearing of forests for agricultural, grazing, mining, infrastructure or other purposes. Conversely, forest degration or denudation refers to the stripping away of vegetation cover, due to shifting cultivation, forest fire and extraction of trees in patches, not necessarily entailing the complete removal of trees as seen in deforestation.

According to UNFAO, at the beginning of 1990 48 percent of the habitable land surface of earth (14.9 billion hectres) was covered by forests. Over the past 123 years over 1.01 billion hectres of forests were lost due agriculture, grazing, mining and purposes, registering an average loss of 8.1 million hectres of forest every year.

Global loss of forests since Ice Age

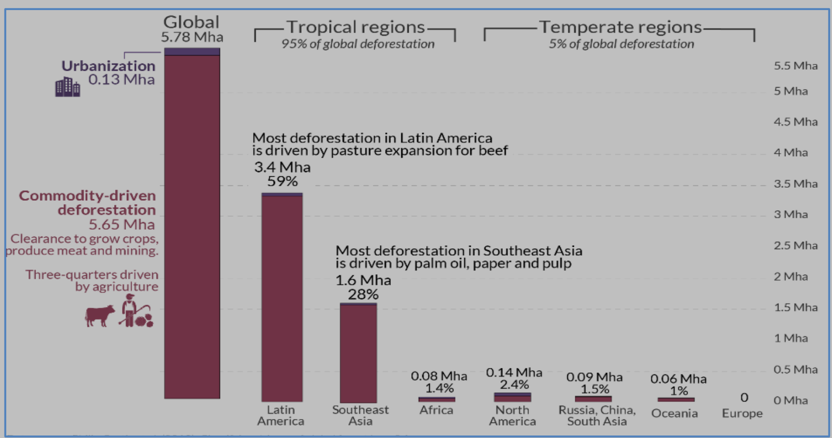


The world is known to have 'peaked deforestation' in the 1980s, and average rate of forest loss has been on the decline since the nineties, largely due to increase of crop yields and conservation of forests in amny countries globally.

Still annually 5.78 million hectres of forests are lost every year amounting to cutting 15 billion, 95 percent of which from the tropical regions of the world, as shown in the infographics below. Most of deforestation in Latin America is Production of beef; and in South East Asia by making palm oil, paper and pulp.

There is a marked divide in the state of the world's forests. In most rich countries, across Europe, North America and East Asia, forest cover is increasing, whilst in many low-to-middle income countries it's decreasing, 71 percent of deforestation occurs for the production of goods that are consumed within domestic markets; less than one-third (29%) is for the production of goods that are traded. High-income countries were the largest 'importers' of deforestation, accounting for 40% of it, which means that these countries are causing deforestation in poorer countries. Tropical deforestation is responsible for contributing 2.6 billion tonnes of CO_2 per year, which accounts for 6.5% of global CO_2 emissions. Therefore it is crucial that the tropical forests are saved by programmes like REDD+ that compensate for the opportunity costs of preserving these forests, and improvements in agricultural productivity that enable countries to produce more food on less land.

Deforestation in Tropical and Temperate Regions



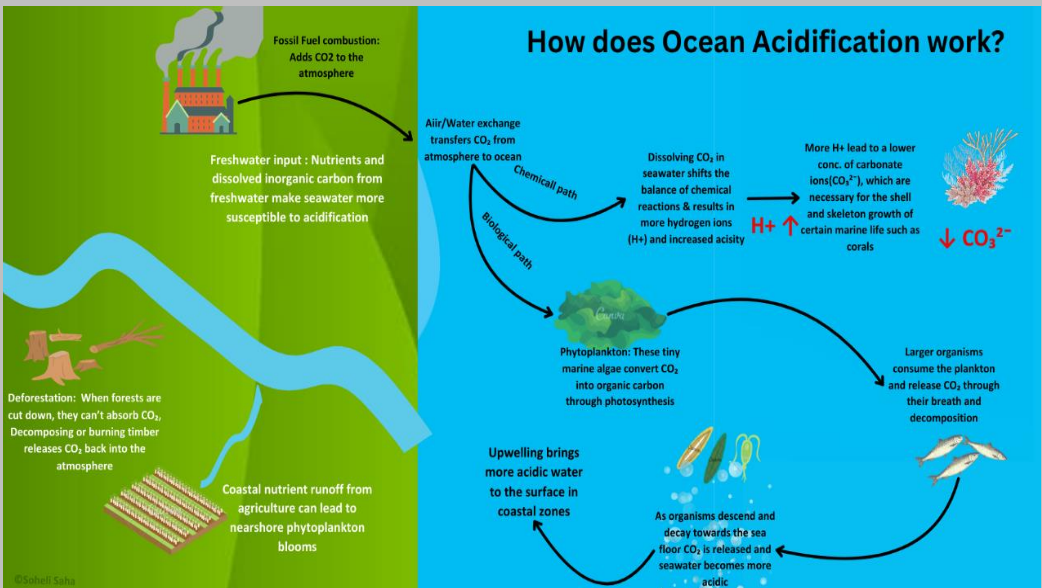
Ocean Acidification: A Silent Threat to Marine Life

Soheli Saha

Ocean acidification is the evil twin of climate change - ***Sylvia Earle***

The world's oceans are facing an insidious and silent threat—ocean acidification. It is a consequence of human activities that have severe implications for marine life. Since the Industrial Revolution, the oceans have experienced a pH drop of approximately 0.1 units, equivalent to a 30% increase in acidity. According to scientific predictions, the pH of the ocean will have decreased by an additional 0.3 to 0.4 pH units by the year 2100, making it the most acidic ocean in the last 20 million years. There have been instances of ocean acidification in Earth's past. The ocean's subsequent ecological collapse has a lasting impact on the climate and global carbon cycle. At present atmospheric carbon dioxide (CO_2) levels are currently about 415 ppm, which is approximately 50% higher than preindustrial amounts. The current elevated levels and rapid growth rates are unmatched in the previous 55 million years of geological record.

Ocean acidification refers to the ongoing decrease in the pH of Earth's oceans due to the absorption of carbon dioxide (CO_2) from the atmosphere. This phenomenon poses a significant risk to the delicate balance of marine ecosystems and the multitude of organisms that call them home. It results from the excessive release of carbon dioxide into the atmosphere, primarily from the burning of fossil fuels and deforestation. As carbon dioxide dissolves in seawater, it triggers a series of chemical reactions that lead to the formation of carbonic acid, reducing the pH of the water. The consequences of ocean acidification on marine life are far-reaching. Organisms such as corals, shellfish, mollusks, and certain types of plankton rely on calcium carbonate to build their skeletons or shells. However, in acidic conditions, the availability of carbonate ions necessary for calcium carbonate formation decreases. As a result, their development, reproduction, and survival are compromised.



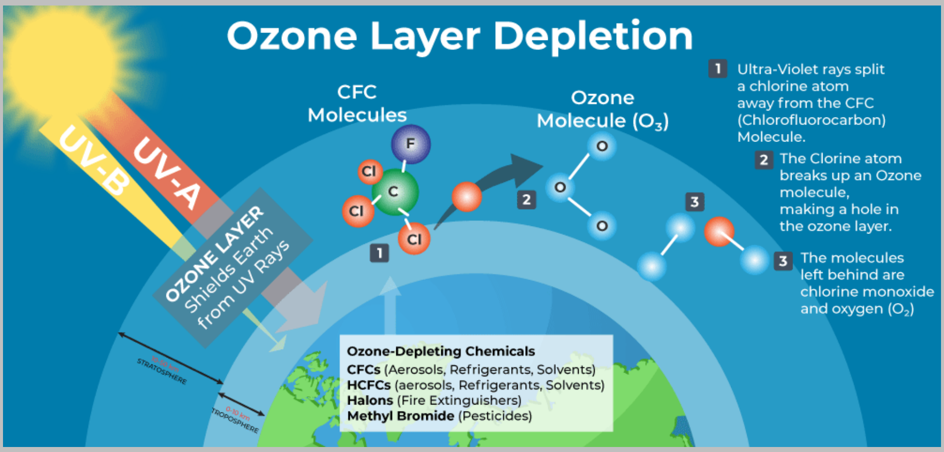
The repercussions of ocean acidification extend beyond individual organisms. Coral reefs, known as the "**Rainforests of The Sea**," face significant risks, as they provide crucial habitats for countless marine species. The loss of corals due to acidification disrupts the delicate balance of these ecosystems, leading to reduced biodiversity, diminished food resources, and potential collapses of entire reef systems. Furthermore, the disruption of marine food webs and the decline of certain species can have cascading effects on the entire ecosystem.

Looking ahead, urgent action is needed to reduce carbon dioxide emissions, protect marine habitats, and invest in scientific research to safeguard the health and resilience of our oceans. This includes moving to cleaner and more sustainable energy sources, increasing energy efficiency, and enacting regulations that promote carbon neutrality. Additionally, addressing ocean acidification demands worldwide collaboration. Furthermore, conserving and rebuilding marine habitats such as coral reefs and seagrass meadows can assist marine ecosystems withstand acidification and other pressures. Only by addressing ocean acidification can we ensure the long-term survival of marine life and the well-being of our planet.

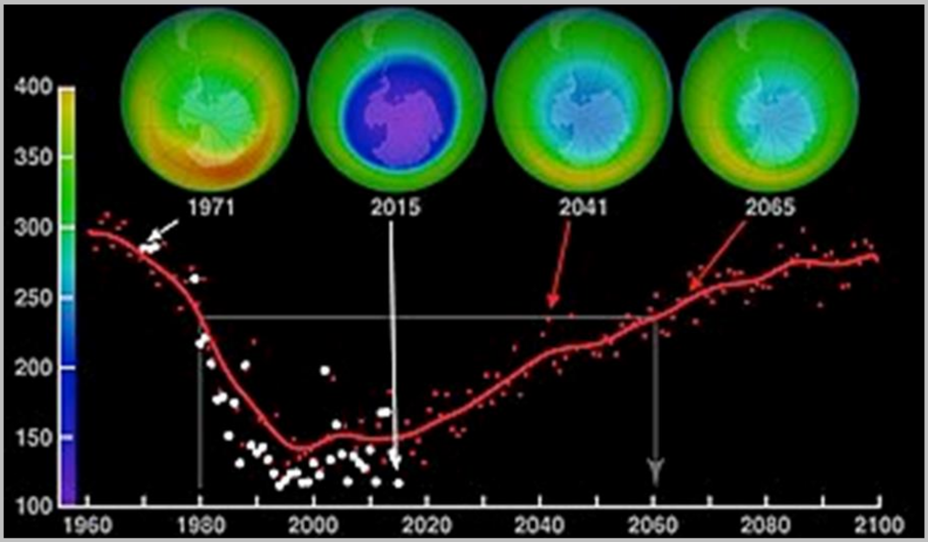
Ozone Layer Depletion

Riyanka Das

The Earth's ozone layer, situated in the stratosphere, plays a crucial role in shielding life on our planet from harmful ultraviolet (UV) radiation emitted by the sun. However, in recent decades, concerns have risen over the depletion of this protective layer due to human activities. Ozone layer depletion, primarily caused by the release of chlorofluorocarbons (CFCs), halons, and other ozone-depleting substances (ODS), poses significant environmental and health risks that demand urgent attention and action. The discovery of the ozone hole over Antarctica in the 1980s served as a wake-up call for scientists and policymakers worldwide. Further research revealed that ODS, commonly found in refrigerants, solvents, and propellants, were responsible for the thinning of the ozone layer. These chemicals, once released into the atmosphere, undergo reactions that break down ozone molecules, leading to the formation of the infamous ozone hole.



The consequences of ozone layer depletion are far-reaching. Increased UV radiation reaching the Earth's surface poses severe risks to human health, including skin cancer, cataracts, and immune system suppression. Moreover, UV radiation adversely impacts ecosystems, causing harm to marine life, terrestrial vegetation, and disrupting the delicate balance of various ecosystems. Recognizing the urgent need to address ozone layer depletion, the international community came together to enact the Montreal Protocol in 1987, a landmark agreement aimed at phasing out the production and consumption of ODS.



Ozone hole recovery projection, 1960-2100. [Source: NASA]

As a result of global efforts to curb ODS, there are promising signs of recovery in the ozone layer. Recent studies indicate that the ozone hole over Antarctica is gradually shrinking, showcasing the effectiveness of international cooperation and environmental policies. However, challenges remain, particularly in enforcing compliance and addressing emerging threats from new ozone-depleting substances. While the Montreal Protocol has made remarkable progress in addressing ozone layer depletion, ongoing vigilance and innovation are necessary to safeguard this vital protective shield. Continued research into the dynamics of ozone depletion, along with the development of alternative technologies and substances, is essential for sustaining the recovery of the ozone layer and mitigating future risks. Moreover, individuals also have a role to play in protecting the ozone layer. Simple actions such as reducing energy consumption, proper disposal of ozone-depleting substances, and supporting eco-friendly initiatives can contribute to the preservation of this crucial environmental asset.

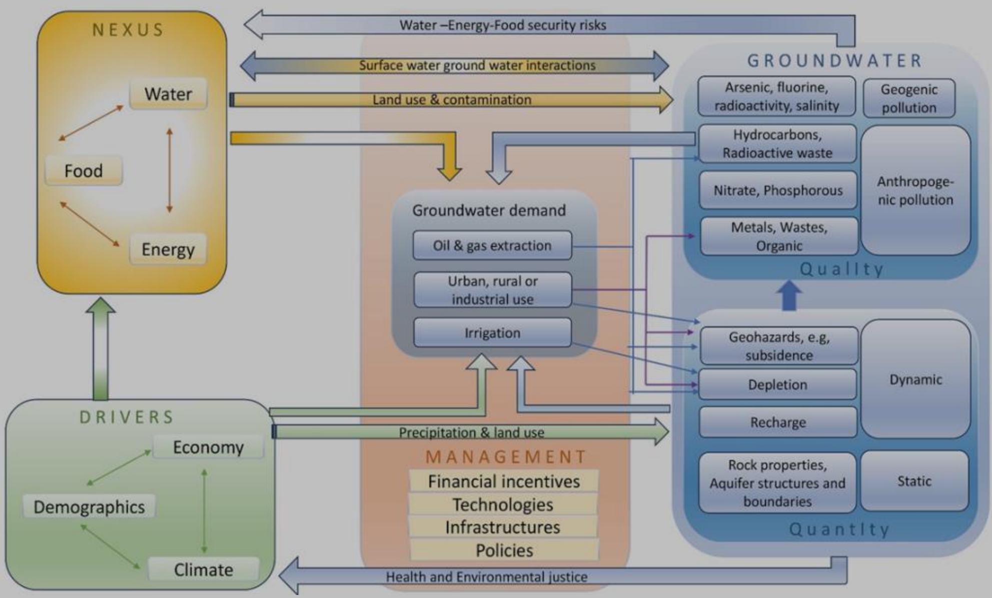
In conclusion, ozone layer depletion remains a pressing environmental challenge with far-reaching implications for human health and ecosystems. While significant strides have been made through international cooperation and policy measures, sustained efforts are required to ensure the long-term recovery and protection of the ozone layer. By working together and adopting responsible practices, we can secure a healthier and more sustainable future for generations to come.

DEPLETION OF GROUNDWATER

Ashmita Rakshit

Water, the elixir of life, covers about 71% of Earth's surface, yet only a fraction of it is accessible freshwater. Groundwater, hidden beneath the surface, has long been a crucial resource for human survival, agriculture, and industry. However, this hidden treasure is now facing a silent crisis – depletion at an alarming rate. The overexploitation of groundwater resources has dire consequences, threatening ecosystems, food security, and human livelihoods.

One of the primary contributors to groundwater depletion is excessive pumping for agriculture. In regions where rainfall is scarce or unreliable, farmers heavily rely on groundwater for irrigation. However, the unchecked extraction of water surpasses the rate of natural recharge, leading to a decline in groundwater levels. This imbalance not only jeopardizes agricultural productivity but also exacerbates the vulnerability of communities to droughts and water scarcity.



Urbanization and industrialization further intensify the strain on groundwater resources. Rapid urban growth leads to increased water demand for domestic use, sanitation, and industrial activities. As cities expand, more wells are drilled to meet the escalating demand, intensifying the depletion of aquifers. Additionally, industrial processes often require large volumes of water, which are frequently sourced from groundwater reserves. The cumulative effect of these activities is the rapid depletion of groundwater, posing a significant threat to sustainable development. The depletion of groundwater has far-reaching consequences for both the environment and society. As aquifers shrink, land subsidence becomes a pressing issue in many regions. The excessive withdrawal of groundwater causes the soil to compact and sink, resulting in irreversible damage to infrastructure, such as roads, buildings, and pipelines. Moreover, the depletion of groundwater alters the hydrological balance, leading to the drying up of rivers, wetlands, and springs. These ecosystems, dependent on groundwater, face degradation and loss of biodiversity, further exacerbating environmental challenges.

Addressing the depletion of groundwater requires concerted efforts at local, national, and global levels. Implementing sustainable groundwater management practices is essential to ensure the long-term availability of this vital resource. This includes measures such as regulating groundwater extraction, promoting water-efficient irrigation techniques, and investing in water recycling and recharge projects. Public awareness and education are also crucial to fostering a culture of water conservation and responsible usage. International cooperation is paramount in managing transboundary aquifers and addressing shared water challenges. By fostering dialogue, sharing data, and coordinating strategies, nations can mitigate the impacts of groundwater depletion and promote equitable access to water resources. Additionally, integrating groundwater considerations into broader environmental policies, such as land use planning and climate adaptation strategies, is essential for building resilience to water scarcity and environmental degradation.

In conclusion, the depletion of groundwater represents a looming crisis with profound implications for ecosystems, agriculture, and human well-being. Urgent action is needed to reverse this trend and ensure the sustainable management of groundwater resources for future generations. By adopting holistic approaches that balance economic development with environmental conservation, we can safeguard this precious resource and build a more resilient and water-secure future.

Desertification: A Silent Threat to Our Ecosystems

Shreya Mitra

"*Desertification means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities*" — By **UNCCD**.

Desertification is a pressing global environmental concern and the process of land degradation that transforms fertile areas into deserts. Desertification arises from complex interactions between natural and human factors. Climate change, prolonged droughts, deforestation, overgrazing, improper agricultural practices, and unsustainable land management practices contribute to its occurrence. Rising temperatures and altered rainfall patterns associated with changing climate exacerbate the risk of desertification in many regions. In addition, overexploitation of natural resources, such as water and vegetation, further intensifies this process, leading to the expansion of arid and semi-arid areas.

Figure: Green land slowly converts to Desert

Desertification has severe consequences on ecosystems, biodiversity, and human societies. It leads to the loss of fertile soil, vegetation cover, and water availability, disrupting ecosystem balance and causing biodiversity decline. As land becomes degraded, this also affects agricultural productivity, threatening food security for farming communities. Desertification also increases poverty, forced migration, and resource conflicts, exacerbating socioeconomic inequalities. At least 90% of dry lands inhabitants live in developing countries, facing poor economic and social conditions. Except all of these consequences, Sand and dust storms, caused by desertification, have also increased, contributing to respiratory disorders, polluting open water, and halting transportation.

The global weather has been shifting since 1970 and some parts of the planet are getting drier, and there hasn't been as much rain. Over 38% of the 6.5 billion people on Earth live in dry lands, which represent about 40–41% of the planet's surface area. According to estimates, 10–20% of dry lands have already degraded, 6–12 million square kilometres have been affected overall by desertification, 1-6% of dry land inhabitants live in areas that have become desertified, and a billion people are at risk from additional desertification. Scientists have shown that if things keep on this way, more than 90% of World becomes decertified by 2050.

So we need to take some initiative to make our world green again. Though combat desertification, a multi-faceted approach involving international cooperation, sustainable land management practices, and community involvement is needed. Sustainable agricultural techniques like agroforestry, contour ploughing, and terracing can help retain soil moisture, prevent erosion, and promote vegetation growth. Reforestation and afforestation initiatives can restore degraded land by reintroducing native plant species and enhancing ecosystem resilience. Furthermore, in order to preserve water resources and prevent additional desertification, water management strategies like rainwater harvesting, effective irrigation, cloud seeding, and the restoration of water bodies are essential. In order to encourage sustainable land use practices among local populations and give them the tools they need to actively participate in the battle against desertification, education and awareness initiatives are also crucial.

Overall, desertification poses a silent but significant threat to our ecosystems. Its past and present impacts demonstrate the urgent need to take action. By safeguarding our ecosystems, we protect biodiversity, ensure food security, and secure the livelihoods of millions of people around the globe. It is our collective responsibility to address this silent threat and preserve the health and productivity of our planet's land.

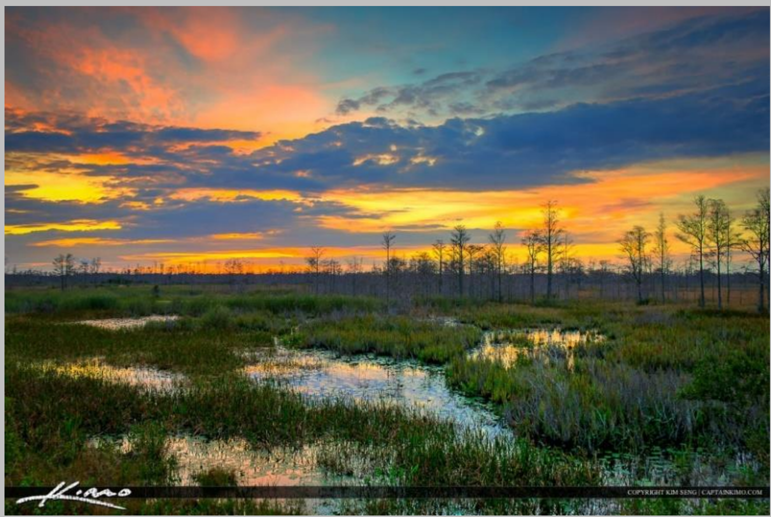
FUTURE OF WETLANDS

Kaberi Saha

Wetlands are areas where water covers the soil, or is present either at or near the surface of the soil round the year. The source of the water in a wetland is often groundwater, seeping up from an aquifer or spring, or a nearby river or lake, or rainwater collected by gravity from surrounding areas, or even seawater in coastal areas that experience strong tides. Wetlands can be of various types, such as swamps, peatlands, sloughs, marshes, muskegs, bogs etc., all having a complex ecosystem characterized by flooding or saturation of the soil, which creates low-oxygen environments that sustain a specialized assemblage of plants, animals, and microbes, adapted to sluggishly moving or standing water.

Wetlands play significant role in our planet Earth – recycling waste water, sequestrating atmospheric carbon, reducing flooding in urban areas, and above all, providing habitat for many species including migratory birds, mammals etc. Wetlands play an irreplaceable role in regulating climate worldwide, maintaining global water cycles, protecting ecosystem diversity and providing livelihood opportunities to millions of people through agriculture, fisheries, tourism and recreation.

In 1971, the Iranian city of Ramsar hosted an international conference that negotiated and adopted the Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat for conservation and sustainable and wise use of wetlands. Since November 2023, 171 States have joined the Convention and designated nearly 2,500 sites to be included in this list of Ramsar sites. Río Negro (Brazil) is the largest Ramsar site in the world, extending across more than 120,000 km², and the Sundarbans is the largest in India. However, this represents only a fraction of the world's wetlands, as many wetlands do not have Ramsar designation and are not included in this list.



Despite the global efforts to conserve and protect the wetlands, more than half of the Ramsar sites, mostly located the developing countries, are facing existential crises due to varieties of anthropogenic pressures. Most important is the inflow of sewage, solid waste and effluents into the wetlands located in and around the urban areas. Run off from chemical fertilisers and pesticides from farmlands and orchards are polluting wetlands in the countryside. Accumulation of toxic pollutants in water and soil are threatening lives of aquatic plants and animals and giving birth to dangerous weeds and pests, driving native species to extinction. Often the biotic and abiotic resources of the wetlands, such as plants, fishes, soil and sands are exploited beyond the regenerative potentialities of these unique ecosystems. Many wetlands are being filled up to create space for real estate development pushing many cities to the threats of recurring floods that wetlands shielded for centuries.

Global warning and its associated changes, such as sea level rise, increased sea surface temperature and changes in the hydrology are impacting negatively on the wetlands. The greatest dangers are to the Arctic and Montan wetlands. Reports from IPCC suggest that many wetlands are facing net loss of area as a result of drying, desertification and coastal erosion. Adaptation is becoming necessary to handle the situation, and restoration becomes a necessity where the deterioration occurs.

The future of wetlands depends on the effectiveness of the action taken to **conserve, restore** and **sustainable** and **wise use** of wetlands. There is need to have more focus on better implementation of international agreements and national policies and programmes on wetland management. These include enforcement of laws and regulations for protection and conservation of wetlands from encroachments and pollution; strengthening of nature-based solutions, such as ecosystem restoration; integrated management practices such as river basin management and coastal zone management; developing innovative practices to adapt to climate change; and last but not the least, multi-stakeholder approach involving science and technology, urban planning, private public participation and engagement of local communities.

The Declining Quality of Aquatic Lifeline

Kasturi Datta

Water, the essential source of life, has always been the primary means of sustenance for all living beings on our planet. However, there has been a concerning trend of declining water quality in recent decades, which has resulted in devastating consequences for both human health and the environment. This decline is primarily attributed to various human activities such as industrialization, urbanization, and agricultural practices. The genesis of water contamination issues can be traced back to the onset of the Industrial Revolution, as industrial activities began releasing toxic components into water bodies, disrupting their ecological balance. Subsequent urbanization further exacerbated this problem, as inadequate sewage management facilities led to the untreated discharge of sewage and chemical waste into rivers, lagoons, and oceans.

In the present day, the situation has only worsened due to the relentless march of industrial development and population growth. Water contamination persists as one of the most pressing environmental challenges globally, affecting both developed and developing nations alike. Daily, a plethora of harmful substances, including heavy metals, pesticides, pharmaceuticals, and microplastics, infiltrate water sources, resulting in dire consequences for both human populations and aquatic ecosystems. Furthermore, the compounding effects of climate change exacerbate this crisis, disrupting rainfall patterns and elevating temperatures, thereby further compromising water resources. Consequently, water quality suffers, exacerbating water scarcity issues in many regions. Looking ahead, addressing the deteriorating state of water demands comprehensive strategies and concerted efforts from national and international authorities. Sustainable water management practices, such as robust wastewater treatment, watershed protection initiatives, and proactive pollution prevention measures, stand as viable solutions. The urgency for implementing these measures has never been greater.

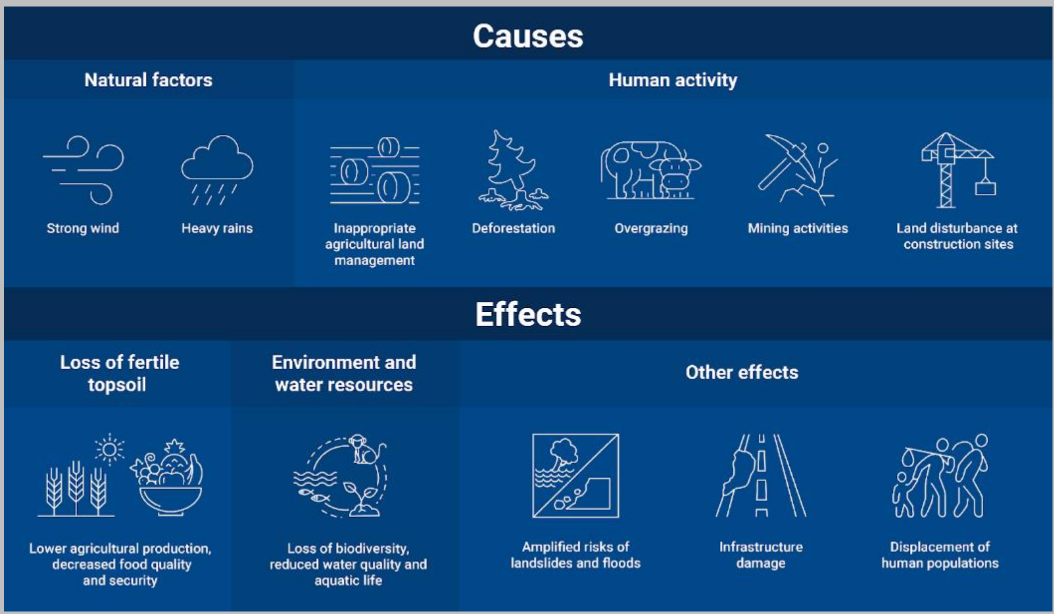
The World Health Organization (WHO) reports that around 80% of the world's wastewater is discharged into rivers, lakes, and oceans without any treatment. This untreated wastewater is a major source of contamination that not only endangers aquatic ecosystems but also poses a significant threat to human health. Every year, millions of people worldwide suffer from waterborne diseases due to this contamination. Furthermore, the problem is being compounded by climate change-induced shifts in precipitation patterns and rising temperatures, which are putting additional pressure on water resources. To address this issue urgently, we need to take global action to tackle the root causes of water pollution, implement effective management strategies, and safeguard our aquatic resources for current and future generations.

Furthermore, investing in suitable water purification and conservation technologies can alleviate undue strain on freshwater sources. Moreover, raising awareness and educating communities about water conservation and pollution prevention are vital steps in ensuring sustainability for the future. Encouraging public participation and community engagement in water management initiatives can serve as effective tools in shifting societal attitudes towards water issues and fostering collective action to safeguard water quality. Innovative approaches such as decentralized wastewater treatment plants, green infrastructure development, and nature-based solutions offer promising avenues for addressing water pollution and enhancing ecological resilience. Integrating these strategies into policy frameworks and urban planning methodologies is essential to design water systems capable of withstanding uncertainties and promoting long-term sustainability. The deteriorating quality of water, alongside other pressing environmental concerns, underscores the collective challenge of maintaining ecological balance and improving the quality of life for future generations. Addressing this challenge requires a holistic approach, encompassing proper pollution management, adoption of eco-friendly practices, and technological development. By embracing preventive strategies and enhancing inter-sectorial coordination, we can ensure not only the safety of water for present communities but also for future generations to come.

Unearthing Soil Degradation: Challenges and Solutions for Restoration

Dipayan Laha

Soil degradation is a significant global issue that refers to the decline in the quality and fertility of soil, leading to reduced productivity and ecosystem health. This problem is caused by various processes, including erosion, nutrient depletion, compaction, salinization, and contamination by pollutants. Human activities such as deforestation, industrialization, and urbanization contribute significantly to soil degradation. Erosion, caused by wind and water, removes the topsoil, reducing its capacity to support plant nutrients. Poor agricultural practices such as mono-cropping, overgrazing, and excessive tillage worsen soil degradation by disrupting its natural structure and depleting essential nutrients. Chemical pollutants from pesticides, fertilizers, and industrial waste further compromise soil health, affecting microbial communities and contaminating groundwater. Soil degradation poses a threat to food security by reducing agricultural yields and also undermines the resilience of ecosystems, leading to loss of biodiversity and ecosystem services decline. Mitigating soil degradation requires a multifaceted approach, including sustainable land management practices, afforestation, soil conservation techniques, and pollution control measures. It is imperative to raise awareness, promote policy interventions, and foster collaboration among stakeholders to ensure the long-term sustainability of our soils and ecosystems. According to the National Bureau of Soil Survey and Land Use Planning, 146.8 million hectares, which is approximately 30% of the soil in India, is degraded. Of this, around 29% is lost to the sea, 61% is transferred from one place to another, and 10% is deposited in reservoirs.



Soil degradation is a significant global issue that poses critical challenges to agricultural productivity, food security, and environmental sustainability. Soil degradation has far-reaching consequences, affecting not only agricultural yields but also ecosystem health, water quality, and climate resilience. The problem is escalating, particularly in regions vulnerable to climate change and rapid land-use changes, with an estimated one-third of the Earth's soils already degraded. Addressing this global challenge requires concerted efforts, including the adoption of sustainable land management practices, conservation agriculture techniques, reforestation efforts, and policies that promote soil conservation and restoration.

To address soil degradation, a comprehensive approach is needed that integrates sustainable land management practices, conservation efforts, and policy interventions. Adopting agro-ecological farming methods like crop rotation, cover cropping, and integrated pest management can help restore soil health by promoting biodiversity, improving soil structure, and reducing reliance on harmful agrochemicals. Conservation practices like terracing, contour ploughing, and agroforestry can mitigate erosion, enhance water retention, and prevent soil compaction. Afforestation and reforestation initiatives are also essential for restoring degraded lands and protecting soil from erosion. Policies that promote sustainable land use, incentivize soil conservation practices, and regulate the use of agrochemicals can provide a framework for long-term soil health management. Moreover, investing in research and extension services, as well as providing education and training to farmers and land managers, are crucial for promoting widespread adoption of soil-friendly practices. By prioritizing soil health and resilience, we can mitigate soil degradation and ensure the long-term sustainability for our future generation.

Overfishing and Its Far-Reaching Impacts

Arkadip Mondal

Overfishing is a major problem for marine ecosystems around the world. This practice involves catching fish at a faster rate than they can reproduce, which leads to reduced fish populations and ecological imbalances. Overfishing not only affects the targeted species but also has a ripple effect on other marine organisms and habitats. It disrupts entire marine food webs, causing cascading effects that can impact the wider ecosystem. Moreover, it puts the livelihoods of millions of people who depend on fishing for food and income at risk. This exacerbates social and economic inequalities in coastal communities.

Overfishing has had a disastrous impact on marine ecosystems, economies, and food security. One of the most notable examples is the decline of the Atlantic cod population along the coast of Newfoundland, Canada. Cod used to be abundant in these waters and supported a thriving fishing industry. However, extensive overfishing, particularly during the late 20th century, led to a collapse in the cod population. This collapse had devastating effects on local economies and ecosystems, causing widespread unemployment in fishing communities and disrupting marine food webs. Another example of overfishing is the depletion of Bluefin tuna populations in the Mediterranean Sea and the Atlantic Ocean. Bluefin tuna is highly prized for its meat and can fetch high prices in international markets, leading to rampant overfishing, particularly driven by the demand for sushi and sashimi. This has caused significant declines in Bluefin tuna populations, with some species facing the threat of extinction. In Southeast Asia, the practice of blast fishing, where explosives are used to stun or kill fish, has led to severe overfishing and damage to coral reefs. Blast fishing is often conducted illegally and has caused widespread destruction of marine habitats, leading to declines in fish populations and loss of biodiversity. These examples illustrate the global scale of overfishing and its detrimental effects. Addressing overfishing requires concerted efforts from governments, fishing industries, and consumers to implement sustainable fishing practices and conservation measures to protect marine resources for future generations.

Research indicates that almost 90% of the world's fish populations are either fully exploited or overexploited. We are taking fish out of the oceans faster than they can replenish, which is leading to a steady decline in the health of our oceans. Large fishing fleets using advanced technology are relentlessly scouring the seabed. Fishing techniques like bottom trawling, which is similar to clear-cutting a forest, are causing severe damage to precious habitats and unintentionally catching all kinds of marine creatures, leaving behind scars and a trail of unwanted, dying animals. This is not just fishing; it's a war being waged against the natural balance of our planet. The consequences of our actions are felt throughout the ocean and have a direct impact on the food we eat. As top predators, such as sharks and tuna, become scarce, the entire food web is impacted, leading to the collapse of entire ecosystems, devastating coastal communities that have relied on the ocean for generations. Unfortunately, bycatch is another tragic reality of this industry, with dolphins, sea turtles and seabirds becoming entangled in nets and lines. These innocent creatures are caught in the crosshairs and are a testament to our inhumane demands. If we continue to exploit the oceans, the future is bleak. Fish stocks, which are the foundation of food security for billions of people, will continue to decline. Our oceans, which are the primary lungs absorbing excess carbon emissions, will deteriorate, exacerbating the effects of climate change faster than we can even imagine.

Overfishing is a global issue that has adverse impacts on economies, food security, and ecosystems. Coastal nations, especially those with small island economies and developing countries, suffer from food shortages, lost livelihoods, and economic instability due to this issue. Even industrialized nations face reduced revenues for fishing communities and businesses because of depleted fish stocks. Overfishing can also pose a threat to the long-term sustainability of fisheries and undermine tourism-dependent economies. To address overfishing, it is essential to implement sustainable fisheries management practices collaboratively at the local, national, and international levels.

Worsening Quality of Air

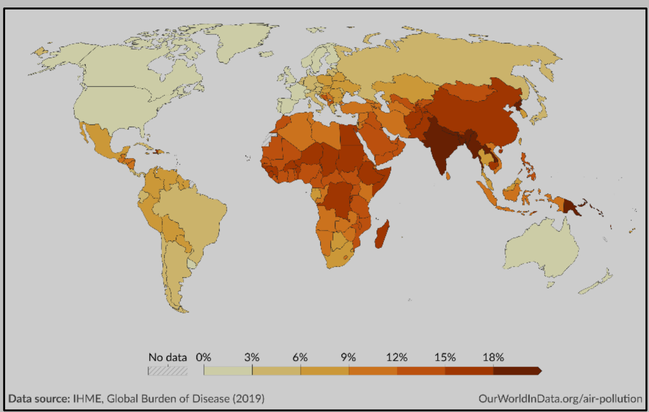
Banashree Chakraborty

Air pollution is the contamination of air, both indoor and outdoor, due to the presence of pollutants in the atmosphere such as toxic gases (including ammonia, carbon-monoxide, sulphur-dioxide, nitrous-oxide, methane, and chlorofluorocarbons), particulate materials (both organic and inorganic), and biological molecules (bacteria, viruses, fungi, algae, mites, insect debris/animal epithelia, and their by-products) that are harmful to the health of humans and other living beings. Air pollution can cause diseases, allergies, and even death to humans; it can also cause harm to other living organisms such as animals and crops, and may damage the natural environment.

WHO has laid down standards of acceptable quality of air in 24 hour mean period in terms of presence of 15 (PM2.5), 45 (PM10), 25 (nitrous-oxide), 40 (sulphur-dioxide) etc, all measured in µg/m3. One-third of the world's countries have no legally-mandated outdoor (ambient) air quality standards. Where such laws exist, standards vary widely and often misalign with WHO guidelines. Additionally, at least 31% of countries that do have the power to introduce such ambient air quality standards have yet to adopt them. More than 2.3 billion people in the world still use traditional methods for daily cooking which triggers pollution at household level, and mostly children and women are primarily exposed to it for a long time and face several health problems. Bangladesh, Pakistan and India are the top three air polluted countries in the world with annual average PM 2.5 of 79.9, 73.7 and 54.4 respectively

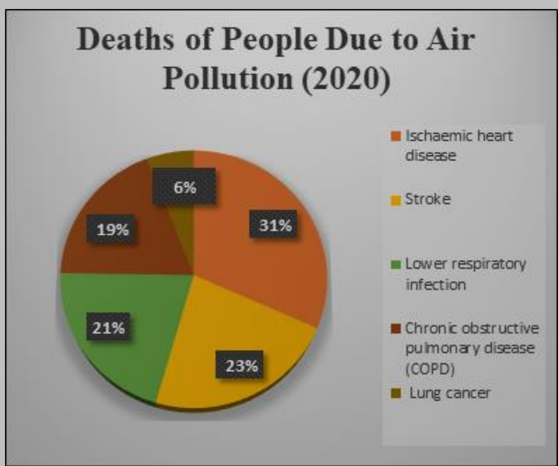
Average air quality in urban areas are significantly higher than the rural areas. www.iqair.co has ranked 7812 cities in the world based on annual average PM2.5 concentration (µg/m^3) in 2023. Out of the top 50 most polluted cities, 44 are in India, 3 in Pakistan, 2 in China and 1 each in Bangladesh and Kazakhstan.

Share of deaths due to Air Pollution



Air pollution has been identified by the WHO as the single largest environmental health risk, with 92% of the world's population living in places where air pollution levels exceed safe limits, disproportionately affecting women, children and elderly people in low-income countries. Every year 237,000 deaths of children who are under the age of 5 due to indoor pollution. Every year normally around 7 million deaths have been caused by exposure to air pollutants, especially the particles (PM2.5 and PM10). This is the third most important risk factors for death, after high blood pressure and smoking. Several studies suggest possible correlations between COVID-19 mortalities and air pollution in many countries.

Polluting air create risks for many of the leading causes of death, including heart disease, stroke, lower respiratory infections, lung cancer, diabetes, and chronic obstructive pulmonary disease. Ischemic heart disease accounted for nearly one third of all deaths due air pollution, followed by stroke (23%), lower respiratory infection (21%), COPD (19%) and lung cancer (6%).



Poor quality of air hurts not only human beings, it affects plants and animals alike. Animals exposed to air pollution have a higher mortality rate. This is because air pollution can cause various health problems, and weaken the immune system, making animals more susceptible to diseases. Air pollution can cause animals to change their behavior in a variety of ways. For example, it can make birds sing less or force bees to abandon their hives. Additionally, air pollution can alter the migration patterns of some animals.

High levels of nitrogen and sulfur dioxide in air can damage the plant tissues and reduce the process of photosynthesis. When these toxic gases mix with water vapor, they form acids in the atmosphere that can precipitate as acid rain on the ground, causing damage to the marine ecosystem and marble structures. Therefore deteriorating quality of ambient air is a very serious environmental issue that must be addressed effectively for life to sustain in planet Earth.

Rising Tides of Global River Pollution

Sangita Saha

Rivers are an essential resource for human societies, providing recreation, transportation, and sustenance for centuries. However, pollution is becoming a growing concern that is affecting their natural beauty and functionality. Human activities, such as industrialization, urbanization, and agricultural intensification, have introduced a wide range of pollutants into river systems. These pollutants include pesticides, medications, and cosmetics, among others, and they are currently not adequately monitored or regulated. The sources of these pollutants are diverse, including hospital effluents, industrial discharge, residential runoff, agricultural activities, and leachates from landfills. Municipal wastewater treatment plants are also significant contributors to river contamination. This is a global problem, with countries like China, Portugal, Mexico, Colombia, and Brazil facing scrutiny for their contributions to pollution that extends beyond their borders, affecting river systems on all continents. To address this pressing issue and mitigate environmental degradation, a crucial step is to upgrade wastewater treatment plants. These upgrades should include the implementation of tertiary treatment systems capable of removing contaminants such as oestrogens, antibiotics, and pesticides from wastewater streams. By investing in advanced treatment technologies and regulatory measures, we can work towards safeguarding our precious river ecosystems for generations to come.

River pollution is a global issue that confronts all major rivers in the world such as the Ganges River in India, the Yangtze River in China, the Mississippi River in the United States, the Amazon River in South America, and the Nile River in Africa. All these rivers suffer from pollution caused by industrial waste, sewage discharge, agricultural runoff, deforestation, mining operations, and oil spills. No continent is immune to the impacts of human activity on freshwater ecosystems. Addressing this issue requires concerted efforts to implement effective pollution control measures and promote sustainable water management practices.

A global hydrological-water temperature model, when combined with heat rejection rates from power plants, has identified hotspots for riverine thermal pollution worldwide by simulating streamflow and water temperature. The study reveals that the Rhine basin is the most polluted despite receiving only 20% of the total emissions, while the Mississippi receives 62% of heat emissions from nuclear and 62% from coal-fueled power plants. This is because temperature increase events exceed the 3°C limit. Smaller European basins like Po and Weser experience streamflow temperature increases of at least 3 degrees Celsius, revealing high riverine thermal pollution zones and enabling better understanding of aquatic ecosystem effects. Another study investigates the amount of nitrogen pollution in rivers caused by industrial, agricultural, and residential sources, as well as atmospheric discharge. To calculate the amount of nitrogen leaching from soil layers, a model of the terrestrial nitrogen cycle was created. This cycle includes nitrogen-fixing, nitrification, denitrification, immobilisation, mineralization, leaching, and plant-based absorption processes. The model accurately predicted the amount of dissolved inorganic nitrogen concentrations in rivers, indicating that nitrogen loading is directly related to basin size. Areas with low population density experienced reduced nitrate leaching. In contrast, tropical, humid river basins with high population density and agricultural activity had elevated nitrate concentrations. The study found that areas with substantial agricultural activity and little precipitation surplus experienced major nitrogen contamination.

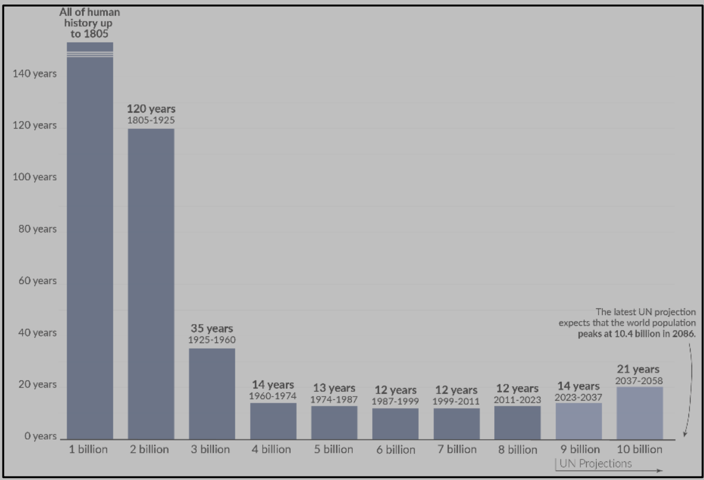
The Ganga River in India is an important ecosystem that is under threat from human activities. One of the major concerns is the heavy metal pollution caused by the development of cities. This pollution can lead to bioaccumulation and biomagnification, which can have serious consequences for water safety. Heavy metals can accumulate in animals and humans, causing toxic levels and negative health effects. Riverine environments pose a persistent risk, including developmental retardation, renal damage, malignancies, and even death.

Population and Environment

Sneha Mistri

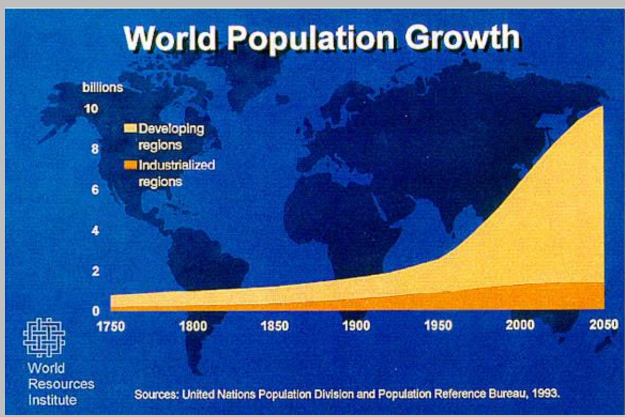
Global population has exploded from less than 1 billion in pre-industrial age to more than 8 billion today. It took all of human civilization till 1805 for population to reach the level of 1 billion; it took only 118 years for population to jump eight times to reach the level of today.

Time taken for growth of global population by a billion



This exponential growth of population has been attributed to a variety of positive and negative factors. The positive factors include rise in life expectancy, increase in production of food grains, improvement in global supply chains and local network of distribution, welfare measures of national governments for subsidised supply of food, and international humanitarian mechanisms for prevention and mitigation of hunger and food and nutritional insecurities. The negative factors include poverty, illiteracy particularly among the females, absence of social security, and lack of awareness and facility for reproductive health care.

The negative factors have been addressed to some extent over the years by the national governments and international communities, leading to contraction in growth of population since 2000. Demographers have projected that global population shall stabilise at 10 billion by 2058 and thereafter population growth may be negative in many countries.



Rapid growth of population during the twentieth century, mainly in developing countries, has adversely impacted the environment in multiple ways. First, large tropical forest areas have been cleared for cultivation of crops and grazing of animals for diary and meat products, leading to landslides, top soil erosion, and water scarcity. Chemical fertilisers, pesticides and genetically modified seeds have been used on a large scale leading to degradation of soils and increase in chemical residues in food resulting in rapid proliferation of cancer and other diseases. Ground water reserves have been extracted in an indiscriminate manner to facilitate agriculture in dryland areas resulting in both salinization of soils and depletion of ground water reserves. Non-renewable natural energy resources like coal, oil and gas have been burnt in an unrestricted manner, emitting dangerous greenhouse gases in atmosphere, resulting in global warming and climate change with consequential rise in temperature, melting of glaciers and sea level rise.

Global debate on population and environment was initiated by 1798 book of Thomas Malthus on *Essay on the Principles of Population*, in which he propounded the concept of natural balancing of the gap between growth of population and food production through periodic famines and epidemics. Although advancement in agricultural and medical sciences have busted the Malthusian Trap, the debate was reignited by the 1968 publication of *Population Bomb* by Prof Paul Ehrlich in which he predicted worldwide famines due to overpopulation, as well as other major societal upheavals, and advocated immediate action to limit population growth. The United Nations coordinated an International Conference on Population and Development (ICPD) in Cairo, Egypt, in 1994, resulting in a Programme of Action that eventually led to the setting up of the United Nations Population Fund (UNFPA).

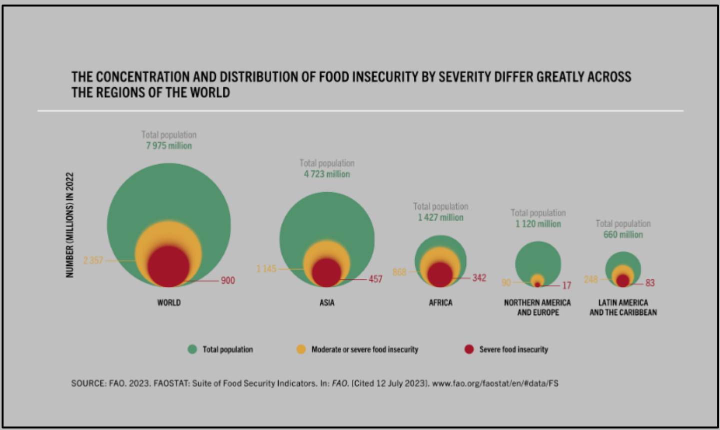
UNFPA has been working on the intersecting issues of population and development, such as universal education, reduction in infant and child mortality, reduction in maternal mortality and access to reproductive and sexual health services. With the prospects of stabilisation of global population in another two decades and half, population is no longer considered as a threat to environment globally, although it continues to remain a critical issue in many developing countries where population is growing with a heavy costs on environment.

Food and Nutritional Insecurity

Sanchari Roy

The concept of food security has evolved over the years. For a long time food was narrowly defined as cereals excluding other nutrients like protein and vitamins that are vital for growth and sustenance of human body and mind. Similarly security was defined generically to mean security of population in general without reference different age and sex groups that have different standards of food security in life cycle. A comprehensive understanding of food security emerged during World Food Summit in 1996, and based on this understanding, food security is achieved when 'all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life'.

Comprehensive food security has four main dimensions: (a) **Availability of food:** Food availability addresses the "supply side" of food security and is determined by the level of food production, stock levels and net trade; (b) **Access to food**: An adequate supply of food at the national or international level does not in itself guarantee household level food security. Concerns about insufficient food access have resulted in a greater policy focus on incomes, expenditure, markets and prices in achieving food security objectives; (c) **Utilization of food:** Utilization is commonly understood as the way the body makes the most of various nutrients in the food. Sufficient energy and nutrient intake by individuals are the result of good care and feeding practices, food preparation, and diversity of the diet and intra-household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals; and (d) **Stability of food over time**: Adverse weather conditions, political instability, or economic factors (unemployment, rising food prices) may have an impact on your food security status. Therefore food security has to be ensured and stabilized on a continuing basis.

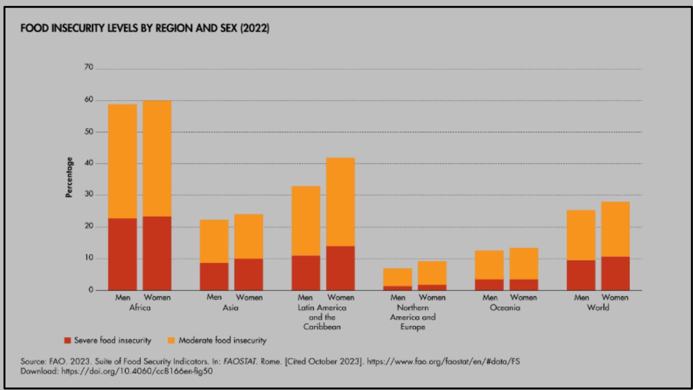


World-wide food and nutritional security has been adopted as one of 17 UN Sustainable Development Goals to be achieved by 2030. SDG 2 calls for 'end hunger, achieve food security and improved nutrition'. Two related targets of SDG-2 are:

(a) end hunger and ensure access by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round; and

(b) end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.

The world is far from achieving these goals and targets on food and nutritional security. Food and Agriculture Organization, World Food Programme, International Fund for Agricultural Development, World Health Organization, and United Nations Children's Fund collaborate every year to produce *The State of Food Security and Nutrition in the World*. As per the latest report, 735 million people (9.2% of world population) faced hunger during 2022. About 29.6 percent of the global population – 2.4 billion people – were moderately or severely food insecure in 2022, of which about 900 million (11.3% of world population) were severely food insecure. Every continent had its share of severe to moderate food insecurity, but it was prevalent more in Africa, Asia and Latin America.

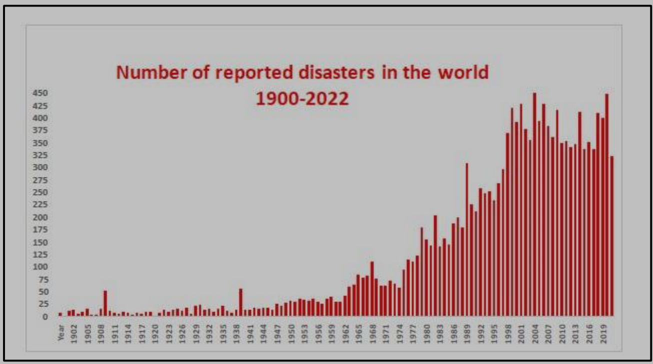


Worldwide, food insecurity disproportionately affects women and people living in rural areas. Moderate or severe food insecurity affected 33.3 percent of adults living in rural areas in 2022 compared with 28.8 percent in peri-urban areas and 26.0 percent in urban areas. The gender gap in food insecurity at the global level was 2.4 percentage points, but was wider in Asia, Africa and Latin America. Addressing these gaps in food and nutritional security will be challenging tasks in the years of come in the face of changing climate and conflicts around the world.

Rising Incidents of Disasters

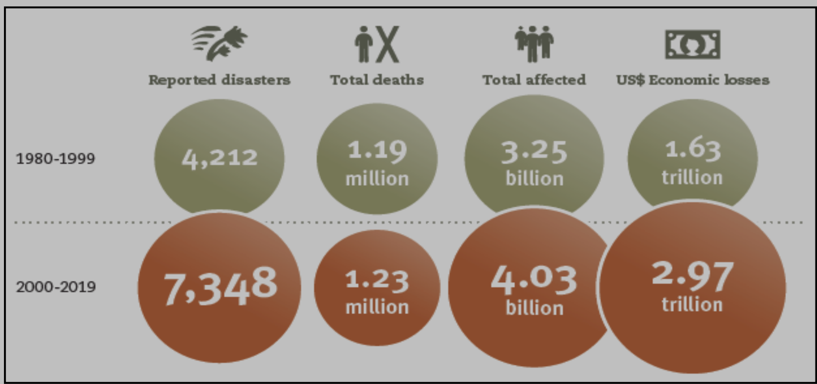
Ashis Sarkar

Hazards of nature – geological (earthquake, landslides, tsunami, volcanoes), hydrological (flood, snow avalanche, mudslides), meteorological (cyclones, storms, heat wave, cold wave), climatological (drought, wild fire, glacial lake outbursts), biological (epidemic, pandemic, locust attack), extra-terrestrial (geomagnetic storm, shock wave, impacts) - have always been there since the beginning of civilization, but these did not always turn into disasters, resulting in loss of lives, livelihoods, assets and infrastructure. What transforms natural hazards into disasters are the manners by which hazards interact with vulnerabilities and exposures. Vulnerabilities can be multifarious – physical (unsafe buildings, infrastructure etc.), economic (poverty, lack of coping capacity etc.), social (vulnerable women, children, disabled, elders, migrants etc.), environmental (deforestation, loss of mangroves, depletion of ground water. Air pollution etc.). Exposure mainly refers extent of population and economy that have been exposed to hazards.



Sharp rise in all types of vulnerabilities and exposures around the world have contributed to meteoric in disasters since the middle of twentieth century. In the developing countries unsafe buildings, poverty and social vulnerabilities contributed to massive loss of lives and livelihoods in disasters. In developed countries disasters economy, infrastructure, trade and supply chains have been exposed to disasters resulting in more economic losses.

A comparative study of the pattern and trend of disasters since 1980 will bring out how disasters have affected countries and communities globally. 7348 disasters affected the world during 2000-2019 compared to 4212 disasters during 1980-1999, registering an increase of 74.4% increase in number of disasters. Number of deaths in these disasters increased from 1.19 million during 1980-1999 to 1.23 million during 2000-1999 showing an increase of 3.3%, but number of persons affected by disasters during the period increased by 24%. Total economic losses due to disasters during 2000-2019 was a staggering USD 2.97 trillion compared to USD 1.63 trillion during previous two decades. Floods accounted for the maximum number of disasters (44%), followed by cyclones (28%), earthquake (7.4%), extreme temperature (6%), drought (4.8%), and wildfire (3%). Earthquake accounted for most of the deaths in disasters (58%), followed by cyclones (16%) and extreme temperature (13%), but cyclone caused maximum economic losses (47%), ahead of flood (22%) and earthquake (21%).



Hydro-meteorological disasters have been rising faster than geological, biological and other types of disasters. This is largely due to the impacts of global warning and climate change that have contributed to the increasing frequencies and intensities of extreme climatic events like cyclonic storms, floods, droughts, forest fires, and heat wave.

Another distressing trend is increasing number of technological disasters (industrial, transport, nuclear and radiological accidents) around the world. In countries like India road accidents have consumed more lives than natural hazards. Industries using hazardous chemicals have met with accidents consuming large number of lives, such as Bhopal Gas Tragedy, Chernobyl nuclear disaster and Fukushima reactor melt down.

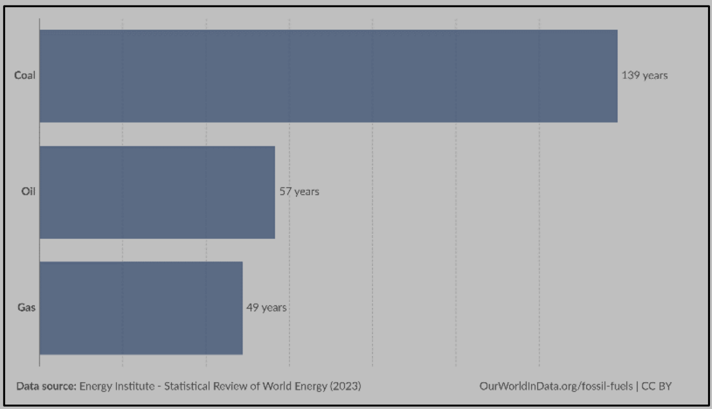
Persistent efforts have been made by international organisations, national governments and local communities for reducing the risks of disasters through various measures for risk prevention and mitigation and disaster preparedness and response and recovery, as prescribed by three successive global frameworks of Yokohama Strategy for Safer World, Hyogo Framework of Action and Sendai Framework for Disaster Risk reduction. Although some success has been achieved in reducing disaster mortalities, absolute number of disasters as also number of people affected by disasters and economic losses in disasters have been mounting without any signs of any downward trend in any region of the world.

Depleting Natural Resources

Sravana Chanda

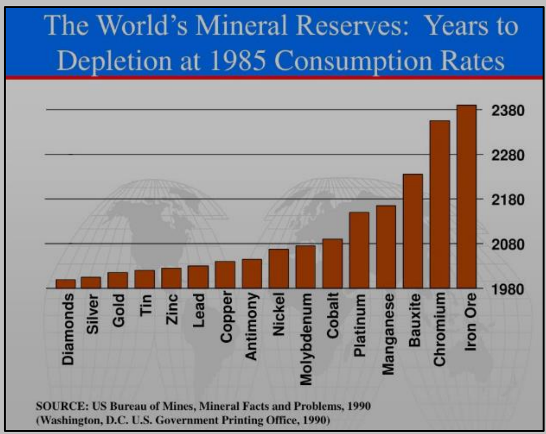
For centuries mankind used both renewable (water, forests, animals) and non-renewable natural resources (land, minerals) to grow food and produce goods and commodities for growth and sustenance. Depletion of natural resources was never a concern until about the middle of the twentieth century when industrial revolution based on consumption of fossil fuel was at its peak. Precious natural resources, both renewable and non-renewable were consumed at a faster pace than these were replenished, leading not only to environmental degradation, but also to competitive explorations for new resources to meet growing demands of these resources, particularly non-renewable mineral resources like coal, oil and natural gas that produced energy to drive industries.

Years of Fossil Fuels Left



Despite mounting scientific evidences of global warming and climate change due to unrestricted use of fossil fuels, demands for coal, oil and gas have not decreased; on the contrary there is mad rush to exploit these resources through mining and trading globally. As a result there is significant depletion of these energy resources. According to the 2020 World Energy Outlook study by the International Energy Agency, the world has approximately 1,139 billion tons of coal reserve that will last another years 139 years at the current rate of burning of this fuel. Natural Gas has reserve of 187 trillion cubic meters and crude oil 1,707 billion barrels that will last for 57 years and 49 years respectively. New explorations may augment the reserve, but not substantially.

Similarly reserves of other precious mineral resources like tin, zink, lead, copper, nickel etc are depleting fast. According to a study conducted by US Bureau of Mines, these resources will vanish globally within the course of next 20 to 80 years. Cobalt has reserve of another 100 years or less considering its widespread use in battery and solar panels. Depletion of this precious mineral may provide a setback to computer and other electronic goods that using lithium batteries. Although deposits of iron ore, bauxite, chromium and manganese are adequate for a few more generations, these are not infinite. Current rate of use of these metals do not meet the test of sustainability - meeting the needs of the present without compromising the ability of future generations to meet their own needs.



As a resource becomes more depleted, its value increases. Global prices of all mineral resources, including coal, oil and gas has been rising continuously, creating inflationary pressures on all goods and services, and affecting in particular the low and middle income families who depend on fixed incomes.

While depletion of mineral resources will eventually lead to exhaustion of these resources, the renewable natural resources like forests and surface and sub-surface water have the chances of replenishing itself, but unfortunately the prospects of such auto-renewal has been very severely compromised over the years. The extent of extraction of ground water at many places has far exceeded recharge of the aquifer; similarly melting of mountain glaciers at many places is creating the real time risk of turning many perennial rivers to seasonal channels. Depletion of forest resources in tropical areas have again been faster than regeneration.

The World Wildlife Fund (WWF) has warned that the renewable natural resources are being consumed 20% more than being replenished. This proportion is increasing progressively, and if we don't take action, we will need 2.5 planets to sustain us by 2050. This overexploitation is also resulting in the loss of habitats that are critical to the survival of various plant and animal species. The International Union for Conservation of Nature (IUCN) reports that out of the approximately 30 million distinct species of plants and animals on Earth, over 31,000 are currently facing threats of extinction.

Poverty the Greatest Polluter?

Saikat Dutta

We do not wish to impoverish the environment any further and yet we cannot for a moment forget the grim poverty of large number of people. Are not poverty and need the greatest polluters?

Smt Indira Gandhi

We live in an increasingly unequal world. Richest 1% of the world own 44% of its wealth, while more than half the world population survive on less than 5 dollars a day. The average person's consumption of oil and other natural resources is up to 30 times higher in rich countries compared to poor ones. Poor countries and communities contribute least to depletion of natural resources or to greenhouse gas emission in the atmosphere globally, yet they suffer the worst consequences of climate change and environmental degradation.

Attempts to solve global environmental challenges must consider the nature and scale of human poverty and deprivations around the world. Climate change, biodiversity loss, land degradation, pollution, and other aspects of global environmental change are not only environmental problems; they are also deeply rooted economic and social problems. From an environmental perspective, both poverty and unsustainable patterns of production and consumption are key drivers of environmental degradation. At the same time, environmental degradation and climate change can drive poverty. While there is no easy solution, poverty and the environment must be addressed together.

The global discourse on poverty-pollution nexus is as old as the environment itself. Prime Minister Indira Gandhi was the first to flag the debate fifty-two years back at the opening session of the first UN Conference on the Human Environment held in Stockholm in June 1972. Since then the debate has continued without any resolution of the persistent problems of either poverty or environmental degradation, although several global initiatives have been taken address the issues.

The connection between poverty and pollution is complex and multifaceted. Poverty can exacerbate environmental degradation as impoverished communities may rely heavily on natural resources for survival, leading to overexploitation and unsustainable practices. This can result in larger families, improper waste disposal, and increased pressure on fragile lands. Conversely, pollution and environmental degradation can also drive poverty. For example, economic growth can lead to increased outdoor air and water pollution. Additionally, climate change and biodiversity loss, driven by unsustainable production and consumption, can further entrench poverty by undermining the natural resources that poor communities depend on. Addressing poverty and pollution requires integrated solutions that consider both environmental and social dimensions of these challenges. It involves reining in excessive resource consumption by the wealthiest and shifting focus from GDP growth to national wellbeing that include the environment and the marginalized. It's a matter of balancing human needs with environmental sustainability to ensure a healthy planet for all.

Millennium Development Goals (2000-2015) were the first definitive global measures for reduction of abject poverty while addressing some environmental dimensions of poverty, such as availability of clean water and sanitation, and protection from water borne diseases. However, environmental sustainability and hazards such as pollution from chemicals, waste, and motor vehicle emissions were not adequately reflected in the MDGs.

Building on the lessons learned from implementing the MDGs, the 2030 Agenda (2015-2030) sets out a framework of **Sustainable development Goals** that combine environmental and poverty eradication aims more concretely than ever before, with 169 targets and 231 unique indicators for measuring progress. The agenda declared: "We resolve, between now and 2030, to end poverty and hunger everywhere; to combat inequalities within and among countries; to build peaceful, just and inclusive societies; to protect human rights and promote gender equality and the empowerment of women and girls; and to ensure the lasting protection of the planet and its natural resources." The implementation of SDGs so far indicate that there has been some progress for eradication of poverty, lots remain to be done to break the nexus of poverty and pollution.

Environmental Costs of Fast Fashion and Textile Waste

Anamika Sarkar

Fast fashion has become a global phenomenon over the last few decades, revolutionizing the apparel industry, offering demanding trendy clothing to the consumers at lower prices, and retailers responding with quick and cheap production. However, this trend has come at a significant cost to the environment, as the rapid production cycles and disposable nature of fast fashion have led to a monumental increase in textile waste.

The rise of fast fashion can be traced back to the 1990s when retailers began to adopt a new production model that emphasised speed and low costs. This model was made possible by the globalization of the textile industry, which allowed retailers to source materials and labour from around the world. This model prioritized quantity and speed over quality and sustainability, resulting in a doubling of global clothing production between 2000 and 2014. In the early years, fast fashion was seen as a win-win situation, with consumers getting access to trendy clothes at affordable prices, and retailers making huge profits.

However, as the fast fashion industry grew, so did its environmental impact. According to the Ellen MacArthur Foundation, the textile industry produces 1.2 billion tonnes of greenhouse gas emissions yearly, more than the aviation and shipping industries combined. Moreover, the fashion industry is responsible for 10% of global carbon emissions. One of the biggest environmental impacts of fast fashion is textile waste. The fast fashion industry encourages consumers to buy more clothes, and as a result, they end up discarding old clothes more frequently. In many countries, textile waste has become a major problem, with landfills overflowing with discarded clothing. According to a report by the World Wildlife Fund, the equivalent of one garbage truck of textiles is landfilled or burned every second. The textile waste problem is compounded by the fact that many clothes are made from Synthetic fibres, such as polyester and nylon, which dominate the market and further contribute to environmental degradation due to their non-renewable sourcing and significant energy and water consumption during production. Additionally, microplastics shed from synthetic garments pollute waterways and harm marine life.

Beyond environmental concerns, fast fashion perpetuates social and economic injustices, particularly in developing countries where garment workers endure exploitative labour practices. Low wages, long hours, and unsafe working conditions prevail, perpetuating a cycle of poverty and inequality. Looking ahead, the trajectory of fast fashion and textile waste is alarming, with global clothing production projected to increase substantially. Without intervention, the environmental and social impacts will intensify, exacerbating climate change, resource depletion, and social inequality.

The good news is that there are solutions to the fast fashion and textile waste problem. One solution to tackle this issue is to reduce textile waste by recycling or upcycling. Recycling involves breaking down textiles into fibres and creating new materials such as insulation, carpet padding, and even new clothing. Upcycling involves transforming textile waste into new products with higher value and functionality, such as turning old t-shirts into tote bags or using scraps of fabric to create patchwork quilts. Another solution is to invest in new technologies that can help reduce the environmental impact of textile production. For example, some companies are developing new materials that are biodegradable or made from recycled fibres. Others are using innovative production methods that require less water, energy, and chemicals. Industrial practices change through conscious consumption habits. By supporting sustainable brands, embracing minimalist lifestyles, and advocating for transparency and accountability, individuals can contribute to positive change within the fashion industry.

Policymakers play a crucial role in enacting regulations to hold fashion companies accountable for their environmental and social impact. Measures such as extended producer responsibility, bans on hazardous chemicals, and fair labour standards can incentivize companies to adopt more sustainable practices. Lastly, donating or giving away unwanted clothing and textiles to second-hand stores or charities can also help reduce textile waste. This not only diverts textiles from landfills but also provides an opportunity for others to use and enjoy them.

In conclusion, the fast fashion crisis poses a significant threat to the planet and its inhabitants, necessitating urgent and decisive action. By reimagining the fashion industry as a catalyst for positive change and embracing sustainable practices, we can work towards a more equitable and environmentally conscious future for generations to come. We need to adopt a more sustainable approach to fashion, one that emphasizes longevity and circularity. This will require a shift in consumer behaviour, as well as investment in new technologies that can help reduce the environmental impact of textile production.

Harnessing the Sun: Powering Our Planet

Pritthish Rauth

"Every 24 hours, enough sunlight touches the Earth to provide energy for the entire planet for 24 years" — **Martha Maeda**

Throughout history, the sun has captivated human beings with its brilliant presence, illuminating our skies with a majestic glow. However, our fascination with the sun has evolved beyond just appreciation. We are now actively harnessing its infinite energy potential through solar power, which is widely regarded as the purest and most abundant form of renewable energy. This technology is transforming the way we generate electricity, protect the environment, and shape the course of our collective future.

Global Solar Journey

The concept of using solar energy was first explored in the 19th century when inventors such as *Augustin Mouchot* from France and *John Ericsson*, a Swedish-American engineer, experimented with solar-powered engines. However, it was only during the oil crisis of the 1970s that serious research and development for photovoltaic (PV) cells, which capture the energy in sunlight and convert it directly into electricity, began. Countries like the US, Japan, and notably Germany started developing more efficient solar cells and enacting policies to encourage widespread adoption of solar energy.

Since then, the global solar industry has experienced explosive growth. For example, in 2022, the world added 268 gigawatts (GW) of solar photovoltaic, raising the total installed capacity to 1,188 GW - almost 50% more than the levels in 2020. Countries like China, the United States, Japan, Germany, and India are leading the way in harnessing the technological advancements in solar energy to achieve energy security, mitigate climate risks, and boost their economies.

India's Tryst with Solar Ambition:

India has made impressive strides in solar energy, growing from 10 MW of installed capacity in 2010 to over 60 GW in 2023. The government's strong political will, favorable policies, and a thriving solar manufacturing industry have been key factors in this growth. India is also the birthplace of the International Solar Alliance, which aims to spread solar energy across the world. ISA is visualising international solar grid that will connect the two hemispheres so that solar power can be transferred from daylight to nightlife countries, obviating the challenges of storing solar power. At the grassroots level, India's solar revolution has brought clean electricity to millions through the world's largest off-grid solar program.

The Future of Solar: A Brighter Horizon:

Solar energy is expected to have a promising future due to cost reductions and technological advancements like solar roads and integrated building panels. However, challenges remain, including energy storage solutions for reliable electricity supply during limited sunlight, seamless integration of solar power into existing grid systems, and overcoming regulatory obstacles, which require continuous effort and attention.

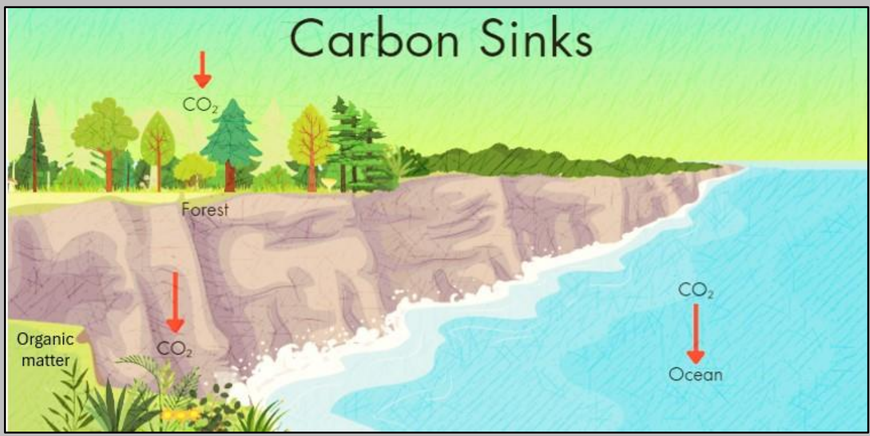
Harnessing the Sun: A Shared Responsibility:

All hands must be on deck to achieve a solar-powered future. Government policies and incentives can encourage people to choose solar power. Businesses may opt for solar to achieve financial benefits through energy independence, in addition to helping the environment. Universities and large institutions with big campuses may harness solar energy to achieve their goals of net zero campuses. Individual households may consider installing solar panels on rooftop or supporting community solar projects. The aim is to create a cleaner and more sustainable future through solar energy for generations to come. It's not about technological achievements, but rather about harnessing the power of the sun to create a better future for our planet.

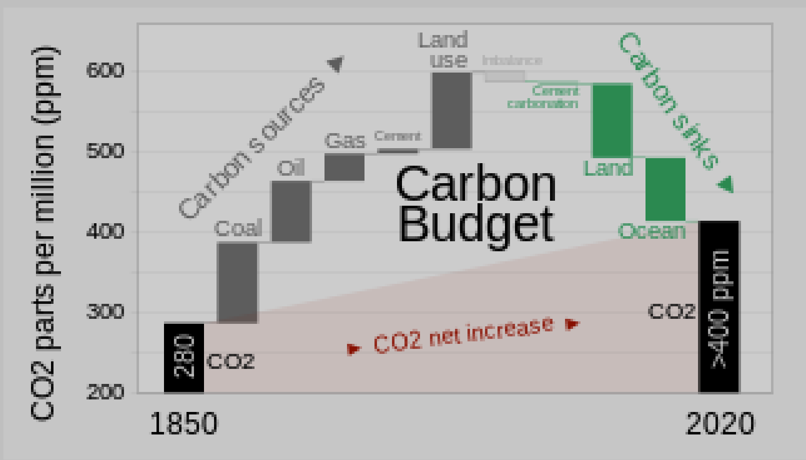
Sinking Carbon for Mitigating Climate Change

Bhagyashree Chatterjee

Carbon sink, nature's invaluable gift to humanity plays a crucial role in mitigating climate change by absorbing carbon dioxide from the atmosphere. Carbon sinks act as natural carbon "vacuums," removing CO_2 from the atmosphere through photosynthesis, oceanic absorption, and soil storage. Forests, in particular, are critical terrestrial sinks, sequestering vast amounts of carbon in their biomass and soil. Oceans also play a crucial role, absorbing CO_2 through dissolution and supporting marine life that contributes to carbon storage. By absorbing and storing carbon, these sinks help offset anthropogenic CO_2 emissions, mitigating the greenhouse effect and its associated impacts on climate change.



Millennia ago, Earth's carbon cycle existed in relative harmony. Natural carbon sinks-maintained equilibrium, sequestering carbon emitted through natural processes. Forests served as primary terrestrial sinks, absorbing vast amounts of CO_2 through photosynthesis, while oceans stored carbon through dissolution and biological processes. However, human activities, especially since the Industrial Revolution, disrupted this balance. Deforestation, primarily for agriculture and urbanization, significantly diminished forest carbon sinks. Likewise, carbon emissions from fossil fuel combustion overwhelmed natural sinks, leading to unprecedented atmospheric CO_2 concentrations. The past reveals a stark contrast between the Earth's natural carbon cycle and the anthropogenically altered one we face today.



In the present day, natural carbon sinks face unprecedented challenges. Deforestation continues at an alarming rate, particularly in tropical regions like the Amazon and Southeast Asia. Oceanic sinks are under stress due to ocean acidification, caused by excess CO_2 absorption, which threatens marine ecosystems. Moreover, the degradation of soil health through intensive agriculture limits its capacity to sequester carbon. Despite efforts to enhance carbon sinks through afforestation and reforestation projects, the rate of carbon uptake by natural systems is insufficient to offset anthropogenic emissions.

Looking ahead, the future of carbon sinks hinges on our ability to address these challenges effectively. Reforestation and afforestation efforts must be intensified, focusing on restoring degraded ecosystems and preserving biodiversity. Sustainable land management practices can enhance soil carbon sequestration, promoting both climate mitigation and food security. Technological innovations, such as carbon capture and storage (CCS), offer additional avenues for enhancing carbon sinks. However, achieving long-term sustainability will require global cooperation, policy interventions, and investments in research and development. Moreover, addressing climate change necessitates not only reducing emissions but also enhancing natural carbon sinks. Investments in conservation, sustainable land management, and technological innovation are crucial for safeguarding these vital ecosystems. As we stand at a critical juncture in human history, our choices will determine the resilience of carbon sinks and the health of our planet for generations to come.

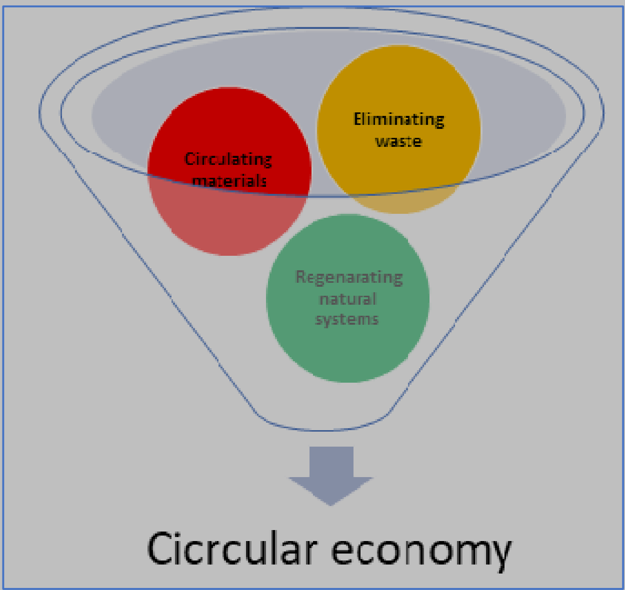
Circular Economy to Conserve Natural Resources

Sonia Paul

Historically productive systems of communities and countries have developed using natural resources of land, water, forests and animals as important ingredients of production. Primitive economy survived hunting animals and gathering fruits and roots, but demands were so minimal that these caused least harms to nature. Pastoral economy learnt to domesticate animals and sustained by rearing, grazing and trading animals. Agricultural economy learnt to use land and water as resource for producing agricultural, horticultural and commercial crops for sustenance as well as downstream value added products. These hardly raised any concerns for environment as natural resources were used in a sustainable manner. Industrial economy made a complete departure from the earlier models of production and consumption, as it is founded on burning coal and oil to produce energy for manufacturing goods and services based on minerals and other natural resources. Industrial economy was essentially linear in nature as it was one way extraction of natural resources for profits and growth with least regards for sustainability or adverse consequences on environment and society.

The circular economy is designed to reverse the process of linear economy by making it circular. Circular economy is a model of resource production and consumption that involves sharing, leasing, reusing, repairing, refurbishing, recycling and regenerating existing materials, products and resources for as long as possible. The concept aims to tackle global challenges such as climate change, biodiversity loss, waste, and pollution by emphasizing the design-based implementation of the three base principles of the model.

The three principles required for the transformation to a circular economy are: eliminating waste and pollution; circulating materials and products for further use; and regenerating natural systems.



Eliminating waste: The elimination of waste through development of products, processes, and systems that eliminate waste and maximize efficiency.

Circulating products and materials: Circulation of products, materials and resources for as long as possible through strategies such as reuse, remanufacturing, refurbishment, and recycling.

Regenerating nature: Minimizing the degradation of the environment and pollution caused by resource extraction, production, or waste disposal as well as by active restoration and regeneration of ecosystems which have been damaged, such as reforestation of catchment areas of hydro-electric projects and eco-restoration of mines

Rapid industrialization, explosive growth of population, and excessive dependence on non-renewable energy have led to global warming, climate change and pollution overload in air, water and soil. Circular economy addresses the issues of both climate change and environmental pollution. It mitigates climate change by enhancing efficiency in use of energy, water and other resources in the systems of production and consumption. Currently, 70 % of GHG emissions are generated by the production and use of material. This means we need to focus on unsustainable consumption and production in large-impact sectors like industry and construction for substantial emission reductions. Studies show that the circular economy strategies could help reduce global greenhouse gas emissions by 40 percent by 2050, through efficient and more circular use of materials in just 4 key industrial materials: cement, steel, plastics, and aluminium. Also we could achieve as much as 49 % overall reductions in global greenhouse gas emissions if we also incorporate circularity into our food system (studies of Ellen MacArthur Foundation, 2021). Circular economy strategies can actively help to sequestration of carbon dioxide from the atmosphere by the help of reforestation and regenerative agriculture. Circular economy can drastically reduce pollution and practically eliminate waste altogether through reuse and recycling of solid and liquid waste from municipal, industrial and other sources by converting organic waste into energy, fuel and fertilisers and recycling inorganic waste back into the system of production.

The Future of Farming: Symbiosis of Technology and Sustainability

Nidrothita Modak

Agriculture has always been crucial in the progress of civilization. To support an increasing population while causing minimal harm, farmers need to change their practices. This includes shifting from traditional methods to adopting innovative approaches. The future of agriculture looks promising, with opportunities for sustainable development. This could involve using data for enhanced precision farming or exploring strategies such as vertical farming.

The trend of *precision farming* is rapidly gaining popularity, which involves the use of robots for everyday tasks such as planting and weeding, and sensors to monitor soil moisture, nutrients, and individual plant health. By leveraging data-based approaches, farmers can accurately deliver quantities of fertilizer, pesticides, and water, thereby reducing resource waste and maximizing yield. Companies like John Deere are already working on developing autonomous tractors and agricultural irrigation systems that are powered by artificial intelligence. This will usher in a new era of agricultural automation. The concept of *vertical farming* is another transforming force in agriculture. Vertical farms, which provide a solution for urban areas with limited land, are gaining traction. Compared to conventional farms, these controlled environments are highly efficient and use significantly less water and land. Companies like Plenty are leading the charge by building large vertical farms in cities and transforming the way fresh produce is distributed to consumers. The key to the future of agriculture is sustainability.

Regenerative farming is gaining momentum as it focuses on improving soil health through practices such as reduced tillage and cover crops. By improving soil quality, farmers can sequester more carbon, retain water better, and ultimately achieve more sustainable farming practices. While gene editing technologies like *CRISPR (clustered regularly interspaced short palindromic repeats)* have the potential to produce crops that are resistant to pests and diseases, require less water, and offer higher nutritional value, there are still ethical concerns that need to be addressed. Nevertheless, it is important to note that the future of farming is not just about shiny tools and futuristic technologies. Addressing the socioeconomic challenges in agriculture is just as critical. As demographic changes occur in the agriculture industry, new skills such as data analysis will become increasingly important to complement traditional agricultural knowledge. Encouraging young people to enter this field through educational programs and financial incentives is crucial for ensuring food security in the future. Additionally, feeding an ever-increasing population with limited resources presents a huge challenge for the world's food system. To overcome this challenge, reducing food waste in the entire supply chain and promoting a more balanced approach towards consumption is essential.

The future of farming is an intriguing blend of sustainability, social responsibility, and innovation. Although robots can handle much of the laborious work, the human element remains vital. Farmers must learn new skills and adopt new technologies to cope with these changes. Utilizing data, automation, and sustainable practices can help us create a future where agriculture not only nourishes our bodies but also sustains our planet.

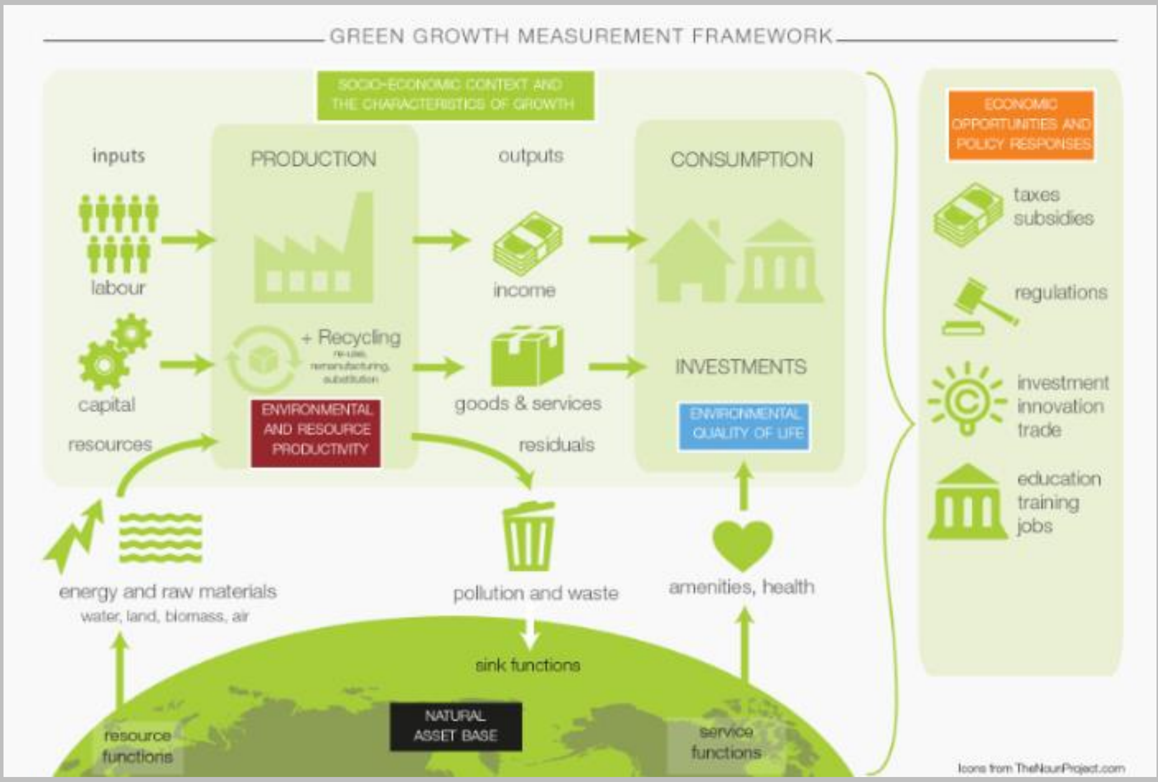
Green Growth for a Bright Future

Chetana Tunga

The future will either be green or not at all- **Jonathon Porritt, British Environmentalist**

There has been a growing demand to move from traditional Economic Growth, characterized by increased production, consumption, and resource depletion detrimental to both human health and the environment, towards Green Growth. However, it is imperative what is green growth and how it can help serve sustainable development for better implications. In May 2011, the OECD (Organisation for Economic Co-operation and Development) presented its Green Growth Strategy to Heads of State and Ministers from more than forty nations.

Green growth policies are essential structural reforms aimed at fostering robust, sustainable, and inclusive economic development by increasing productivity through efficient resource use, boosting investor confidence, opening new markets for green products, contributing to fiscal consolidation via green taxes, and mitigating the risks of growth slowdowns and environmental damage. While Green growth does not serve as a substitute for sustainable development, it presents a practical and versatile approach to achieving tangible progress across economic and environmental fronts and acknowledging the social ramifications of greening economic dynamics. The core of green growth strategies is ensuring natural resources can be fully utilized sustainably, including their vital roles in providing essential services like clean air and water and supporting biodiversity for food production and human health. Recognizing the finite nature of natural assets, green growth policies are crafted with this limitation in consideration.



Green growth initiatives are being implemented worldwide to transition towards more sustainable economic models. For instance, countries like Germany, Denmark, and China have invested heavily in renewable energy infrastructure, while Japan and South Korea have implemented energy efficiency programs. Sustainable agriculture practices are being promoted in countries like the Netherlands, Sweden, and Costa Rica, and cities such as Singapore, Vancouver, and Copenhagen are investing in green infrastructure projects. Comprehensive waste management systems prioritizing waste reduction and recycling are found in countries like Sweden, Switzerland, and Japan, while cities like Amsterdam, Paris, and Bogota are leading sustainable transport initiatives.

Recent events provide compelling evidence for the promising future trajectory of green growth initiatives. COP26 outcomes highlight global commitment to ambitious emissions reduction targets and increased climate action funding. Moreover, the rapid expansion of renewable energy capacity globally, coupled with the declining solar and wind energy costs, demonstrates sustainable energy sources' economic viability. Major corporations' ambitious sustainability goals and governments' green recovery plans post-COVID-19 bolster momentum towards sustainability. The surge in public awareness and grassroots activism, such as Fridays for Future, signals a societal shift towards prioritizing sustainability.

Rethinking Waste: Tackling Food Waste for a Sustainable Future

Jubaraj Roy

Food, a symbol of nutrition and celebration, now casts a long shadow on our path toward a sustainable future. According to the World Food Programme (WFP) report one-third of all food produced for human consumption globally is wasted and discarded. This amounts to about 1.3 billion tons/year, worth approximately 1 trillion USD. This poses a significant threat to the economy as well as the environment that sustains us. When food is dumped in landfills, it releases methane, a greenhouse gas that is 25 times more potent than carbon dioxide at trapping heat, thus impacting climate change.

We all have a role to play in reducing food waste. By planning meals and purchasing only the necessary ingredients, we can minimize overstocking and spoilage. Proper storage techniques like refrigeration, freezing, and using airtight containers or wraps help extend the shelf life of food and preserve freshness and flavor. At the retail level, food waste can be reduced by selling products nearing their expiry date at a discounted price, and new apps like Too Good To Go and Olio connect consumers with local businesses and individuals offering surplus food at a discounted price. Another way to reduce food waste is by donating nearing-expiry food to food banks or charities. Leveraging technology like AI can also help reduce food waste by analyzing data to predict demand, minimize losses, and streamline supply chains. AI algorithms enhance efficiency, ensure resources are used effectively, and contribute to a more sustainable and resilient food system.

To address the ambitious target set by SDG 12.3 of having global food waste by 2030, comprehensive strategies spanning production, distribution, consumption, and waste management are imperative. Central to this endeavour are the principles of reducing, reusing, and recycling (the 3Rs), which serve as guiding pillars for minimizing waste at every stage of the food supply chain. Leveraging the synergies between SDG 2, aimed at ending hunger, and SDG 12, promoting sustainable consumption and production, is essential in fostering a holistic approach to tackling food waste. Businesses play a pivotal role in reducing food spoilage through the implementation of standardized labeling systems, improved forecasting techniques, and the promotion of portion control measures. Meanwhile, restaurants and cafes can contribute by offering smaller portion sizes to minimize plate waste. Reuse strategies, such as community-based composting programs, divert food scraps from landfills, turning them into valuable soil amendments. Additionally, embracing recycling processes to convert food waste into renewable energy sources like biofuel and biogas further contributes to sustainability efforts. By embracing these strategies, we can effectively mitigate the environmental, social, and economic impacts of food waste while promoting a more sustainable future for all.

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