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Article 11: Climate Change &Biodiversity: FACTS & FIGURE

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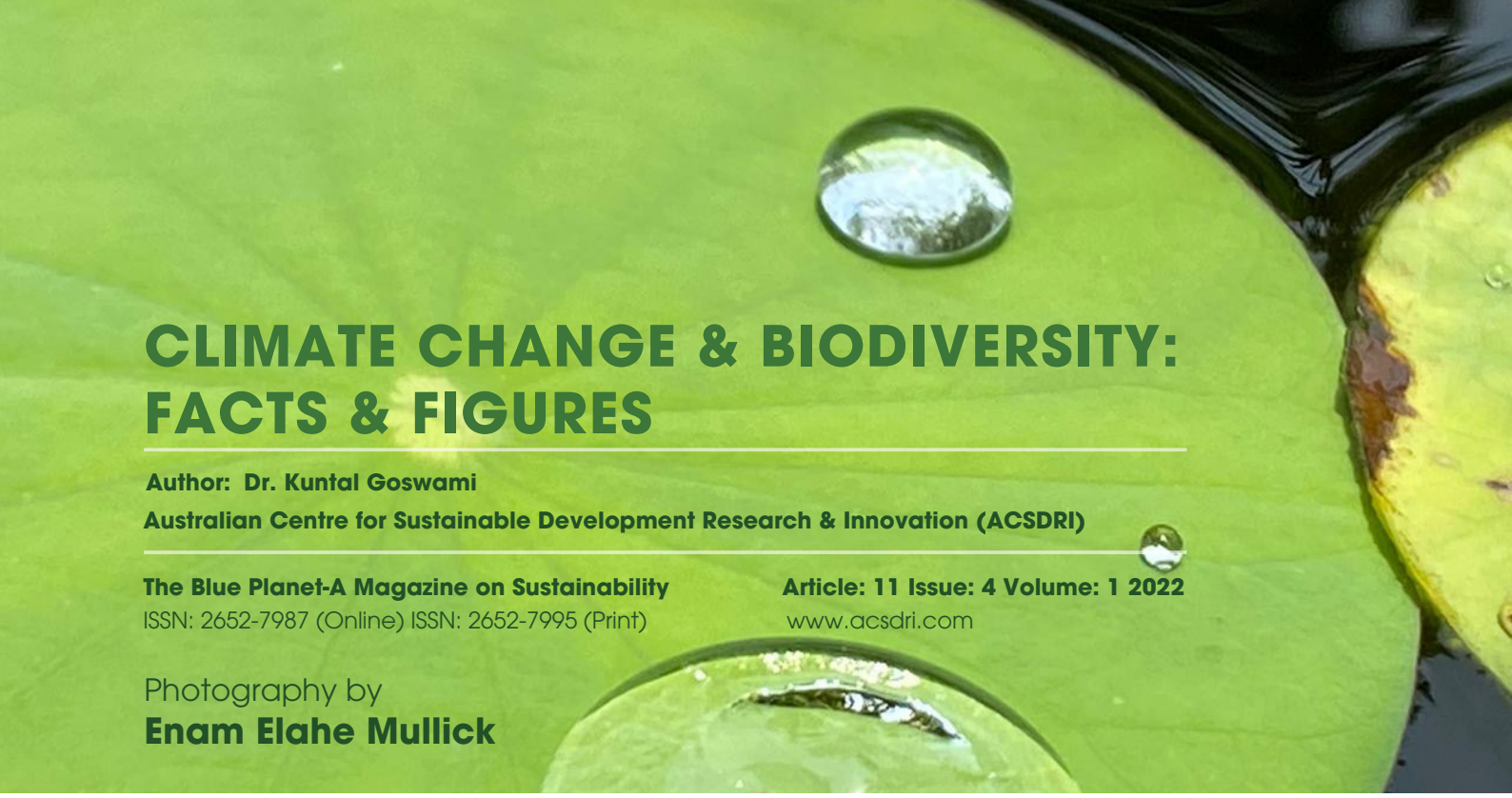

CLIMATE CHANGE & BIODIVERSITY: FACTS & FIGURES

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Climate Change & Biodiversity Loss are the two most intertwined risks of our time. Both are driven by human activities and interlinked through the Carbon Cycle

We are living in the era of human-induced Carbon Imbalance

Carbon - the omnipresent element of nature

Carbon is omnipresent. It is one of nature's essential building blocks. Carbon is profoundly important in the universe. We are all made from carbon and live in a carbon world.

Carbon forms at the core of stars under extreme temperatures. Hydrogen atoms forms Helium. When two Helium atoms stuck together, they form Berylium.

Berylium is extremely instable and does not last long. As it forms, it tends to disintegrate instantly and at that very moment or at that fraction of a second, out of mere chance, if it is hit by another Helium atom, then Carbon is formed.

Carbon is released into the universe as stars die. Carbon is the most abundant element in the universe after Hydrogen and Helium. A fifth of our body is made of Carbon. We are all technically Stardust.

In the context of Climate Change, carbon is not the problem. We need to learn about carbon cycle, how to reduce the present carbon imbalance created by human activities. Hence, we need to learn how to maintain the carbon equilibrium of nature to ensure sustainable life on earth.

What is Climate Change?

Climate change is a long-term shift in global or regional temperature, rainfall, or wind patterns. This shift can be natural however, in the present context, rises in temperature since the 1800s are due to human activities, primarily because of burning fossil fuels like coal, oil and gas. This is popularly referred as climate change.

What is Biodiversity?

The Convention on Biological Diversity defines biological diversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems"

A simpler explanation of biodiversity is that it represents collective diversity of all life on Earth including animals, plants, fungi, and micro-organisms like bacteria.

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Nevitha R.S.

Why does Biodiversity matter?

Simply put, human cannot survive without biodiversity.

Animals and plants provide us with fresh water, food, and medicines. However, humans cannot get food, water, medicines from any single plant and animals, we need a collective diversity of plants and animals to gain all these benefits from nature.

For example: plants and trees are essential to improve the quality of clean air, limit rising temperatures, protect us against climate change and to limit soil erosion from rising sea levels.

In the past the value of biodiversity and the ecosystem was sidelined in national decision-making, which resulted in a widespread loss of biodiversity and a significant decline in ecosystem services. An estimate shows more than half of the world's GDP, approximately $44 trillion of value-added goods, is dependent on industries that are highly or moderately reliant on nature and its services.

It is also estimated that transitioning to nature-friendly production practices could generate about $10 trillion in business opportunities and about 395 million jobs by 2030. Most importantly, a biologically diverse ecosystem can reduce upto 37% of carbon emissions, which will be an important contribution towards the objectives of the Paris Agreement.

Hence, our natural environment is fundamental to our economics, health, and climate change mitigation and adaptation plans. However, human economic activity is causing biodiversity loss at an unprecedented level.

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Dr Veena Sagar

Climate Change & Biodiversity loss – interrelation

As climate change will intensify, it will shift the distribution and habitats of animals and plants. The extent of intensification will also determine whether species will ultimately thrive or not. Climate change as such is not the key driver of biodiversity loss; rather overexploitation and habitat destruction are the leading causes of biodiversity loss.

Conti…

However, as the intensity of climate change increases it will contribute to biodiversity loss. At the same time loss of biodiversity will also cause climate change and can lead to vicious cycle of relentless escalation.

A rich and thriving biodiversity can maintain health of ecosystem and facilitate carbon capture. Hence, natural carbon sequestration will absorb excess carbon out of the atmosphere otherwise which will further absorb and reflect heat.

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How are Climate Change and Biodiversity intertwined?

Climate change, biodiversity loss and human wellbeing are interdependent and inextricably connected with one another.

Carbon is one of the fundamental elements of life on Earth. All plants and animals are made from carbon. At the same time carbon is the common elements of all heat trapping gases in the atmosphere.

Carbon dioxide is the raw material for photosynthesis, and also a source of energy circulation. Therefore, distribution of carbon in appropriate quantity in both above and below the ground is important.

Plants transform light energy into chemical energy and produces organic compounds (carbohydrates) as food to live and grow.

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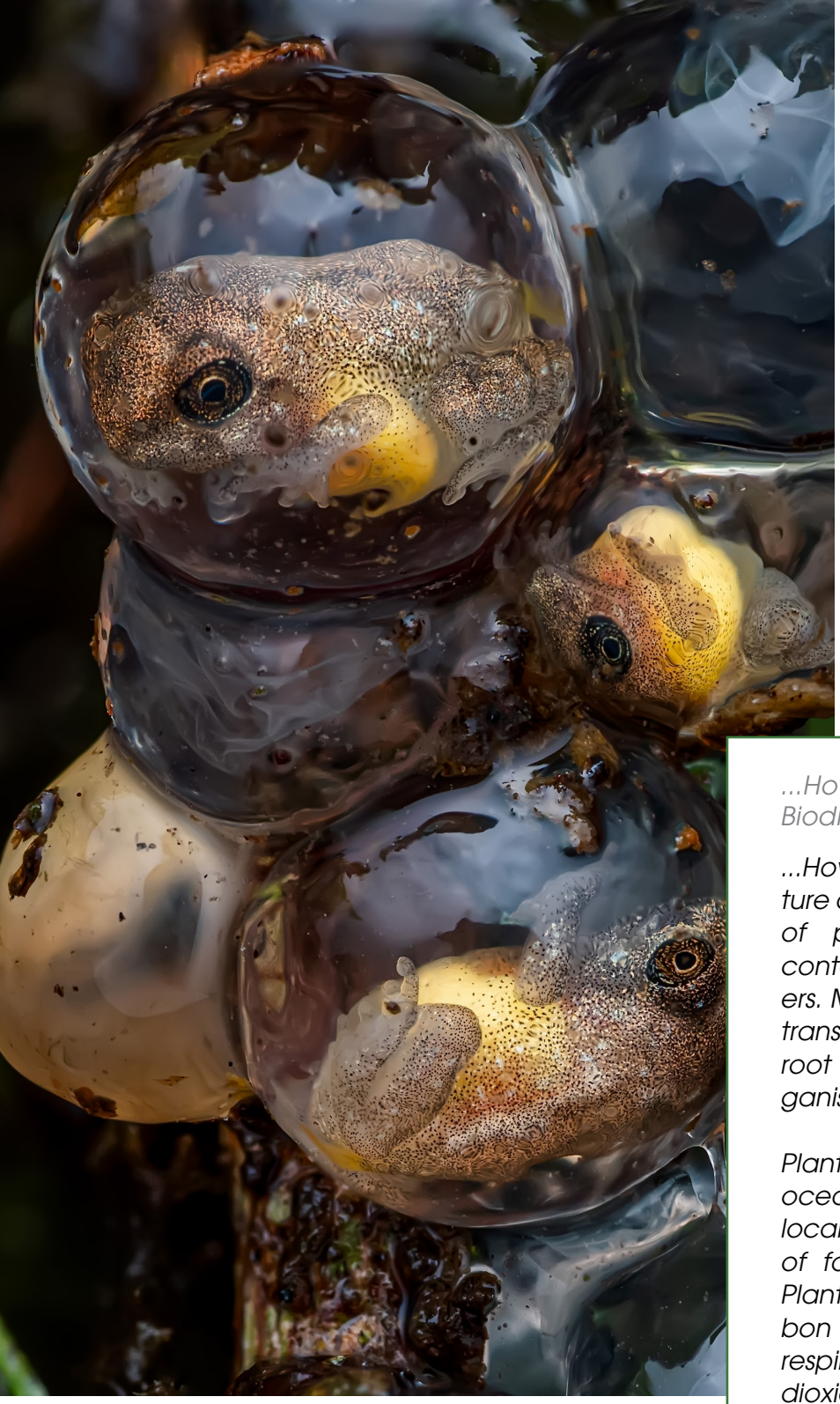

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...How are Climate change and Biodiversity intertwined? ...

...However, change in temperature and carbon dioxide alter rates of photosynthesis and carbon content within primary producers. Most carbon and nutrients are transferred to soil through litterfall, root exudation and decaying organism.

Plants and animals on land & in the ocean create habitat structure, local environment, and source of food in ecosystem hierarchy. Plants also return half of the carbon to the atmosphere through respiration in the form of carbon dioxide.

Eventually plants, algae, microplankton degrade after death and some are buried for millennia to form coal, oil, and gas. In this process, carbon is trapped in these fossil fuels. These fossil fuels have become the primary source of energy for human activities since the industrial revolution...

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...How are Climate change and Biodiversity intertwined? ...

Human economic activities release these trapped carbon dioxides again in the atmosphere through the combustion process and alter atmospheric chemistry. We also transform land and ocean surface, causes deforestation and results in widespread loss of biodiversity and climate change.

Human activities such as change of land use or sea use, agricultural practice, and fossil fuel combustion are the direct drivers of biodiversity loss and climate change. A recent study based on cross-national sample of 115 countries showed that the occurrences of natural disaster events, rise in temperature, and change in precipitation, play important role in affecting biodiversity loss.

However, the impact on biodiversity loss is more affected by the changes in precipitation and temperature rise than the changes in the frequency of the natural disaster events.

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Strategies to reduce impact of Climate change and Biodiversity loss

Strategies to conserve biodiversity must be formulated in the context of climate change and reciprocally, strategies to mitigate climate change should be formulated in the context of impact on biodiversity impacts.

The government, the industry and the financial sector should be held responsible for the loss in biodiversity. Their activities in pursuing the ultimate goal of prosperity and profits are at the expense of biodiversity leading to unbalance economic development. Hence, to conserve nature we need better planning, control of corruption and stricter enforcement of environmental protection law.

From now the government should sanction only "nature friendly" investment and development program for future development. There is a need to strengthen respective countries' national biodiversity strategies and action plans to reduce emission of carbon stocks by preventing degradation of ecosystem which will in turn halt climate change.

The parties involved in the development process (including the financial institutions that provide funding and their potential borrowers) should understand the risk of biodiversity loss and should build certain criteria for safeguarding biodiversity loss into every step of the project planning and in its financing approval.

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What is Biodiversity Finance?

Biodiversity finance is a growing area of Green Finance.

It is defined as finance that contributes or intends to contribute to activities that conserve, restore, or avoid negative footprints on biodiversity and nature caused by people.

For a project to be eligible for biodiversity finance, the project must be consistent with the criteria for Green Bond and Green Loan Principles, and it needs to contribute either to SDG-14 or to SDG-15

What constitutes biodiversity or nature related investment activities?

To be considered as biodiversity or nature related investment activities, it should address one of the following drivers of biodiversity loss:

a) to change land use - from agriculture, unsustainable forest management, urbanization, industrial developments, and transport networks.

b) to stop over-exploitation and unsustainable use of nature.

c) to stop pollution from nutrients (nitrogen and phosphorous) and other pollutants from industrial, mining, and agricultural activities as well as air pollution, greenhouse gas emissions, untreated urban and rural waste, and plastic pollution.

d) to mitigate climate change

e) to stop spread of invasive species

What is Blue Carbon?

Blue Carbon is the carbon stored in the marine biosphere, such as in the leaves, branches, stems, roots of mangroves, saltwater tidal marshes, and seagrass meadows, and in the coastal organic soil. Data suggest that coastal ecosystem can sequester carbon dioxide from atmosphere and oceans at significantly higher rate per unit area than terrestrial forest.

Mangrove forest, saltwater or tidal marshes, and sea grass meadows are three most important components of marine and costal ecosystems in the context of Blue Carbon.

Mangroves are tropical marine forest grows in the tidal flooded area at the edge of the land and sea.

Tidal marsh are coastal wetlands containing partially or fully submerged vegetation suited to both fresh and salt water.

Seagrasses are fully submerged flowering plants that can grow in meadows.

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Importance of Blue Carbon

The marine ecosystem is a major element of the global carbon cycle, and it contributes approximately half of the annual photosynthetic absorption of carbon dioxide (a greenhouse gas (GHG)) from the atmosphere.

Carbon is sequestered in both terrestrial and marine ecosystems. Blue carbon is sequestered in living marine biomass for relatively short time scales (years to decades). However, unlike terrestrial ecosystems, carbon can be stored or remain trapped in coastal soil for much longer time periods (centuries to millennia).

The reason for this is that in the terrestrial ecosystem there is potential for aerobic microbial oxidation and release back into atmosphere, while in the marine ecosystem, the soil remains submerged underwater in an anaerobic state (low to no oxygen). The Coastal Blue carbon ecosystem is highly efficient in storing and sequestering carbon. However, if the coastal ecosystem gets degraded, lost, or converted for other land use, then there will be a high risk or chance of releasing blue carbon or CO2 to the atmosphere.

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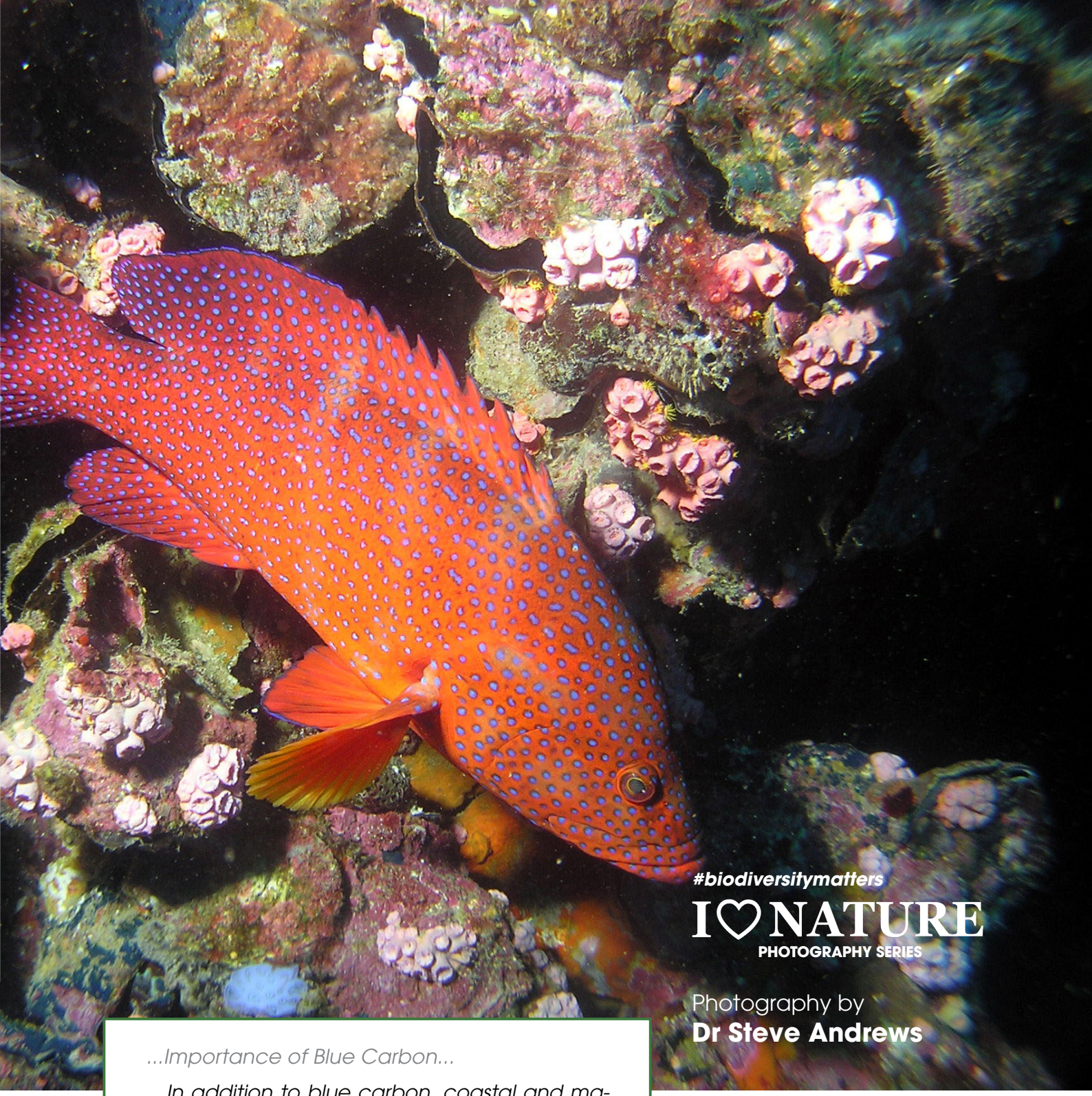

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...Importance of Blue Carbon...

...In addition to blue carbon, coastal and marine ecosystems provide other benefits such as protection from storm and flood, erosion prevention, filtering of pollutants and contaminants, spawning grounds for fish species, and habitats for fisheries and marine species.

Studies suggest 83% of global carbon is circulated through the ocean. Data also suggests that even though coastal habitats cover less than 2% of the total ocean area, it accounts for almost 50% of the total carbon sequestered in ocean sediments.

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What is a Wetland?

Water is the blood stream of the biosphere and wetlands are the source and purifier of water. About 75 Sustainable Development Goal (SDG) Indicators are directly or indirectly related to Wetlands.

Lakes, rivers, swamps, marshes, peatlands, mangroves, underground system, lagoons, shellfish & coral reefs, and kelp all constitute the global natural wetland ecosystem. Wetland protects us from floods, droughts, and other disasters. It supports biodiversity, provides us with food and livelihoods. Wetland is the largest storage facility for carbon across among all the ecosystems.

All these wetland ecosystem services can be consolidated under the following categories Provision services (food, fresh water, fibre, fuel, biochemical and genetic material), Regulating services (climate, hydrology, pollution control, erosion protection, natural hazards); Cultural services (spiritual and inspirational, recreational, aesthetic, and educational); and Supporting services (biodiversity, Soil formation, Nutrient cycling, and pollination).

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Composition of natural inland wetlands by percentage:

Rivers & Streams - 6%; Natural lakes - 29%;
Non-forested peatlands-27%; Forested peatlands-6%
Marshes and Swamps -22%; Forested Wetlands-10%

Composition of natural marine and coastal wetlands by percentage:

Unvegetated tidal flats-28%; Saltmarshes-34%;
Coastal deltas-2%; Mangroves-8%;
Seagrass beds-11%; Coral reefs (warm water systems)-17%

Regional distribution of global wetlands by percentage:

Asia-31.8%; North America-27.1%;
Latin America and the Caribbean 15.8%;
Europe-12.5%; Africa-9.9%; Oceania-2.9%

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Types of Wetlands

Globally we have lost about 35% of wetland since 1970.

A recent estimate shows globally we have total natural wetland ranging between 1.5 to 1.6 billion hectares of wetland and out of this about 93% of wetlands are inland system whereas remaining 7% is categorised marine and coastal wetland.

In addition to that there are human made wetland in form of agriculture water storage bodies, agricultural wetlands (such as rice paddy), wastewater treatment / constructed wetlands, saltpans, aquaculture ponds and human-made karst & caves.

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Significance of WETALNDs from the SDGs perspective	
SDG-1	*More than a billion people depend on wetlands for living*
SDG-2	*Rice paddy agricultural wetlands provides staple diet for 3.5 billion people*
SDG-3	*Wetlands (especially rivers, lakes and coastal areas are hotspot for relaxation and pleasure tourism*
SDG-4	*Safe water access enhances educational opportunities for communities living along wetland*
SDG-6	*Almost all of world's freshwater consumption is either directly or indirectly drawn from wetlands*
SDG-7	*Sustainable upstream water management can provide affordable and clean energy*
SDG-8	*Wetlands supports 266 million jobs through wetland-based tourism and travel activities*
SDG-9	*Health wetlands protects from flooding and storm surge*
SDG-11	*Urban wetland acts natural affluent treatment zone*
SDG-12	*Sustainably managed wetlands support water consumption demand*
SDG-13	*Heathy wetland can mitigate climate change as natural carbon storage zone. For example: Peatlands cover only 3% of global land but store about twice the amount of carbon stored by world's entire forest biomass.*
SDG-14	*Healthy and productive oceans rely on well-functioning coastal and marine wetlands.*
SDG-15	*40% of all the world's species live and breed in wetlands*

NOT just HUMAN-induced CLIMATE CHANGE but

HUMAN-induced
EXTINCTION OF SPECIES

Species evolve and become extinct overtime – a normal process of nature. It is estimated that 98% of all species that ever lived are now extinct.

Scientists have observed that, at present, the extinction of species is happening 1000 times more quickly than expected and 29% of 142,000 assessed species are now extinct

Percentage of Species in the International Union for Conservation of Nature (IUCN) Red list

Date shows one in four species are at risk of extinction.

Recent assessment shows that, 40% of amphibians; 34% Conifers; 33% Reed corals; 31% Sharks and rays; 27% selected crustaceans; 25% Mammals; and 14% Birds, are at very high risk of extinction.

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What is Living Planet Index (LPI)?

The Living Planet Index (LPI) started in 1970 as the base year. It measures the average change in the number of individuals animal populations across the world. A 'population' is defined as a species within a geographical area.

For example: All African Elephants are same species, however, South African, and Tanzanian elephants are considered as different populations.

The index represents 20,811 populations of 4,392 species.

The LPI does not tell us the number of species, populations or individuals lost; the number of extinctions that have occurred; or even the share of species that are declining.

The LPI only tells us that between 1970 and 2016, on average, there was a 68% decline in population size across the 20,811 studied populations.

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Forests in the Natural Ecosystems – the Bedrock of Life on Earth

Forest is fundamental to fight climate change, to conserve nature, to save people and to run the economy. It is estimated that 1.6 billion people depends on forests for food, water, wood, and employment.

Forests sequester carbon, regulate our climate, acts as flood barriers, recharge groundwater, filter air, protect biodiversity. In addition, forests contribute about $150 trillion to economic progress.

Deforestation is increasing global CO2 emissions by 15% and if we consider tropical deforestation a country then it would be the world's third largest emitter. It is estimated that globally we deforest tropical forest equal to the size of New York's Central Park in every 15 minutes.

Hence, it is impossible to halt climate change and stay well below 1.5 degree C temperature rise relative to pre-industrial revolution days, until or less we can stop deforestation.

Alarming facts of the Global Biomass of all mammals and birds

Even though farmed animals (mainly cows, pigs, sheep, goats, and horses) constitute a handful varieties but compared with wild animals, farmed animals now constitute 60% of the global biomass of all mammals.

Single human species constitute 36 % of the global biomass of all mammals.

Wide varieties of wild mammals make up only 4 %.

Similar facts also noticed in the case of birds.

One single bird, the farmed chicken, constitute 57% of global bird biomass, whilst wild birds' make-up 29%.

What are Aichi Biodiversity Targets and how much each target has progressed?

The Aichi Biodiversity Target was the Strategic Plan for Biodiversity 2011-2020. It had five strategic goals and 20 targets.

- *Strategic Goal A: Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society.*
- *Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable use.*
- *Strategic Goal C: Improve the status of biodiversity by safeguarding ecosystems, species, and genetic diversity.*
- *Strategic Goal D: Enhance the benefits to all from biodiversity and ecosystem services.*
- *Strategic Goal E: Enhance implementation through participatory planning, knowledge management and capacity building.*

Out of 20 targets only six targets had been partially progressed and these six targets are:

- *Target 9: Controlling invasive alien species pathways and preventing their establishment.*
- *Target 11: 17% of terrestrial and inland water areas and 10% of coastal and*
- *marine areas are conserved.*
- *Target 16: Use of Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of benefits arising from their utilization is present in signatories.*
- *Target 17: Submission, development, and implementation of national biodiversity strategy plans.*
- *Target 19: Research, scientific support and technology relating to biodiversity conservation are improved and widely shared.*
- *Target 20: Signatories have mobilised the needed amount of financial resources to implement their national biodiversity strategy plans via domestic spending and international financial flows.*

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The Need for a Global Annual Biodiversity Conservation Fund

The World Economic Forum, estimates that about USD $44 trillion of economic value or over half of the world's GDP, is moderately or highly dependent on nature. The Biodiversity and Ecosystem Services (BES) Index has estimated that one-fifth of all countries, with both developing and advanced economies, have more than 30% of their territory at risk of ecosystem collapse due to a decline in biodiversity.

For example: countries such as Kenya, Nigeria and Pakistan are particularly at risk as they are highly dependent on their agricultural sectors and, additionally, they have highly fragile ecosystems.

A recent study shows about 60% of global biodiversity loss happens to seven countries: Indonesia, Malaysia, Papua New Guinea, China, India, Australia, and the USA.

It is estimated the world needs USD 722-967 billion per year by 2030 as Global Annual Biodiversity Conservation Funding and out of that 76% will be required to halt and reserve global biodiversity loss.

A) Funding requirement for Biodiversity Conservation

⌀ *Expand the global protected area network to 30% of all terrestrial and marine ecosystems*	*USD $149-192 billion*
⌀ *Global conservation and restoration of critical coastal ecosystems including mangroves, seagrass, saltmarshes, and oyster reefs*	*USD $27-37 billion*

B) Funding requirement for mainstream biodiversity conservation

⌀ *Global sustainable management of agricultural lands (cropland, and rangelands), forests, and fisheries*	*USD $438-580 billion*
⌀ *Global invasive species management*	*USD $36-84 billion*
⌀ *Biodiversity conservation in urban environments and reducing water pollution*	*USD $72.6-73.2 billion*

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Roots – the Invisible Heroes

Roots remain out of sight and out of mind, but the root is almost half of the overall plant. It is extremely important to stop soil erosion, to hold nutrients in the soil and to fight climate change. Forest soil holds 60 to 70% of carbon and the way to pass carbon from the atmosphere to the soil is through roots. Through photosynthesis plants and trees absorb carbon dioxide and store the carbon throughout their biomass including the roots and then transferred to the soil.

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...Roots – the Invisible Heroes (conti...)

... Roots also creates a new hotspot of ecosystem under the soil and creates a symbiotic relationship with fungi to source minerals.

In future we may prefer plants with longer roots keeping in mind longer dry spell due to climate change. Plants may need to grow deep in the soil to source water. Longer roots can also maintain soil fertility.

As roots form a web of network it hold the soil, absorbs sediments, and helps to protect coastal erosion and plants diminish the energy of larger waves, thereby, helps in coastal protection.

New research also suggesting that roots can be used to mine resources such rare earth minerals

Soil – reservoir of Biodiversity & stock of Carbon

Soil is the reservoir of global biodiversity, and home to more than 25% of global biological diversity. It supports the range of micro-organisms, alongside flora and fauna. It is estimated that 1 gram of soil contains upto 1 billion bacteria cells, upto 200 meters of fungal hyphae and a wide range of nematodes, earthworms, and arthropods. Hence, arguably, soil contains the most diverse terrestrial communities on the planet.

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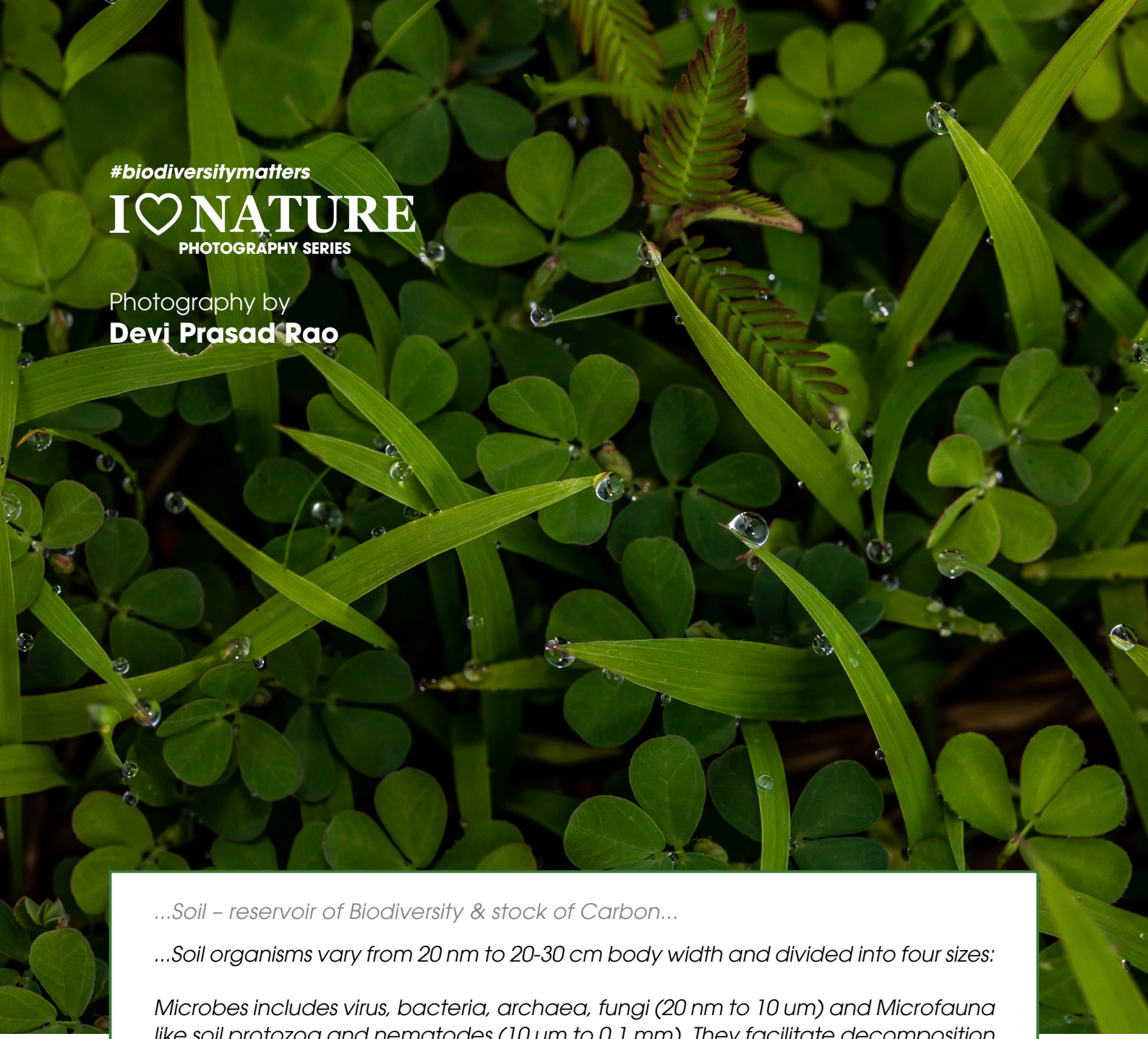

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...Soil – reservoir of Biodiversity & stock of Carbon...

...Soil organisms vary from 20 nm to 20-30 cm body width and divided into four sizes:

Microbes includes virus, bacteria, archaea, fungi (20 nm to 10 um) and Microfauna like soil protozoa and nematodes (10 um to 0.1 mm). They facilitate decomposition of soil organic matter, weathering of minerals.

Mesofauna (0.1 mm to 2 mm) are soil microarthropods (mites, springtails, enchytraeids, apterygote and small larvae of insects). They facilitate transformation of soil organic matter and increases the surface of active biochemical interactions in the soil.

Macrofauna (2 nm to 20 mm) are large soil invertebrates (earthworms, woodlice, ants, termites, beetles, insect larvae). They act litter transformers, increases water permeability and soil aeration.

Megafauna (greater than 20 mm) are vertebrates (mamalia, reptilian and amphibia). They create spatial heterogeneity on the soil surface and in its profile through movement.

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...Soil – reservoir of Biodiversity & stock of Carbon...

...Soils holds largest stock of carbon on earth and in a broad sense, the carbon in soil is recycled within a microbe-driven soil food web. Microorganisms are thus central players in the transformation of plant and animal residues and are also key reservoirs of organic carbon in soil.

Carbon is either fixed or released from soils, depending on the activity of the soil microbiomes, and driven by abiotic conditions such as water content, temperature, oxygen level and pH level.

Soil has a tremendous potential for regulating the atmospheric carbon content by sequestering carbon and mitigating climate change.

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...Loss of Biodiversity is one of the TOP EXISTENTIAL THREATS for mankind...

Source: Global Risk Report

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