

## Diversity of Species

### 1992 Convention of Biological Diversity

- Rio de Janeiro - Variability among living org. from all sources includ. terrestrial....

**Specie Diversity** - Variability within specie. Represent specie richness & abundance.

Indices → Shannon Wiener & Simpson

**Shannon Wiener** → No. of each specie., proportion each specie is of total, sum of proportion times natural log of proportion of each specie.

**Simpson's Diversity** → measure of diversity, takes into account number of something as well as abundance.

**Ecosystem Diversity** - Variability in ecological niche, trophic structure, food web, nutrient cycling. Also physical variation - temp, moist, altitude, precip.

Destroying diversity → disrupt ecological Biodiversity loss → cause: Climate change, pollution, destruction of habitat, hunting etc.

Value: commercial, ecological, social, fuel aesthetic, consumption, drugs, productive

**Drugs**: 75% world population dependant on plants for meds. **Pencillin** (penicilium).

**Tetracycline** (Quinine), cure for **malaria** (cinchona tree) **Digitalin**(foxglove, Digitalin) for heart. **Vinblastin, vincristine** (anticancer) (periwinkle/catharanthus) plant which contains alkaloid. **Marine animals** contain anti-cancer properties.

Despite ban, trade in products from endangered species, fur, hide horn worth millions of dollars are sold every year.

**Consumption** → Direct use food, fuel, drug

**Fuel** → Coal, petrol, natural gas, firewood

**Productive** → lumber, genes (scientist for introducing traits in crops), animal products, paper

**Social** → custom, religion, psycho-spiritual

**Ethical** → existence value (save all lives)

[Saving useless animals coz they exist]

**Aesthetic** → people pay to watch animals

**Option** → potential presently unknown

**Ecosystem Service Value** → service provided by the ecosystem (prevention of flood, soil ero., maintain soil, fix N<sub>2</sub>)

**1.5 species known** → 1-2% of actual

**Tropical defor.** → reducing biodi. by 0.5% / year.

**Terrestrial biodi. (biomes)** → forest, prairies, savannas, desert, tundra Major life zone (community of plants, animals)

**Tropical rainf.** → earth's largest storehouse of biodi. 50-80% global biodi. 1.25L flowering plants (1-3% known) Several drugs made.

**Temperate Foreste** → much less biodi Better documentation, 1.7L flowering plants, 30k vertebrates, 2.5L others

**Marine** → more than terrestrial, less known. 35% phyta of multicellular org, 34 in marine, 16 exclusively marine.

**National Level**

10th among plant rich countries

11th endemic species of higher vert.

6th cntr of divers./ origin of agri crops.

1.5L species identified.

1 of 12 mega-diversity

47K species of plants, 81K animals.

7K plants endemic (62% endemic)

7% & 6.5% of global count.

**Endemism** → Species restricted to particular area.

62% amphibians, 50% lizards endemic

Western Ghats → max endemism

**Important endemic flora** include orchids and species like Sapria himalayana, Uvaria liriod, Nepenthes khasiana, Pediocaris perrotieri etc.

**Endemic fauna** species of monitor lizards (Varanus), reticulated python and Indian Salamander and Viviparous toad Nectophryne

**Center of Origin** → 5000 species of flowering plants origin India, 166 species of cop, 320 species of wild relative of cultivated crops.

**Marine India** → 7500km coastline (mangrove, reef, backwaters) 340 species coral, rich in mollusk, crustacean(crab)

**Regional / Local** → Categorize 4 level Point (o-) richness → no. of species found at single point in space.

**Beta (B-) richness** → rate change of specie composition across diff. habitat

**Gamma (γ-) richness** → rate change across large landscape gradient

**β diversity = γ/a**

**Biodiversity Hotspot** → areas which exhibit high species of richness, high endemism. 25 hotspots in world, 2 in India. **East Himalaya, West ghats.**

Cover <2% world land, 50% terri. biodi. 0.5% plant endemic, 40% terri plan, 25% vertebrate endemic, found here.

**Indian** → extends to neighbour country rich in floral, reptile, amphi, swallow tail butterfly, mammal.

**East Himalaya** → deep, semi-isolated valley in Sikkim. 7298km area 4250 species found. 60% endemic.

**Western Ghat** → 17k km strip of forest

Maha, Karna, Tamil, Ker. 40% of plant,

62% amphi, 50% lizard.

## Biodiversity loss and its Conservation

**Threat to Biodiversity**: extin / elim of specie, natural & slow, but mass extinction happening fast.

10K species/year or 27/day extinction. 1/3 to 2/3 loss by mid of 21 century.

**Loss of habitat** → billion of hectare cleared over past 10K years for agric. wetland destroyed → drain, fill, pollute Habitat fragment, poaching

**Poaching**, illegal killing \$100 / kg elephant tusk \$1L leopard fur, bird catcher \$10k

**Man-Wildlife conflict** → when animals harm human, conflict

Endangered species India → **International union for conservation of Nature(IUCN)** → Red Data Book → list of endangered animals/plants

450 plant → endangered/threaten/rare 150 Mammal | 150 birds | unknown insect

Toad: rough skin, warts, terrestrial, gland

Frog: smooth, jump, live near water

### Conservation of Biodiversity

**In situ conservation** → within habitat, protect in nature (reserves)

**Ex-situ conservation** → gene bank, seed bank, zoo, culture collection.

7 major biosphere reserve

80 National Park

420 wildlife sanctuary

120 botanical garden

4% of geographical area

### Biosphere reserve:

Nanda Devi (U.P.), Nokrek (Meghalaya)

Manas (Assam), Sunderbans (WB)

Gulf of Mannar (TN)

Nilgiri (Karna, Kerala, TN)

Great Nicobar

Simlipal (Orissa)

Areas:Core: Buffer > transition > human settlement > research station> monitoring > education > tourism

Might have national park inside.

Nilgiri bio has Bandipur + Nagarhole.

**National Park**: dedicated area for conservation of wildlife. also for tourism without impact to envir.

Kaziranga(Assam) 1-horn Rhino

Gir (Gujarat) Lion

Dachigam (JK) Elephant

Periyar (Kerala) Elephant, Tiger

Kanha (MP) Tiger

Corbett(UP) Tiger

Dudhwa(UP) Tiger

Ranthambore(Raj) Tiger

Sariska(Raj) Tiger

**Wildlife Sanctuary**: Protected areas where killing, hunting is prohibited except under control of high. auth.

Ghana Bird (Raj) 300 spec. of bids

Hazaribagh (bihar) tiger, leopard

Sultanpur Bird(Haryana) migratory

Nal Sarovar (Gujarat) water bird

Abohar (Punjab) Black buck

Mudamalai (TN) Tiger, elephant, leopard

Vedanthangal Bird(TN) Water bird

Jaldapara (WB) Rhino, elephant, tiger

Gene sanctuary for **citrus** and for **Pitcher plant** in NE India. Projects to protect wild -

Project Tiger, Gir Lion project, Crocodile Breeding project, project elephant, snow leopard project.

**Ex-situ** done to conserve crop variety, wild relatives, local variety, to conserve the genetic variability of crop for future improv. eg. bonzai, gene/seed bank

### National Bureau of Plant Genetic resources (Delhi)

agri and horti crop

conserved with cryo-preserve of seed, pollen with liq. N at -196c. Variety of ice, millet etc preserved for several years.

### National Bureau of animal Genetic Resources(Karnal)

preserves semen of domesticated animal.

### National Facility for plants tissue culture repository

facility of conservation of variety of crop, created within NBPR

G15 have set up network of gene bank to facilitate conservation of various varieties.

India is networking coordinator country.

Argentina, Chile, Peru, Brazil, Mexico,

Jamaica and Venezuela from the Americas;

Egypt, Algeria, Senegal,

Nigeria and Zimbabwe from Africa; and

India, Malaysia and Indonesia from Asia.

The first G-15 summit was held in Malaysia in 1990.

**Life on earth - 4.6 million year**

**Total no. of species - 8.7 million**

**Total no. of animals - 1.6 million**

**900K kinds of living insects 80% of world's <find it yourself>**

### Environmental Science

This is the study of how humans interact with the environment.

**Atmosphere** → Troposphere, Stratosphere, Mesosphere and Ionosphere.

**Hydrosphere** → Water

Lithosphere → Solid part of the earth's crust. includes minerals and soil, largest volume of Earth's interior Mantle.

**Biosphere** → It is the part of the Earth that includes Air, Land, Water, Rock within which life occurs.

## Ecology and Ecosystems

**Biome** → Area classified according to the species that live there, niche for specific species.

**Mineralization** → Return of chemical elements from living organisms to abiotic components.

**A trophic level** → Is the position occupied by an organism in a food chain and can be analysed on the energy pyramid. Producers are the base of the pyramid(first trophic level) primary consumers(Second), secondary consumers(third) and tertiary consumers at the top.

**Commensalism** → is the relationship between individuals of 2 species which one obtains food or other benefits from the other without harming/benefiting the latter. **Antagonism** → is the relationship between organisms in which one benefits at the expense of the other. Natural selection has favoured organisms that are able to efficiently extract energy and nutrients from their environment.

**Symbiosis** → is the relationship between 2 dissimilar organisms, the kind of symbiosis depends on whether either or both organisms benefit from the relationship.

**Mutualism** → Is the interaction between individuals of different species that results in positive effects on per capita reproduction and survival of the interacting populations.

**Sustainable Development**:

Using resources to satisfy current needs without compromising future availability of resources.

It involves: **using Renewable energy sources, soil conservation, pollution reduction, habitat and species protection, recycling and fighting global climate change**.

**Humans impact the environment**:

overpopulation, pollution, burning of fossil fuels and deforestation. **Industrial revolution** started in 1760 till 1840, **Digitilization** is happening in the Industry 4.0 period.

**Agricultural revolution** → **Industrial revolution** → **Digitilization**.

**Emissions of greenhouse gas, Hazardous chemicals, production of nuclear materials, nuclear waste and biological warfare** make life difficult and these should be controlled inorder to make life sustainable.

**Ecology**: Study of interaction of organisms in their natural space with their surroundings. **Tansley(1935)** defined ecosystem as a self - regulating group of biotic community of species interacting with each other and with their non-living environment exchanging energy and matter. **Ecosystems change because of(Natural causes)**: Drought, Disease, Fire.

**Human changes include**: Water, Air and Land pollution and Construction.

**Humans can prevent the change in the ecosystem by**: Using resources wisely, Laws that control pollution, Clean up filter and keeping rivers and lakes clean.

**Fundamental characteristics of Ecosystems**

**Abiotic components**: Solar Energy,Inorganic substances + organic debris. It contains: Canopy,Sub-canopy,Middle-flora, Ground flora,litter and Rhizosphere zones with sun light penetration.

**Biotic Components**:

Living organisms present in the food chain, Autotrophs, Heterotrophs and micro-organisms which degrade aromatic and aliphatic compounds which degrade organic chemicals for being recycled to nature through biological and biogeochemical processes.

**Grassland**

19% of the Earth. Dominated by grass species and allow the growth of the occasional tree and shrub and erratic rainfall. **Components of a Grassland**

**Ecosystem :**

**Abiotic Components**: Nutrients from the Earth.

**Biotic Components**: Autotrophs, Heterotrophs(all consumers)

**Desert Ecosystem**: 17% of the land of the Earth. Extreme weather conditions less than 25cm of rainfall.

**Components of a Desert Ecosystem :**

**Abiotic Components**: Sandy

**Biotic Components**: Desert biomass and animals, plants in this region are called as Xerophytes-cactus, Heterotrophs(All consumers).

**Decomposers**: Fungi and bacteria which survive on plant species.

**Aquatic**

Interaction of biotic and abiotic components in the hydrosphere. 3 main aquatic ecosystems: **Freshwater, Marinee and Astuary**.

**Freshwater**

2 types: Lentic and Lotic

**Lentic**

Stagnant water, small but several biotic and abiotic components interact in several ways.

**Components of a Lentic Ecosystem :**

**Abiotic Components**: Organic and Inorganic compounds,Phosphate and Nitrogen.

**Biotic Components**: Autotrophs:

Photosynthetic bacteria with the help of inorganic compounds make minerals. Plants submerged in water.

**Consumers**: Detritivores which eat dead plant matter.

**Decomposers** : Fungi and bacteria

**Lotic**

Flowing Water

**Biotic Components**: Producers -eg.Green Algae,Consumers -fish and Decomposers -fungi.

**Marine**

70% of the Earth

**Components of a Marine Ecosystem :**

**Abiotic Components**: Physicochemical factors such as temp,pressure salinity.

**Biotic**: Producers,Consumers and Decomposers

**Astuary**

Here river meets sea.

**Components of a Forest Ecosystem :**

**Abiotic Components**: Change in Salinity, more nutrients than fresh water.

**Biotic**: Producers,Consumers and Decomposers

## Cycles and various Ecosystems

**Energy flow**: Autotrophic organisms use sun light to produce food and energy through photosynthesis, this energy is used by other levels to remain alive. In deep sea conditions since there's no light organisms are dependant on organic debris as food, there autotrophic bacteria use H2S and CO2 to produce food these are known as **chemoautotrophic bacteria**. The nutrients, chemicals and energy is circulated within ecosystem are known as biogeochemical cycles.

**Food chains**:

These depict the transfer of energy from one feeding group to another and not who eats who.

**Ecological Balance**:

Is the maintaining and regulating of the population size. Due to the consumers having multiple food sources **food chains become food webs**. There's only a one way flow of energy through the biotic community and a cycling of nutrients between the biotic and abiotic components of the ecosystem, no **reverse direction flow**.

**Nutrient cycles** involve storage and transfer of nutrients through different components of the ecosystem, so that the nutrients are repeatedly used.

**Biochemical cycles**

Hydrological,Carbon,Nitrogen and Phosphorous cycles.

**Hydrological Cycle**

Evaporation, Condensation, Infiltration, Runoff, Precipitation.

**Carbon Cycle**

Plants(respiration outcome),

Photosynthesis(fix carbon into organic molecules) and Cellular respiration,

Combustion and Erosion of limestone.

**Nitrogen Cycle**

Crucial for all organisms in DNA,RNA, 78% in the atmosphere and broken into atoms and combined with others into usable form.

**Phosphorous Cycle**

Doesn't have a gaseous state. Animals obtain P by water and animal consumption.

**Oxygen Cycle**

21% of the atm is O2. Plants and animals take in O2 through respiration and release CO2 and water in the atm.

**Types of Ecosystems**

On the basis of the presence of abiotic and biotic factors and their interaction amongst each other : **Terrestrial and Aquatic**.

**Terrestrial**

Land ecosystem and the major reservoirs are **Lithosphere** and **Atmosphere**. Major terrestrial system is also called a **Biome**.

**Forest**

Occupies 40% of land on Earth and 21% in India.

**Components of a Forest Ecosystem**

**Abiotic Components**: Inorganic substances + organic debris. It contains: Canopy,Sub-

canopy,Middle-flora, Ground flora,litter and Rhizosphere zones with sun light

penetration.

**Biotic Components**:

Living organisms present in the food chain,

Solar cooker: heat used to make food reflecting light using mirror, black box

**Solar water heater:** insulated box, paint black, glass lid, receive, store heat, water flows → heated, flows out.

**Solar furnace:** mirror arranged in concave reflector → collect solar heat, produce high temp ~3000C

**Solar power**→ Harnessed on large scale using concave reflective, make boiling of water, produce steam, turbine move, produce electricity. 50kWatt plant set up in Gurgaon. More pv systems installed in Kar, Telan, Raj, Andhra, Guj.

**Wind Energy:** high speed winds, energy, kinetic due to movement, harnessed to make wind mill move. Located in coastal region, open grassland, hill.

**minimum speed → 15km/h**

**India achieved 41GW cap.(60 target)**

**Hydropower:** water flowing is collected in dam, water stored, allowed to fall from height, turbine move, rotate generator, produce electricity.

**Faraday law of induction.**

India's potential → 4x 10^11 kw-hour only 11% utilised.

**Tidal energy**→ ocean current due to gravity of sun, moon, contain energy, high, low tide refer to rise and fall.

Only few sites in world where energy can be utilised. Fundy Canada → 17-18m high tides → 500MW power generation potential. Wave energy also used for power.

Tidal mill at **La Rance, France** one of first modern tidal power mill.

**Gulf of cambay, gulf of kutch, sundar ban** are also sites.

**Ocean thermal energy conservation(OTEC) → energy available due to difference in temp of water at deeper level.**

20+e difference required for OTEC plants. warm surface water used to boil ammonia liquid, vapor of boiled liquid used to turn turbine, produce electricity (Rankine Cycle).

Colder water is pumped to cool & condense, goes on for 24 hours a day,

**Renewable 2022 Global status report.** India ranks 3rd after China, USA. Raised target to achieve 100GW of solar by 2022.

4th largest in solar and wind (41GW)

**Geothermal:** Hot-rocks inside earth, high temp, pressure, exist below surface

Hot water geyser- Manikaran, kullu & Sohna Haryana.

USA and New Zealand has lot of plants

**Biomass energy:** Energy Plantations: fast growing trees(lke cottonwood) grass, sugarcane, sorghum, sugarbeet, water hyacinth are grown.

**Agri & Urban waste biomass:** crop residue, sugarcane residue(Bagasse), coconut shell, peanut hull, cotton stalk, are common agri waste which produce energy. Animal dung, fishery, poultry waste.

**Brazil → 30% electr. from bagasse.** India → 80% rural heat energy through cow dung.

**Biogas:** mix of methane, co<sub>2</sub>, h<sub>2</sub>, hydrogen sulphide. Major methane, produced by anaerobic degradation of animal waste in water presence.

**Biogas plant:** 1. Floating gas holder type 2. Fixed done type.

**Biofuel:** ethanol can be easily produced from carbohydrate rich substance (eg. sugarcane) burns clean, non-polluting. calorific value less than petrol, less heat than petrol.

Methanol v. useful since burns at lower temp. than gasoline, diesel.

**Biodiesel, Green Diesel:** seed oil, sunflower oil, soybean, castor oil, Jatropha etc, waste cooking oil

**Hydrogen** → electrolysis of water Green Hydrogen, Blue hydrogen, Brown H, Pink H

**Non Renewable energy**

**Coal:** 250-350M year ago, hot, damp, region during Carboniferous age.

Coal likely to last for 200 years, if use increases 2% / year, only last for 65.

Peat, lignite(brown) coal, Bituminous, Anthracite.

**Coal production in 778.19MT (with growth @ 8.67%)**

India → 9% of world's coal (320B tons) Major field → Raniganj Jharia, Bokaro, Singrauli, Godavari

Coking coal→ Imported(58M ton) Same amount produced as well.

Coal state: Jhar, Orissa, WB, MP, AP, Maha, Anthracite only in JK&

Coal burning → CO<sub>2</sub>(Greenhouse gas), fly ash.

There are clean coal tech, Sulphur impurity , sul,N toxic gas.

**Petroleum:** lifeline of global economy. 13 countries → 67% petrol. together OPEC.

1/4 reserve in Saudi arabia

**Refining:** only 40 years of use left. Crude reserves will last 40 years only.

**Crude Petroleum:** mix of alkane and aromatic hydrocarbon. needs to be purified and refined by fractional distillation. Gasoline, diesel, LPG, ATF made.

Oil fractions separate out at different temperature. variety of products are found.

Petroleum is cleaner fuel compared to coal, burns completely, leaves no residue, easy to transport and use this is why petrol is preferred. IOC, HPC, BP etc.

**LPG(Liquified petroleum gas)**

main component is butane, other propane and ethane, petroleum is converted to liquid under pressure.

**Natural Gas:** Methane(95%) small amount of propane, ethane. Shale gas(70-90% methane) from shale formation, it is fossil fuel.

formed by decomposing remain of dead animals/plants.

Cleanest fossil fuel, easily transported high calorific value 34-52MJ/m<sup>3</sup>.

no smoke.

**Russia → Max reserves (40%)**

Iran → 14% USA → 7%

Natural gas found in assoc. w oil field: Tripura, Jaisalmier, Offshore Mumbai, Krishna Godavari (ONGC, GAIL)

**Nuclear Energy:** high destructive power evidenced from nuclear weapon, can be harnessed for energy.

**Nuclear Fission:** nucleus of certain isotopes of mass no. are split into lighter nuclei on bombardment of neutron, energy released.

92U235 + On1 → 36Kr92 + 56Ba141 + 3 On1 + Energy

U 238 + Nu 1 = Pu 239 + Energy

2kg uranium-235 produce 1000mw

5400 ton(5.106kg) used for coal to make same energy/

**Nuclear Fusion:** isotopes are forced together at high temp.(1billion c)

heavy nucleus formed, releasing energy. 20 fusion reactor in world, all strive to reach high temp. RnD WIP.

**Fusion** powers sun, 2 light nuclei merge to form single nucleus. Mass total is less than 2 nuclei together.

**Present Energy Scenario:**

Present trend is go to cleaner renewable energy.

Electric vehicles encouraged fueled by fuel cell/Hydrogen

Chloride water is pumped to cool & condense, goes on for 24 hours a day,

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made.

**j)Kukrail Reserve Forest Lucknow, UP**

**k)Mhadei Wildlife Sanctuary**

Sattari taluk, Goa 208.5 km<sup>2</sup>: Have

bengal tigers.)**l)Molai forest,Majuli**

island, Assam 5.5 km<sup>2</sup>, Assam

**m)Nagarhole National Park:** Have

elephant herd. **n)Kodagu** district and

Mysore district, Karnataka 642 km<sup>2</sup>→

Tiger reserve **o)Nallamala Hills,** Hill,

Hill on Nallamala Hills Eastern Ghats,

AP (South of River Krishna).

**p)Namdapha National Park,AP,1985**

km<sup>2</sup>, 4th largest National park

**q)Nanmangalam** forest Chennai,

TN, 24 km<sup>2</sup>, forest area: 3.2 km<sup>2</sup>

**r)Neutravali Wild.** Sanctuary Goa 21

km<sup>2</sup> **s)New Amarambalam** Reserved

Forest Nilambur, Malappuram district,

Kerala **t)Pichavaram** Mangrove Forest,

Cuddalore district,TN

**Umiam** Meghalaya, Meghalaya

**Whitemouth** forest, Meghalaya

**Yercaud** Tamil nadu, Tamil nadu

**Zoological parks:** Dehradoon, Darjeeling,

Shillong, Port Blair, Agartala, Gangtok,

Shillong, Port Blair, Agartala, Gangtok,

**Ground water**

1) About 9.86% of fresh water is

groundwater.

2) Groundwater = (35-50)times

surface

3) Layer of sediment/rock that is

highly permeable and have water is

called an aquifer.

**Unconfined Aquifer:** overlaid by

permeable earth materials &

recharged by rainfall & snow melt.

**Confined Aquifer:** sandwiched

between two impermeable layers of

rock or sediments & recharged where

aquifer intersect land.

Effects of groundwater usage:

1) **Ground subsidence:** Groundwater

withdrawal > recharge rate → sediment

get compacted.

2) Lowering water table

In India decline in groundwater is

5-10m.

**Water logging:** Excessive irrigation

with brackish water leads to water

logging & sanitary problems.

**Surface water:** Precipitated water that

don't go to ground/evaporate.

ex:streams,lakes, ponds, wetlands or

artificial reservoirs.

**Water rich countries:**

Iceland, Surinam, Guyana, Papua New

Guinea, Gabon, Solomon Islands,

Canada, Norway, Panama, and Brazil

in far north + low evap. loss.

**Water poor countries:**Kuwait, Egypt,

UAE, Malta, Jordan, Saudi Arabia,

Singapore, Maldives, Israel and Oman →

in 15 to 25degree latitude.

Malta and Singapore have low per

capita as high population.

**Ottawa River:**1,271 km (790 mi) long,

drains an area of 146,300 km<sup>2</sup> (56,500 sq mi), 65% in Quebec and the rest in Ontario.

**Floods**

**causes:**Deforestation,

overgrazing, mining, rapid

industrialization,global warming

\***Cloud bursts:**Kedarnath(2013)

**Droughts**

80 countries in arid & semi-arid

regions.

**causes:**

1) Anthropogenic causes:Over grazing,

deforestation, mining increase

deserts.

70% land dry in India.

2) Intensive & Erroneous cropping &

increase of water exploitation.

Ex:Maharashtra 39yrs drought.

**Measures:**

1) Selected cropping pattern.Ex

:wheat+gram, wheat+mustard.

2) Social Forestry & wasteland

development.

**Eucalyptus** lowers water table as high

transpiration & allelopathy.

**Conflicts on water:**

In middle east:

1)Jordan,Tigris-Euphrates ,Nile → main

water source in middle-east.Ethiopia

controls 80% → Egypt is affected.