BIOSPHERE

Soils

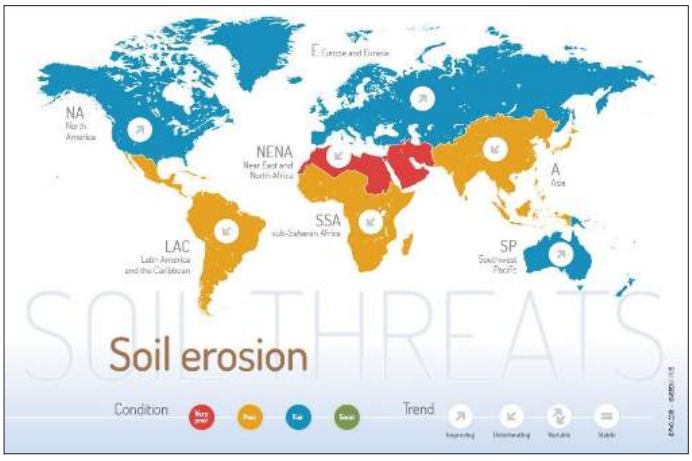
- Soil and Life
- Defining Soil and Pedology
- Pedogenesis: The Process
- Soil Types & Characteristics
- Soil Erosion & Degradation

Soil Erosion & Degradation

- **Erosion of the soil** means **loss of topsoil,** it is carried out by natural agents like rainfall, river, glaciers, wind.
- Slopes tend to move soil down either very slowly as in **soil creep** or very rapidly as in **landslides.**
- Problem of **"degradation".** Degradation means **lateritisation, alkalisation and salinisation** of the soil.
- Anthropogenic activities including deforestation, overgrazing, shifting cultivation, faulty methods of cultivation are a leading cause of soil erosion and degradation.

Soil Degradation

- 33% of Global Soils are moderately to highly degraded.
- Most significant threats to Global Soils are:
  1. Erosion
  2. Loss of Organic Carbon
  3. Nutrient Imbalance
  4. Soil Sealing
- **Way ahead**
  1. Sustainable Soil Management
  2. Use of Scientific and Local Knowledge
  3. Proven Approaches and Technology



Soil Erosion In India

Ravine Erosion

- In India, there are 4 major regions affected by **the gullies and ravines,** and they are:

1. Yamuna-Chambal ravine zone
2. Gujarat ravine zone
3. The Punjab Siwalik foothills zone
4. Chotanagpur zone

- Apart from the above major ravine regions, substantial ravine erosion is found in Mahanadi valley, Upper Narmada, and Tapi Valley.

Desertification: land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (around Thar desert, rain shadow regions like parts of Karnataka, Telangana etc.)

Waterlogging: (Punjab- Haryana Plain)

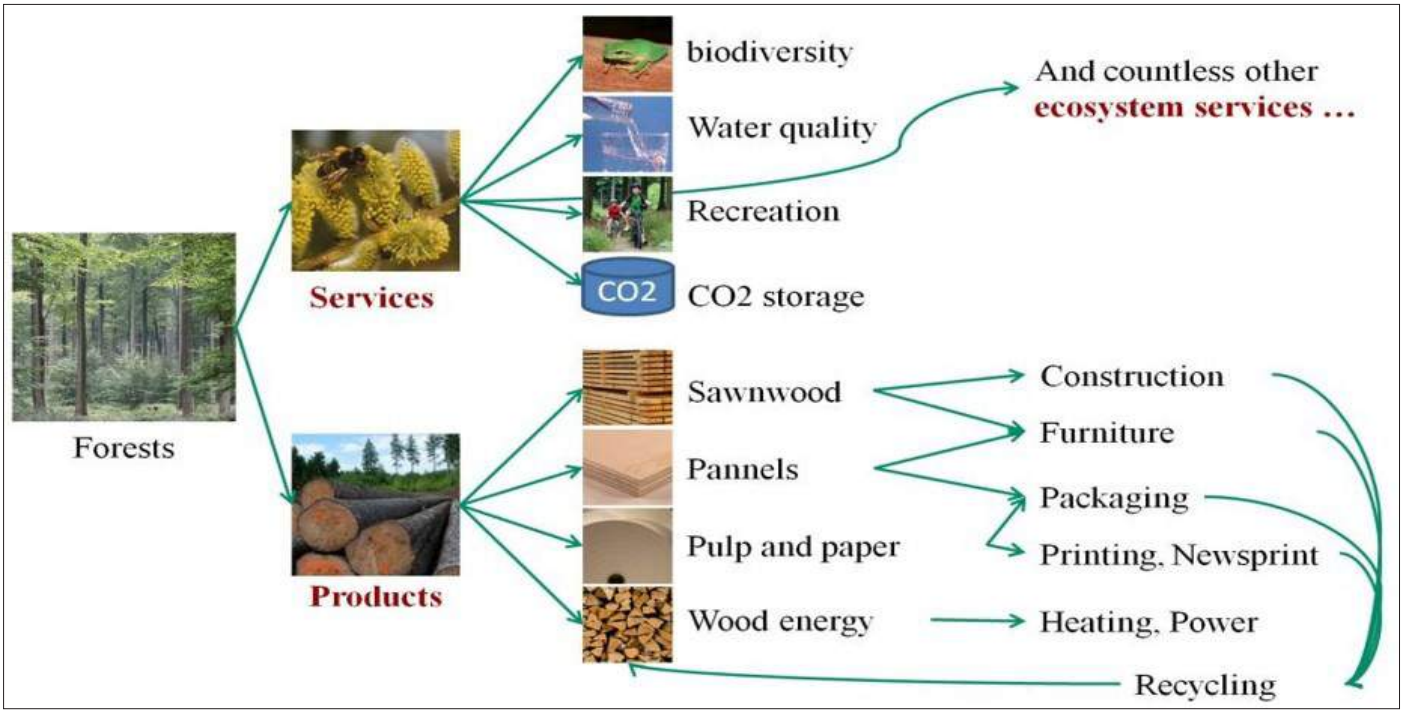
Salinity & Alkalinity (excessively irrigated regions of Punjab, Haryana, Karnataka etc.)

Soil Sealing: Encroachment of agricultural land due to urban and transport development.

Lecture Outcomes

- Biome Concept
- Natural Vegetation Concept
- Forest as a Natural Vegetation type
- Foerst Biome Types & Characteristics
- Forests of the world : Data and Distribution
- Deforestation

Roles of Forest



World Forests & Sdgs

Forests and trees contribute towards achieving 28 targets within ten SDGs of the 2030 Agenda.

- **SDG1.** End poverty in all its forms everywhere
- **SDG2.** End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- **SDG5.** Achieve gender equality and empower all women and girls

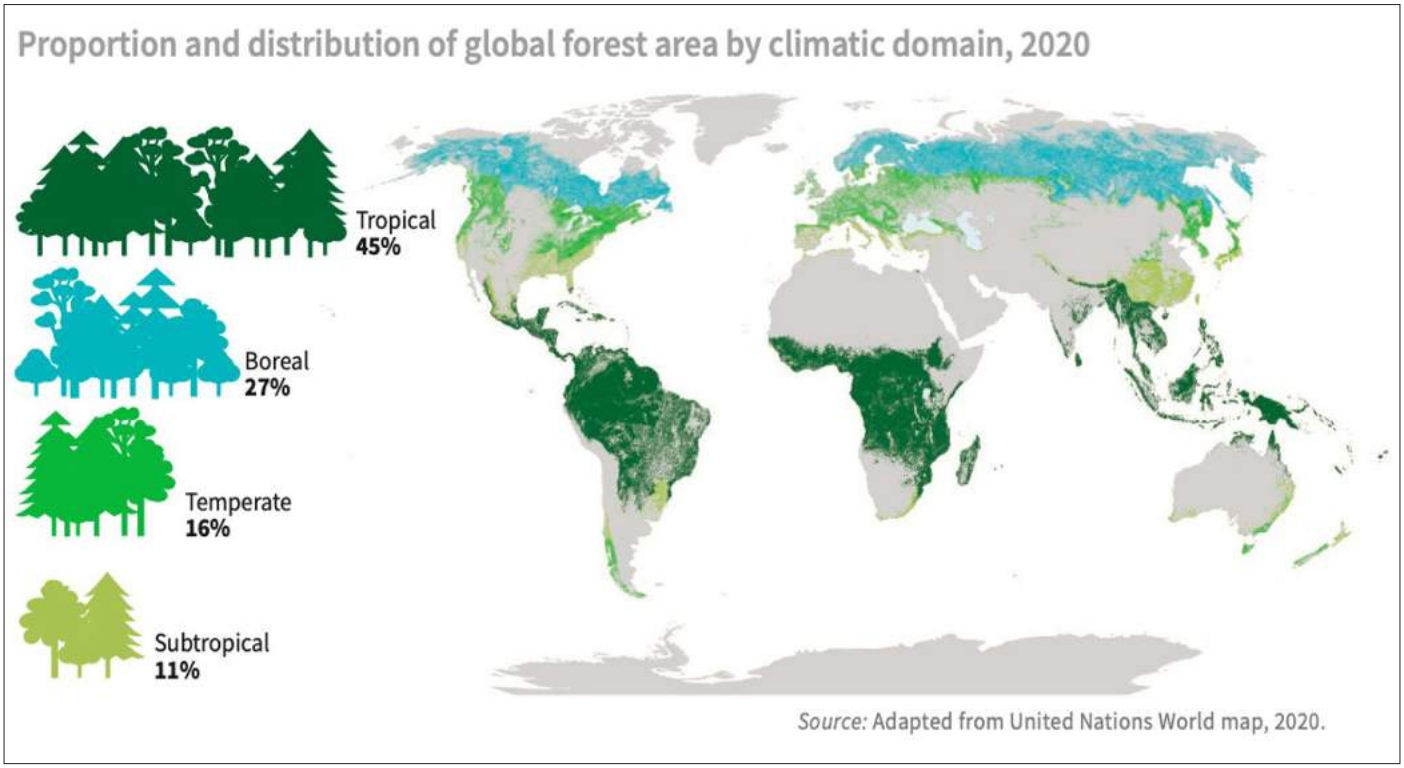
- **SDG6.** Ensure availability and sustainable management of water and sanitation for all
- **SDG7.** Ensure access to affordable, reliable, sustainable and modern energy for all
- **SDG8.** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
- **SDG11.** Make cities and human settlements inclusive, safe, resilient and sustainable
- **SDG12.** Ensure sustainable consumption and production patterns
- **SDG13.** Take urgent action to combat climate change and its impacts
- **SDG15.** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Global Forest Goal Report 2021

- Prepared by the **Department of Economic and Social Affairs** of the **United Nations,** this report provides an initial overview of progress of Goals and targets contained within the **United Nations Strategic Plan for Forests 2030.**
- An estimated 1.6 billion people, or **25% of the global population,** rely on forests for their subsistence needs, livelihoods, employment, and income.
- At the same time, **climate change is jeopardizing** the resilience of forest ecosystems and their ability to support ecosystem services worldwide.

Status of World Forest

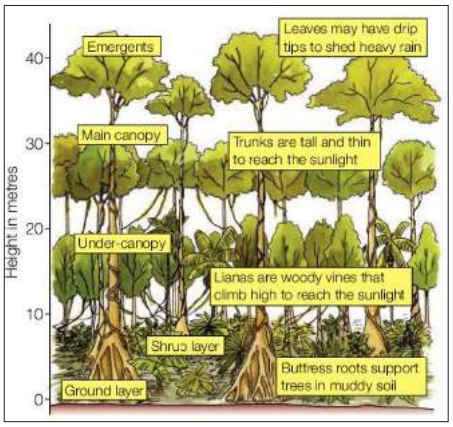
- **Total Forest Area:** According to the Global Forest Resources Assessment 2020 (FRA 2020) report, the world's total forest area is **4.06 billion hectares (bha),** which is **31% of the total land area.**
- This area is equivalent to 0.52 hectares per person.
- **Top Countries in Forest Cover -** the Russian Federation, Brazil, Canada, the United States of America and China constituted more than 54% of the world's forests.



Equitorial Rain Forest

Looking from air they are **continuous mass of trees,** broken only by river courses.

Trees are tall with straight trunks and branch only at the top.



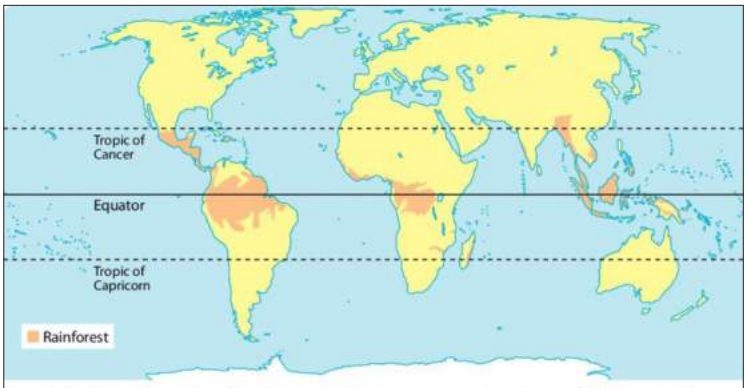
Equitorial Rain Forests

- The Equatorial Region has **uniformly hot and wet** climatic conditions throughout the year. There is **no dry season** during the year.
- Annual **range of temperature is low.**
- **Seasonal contrasts** are minimum.
- The combination of high temperature and high humidity makes the **climate unfavourable for sustained human effort.**
- The region has soils of low fertility as they get leached by heavy rainfall.
- The natural vegetation consists of **tropical evergreen forests containing a variety of species.**
- Tall hardwood trees form **a continuous cover at a high level.** There are smaller trees forming a second layer. The ground is roofed with ferns and herbaceous plants which can tolerate shade.
- Because the trees have large canopies, they **cut out most of the sunlight** the undergrowth is not dense.

Tropical Rain Forests

On this Planet they are the ones with...

1. The heaviest Rainfall
2. The highest Humidity
3. The densest Forests
4. The greatest Biodiversity
5. The largest Reserves of Hardwood
6. A winterless Climate
7. Very little Seasonality
8. The most uniform temperature during the year
9. The most diverse and productive forest ecosystems
10. The lowest diurnal and annual temperature Range



Tropical rainforests are found in the tropical regions between the Tropic of Cancer and the Topic of Capricorn. Which **continent** has the largest area of tropical rainforest?

Tropical Deciduous Forests

- This region includes eastern margins of continents between 10^0N to 30^0N and 10^0S to 30^0S.
- Parts of this region such as India, South East Asia, East Africa and Northern Australia experience a typical monsoonal climate having seasonal reversal of winds.
- In these areas, Trade winds prevail in winter and Monsoon winds blowing from the opposite direction prevail during summer. Other areas such as Eastern Brazil and Central America and Natal Coast of South Africa experience trade winds throughout the year.
- Rainfall is generally moderate except in coastal regions and mountainous tracts.
- The natural vegetation is **Tropical Deciduous forests.** These forest yield valuable timber and are prized for their durable hardwood. Amongst these **Teak** is the best known.

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Temperate Forests

- This region is under the influence of Westerly winds throughout the year.
- As these winds blow from warm oceans towards the coast, winters are warmer and annual rainfall is higher than in the cool East Margin region.
- Rainfall is of cyclonic origin and occurs throughout the year with a maximum in winter.
- Deciduous forests is the natural vegetation of this region. Coniferous forests are found on the hill slopes.
- A long history of human occupance of these wooded regions has reduced many forests to tiny remnants. Dense forests are now found only on mountains and highlands, these are mostly Coniferous.

Boreal Forests

- This region occurs as a broad belt in Europe, Asia and North America between the Midlatitude Grassland region in the South and Polar Tundra in the North. The region has short warm summer and long cold winter.
- Coniferous forests occur extensively. The trees are evergreen and the needle-shaped leaves prevent loss of moisture by transpiration.
- Taiga is a Russian word for coniferous forest, which is the predominant natural vegetation of the Siberian climate.
- Pine, fir, spruce and larch are the four major species in the coniferous forests. Among them larch is the only deciduous variety found towards the warmer southern margin of the Taiga.
- That the conifers are so called because of their conical shape with sloping branches, an adaptation to ward off snow.

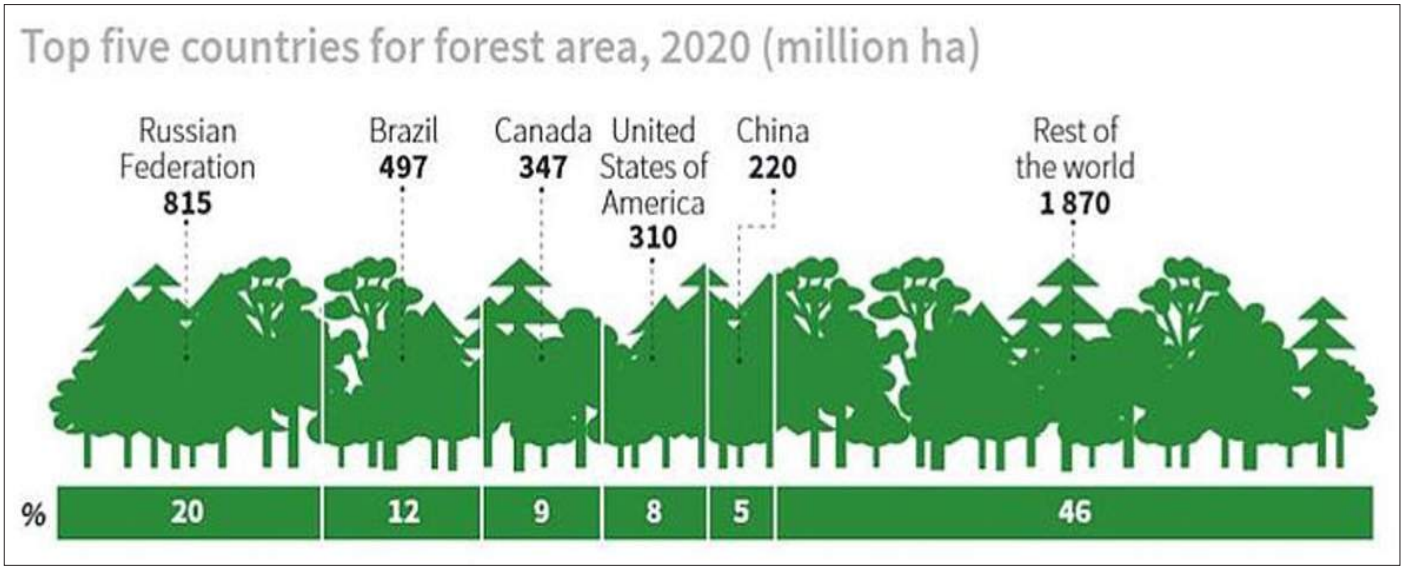
FORESTS OF THE WORLD

Global Forest Resources Assessment -2020

- Since 1946, FAO has been monitoring L SEP the world's forest resources through periodic assessments conducted L SEP in cooperation with its member countries.
- According to the report, the world has a total forest area of **4.06 billion hectares (ha), which is 31 percent of the total land area.** This area is equivalent to 0.52 ha per person– although forests are not distributed equally among the world's peoples or geographically. The tropical domain has the largest proportion of the world's forests (45 percent), followed by the boreal, temperate and subtropical domains.
- **More than half (54 percent)** of the world's forests is in **only five countries** – the **Russian Federation, Brazil, Canada, the United States of America** L SEP and **China**

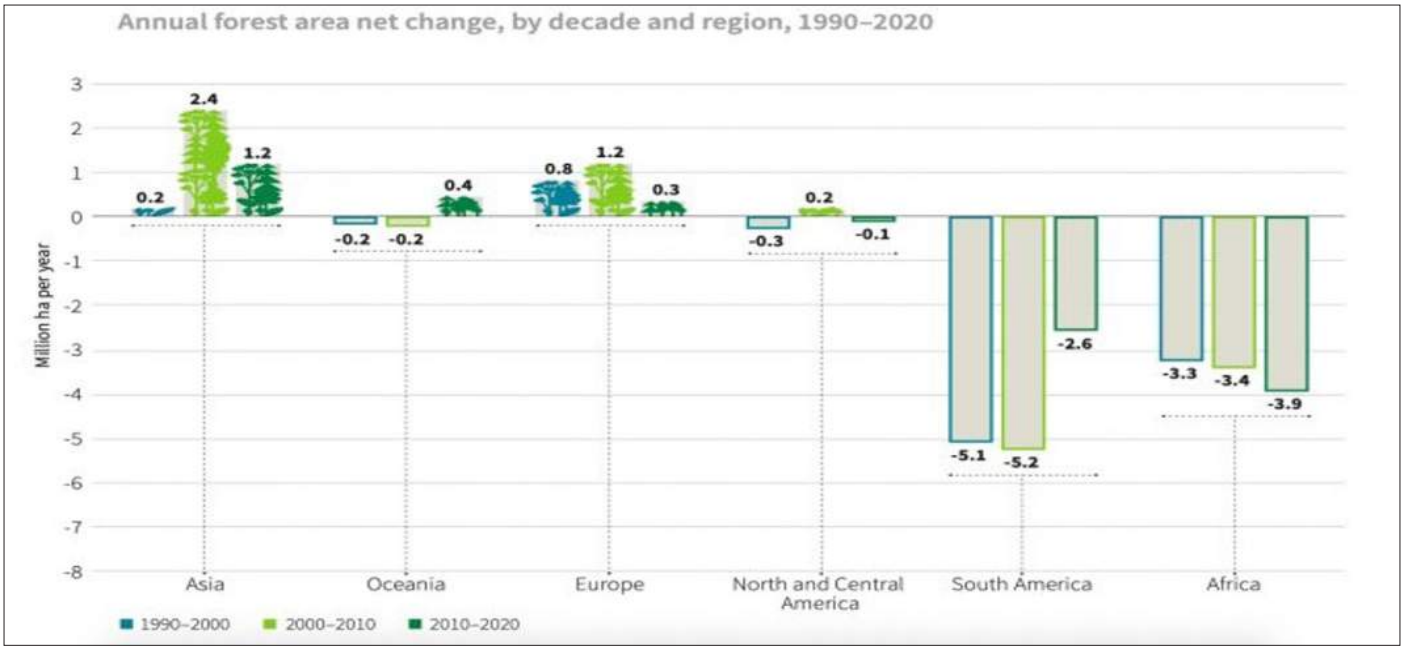
Distribution

- The Global Forest Resources Assessment (FRA), coordinated by FAO, found that the world's forest area decreased from 31.6 percent of global land area to 30.6 percent between 1990 and 2015, but that the pace of loss has slowed in recent years
- Forests are distributed across the globe.
- **31%** percent of Earth's total forest area is found in **Asia (including Asian Russia),**
- **21%** in **South America**,
- **17%** in **Africa**,
- 17% in North and Central America,
- 9% in Europe, and
- 5% in Oceania.
- Globally, **5% of forests are plantations generally used for commercial purposes.**



Deforestation

Deforestation continues, but at a lower rate: Global Forest Resources Assessment 2020



Causes of Forest Loss

- Fire is a prevalent forest disturbance in the tropics
- Forests face many disturbances that can adversely affect their health and vitality and reduce their ability to provide a full range of goods and ecosystem services.
- **About 98 million ha of forest were affected by fire in 2015;** this was **mainly in the tropical domain,** where fire burned about 4 percent of the total forest area in that year.
- More than two-thirds of the total forest area affected was in **Africa and South America.**
- **Insects, diseases and severe weather events** damaged about 40 million ha of forests in 2015, mainly **in the temperate and boreal domains.**

Global Forest Resources Assessment -2020

- The **world has lost 178 million ha of forest since 1990,** which is an area about the size of Libya.
- The **rate of net forest loss declined** from 7.8 million ha per year in the L SEP decade 1990–2000 to 5.2 million ha per year in 2000–2010 and 4.7 million ha per year in 2010–2020.
- **Africa had the largest annual rate of net forest loss** in 2010–2020, at 3.9 million ha, followed by **South America**, at 2.6 million ha. The rate of net forest loss has increased in Africa in each of the three decades since 1990. It has declined substantially in South America, however, to about half the rate in 2010–2020 compared with 2000–2010.
- **Asia had the highest net gain of forest area** in 2010–2020, followed by **Oceania and Europe.** Nevertheless, both Europe and Asia recorded substantially lower rates of net gain in 2010–2020 than in 2000–2010. Oceania experienced net losses of forest area in the decades 1990–2000 and 2000–2010.

Global Fra 2020

The Global Forest Resources Assessment (FRA) reports on the status and trends of the world's forest resources.

- It is led by the **Forestry Department of the Food and Agriculture Organization** of the United Nations.

- The FRA reports the extent of the world's forest area as well as other variables, including land tenure and access rights, sustainable forest management (SFM), legal and institutional frameworks for forest conservation, and sustainable use.

The **deforestation rate globally declined between 2015 and 2020,** according to the Global Forest Resources Assessment, 2020. This decline is **a result of sustainable management measures worldwide.**

2021 Declaration on Forests

- At the 26th Conference of Parties (CoP26) to the United Nations Framework Convention on Climate Change (UNFCCC) in Glasgow, 141 countries got together to sign the Declaration on Forests and Land Use (or the Deforestation Declaration).
- These countries, which represented over 90 per cent of forests across the world, committed to "halt and reverse forest loss and land degradation by 2030 while delivering sustainable development and promoting an inclusive rural transformation".
- The signatories committed $19 billion in private and public funds to this end.
- India was among the few countries that did not sign the declaration. According to official sources quoted in the media, India had concerns about the linkage the declaration makes between deforestation, infrastructure development and trade.

India's palm oil imports are already linked to deforestation, biodiversity loss and land conflicts in Southeast Asia. Will the same pattern be repeated in India's North East?

"any commitment to the environment and climate change should not involve any reference to trade... as India is a member of the World Trade Organization (WTO), any trade-related matter should only be looked into by the WTO".

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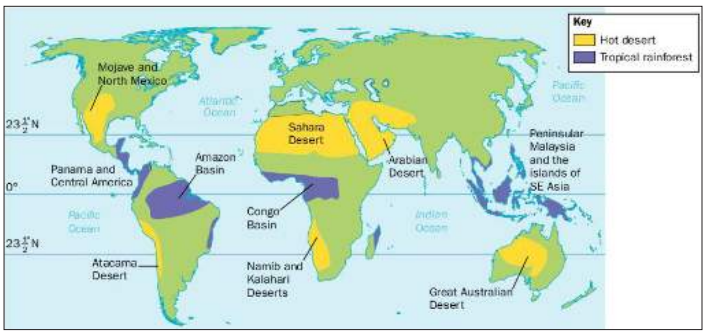
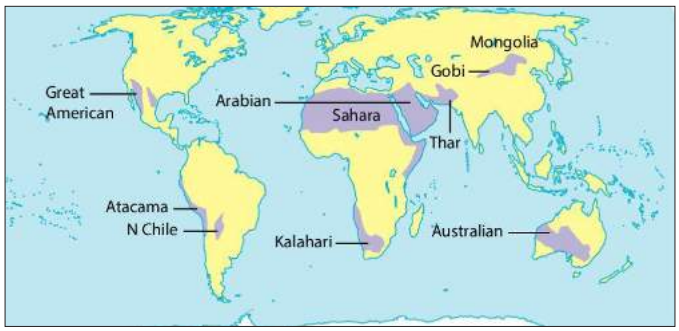
Desert Biome

- **Tropical deserts** are located on the western margins of continents in the Trade wind belt.
- Annual precipitation is generally less than 25 cm in most of the region.
- Clear skies favour free passage of insolation during day-time and outgoing radiation from the earth during the night. Therefore, the diurnal range of temperature is quite high.

- Soils are sandy with saline deposits on the surface caused by evaporation.
- Thorny scrub and bushes which' are drought resistant occur in patches here and there.
- In the oases, date-palm and other trees may be grown and small areas may also be cultivated.
- **Mid-Latitude deserts** are mainly located in the **continental interior plateaus and basins.**
- This **continentality** results in scanty rainfall and **greater extremes** of temperature. Tibet and Gobi are typical examples.
- The region receives scanty rainfall as the interior location surrounded by high mountains prevents inflow of moist air.
- Interior location also results in greater extremes of temperature between summer and winter.
- Light snowfall occurs in winter.
- Mid-latitude deserts are inhabited by pastoral nomads who migrate in search of pastures.





Grassland Biome

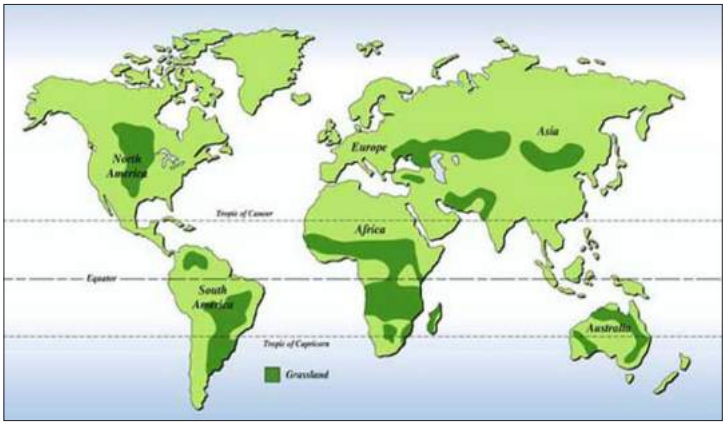
Tropical Grasslands

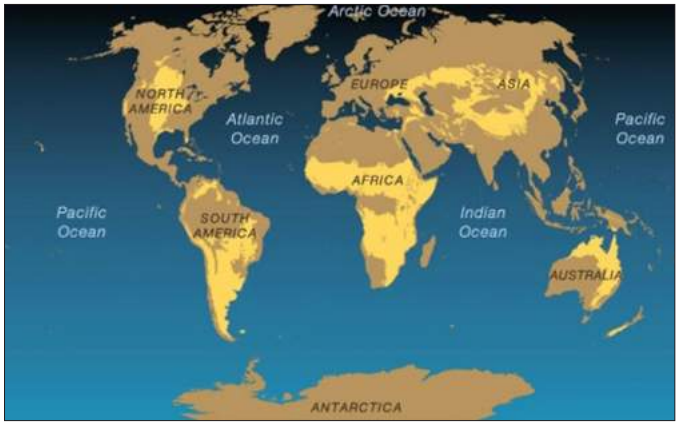
- The tropical grassland regions occur **extensively in Africa as a belt around the Equatorial region.** Other areas are parts of Brazilian plateau and Orinoco basin in South America and Northern Australia.
- This region lies in the **interior of continents** in the **tropical belt.**
- Therefore, the region has **moderate rainfall** and experiences **greater annual range of temperature.**
- Rainfall mainly occurs in the short summer season with a long dry season.
- **Coarse tall grass** which grows to a **height of about three metres** is the typical vegetation.
- The tropical grassland has been known as **"the big game country"** as carnivorous animals like lion, leopard and tiger abound in this region.

Temperate Grasslands

- This region lies in the interior of continents and therefore, receives low rainfall.
- Interior location is also responsible for high annual range of temperature between warm summer and cold winter.
- Rainfall occurs as a result of convectional ascent of air during summer.
- The natural vegetation is predominantly short grasses. The grasslands are known by different local names. They include the **Steppes** of Eastern Europe and Central Asia, the **Prairies** of North America, the **Pampas** of Argentina, the **Veld** of South Africa and the **Downs** of Australia.
- Owing to low rainfall and cold winter, **trees are generally absent.**

Grasslands of The World





Savanna Grassland & Park Landscape

Temperate Grassland

Tundra Biome

Arctic Tundra

- Arctic tundra is located in the northern hemisphere, encircling the north pole and extending south to the coniferous forests of the taiga.
- The arctic is known for its cold, desert-like conditions. The growing season ranges from 50 to 60 days.
- The average winter temperature is -34°C (-30°F), but the average summer temperature is 3-12°C (37 54°F) which enables this biome to sustain life.

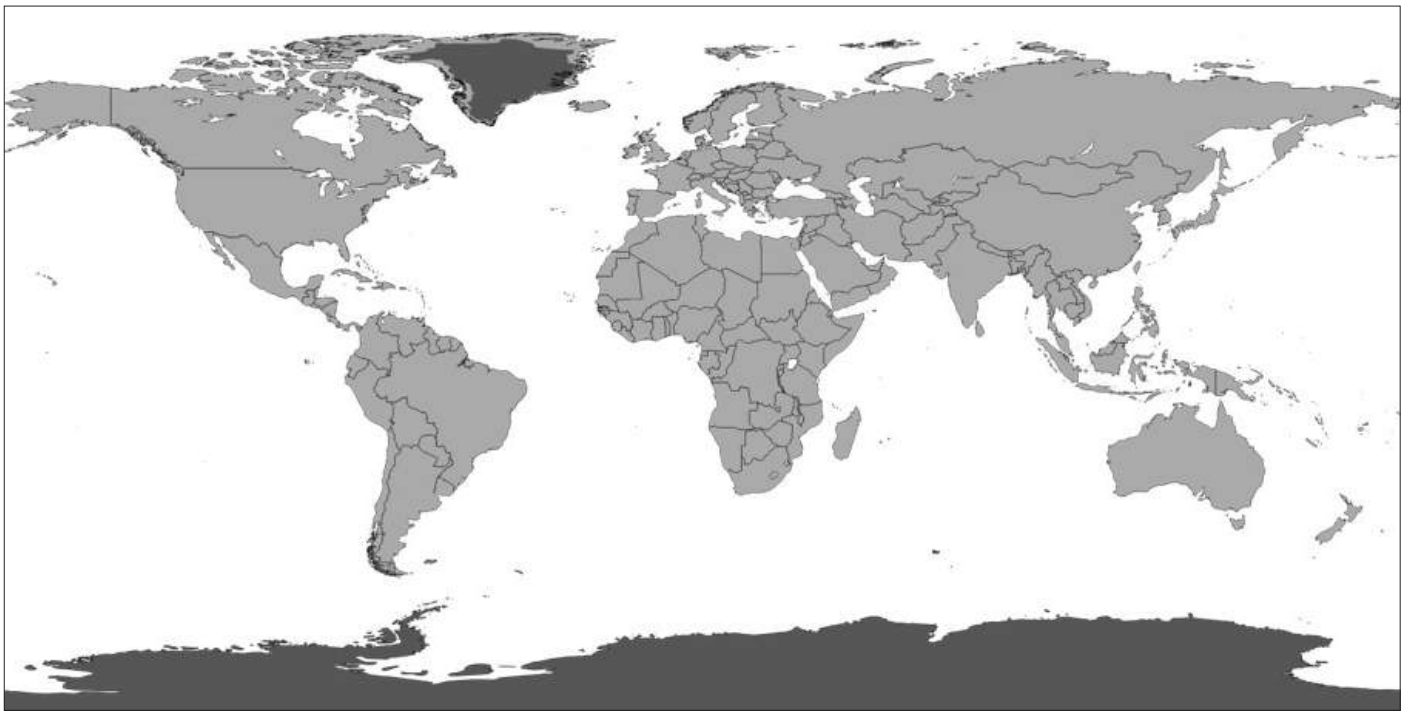
Tundra

- Greenland is an example of large landmass in north Polar region having permanent ice sheets.
- During the short summer season, the fringes of the ice caps melt exposing the land along the coast. The sub-soil remains permanently frozen.
- During summer, temperature does not exceed 100C. Precipitation is low and occurs as snowfall during winter.
- In some places a distinct tree line, coinciding approximately with the 100C (500F) isotherm of the warmest month (the tree survival line), separates the Tundra from the Coniferous Forests.
- The short growing season of about three months permits the growth of flowering plants and grasses.
- Tundra type of vegetation such as mosses, lichens and sedges occur in scattered patches. These provide pastures for reindeer.
- Besides reindeer, wolves, foxes, musk-ox and seal are other animals found in this region.
- Breeding and raising of fur-bearing animals is the most important occupation of the local people of Tundra.

Alpine Tundra

- Alpine tundra is located on mountains throughout the world at high altitude where trees cannot grow.
- The growing season is approximately 180 days. The nighttime temperature is usually below freezing.
- Unlike the arctic tundra, the soil in the alpine is well drained.

Polar Ice Caps



Ice Caps

- Antarctic is **the greatest single stretch of ice-cap** where the layers of permanent ice are as thick as 1800 metres!! Contributed by this thickness, it has the **highest mean elevation** of **1846 metres** which is twice as high as the 2nd ranking Asia with oly 923 metres.
- Ice cold winds called **Blizzards** in **Canada**, reaching velocities over 200 km/hr are common in polar areas and **Antarctica** happens to be **the windiest of all continents !!**
- The continent of Antarctica in south Polar region is covered by thick permanent ice sheets.
- Penguins are the familiar birds of Antarctica.

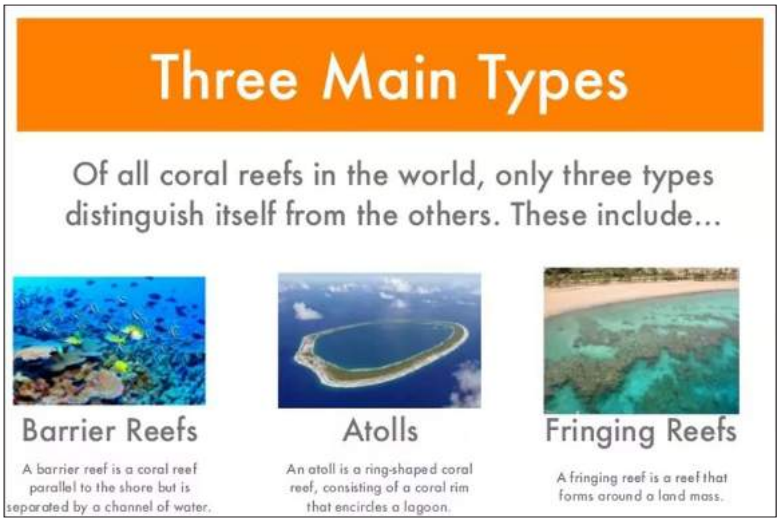
Tundra & Ice Caps

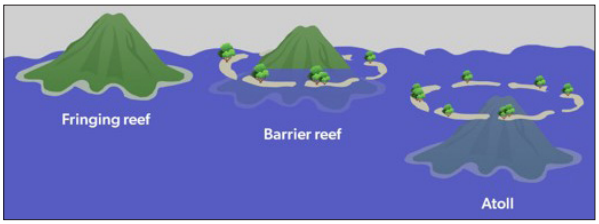
The polar world lies on the colder extreme of the **Equatorial – Polar Continuum** and therefore, they are the ones with...

1. The heaviest snowfall
2. The lowest mean diurnal and annual temperature
3. The least Biodiversity of both Plants & Animals
4. The lowest Biological productivity
5. The least Bacterial Activity
6. The most Germ-free Environment
7. The largest continental glaciers
8. The thickest ice sheets and caps
9. The lowest Biomass
10. The slowest nutrient cycling
11. The finest fur bearing animals
12. The largest fur farms in the Tundra region
13. The poorest drainage
14. The shortest growing season
15. The longest days during summers
16. The longest nights during winters
17. Not a single tree(lies beyond the tree line!)
18. Regions lying beyond the Arctic and Antarctic circles
19. The coldest deserts (the greatest heat deficit regions)
20. The least density of population

Coral Reef

Coral reefs are built **by coral polyps as they secrete layers of calcium carbonate** beneath their bodies.





Corals have a set range of conditions that they need in order to survive.

- **Clean Sediment Free Salty Water**
  - ✔ Most reef-building corals depend upon zooxanthellae (tiny little algae that grow inside of them) to photosynthesize and provide food. If the water becomes cloudy or murky, or if corals are covered in sediment, the sunlight can't get to the zooxanthellae and the corals lose that important food source.
- **Warm Water**
  - ✔ Most hard corals prefer water temperatures that range between 23° and 29° Celsius, though some can tolerate temperatures as low as 20°C and as high as 32°C.
- **Healthy Wildlife Population**
  - ✔ Herbivores like parrotfish and sea turtles graze on algae and help keep algae populations under control. When herbivore populations decline, coral reefs can quickly become overtaken with algae.

Coral bleaching occurs when corals are stressed by alterations to their living conditions – temperature, light, nutrients, etc. – and so then expel the symbiotic algae living in their tissues, causing them to 'bleach' by turning white or pale.

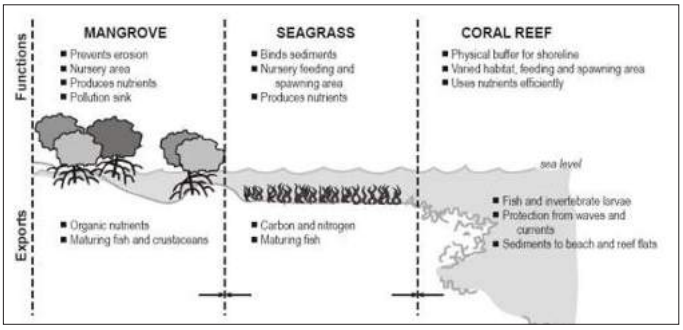
While **not always fatal,** bleaching makes coral far less likely to survive as, without the algae, the coral **loses its major food source and is more susceptible to disease.**

Mangroves

Mangroves are salt tolerant plant communities found in tropical and sub- tropical intertidal regions of the world. Such areas are characterized by high rainfall (between 1,000 to 3,000 mm) and temperature (ranging between 26°C-35°C). Mangrove species exhibit a variety of adaptations in morphology, anatomy and physiology to survive in water logged soils, high salinity and frequent cyclonic storms and tidal surges. Mangroves are important refuges of coastal bio-diversity and also act as bio-shields against extreme climatic events. Large populations, primarily rural, depend on Mangrove ecosystems for a wide variety of biomass dependent livelihoods.

Biotic pressure and natural calamities play a major role in negatively impacting Mangrove ecosystems. Growing land reclamation for agriculture and industrialization along the coastlines and discharge of untreated domestic sewage and industrial effluents are damaging to these forests. Upstream activities related to river training and natural erosion and accretion also have an affect on the health of Mangroves since an adequate ecological flow in the rivers is essential for flushing of the Mangroves of silt and other wastes. Many studies have highlighted these problems and intensive conservation efforts are needed to ensure the survival of these sensitive ecosystems.

Role of Mangroves



Mangrove's Coastal Role

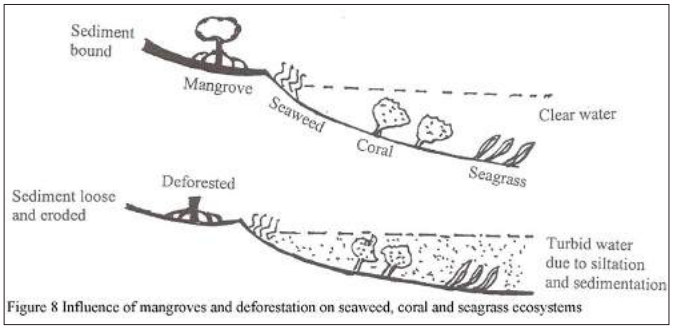
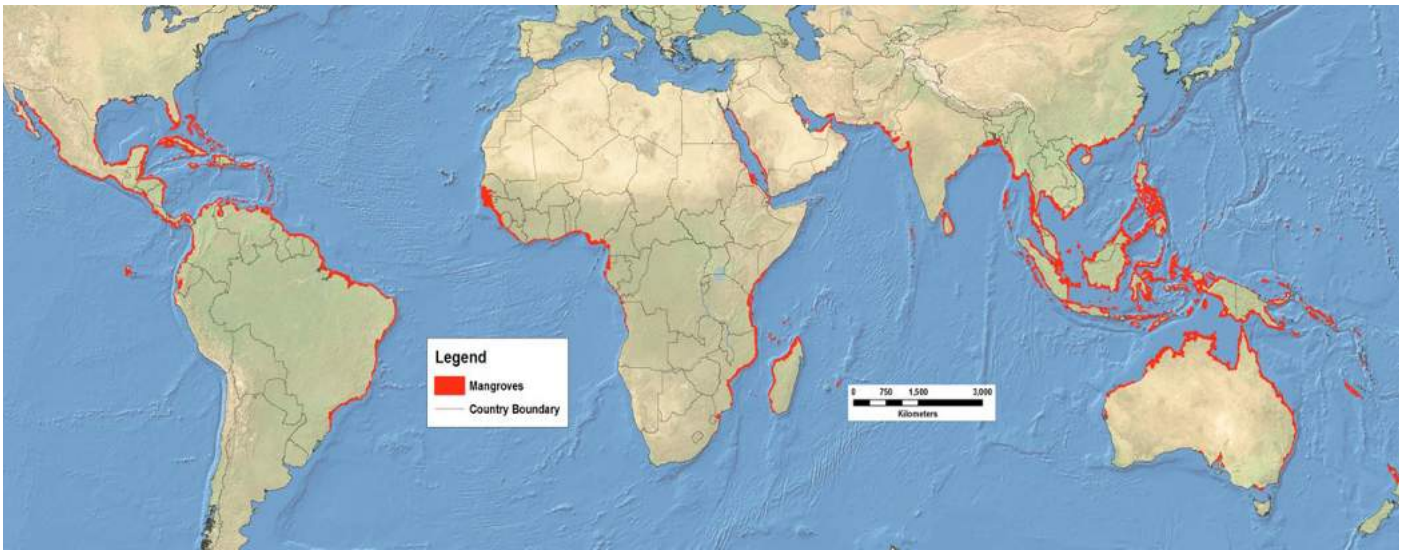


Figure 8 Influence of mangroves and deforestation on seaweed, coral and seagrass ecosystems

Mangroves: Significance and Threats

- Mangroves are an important protection against climate change as they sequester up to five times more carbon than other forests, area for area.
- They protect coastlines against flooding and tsunamis, and provide a vital habitat for marine animals, especially crabs, shrimp and juvenile fish.
- The reasons for the decrease in the mangrove cover may be:
- Grazing by domestic cattle and exploitation of mangrove woods for fuel and timber.
- The neo-tectonic movement of river courses.
- Abatement of upstream freshwater discharges due to construction of dams and reservoirs.
- Rapid trend of reclamation of mangrove forests for habitations.
- Pollutant discharges from cities and industries etc.



Status of Mangrove Cover Worldwide

As per Global Forest Resource Assessment, 2020 (FRA 2020), world over, 113 countries have Mangrove forests covering an estimated 14.79 million hectares. The largest Mangrove area is reported in Asia (5.55 million hectares), followed by Africa (3.24 million hectares), North and Central America (2.57 million hectares) and South America (2.13 million hectares). Oceania has reported the smallest area of Mangroves (1.30 million hectares). More than 40 percent of the total area of Mangroves was reported to be in just four countries: Indonesia (19 percent of the total), Brazil (9 percent), Nigeria (7 percent) and Mexico (6 percent).'

Conservation of Mangroves

In most countries, Mangrove ecosystems face constant pressure due to increasing human population in coastal areas and the rising demand for land, timber, fodder, fuel-wood and other non- wood forest products. Appropriate management regimes are germane to effective conservation of Mangroves.

Mangroves are repositories of rich biodiversity. According to Champion & Seth Classification (1968), Mangroves are included in Type Group-4 Littoral & Swamp Forests and are covered under 4A/L1Littoral forest, 4B/TS1 Mangrove scrub, 4B/TS2 Mangrove forest, 4B/TS3 Saltwater mixed forest (Heritiera) and 4B/TS4 Brackish water mixed forest (Heritiera) types.

Important species of Mangrove ecosystems in India include Avicennia officinalis, Rhizophora mucronata, Sonneratia alba, Avicennia alba, Bruguiera cylindrica, Heritiera littoralis, Phoenix paludosa, Morinda citrifolia & Ceriops tagal.

Sunderban, located in the northern Bay of Bengal is the world's largest single patch of Mangrove Forests. Spread over approximately 10,000 sq km, in Bangladesh and India, Sundarban is the first Mangrove forest in the world, which was brought under scientific management, as early as in 1892. Appreciating the importance of Mangroves, the Government of India set up a National Mangroves Committee in 1976 to advise the Government on issues related to conservation and development of Mangroves in the country. The Committee emphasized the need to conduct a survey of the extent of existing Mangrove areas within the country. Subsequently, the government formulated a scheme for Mangrove conservation and protection.

PYQ 2021

Q. "Leaf litter decomposes faster than in any other biome and as a result, the soil surface is often almost bare. Apart from trees, the vegetation is largely composed of plant forms that reach up into the canopy vicariously, by climbing the trees or growing as epiphytes, rooted on the upper branches of trees." This is the most likely Description of :

(a) Coniferous forest
(b) Dry deciduous forest
(c) Mangrove forest
(d) Tropical rain forest

Q. The Black cotton soil of India has been formed due to the weathering of

(a) Brown forest soil
(b) Fissure volcanic rock
(c) Granite and schist
(d) Shale and limestone