(3)

Geography
By
Neetu Singh

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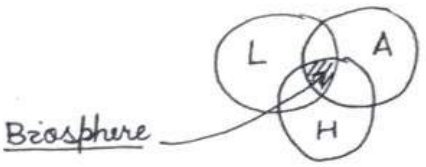
2014

1. Biogeography
2. Physical Geography of India
3. Indian Geography (Human, Settlement etc.)

Lecture #36 (Contd.)

Date
:6.03.2014

BIO GEOGRAPHY



Ecologists → { Genetics, Species, Eco-System diversity }

① Principles of ecology

② Ecosystems (also called Biomes)
- Terrestrial (5)
- Aquatic (2)
- → Plants : World Vegetation
- → Animals: Zoogeography

③ Soil (Edaphic factor of ecosystem)

④ Human ecological adaptations

⑤ Human impact on environment
- ↳ IPCC for climate etc.
- ↳ IUCN, CBC etc.

⑥ Global Concerns
- Education
- Legally binding

} Earth Summit, 1992

⑦ UNFCCC
UNCCD
CBD

} → Greenhouse gases CH_4, O_3, CO_2.

Fundamental Principles of Ecology

The life bearing sphere of the environment is called biosphere which represents narrow zone of contact of lithosphere, hydrosphere and atmosphere, sustaining life. The environment provided in biosphere to sustain life involves varied combinations of habitat It is this combination along with the complex interlinkages between the organisms that makes biosphere complicated system. The analysis of this system is credited to ecologists Odum, who identified that biosphere is comprised of 6 different hierarchy of biological systems. These includes :=

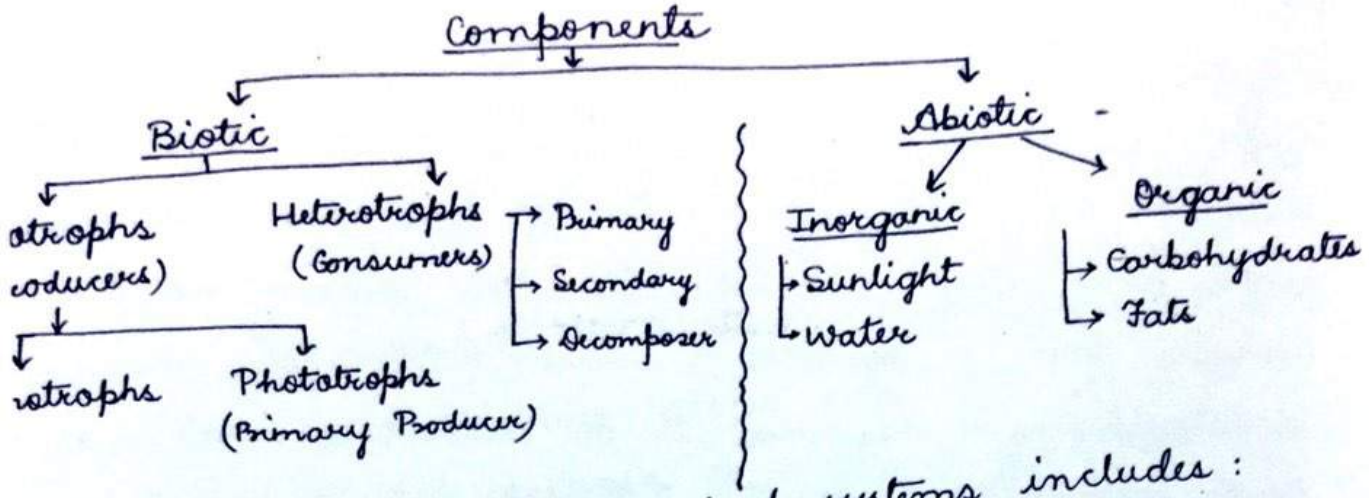
Gene System, Cell system, Organ system, Organism system, population system & highest hierarchy, ecological system. At all these hierarchy systems, biotic components interacting with abiotic components leads to the formation of the system wherein there is the generation of food, energy and matter.

BIOLOGICAL SYSTEMS (ODUM) (Hierarchy →)

Biotic Components	Gene	Cell	Organ	Organism	Population	Biotic Community
interacts with Abiotic components	↕	↕	↕	↕	↕	↕
	ENERGY AND MATTER					
leads to	↓	↓	↓	↓	↓	↓
System	Gene System	Cell System	Organ System	Organism System	Pop'n System	Ecological System

ECOLOGICAL SYSTEM :

The ecological system that is highest hierarchial biological system is comprised of components (biotic & abiotic) and their linkages. The components of ecosystem includes biotic and abiotic constituents. The biotic category includes both :- Autotrophs and heterotrophs. The autotrophs are referred to be producers, produces food, energy and matter. Interacting with abiotic components, the producers are sub-categorised into chemotrophs and phototrophs. The chemotrophs are the producers which produces food, energy and matter by the process of chemosynthesis that do not require sunlight. The chemotrophs as autotrophs are self-feeders but cannot support heterotroph community and thus are distinguished from the phototrophs. The phototrophs or primary producers includes green plants which produces food, energy and matter by the process of photosynthesis which marks the mandatory requirement of sunlight. It is primary producers that support big range of heterotrophs that are consumers. This category of biotic constituents includes primary consumers (herbivores), secondary consumers (carnivores) and decomposers. The abiotic components of ecological system includes sunlight, water & range of soil or water nutrients.



The linkages of the ecological systems includes :

a) Abiotic - biotic

b) Biotic - biotic

c) Biotic - abiotic

ABIOTIC-BIOTIC : The abiotic - biotic link is called production which includes interactive relation of producers with abiotic components to produce food, energy and matter. This interactive relation though involves both chemosynthesis and photosynthesis, it is photosynthesis that is mainly recognised as it involves primary producers. The photosynthesis, as the process of production representing abiotic - biotic link, is applicable to all the locations where green plants are present. However, as the production process is determined by 4 different set of factors, there is variations in the amount of production. The determining factor includes :

- Sunlight } as major factors &
- Water
- Season Cycle
- Age of the vegetation } as minor factors

(b). Biotic – Biotic Link :

The amount of food, energy & matter produced by phototrophs is recognised to be production which regulates productivity. Productivity is defined to be amount of stored energy per unit time and area. For biogeographical purposes, it is interpreted as dry-gm/m^2/yr. The average biospheric productivity is 320 drygm/m^2/yr which involves big range of 2000 drygm/m^2/yr in the wet tropical location to as low as 3 drygm/m^2/yr in deserts. Clearly the amount of productivity is directly related to amount of production making productivity also determined by 4 set of factors which determines production.

The productivity is classified as primary productivity at producer's level and secondary productivity at consumer's level. Both primary and secondary productivity involves the distinction of gross (total) and net (i.e. total minus respirational loss) productivities. As production is applied only with phototrophs & RL with all the trophic levels (that are the nature of feeding links between the biotic communities), the feeding capacity or ecological capacity decreases with increase in trophic levels. The biotic - biotic link, therefore, is best deciphered in the support of food pyramid.

which practically incorporates not more than 4 to 5 trophic levels. Moreover, it clearly depicts that the largest biomass (weight of living matter per unit time-area) always relates to phototrophs that occupies trophic level 1.

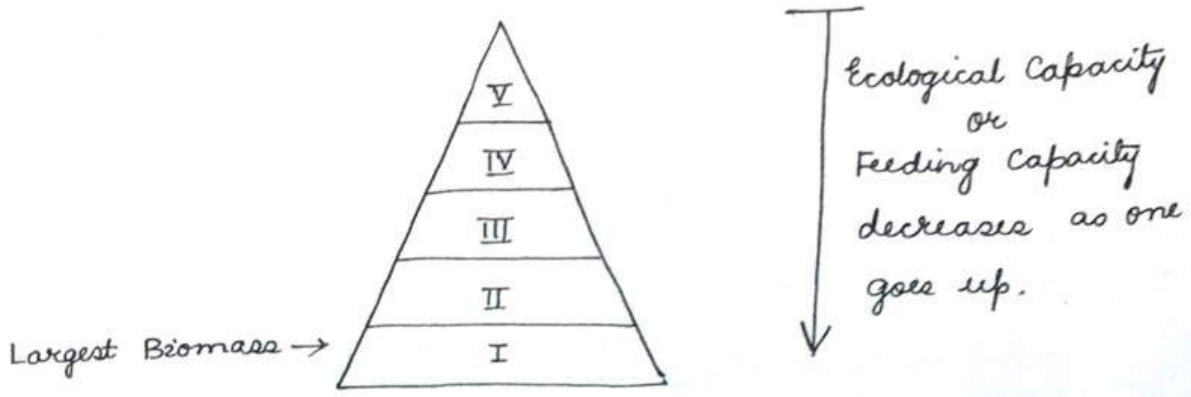


Fig.:= Food Pyramid/ Trophic levels/ Ecological Capacity/ Feeding Capacity

The biotic-biotic link in the feeding interacting relation also includes prey-predator relation and parasitism which involves loss of one organism and gain of the other. Apart from feeding, this interactive relation also includes symbiosis and competition. The symbiosis biotic linkage denotes living together with no loss involved. It incorporates 2 distinctive types of prevailing inter-relations called commensalism (gain of one with other being neutral) and mutualism (both gaining). The competitive interrelation is always applicable to intra-trophic level. However, it is distinguished to

be less intense as inter-specific and most intense as intra-specific.

Symbiosis → Commensalism
Symbiosis → Mutualism

Competition → Intra-trophic level
→ Inter-specific & intra-specific (Category)
(Weak) (Strong)
eg. Goat vs Giraffe eg. Goat vs Goat

Biotic - Abiotic Link : DECOMPOSERS

It involves the role of decomposers which converts biotic excreta as well as dead remains to abiotic substances completing nutrient cycle. This process called decomposition involves humification and mineralism. Humification is the process of prodⁿ of humus i.e. decomposed organic matter which leads to mineralisation that is biotic remains converted back to abiotic substances replenishing soil nutrients and facilitating production process.

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11/03.2014

Sunlight / Water ↑ ⇒ Prdⁿ / Productivity ↑

Biodiversity ↓ with ↑ latitude

BIOMES OF THE WORLD

Ecological system or ecosystem incorporates distinctive characteristics which are regulated by specific location, thus, climate. Fundamentally, biomes are classified on the basis of 1st Order relief as terrestrial biomes or ecosystems and aquatic biomes or ecosystem.

The terrestrial ecosystems are regulated of their characteristics by the prevailing climate which regulates amount of sunlight and precipitation which are the regulators of primary production, thus, feeding capacity. This ecosystem, therefore, includes :=

(i) Desert Biome
(ii) Tundra Biome
} Less productivity

(iii) Forest Biome
(iv) Savanna Biome
(v) Grassland Biome.
} Productive

Prime regulator = Sunlight

⇒ Among desert & tundra, desert having more sunlight reception than tundra is comparatively more productive.

① TUNDRA BIOME:

Located in subpolar latitude represents the combination of long cold winters with short summers. Melting of surface ice and permanently frozen subsurface forms the cause of water logged conditions, sustaining habitat. In northern subpolar region, upto 20 cms of summer concentrated warm front weather-related precipitation forms additional climatic characteristics. It is this brief summers that provides habitat with phototrophs correlating with "extremely small growing season" depicting adaptability of floatage, mosses and lichens makes excellent examples of tundra vegetation. The heterotrophs denotes migratory adaptability moving to this biome only during summers and returning to lower latitudes during winters. Range of insects, Avifauna (as Siberian Crane), Polar Bear and Taiga Antelope represents the heterotrophs of N-hemisphere whereas Penguins depicting the adaptability to harsh Antarctic climate represents S-hemisphere.

DESERT BIOME:

This less productive biome represents its productivity limit to be regulated by scarcity of water. Unlike tundra biome, it however ∫ incorporates wider range of habitat combined with less productivity, thus, less biodiversity. It is therefore "that desert biome represents maximum Niche diversity from among the terrestrial biomes."

The desert biome in the reference of evaporational loss to be always more than precipitational gain represents phototrophs adaptability as being xerophytic i.e. adapted to drier weather conditions involving deep-seated roots (Phreatophytes) and moisture holding capacity (Succents). Prominent examples of xerophytes includes Mesquite Plants, Aloe Vera, Thorny bushes, Cactus, Sabaigrass along with tree variety Acacia and Senegal. It is only in isolated Oasis, in both tropical and subtropical deserts, that date palm adds to the variety of phototrophs. The heterotrophs in the deserts commonly includes the adaptability of thick skin coatings to protect themselves from extreme winter conditions for the subtropical plateau deserts, with Tibetian Yak and

Tibetan Antelopes and Gazelle forming the examples. For the tropical deserts, this adaptability helps the animals to protect themselves from heat stroke. It is therefore that tropical animals — camels, rodents, kangroorats — also reveals big ears to ease out body heat and nocturnal adaptability i.e. becoming active during nights and remaining passive throughout the day.

Locationally → T
↳ ST

Diversity : high
Biodiversity : Low ⇒ Niche Diversity.

} Deser Biom

) FOREST BIOME :

The most productive terrestrial biome that collectively accounts for more than 70% of the biomass of biosphere also qualifies to be most well spread biomes. Fundamentally this biome is subclassified into 3 categories :

A) Equatorial Rain Forest Biome (ERF)
B) Taiga Forest Biome (TF)
c) Deciduous Forest Biome (DF)

The equatorial RF biome confined in warm and wet equatorial climate makes the adobe of vegetation. Prevailing high temperature throughout the year and heavy precipitation thro'out the year makes this forest biome densest and diverse-most vegetation biome of the world. It therefore incorporates mixed stand of deciduous varieties of trees making forests - evergreen. Such productive environment for the phototrophs is specified with this biome that even the trunks of the big trees avails the habitat for growth of vegetation. With such dense diversity of phototrophs, immense competition (intra-specific) makes trees exceptionally tall in equatorial RF. Among the other phototrophs adaptability:- shallowest roots, broad and thin leaves are included. The producers are demarcated in well-defined vertical stratas with tall trees, medium-heighted trees, short-heighted trees, small grasses, bushes and range of Epiphytes (plants requiring physical support to grow) which makes the canopy of these forests such dense that sunrays do not penetrate the forest floor making these forests dark gloomy forests. Among the prominent varieties of trees - Rosewood, Ebony, Ironwood, Balsam - are included. with Liana, most common epiphyte.

Dense Canopy ⇒ Leaf Cover
Broad leaf ⇒ Maximum transpiration ⇒ Prevent Rotting
Balsam ⇒ Lightest hardwood, can float over water
Commercial lumbering ⇒ Not developed bcoz of impure stamp.
ERF ⇒ Completely deprived of big terrestrial animals
Adobe of insects, reptiles, apes present.
Selvas → Amazon basin in Brazil as example.
ERF of Congo ⇒ Surplus Carbon Content

Heterotrophs in ERF is completely deprived of big terrestrial animals. Dense vegetation stand and water-logged dark gloomy forests avail the habitat for diverse range of insects. thriving on these insects, big range of reptiles including Pythons and snakes adds to the heterotroph diversity. The animal population is only restricted to apes XSS representing "Arboreal" adaptability (tree-living)

B. TAIGA FORESTS :=

The highest latitudinal forest biome, Taiga forest (TF) forms open-most forest with no undergrowth. This pure stand of forest correlates to softwood yielding boreal vegetation with adaptability as shallow roots, needle-shaped leaves and conical structure of plants, this, are called as coniferous. Major examples of the trees - Pine, Spruce and Fur - are tall trees with the height of 35m. The only conifer that represent deciduous characteristic is

is Larch, otherwise coniferous forest represents the evergreen forest type. With pure stand and absence of undergrowth, Taiga forests provides habitat to big range of terrestrial animals as- Polar Bear, Taiga Antelopes - which involves hibernation (becoming inactive during winters) and migration as their adaptability.

DECIDUOUS FORESTS :=

It is the transitional forest type b/w the two extremes incorporating moderate temperature, precipitation and thus moderate adaptability of phototrophs and heterotrophs. This forest biome is sub-classified into:

(A) Tropical Monsoonal

(B) Temperate Deciduous Biome.

The tropical monsoonal hardwood deciduous biome forms example of "closed deciduous forest biome" i.e. there is significant prevalence of undergrowth compared to temperate counterpart. The prominent varieties of trees - Teak, Sal, Sandalwood - sustains well developed and balanced ecosystem combining big terrestrial animals - tigers, elephants, lions, rhinos along with apes (monkeys).

(B) The temperate deciduous biomes located in higher latitudes not just makes openmost deciduous forests but also correlates to different varieties of hardwood yielding trees as Oak, Chestnut, Walnut with well developed ecosystem involving smaller terrestrial animals - Squirrels rabbits, wolves, foxes. This forest biome correlates to "Laurel Vegetation" i.e. temperate rainforests at its wetter margins with Redwood (the tallest tree of the world) being correlated. Redwood stand is prominently in Vancouver and UK. Among the other trees, Kauki (NZ) and evergreen Oak (Japan) are also included. In between tropical hardwood deciduous and temperate hardwood deciduous, transtitional mixed deciduous is distinguished in the China Type of Climate.

MEDITTERRANEAN VEGETATION:

Belonging to Mediterranean climate, mediterranean vegetation called Screlophyll vegetation is special type of forest vegetation that is adapted to long hot summer drought. This vegetation type therefore, includes short stunted varieties of evergreen trees & bushes with deep-seated roots, small thick glossy leaves in order to minimise transpirational loss.

part from citrus fruits, this vegetation includes fig, Olives, Maqui, Chappral (native of CA, USA) as important varieties. Being less productive biome, it supports smaller terrestrial animals like rabbits, foxes etc.

GRASSLAND BIOME :

Confined to the continental interiors of temperate latitude, grassland biome marks its distinction from the neighbouring deciduous forests due to lesser amount of precipitation. The range of precipitation is 25-75 cms, sufficient to sustain grasslands and not trees. The grassland biome is completely deprived of trees. The existing phototrophs i.e. grasses are divided into 2 categories :

1) Steppes
2) Prairies

1. The steppes are shorter grasses (10-20 cms tall) confined to continental interiors with semi-arid climate i.e. 25-50 cms of rain. These are confined in N. American Prairies, Eurasian Steppes, South African Veld and Australian Downs.

2. The prairies are taller grasses (40-60 cms tall) confined to sub-humid climate i.e. 50-75 cms of rain. European Steppes, Pampas of Argentina

and Canterbury Plains of NZ represents this biome. Collectively in grassland biome lesser production due to less precipitation restricts heterotrophs to be only grazing community. Apart from squirrels and rabbits, prairies dogs and bison forms important animals.

(Bison – Largest herbivore in temperate grassland).

- Densest diversity of heterotrophs in Savanna. due to vertical feeding pattern.
- Maximum protected area.
- Cameroon to Angola: Savanna Belt in Africa.
- Adobe of wildlife = Savanna ; Adobe of vegetation = ERF.

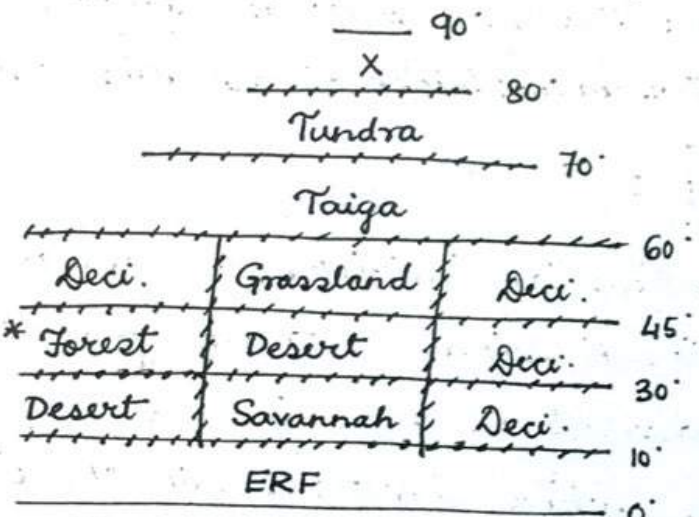
5) SAVANNA BIOME :

In the tropical continental interiors, Savannah biome that is the transitional biome between forest and desert biome is developed. This is also referred as woodland biome which involves the combination of trees, xerophytes and tall grasses (1.8 to 3 metres) as bamboos, runners and tufts. These phototrophs provides densest diverse habitat for the heterotrophs. Supporting maximum diversity with vertical feeding pattern, Savannah Biome is therefore referred to be the ~~As~~ "Adobe of Wildlife" including all big terrestrial animals of lower latitudes including elephants, tigers, zebras, giraffes, wild buffaloes, monkeys,

The diversity of this biome is added with specialised heterotrophs relating to Australian Savannah that largely depicts — Marsupials with Kangroos, Koalas, ~~Rtgl~~ Platypus — as important examples.

Extreme adaptability — Tundra
Taiga
Desert
ERF

Ecotone : Transitional region between 2 biomes, both latitudinally & regionally.



tion on:
↓
Vegetation of World

Framing goes like this:

① Latitudinally
→ Tropical (0°–45°)
→ Temperate (45°– Beyond (70°))
→ Tundra (Beyond 70°)
└ Sub-polar

→ ERF
Monsoonal Deci.
Savannah
Desert
Sclerophyll Veg. (Mediterr.)
Mixed
Littoral

emperate Hardwood Deci.
aurel
Taiga
Grassland

Vegetation of World:

① Latitudinal ② Altitudinal

- Sign of latitude
- Height
- Northern Slope of S-hemisphere / Southern Slope of N-hemisphere
- Slope

Decomposers – Related to study of soil.

Lecture : 38

Date 28.03.2014

Divide of ecosystem – Terrestrial & Aquatic

Desert
- Much habitat diversity } ⇒ NICHE DIVERSITY
- Less biodiversity
- xerophytes
  - Thick skin coatings
  - Big ears
  - Nocturnal Adaptability

Savanna – Vertical feeding pattern
humid, lower latitude
diversity more of animals

Grassland – less productive than same latitudinal deciduous forest because of less rain.

Forest – ERF (Dark gloomy, broad leaf vegetation, dense canopy, water logged conditions
Shallow roots, broad leaves)

Taiga – Shows extreme ; long winters
conifers
Hibernation

Teak, Sal – Tropical hardwood deciduous (India)
Chestnut, Walnut – Temperate " "
Laurel Vegetation" } – Must write on biomes/forest
Screllophyll" -
→ Cs – 75 cm (upto.) → Trees & bushes
thick glossy leaves
reflect sunlight

Biomes → Write 5 terrestrial biomes

Vegetation of world :

1) Latitude based :: (a) 0–45° ② Altitude based
(b) 45°–70°
(c) 70°–90°

Biome :
ng { Location
Climate
phototroph
Heterotroph
Soil

Vegetation :
Framing { Latitudinally = Tropical, Temperate, Tundra
Altitudinally – Montane

Africa : Sahara Desert
Congo Basin } Major types
Ethiopian Realm) Savanna

Minor { China type
Mediterranean etc
Monsoonal

Zoogeographical Realms:

(i)- Darlington (Modern) | (ii) Wallace's Realm (Classical)

I. – Megagea Realm → Ethiopian, Neo Arctic, Paleo Arctic, Oriental

II. Neogea Realm → Neo Tropic (L. America)

III. Notogea Realm → Malaya – Oceanian

Wallacea (Ecotone)

(1) It is the study of heterotrophs which involves the analysis of location, climate and phototrophs as well.

(2) This approach of study is regional in its characteristics including continent level demarcation.

(3) The applied categories includes: Darlington (3 realms) and Wallace's Realm (6 realms).

Ethiopian ⇒ African

Oriental ⇒ Indian

PaleoArctic ⇒ Eurasian

NeoArctic ⇒ Anglo-America

NEOGEA overlaps with NeoTropic.

NOTOGEA overlaps with Malaya-Oceanian.

Wallacea = Overlap of East Indies b/w

2. AQUATIC ECOSYSTEM

The aquatic ecosystem incorporates availability of sunlight, dissolved oxygen and nutrient as the determiners of habitat, thus, biodiversity. This ecosystem, unlike terrestrial counterpart, is always recognised to be 3-dimensional i.e. latitude, regional and vertical dimension. Additionally, unlike terrestrial counterpart, this ecosystem reveals production to be dependent on depth, with respiration independent of it. It therefore sustains life even in the locations where primary production is missing. Aquatic ecosystem incorporates 3 different lifestyles :

- Planktonic i.e. drifting
- Nectonic i.e. swimming
- Benthic i.e. attached.

These 3 life-styles correlates to variable distinctions of aquatic habitat that includes photic (i.e. limonetic) and aphotic (i.e. profundal).

PHOTIC HABITAT :

The photic habitat, i.e. sun-lit habitat, represents the concentration of primary production. The depth of this habitat varies in accordance to sign of latitude and season.

Combining both these factors, the maximum photic depth is taken to be 2000 m. It is this depth that is referred to be critical depth not just demarcating photic & aphotic zones but also the level where production and respiration are in balance with each other. Over the critical depth therefore, production is more than respiration supporting larger biodiversity whereas below the critical depth, respiration more than production, continuously decreases biodiversity. Moreover, it is with critical depth that the process called BLOOM represented to be synonym to spring in aquatic habitat is correlated.

The other demarcated habitat includes pelagic i.e. off the bottom and benthic i.e. on the bottom.

CLASSIFICATION :

The aquatic ecosystem is classified into 2 prominent categories :

i) Fresh Water Ecosystem
   - Standing Water
   - Running Water

(ii) Marine Ecosystem
   - Horizontal
     - → Inter-tidal
     - → Neritic
     - → Oceanic
   - Vertical
     - → Pelagic (0 to 4000m)
     - → Benthic (4000 mts)
     - → Hadal (> 4000 mts)

FRESH WATER

The fresh water ecosystem with lesser supplies of nutrients represents to be less productive than the marine counterpart. Within this category, running water i.e. rivers represents to be less productive due to the movement which restricts the growth of planktonic lifestyle. The running water ecosystem thus marks its confinement to middle and lower courses and thus always represent to be photic habitat. It is however lower latitudinal rivers that represents more productive profile than higher latitudinal counterparts. For the standing water – ponds, lakes, reservoirs are taken into consideration. It is this category that represents well demarcated limonetic and profundal levels. Again for standing water lower latitudinal water bodies will be more productive than higher latitudinal counterparts. ~~The~~

MARINE ECOSYSTEM

The marine ecosystem not just represents larger share of aquatic ecosystem but is also more productive due to favourable and diverse amount of nutrient sourced by saline water. This ecosystem

includes INTER-TIDAL ZONE (littoral vegetation) as transitional biome between true terrestrial and true aquatic. Littoral biome is fundamentally sub-classified as on-shore and off-shore littorals. In both the categories, developed phototrophs are trees and not phytoplanktons. Maximum diversity depicting aquatic habitat is represented by SEA WEEDS. The littoral biome with standing trees reveals uniqueness of vegetation as these requires salt water to survive.

⇒ The on-shore littorals developed over stable lands largely represented by coconut palm, white and screw pines have thin shallow roots, narrow tall trunks with crowning leaves. Moreover, they mark their universal presence along either shorelines of tropical / sub-tropical waters.

⇒ Compared to it the off-shore littorals in the complete absence of stable land have unique structure of densest shallow roots, broad trunk, shorter heights and thick leaf density, represented by mangrooves, Sundari and Nipa-like trees. These are more confined to wetter margins of tropical/ sub-tropical lands.

The boundaries of the ocean representing continental shelf (neritic zone) or upwell zone (along the eastern oceanic boundary) forms the most productive marine aquatic habitat. It is because apart from being photic, boundaries represent favourable availability of terrestrial nutrient. In comparative reference, neritic zone depicts higher biodiversity as it forms safe-breeding ground. In the open ocean, epipelagic, mesopelagic and upper part of bathypelagic (upto 2000 mts depth) forms the photic zones representing production to be more than respiration. However, with increasing depth decreasing productivity makes epipelagic most productive oceanic habitat. Below the critical depth (2000m) the aphotic zone including lower part of bathy-pelagic, benthic and hadal, increasing amount of respiration with increasing depth decreases bio-diversity. In the benthic habitat, random presence of hydrothermal vents that correlates to ejection of sulphur-rich hot water do avails the habitat of production by the process of chemosynthesis, carried on by chemotrophs like worms & calms.

These self-feeders, however, do not modify the characteristics of bio-diversity in the benthic zone.

3. SOIL (EDAPHIC FACTOR)

Weathering (in situ)

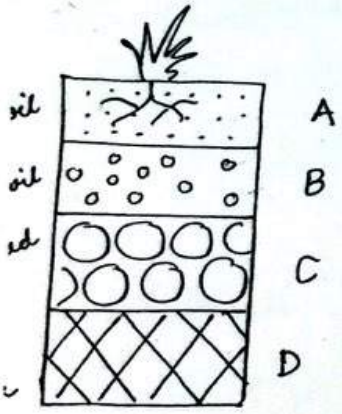
Disintegration (Physical weathering)	Decomposition (Chemical Weathering)
(i) – Spalling	(i) – Oxidation
(ii) – Shattering	(ii) – Solution
(iii) – Exfoliation	(iii) – Carbonation
(iv) – Block Separation	(iv) – Hydration
Agents = Temp. (T), Precipitation (Pt.), Frost (F), Vegetation (V), Insects (I)	Agent = Water only

* Spalling – simple breaking [(T only) & Insects]
Shattering – breaking with blast (T & Pt. both)
Exfoliation – onion peeling disintegration (T + Structure)
Block Sepⁿ – enlargement of joints (Frost/+ vegetation)

* Oxidation – Rusting with iron-rich rocks
Solution – Applicable to salt/gypsum; dissolution
Carbonation – Process of dissolving for $CaCO_3$
Hydration – Chemical union of H_2O (formation of hydroxyl, –OH) eg. formation of alumina from bauxite ore.

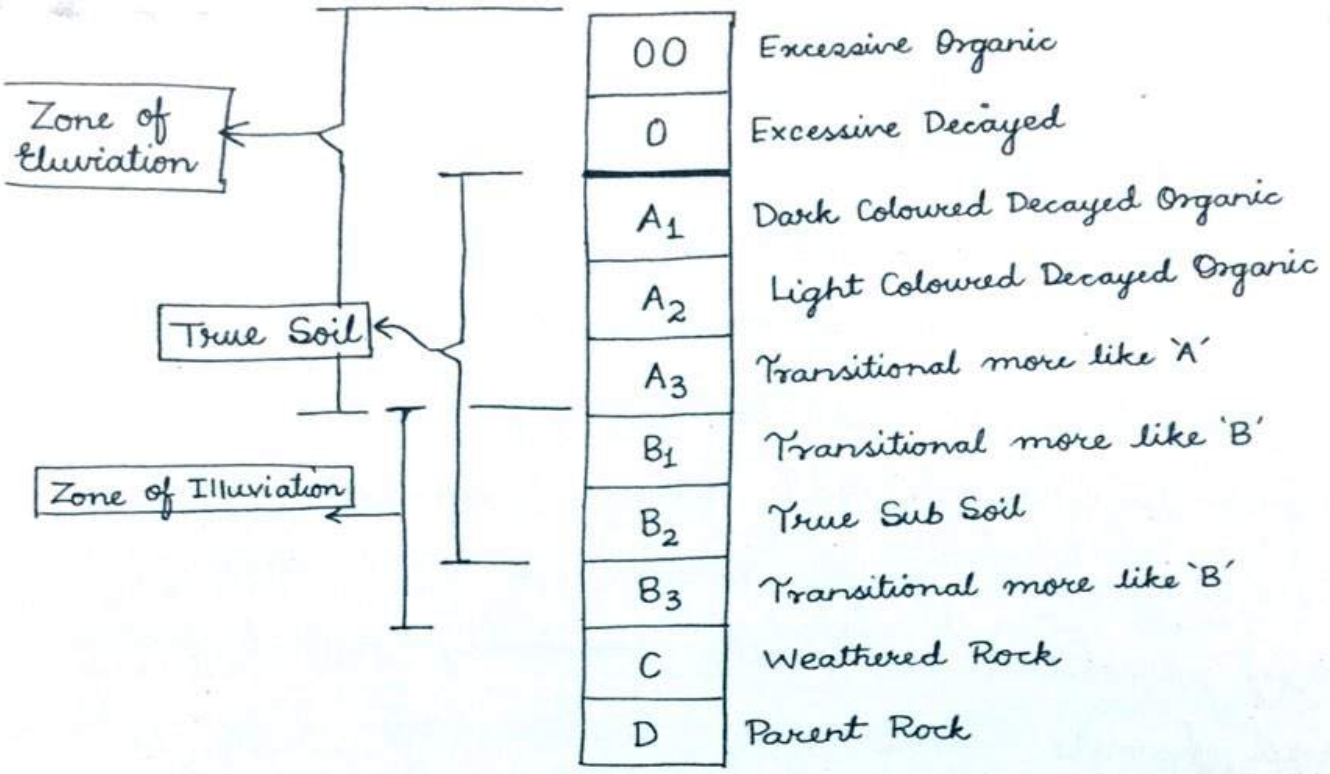
SOIL GENETIC HORIZONS & SOIL FORMING PROCESS

Topmost layer of lithosphere is called soil which is dynamic complex mixture of minerals and humus. The minerals are sourced from disintegration of rocks by the process of weathering or gradation. Among the major categories of minerals analysed in soil study, bulk increasing minerals as silica, aluminium and iron are distinguished from the principle nutrients as calcium, nitrogen, phosphorous and potash. Humus, the decomposed organic matter also forms principle nutrients determining soil fertility Development of soil as extremely slow but regular process results in the development of distinctive genetic horizons developing soil profile. Commonly, the soil profile is comprised of 4 genetic horizons :=



Bulk increasing — Silica, Aluminium, Iron

Principal Nutrients — Ca, N, P, K



. The genetic horizon 'D' forms the parent rock and thus, the base of soil profile. It is from this rock that eventually developed soil attains its mineral composition.

> Genetic horizon 'C' forms the weathered rock materials which represents similar support horizons as is related to parent rock in sourcing the composition of soil.

> Genetic horizon 'B' is sub-soil which is coarse textured mineral-rich, humus-less fertile horizon of the soil. It includes coarsest texture B_3 and finest texture B_1 horizons that form transitional horizon b/w

- respectively
weathered rock and top soil. It is therefore that B_2 is recognised to be true sub-soil. It is this genetic horizon 'B' that qualifies to be ZONE OF ILLUVIATION i.e. concentration of material by both the translocation processes, that are – capillary action in drier climate and percolation in wetter climate.

Genetic horizon 'A' is the top soil which is fine textured mineral- and humus-rich fertile soil incorporating well-developed light coloured decayed organic (A_2) and dark coloured decayed organic (i.e. A_1) as absolute genetic horizons. It is A_1 that represents fully developed soil with absolutely perfect texture and humus. Occasionally, in the water logging experienced in genetic horizon A there is the effectivity of percolational translocation making it ZONE OF ELUVIATION. It is, however, infertile horizon – excessive decayed (O) and excessive organic ($O_4^{(00)}$) that are consistent zones of eluviation.

Lecture # 39

Date
29.03.2014

Ca — Fertile soil

Al — Richest soil

Bulk ↑ ⇒ Si, Al, Fe — No role in soil fertility

Capillary — in dry areas

"O" } Infertile
"O" }

"A" soil ⇒ fertile

A + Percolation ⇒ Infertile

"B" ⇒ Less fertile, less humus

SOIL FORMING PROCESSES :

Within the developed genetic horizon in absolute accordance to the prevailing climatic conditions, variable soil forming processes marks their application, increasing / decreasing soil fertility. Among the important categories of such processes :- Physical processes and biological processes are distinguished.

In the physical processes :

(i) Leaching
(ii) Laterisation
(iii) Podzolisation
(iv) Calcification
(v) Gleying , are included.

In biological processes following are included :

(i) Humification (ii) Mineralisation.

A) ⇒ Perennial vegetation
⇒ Humid (left out after evaporation)

1 & 00 → Water logging always

↳ Percolational

↙ Leaching → Dissolving of humus & percolation

↘ Laterisation → Dissolving Silica & percolation

Si > Al > Fe
Percolation Sequence
Priority Order
of bulk
increasing

humus – primary nutrient
Silica – bulk increasing

Percolation → (water logging) + (Climate such that evaporation is less than gain)

Silica percolate ⇒ More Al, Fe ⇒ More acidic soil ⇒ More infertile

Leaching & Laterisation ⇒ Make soil infertile

Calcification makes soil fertile
↳ in drier areas
Excessive ~~salinisation~~ silanisation ⇒ excessive calcification
⇒ Infertile.

Podzolisation = Opp. of laterisation

LEACHING : It is defined to be the process of percolation of humus in the humid water logged location. This process, therefore, makes genetic horizon 'A' deprived of humus and thus becoming infertile. Simultaneous to this process is process of laterisation.

LATERISATION :
Laterisation is the percolation of silica in the water logged humid conditions. It is due to this process that concentrated presence of aluminium & iron

nodules makes soil acidic and thus infertile. Both leaching and laterisation represents percolational translocation. Distinguished from them is the process of calcification.

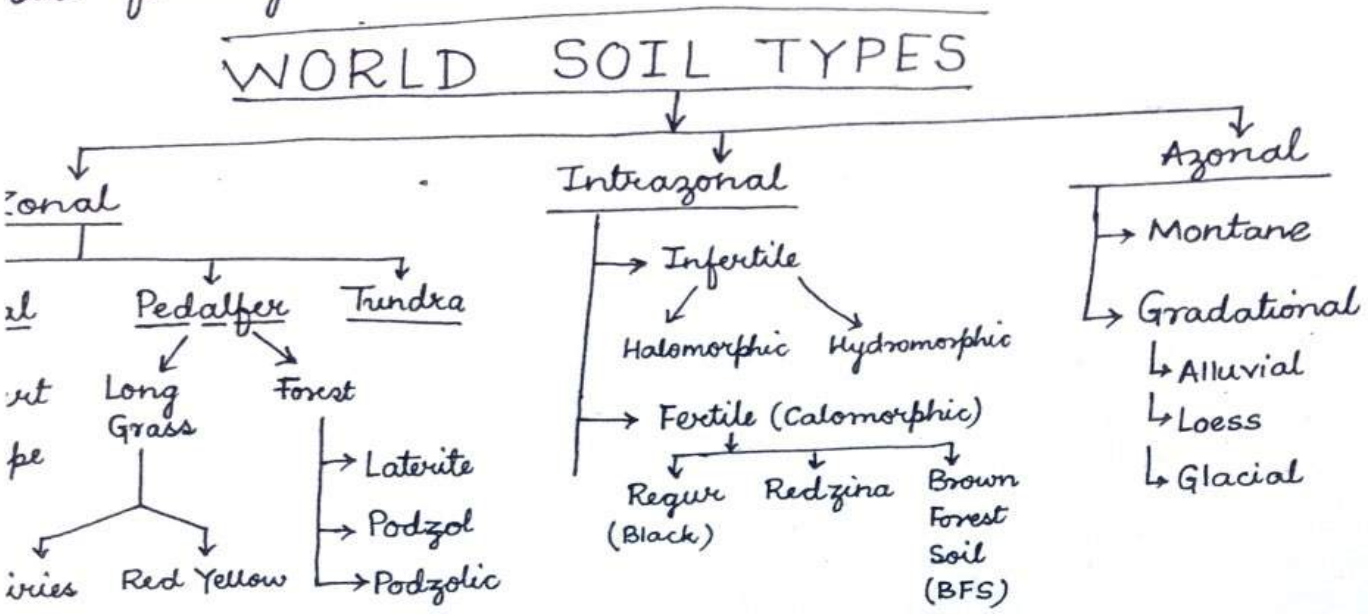
3. CALCIFICATION It represents capillary action to be the dimension of translocation. This process is applied to drier climate with water logged conditions resulting in the concentration of calcium — the principal nutrient. The process of calcification in moderate magnitude thus makes soil fertile. However excessive calcification makes soil alkaline i.e. infertile.

PODZOLISATION: The process of podzolisation is completely deprived of physical movement in the absence of any water-logging. It marks the presence of silica in genetic horizon A developing infertile soil. (Taiga Forest Soil = PODZOL)

GLEYING := The process called gleying, fundamentally is combination of leaching, laterisation and mineralisation. It is confined to warm humid locations where decomposers are excessively active completing nutrient cycle with the development of excessive decayed layer 'O', developing infertile soil.

HUMIFICATION

he process of humification i.e. process of production of humus is the only process that always increases soil fertility.



RF → Laterite

Zonal Category of Soil

It is the principal category of the world soil type that is distinguished on the basis of prevailing climate and related soil forming processes. It is in accordance that zonal categories of soil are categorised into:

i) Pedcal
ii) Pedalfer
iii) Tundra

The Pedcal category is the soil rich in Calcium representing the process of calcification. This soil thus represents arid and semi-arid climates. In the arid climate, desert soil represents to be coarse

textured mineral rich but humus less fertile type of soil favourably responding to induced infrastructural inputs. Compared to it in the semi-arid climate belonging to steppe biome, most fertile natural soil called CHERNOZEM marks its development. Apart from involving calcification as the soil correlates to the fullest development of genetic horizon involves finest texture with fully developed humus. It is the genetic horizon A_1 (dark coloured decayed organic) that forms the basis of its name BLACK EARTH. It is Chernozem soil that therefore corresponds to the bread-baskets of the world (commercial grain farming). Less developed variant of Chernozem is called CHESTNUT SOIL.

The long grass type soil practically represents transitional soil type between true pedcal and true pedalfer. It includes — Prairies and Red yellow soil.

The Prairies soil belonging to sub-humid climate with taller grass than steppes have weaker magnitude of calcification making it less fertile than the black earth. Compared to it the Red yellow soil of Savanna belonging to humid climate is not just completely deprived of calcification but marks the imprint of leaching

nd laterisation making significantly less fertile.
he <u>true pedalfer soil</u> i.e. soil rich in aluminium
nd iron belongs to forest vegetation. within this
ategory most prominent representative is <u>Laterite</u>
oil of ERF. In these water-logged dark gloomy
forests combination of leaching and laterisation
makes soil highly acidic. Moreover excessive supply
of leaf litter causes the development of "OO" (excessive
organic) genetic horizon justifying infertility of soil.
In the highest latitudinal forest biome, Taiga
Forest, combination of pure standing evergreen
trees with weak decomposition, minimal development
of genetic horizon A_3 combined with process of
podzolisation makes soil less infertile called
PODZOL soil. In the forest soil category most
well-spread and fertile forest soil is podzolic
belonging to hardwood deciduous vegetation.
Regularity of supply of leaf litter decomposition
with complete absence of extreme conditions
makes this soil type well developed fertile.
However when compared monsoonal hardwood
deciduous podzolic forms less fertile than temperate
hardwood deciduous due to higher magnitude
of leaching & latericisation.

The tundra soil is technically not a soil type as it is completely deprived of weathering process of rocks. Biogeographically it is included in soil category as the seasonal water logging sustains the growth of floating vegetation.

Steppe > Prairies > Red Yellow > Podzolic

Because of decreasing Calcification →

Because of increasing laterisation

Prairies → More like Pedcal
Red Yellow → More like Pedalfer
} Transitional b/w true pedcal & true pedalfer

90°

Tundra

80°

Podzol

70°

Podzolic	P | C | P		Podzolic
* Special Type Podzolic	Desert		Podzolic
Desert	Red Yellow		Podzolic

60° 45° 30° 10° 0°

Laterite

P = Prairies

C = Chernozem

INTRAZONAL SOILS

Represents the soil category that are regulated by specific structure or process in a given location. Randomly dotting zonal category of soil, this soil group includes infertile and fertile subcategories.

The infertile soils involve halomorphic and hydromorphic sub-categories. The halomorphic soil depicts excessive magnitude of calafication resulting in the development of saline alkaline infertile soil. Commonly continuous water-logging in arid locations correlates to the formation of such type of infertile soils. Among the important examples — Etosha Pan (Namibia), Makgadikgadi Salt Pan (Botswana), Rann of Kutch (India) and Swa Crust (Australia).

Compared to it the hydromorphic soil either represents simple water logging generating swamping soil as in the case of rivers with frozen mouths developing water-logged lower courses as Mck Mackenzie ~~Mackensey~~ (Canada), Ob & Lena (Russia). this The category also includes Peat/Bog soil that represents the process of gleying generating mineralisation thus infertile soil with genetic horizon 'O' (excessive decayed). Among the prominent examples — Pantanal Basin (Brazil) Gran Chaco (Argentina & Paraguay), Pripet Marshes (Belarus and Ukraine) and Okawambo Swamps (Botswana).

CALOMORPHIC / FERTILE

The intrazonal fertile group is prominently represented by structural soil that are typical to specific parent rock. It includes black soil (or regur), developed over basaltic tablelands and redgina, developed over limestone. Both these structural soil correlates to similar fertility with the distinction of combination of compositional constituents For regur soil diverse mineral composition is combined with near complete absence of humus as more than 2/3rd of this soil is devoted to cultivation of cotton, it is also called COTTON SOIL. Borborema Plateau (Brazil), Kordofan Tableland (Sudan), Ethiopian Highland, Deccan Trap (India) and Unan Plateau (China) forms important locations Redgina soils in comparision lacks in diverse minerals but is significantly rich in humus qualifying to be near similar in fertility. While Terraces in Anatolia Plateau (Turkey) and Sarawak, Sabah Provinces of Malaysia makes important examples of Redgina soils. In the calomorphic category climate controlled Brown Forest Soil (BFS) is also included. Confined to the wetter margins of monsoonal climate, this young soil is restricted of its fertility because of

s coarsed texture and limited depths of genetic orizons. It, however, is substantially fertile for the ultivation of typical tropical crops.

AZONAL SOILS

his soil type incorporates universal presence on the map f the world and thus cannot be restricted to a articular location. It includes:

1) Montane Soil
11) Gradational Soil

the montane soil also called forrested soil qualifies to be well drained humus rich fertile soil with only limitation of limited depth due to the prevailing gradient. It is therefore also called as SCREE SOILS. The range of montane soil like montane biome is regulated by sign of latitude, height, sun bearing slope and maritime influence. The azonal category is prominently represented by gradational soil. Collectively these soil represent genetic horizon-less mineral-rich fertile characteristics. In the increasing order of fertility these includes:

Glacial Soil
Loess
Alluvial Soil.

The glacial soil is represented in the outwash plains as fluvio-glacial deposits. They thus are fine textured mineral-rich soil. However due to general absence of humus and prevailing water-logged conditions makes it less fertile soil.

- The loess in comparision is wind-deposited soil which requires thousands of years of continuous deposition to develop recognisable deposits. Fine textured mineral-rich loess soil is fertile gradational soil with only restriction ~~bin~~ being the absence of humus. Three prominent location of this soil includes:

  (i) Loess in NW Hwang Ho Basin, China

  (ii) Adobe in Sacramento, CA, USA

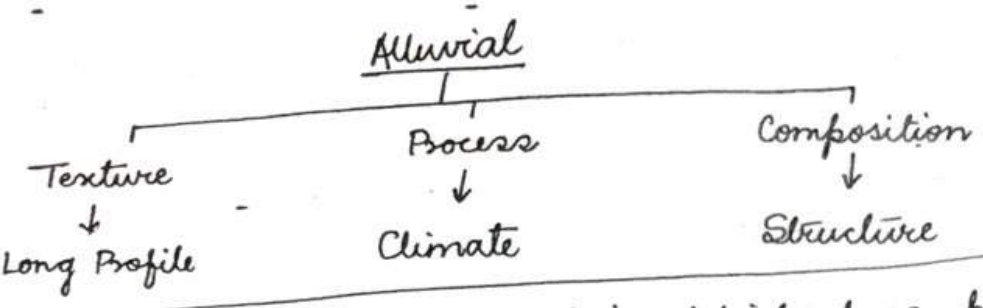
  (iii) Limon in German-Belgian Upland, Europe

= The most fertile gradational soil however is Alluvial Soil developed by universal agent of gradation - running water or river. This most fertile soil however depicts variations in its fertility in accordance to:

a) Texture

b) Process

c) Composition.



the texture-based demarcation depicts long-profile of the channel making deltaic soil (clayey texture) to be more fertile than flood plain soil. Similarly prevailing climatic conditions of existing channel determines the process applicable to alluvial soil which makes pedalfer alluvial (Amazon) less fertile than pedcal alluvial (Nile). Similarly, in the reference of geological structure over which river is draining, soil composition is distenguished which also determines soil fertility making red alluvial (Amazon) less fertile than black alluvial (Nile)

LECTURE – 40

Date 30/03/2014

Pedalogist : Soil scholar

COMPREHENSIVE SOIL CLASSIFICATION SCHEME

(1) Was propounded by Agriculture Department of USA in 1960 as the most comphrehensive soil classification scheme.

2) It includes 10000 different identified soil types which are categorised into 6 different categories which are categorised into 6 different categories which are

(i) - Order Soil
(ii) – Sub-order soil
(iii) – Great Group
(iv) – Group
(v) – Family
(vi) – Series Soil

3) Biogeographers takes into account the order soil category that includes 10 different soils and subclassifi them into :

(i) Well developed Horizons – Forest
- Oxisol
- Alfisol
- Spodosol

– Grassland
- Ultisol
- Mollisol

– Other
- Aridisol
- Vertisol

(ii) No / Weak developed Horizon – Entisol
– Inseptisol

(iii) Excessive decayed – Histosol

Oxisol → Laterite Soil
Spodosol → Taiga Forest Soil (Podzol)
Alfisol → Podzolic Soil

Ultisol → Red Yellow Savanna Soil

Mollisol → Temperate grassland soil (Chernozem etc.)

Aridisol → Fertile + infertile desert

Vertisol → Structural soil (Regur, Redgina)

Entisol → Gradational soil, no genetic horizon

- 3 agents develop soil → alluvial, glacial, loess

Inseptisol → Brown Forest Soil

Histosol → 'O' horizon
Peat / Bog (Pripet Marshes, Gran Chacko etc.)

Vertisol – Intrazonal | Entisol – Gradational Soil
Inseptosol – "
Histosol – "

Location
Climate
Soil
Photoroph
Heterotroph
} Terrestrial Biomes

MAJOR ENVIRONMENTAL REGIONS / HUMAN ECOLOGICAL ADAPTATIONS

Human population as constituent of ecological setup is identified to have been regulated of its activities by prevailing natural conditions. These activities largely includes extractive and reproductive industries which are near absolutely regulated by prevailing environmental conditions. It is in accordance to the variations in natural regions, variations in human ecological adaptability are outlined. Among the major environmental regions depicting well-defined diversity of human ecological adaptations, following are included:

i) Equatorial region
- 10° N to 10° S
- Warm wet climate
- oxisol / laterite soil
- broad leaved evergreen forest
- insects, reptiles & arboreal apes
- Human ecological adaption:

The region includes absolute primitive hunting gathering population representing fourth world community as Pygmies of Congo Basin and Amazons of Selvas. Comparatively sound ecological adaptation correlates to <u>intensive crop culture</u> in the Indonesian islands Java Island in production of rice. Commercially sound activities

regulated by prevailing conditions is extensive commercial farming which includes traditional plantation farming – Rubber (Malaysia), Coffee (Brazil) spices (India) and Cocoa (Ghana)

Monsoonal Region

- 10° to 30° N/S east margin of land
- season cycle with summer rain
- less fertile podzolic / alfisol soil
- Hardwood deciduous trees
- Big terrestrial animals
- Human ecological Adaptations :

The primitive adaptability correlates to shifting agriculture identified with different local names as Conuco (Venezuela), Roka (Brazil), Tamrai (Thailand) Jhum or Poda (India), Chena (Sri Lanka) – involving cultivation of paddy (rice). More developed typology however is intensive subsistence paddy culture with combination of range of crops including non-traditional plantation crops – cotton and cairn. The less developed adaptation is livestock rearing.

(iii) Savanna Region

- 10° to 30° N/S continental interiors
- Season cycle with summer rains
- Less fertile red yellow podzolics / ultisol soil
- Woodland with tall grasses
  ↳ Trees are mixed
- Adobe of wildlife
- Human ecological adaptation in all its range primitive to commercial involves livestock as the prominent constituent. In the primitive category nomadic herding carried on by Masais – the cattle herders of Savanna – forms important examples with commercial livestock ranching – beef, cattle rearing in Brazil, Australia and sheep-rearing in Australia makes important examples.

v) Desert (Tropical / Subtropical)

- 10° – 30° west margin / 30° – 45° continental interiors
- Season cyde with non – dependable summer specific rain.
- Fertile desert soil / aridisol
- Xerophytes with thick-skin coating & nocturnal adaptability of heterotrophs
- Human ecological adaptations includes nomadic herding carried on by primitive 4th world

population as Bedowins - Camel herders (Sahara Desert) and Kazaks (Horse herders in continental deserts) Commercially more developed adaptation is intensive subsistence crop culture without paddy in Nile Valley, Mesopotamian Plains, Indus Plains of tropical desert and Turanian lowlands of subtropical deserts. Crude oil extraction specifically in Persian Gulf region adds to human ecological adaptability.

Mediterranean Region

- 30° to 45° N/S west margins of land
  Well defined season cycle with winter concentrated rains
- Moderately fertile podzolic / alfisol
- Sclerophyll vegetation with smaller terrestrial animals
- HEA in the region is primarily commercial cultivation of horticultural products making the region designated to be gardens of the world. Secondary activity includes food and cash crop production along with rearing of animals.

vi) China Type

- 30° to 45° East margin of land
- Well developed season cycle, summer conc rain
- Fertile podzolic / alfisol
- Mixed deciduous
- Transitional heterobrophs b/w tropical & temperate biomes
- HEA :

Predominantly the region includes intensive subsistence with paddy culture which is combined with range of other non traditional plantation livestock and fresh water aqua-culture. It is in the extension of this region in USA (Piedmont plains of) that commercial typology of adaptations are also added.

vii) European Type Region

- 45° to 60° ∝ N/S West margin of land
- Less defined season cycle with perennial ppt.
- Fertile podzolic /
- Temperate hardwood deciduous
- Well developed diversity of small terrestrial animals
- HEA :

Primarily includes commercial crop culture, mixed with livestock ~ Along with it, marine aquaculture

wolving most developed commercial fishing ground of the world.

i/ Manchurian

- 45° to 60° N/S east land margin
- well defined season cycle
- summer concn rain
- fertile podzolic /
- temperate hardwood deciduous with diverse small terrestrial animals
- HEA :
  Includes mixed commercial farming, commercial aquaculture & softwood lumbering.

ı Taiga

- 60° to 70° N (only)
- Long winters brief summers
- Frontal precipitation throout
- Infertile podzol / spodosol
- Softwood Conifers with hibernation adaptability of heterotrophs
- HEA !
  Primarily includes softwood lumbering on absolute commercial lines (Canada, Siberia).

(x) Grassland Region

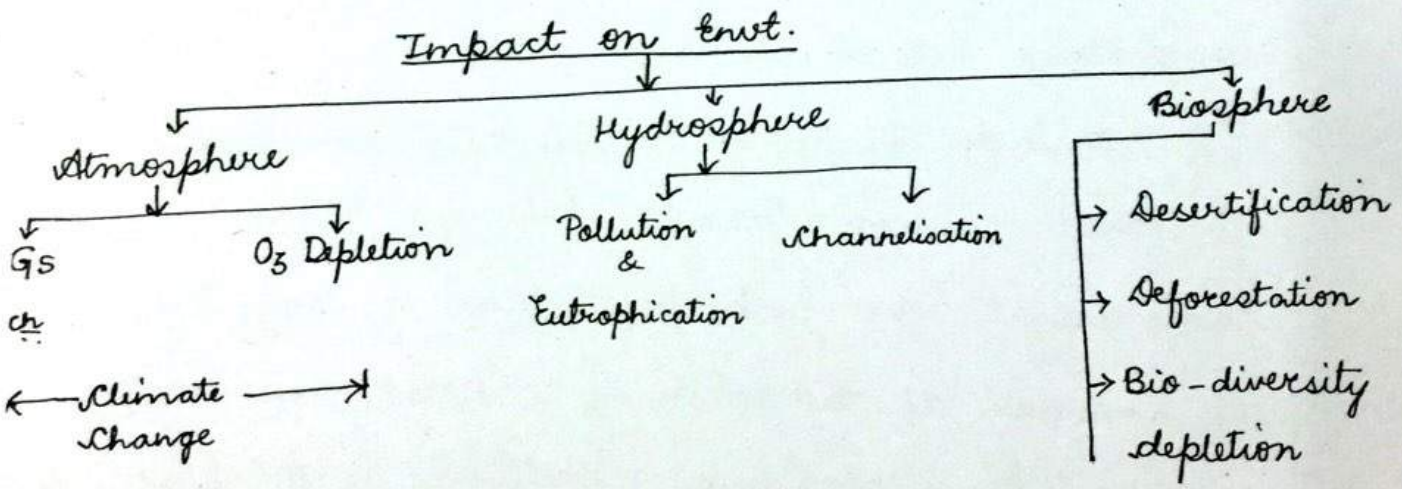
- 45° to 60° continental interior
- season cycle with ppt. throout the yr
- Fertile most soil - chernozem / mollisol -
- Uninterrupted grasses with well developed grazing community.
- HEA: Commercial extensive grain farming i.e. production of wheat as both monoculture or spring wheat with winter combination crops. It is this region that includes bread-basket of N. America & Wheat Triangle of Eurasia.

(xi) Sub-polar Region

- Long cold winters, brief summers
- Warm frontal precipitation upto 20 cms
- Seasonal biome with floating phototrophs & migrating heterotrophs
- HEA: Includes trapping on absolute primitive lines by 4th world communities as Eskimos (Canada) as well as commercial for both polar bear & seal trapping. The commercial extraction of mineral and energy resources have also been mobilised with placer gold extraction (Alaska), lode iron extraction (Sweden), crude oil, natural gas extraction (Sakhlaine, Russia) as important examples.

LUMAN IMPACT ON ENVIRONMENT

'epresenting heterotrophs, largely omnivores, human population ince industrial revolution have such multiplied the chnological capacity that it has been in the position of nanipulating, modifying as well as completely destructing he natural setup. These changes induced weather ncorporate the objective of enhancing the carrying capacity of land to adjust growing population or simply the approach of exponentially exploiting natural resource base have resulted into major destruction in all the constituents of environment, Reverting back the impact on human population. The entire range of impact can be categorised into sphere or realm based category including:



Impact On Atmosphere :

The atmospheric constituents specifically GHGs and O_3 forms the major regulator of planetary heat budget, thus, atmospheric temp. and climate. It is in the effect of industrial-vehicular emissions combined with land use changes that continuous increase in conc. of GHGs in the combination of depleting O_3 have interrupted the planetary heat budget leading to global climate change. In the analysis put forth by UNEP (United Nations Environment Program), the causes of global climate change can be practically classified into :=

(i) Natural Causes

(ii) Human Induced Factors

- Lecture 41

Test: Exogenic + climatology

E 03/2014 ⇒ "Natural Causes"

These causes of climate change correlates to the maximum expanse of geological time-scale & includes:

(A) Solar output variations
(B) Milancovitch Cycle
(C) Vulcanic Dust hypothesis
(D) Continent Drift

> The generation and emissions of solar radiation marks variations in the total amount, regulating glacier and inter-glacier periods experienced on planet Earth. It is outlined by paleoclimatologist that regular succession of solar flare activity phase followed on by sun-spot activity phase generates the rhythmic sequence of planetary climate change. Solar flare is denoted to be excessive generation and emission of solar radiation corresponding to warmer climate experienced on Earth whereas sun-spot represents minimal generation and emission, thus, corresponding to colder climate experienced on Earth. In regards to planet Earth, orbital eccentricity and axial

inclination was taken into account by Milancovitch. His work is refereed to as Milancovitch cycle that takes into account both changing distance & changing inclination of planet Earth in relation to Sun, causing change of the climate. In the component of eccentricity the recognised maximum time gap of 91,000 years changing the shape of earth's orbit around sun from elliptical to circular and vice-versa generating not just the difference in the average distance but also terminating Perihelion & Aphelion positions (during circular orbit), Eccentricity clearly modifies the net attainment of insolation. In the component called Obliquity, changing of the axial inclination is taken into account with the maximum projected time gap of 42,000 years. It is been analysed as wobbling effect of spinning earth which modifies its angle of axis w.r.t. the plane of revolution in the range of 22.1° to 24.5°, modifying the net attainment of insolation.

The third component of the cycle identified to be least agreed upon is called PRECESSION.

According to this component,

in the maximum time gap of 12,000 years there will be reversal of planet earth's alignment with earth's axis pointing at Vega Star in place of Polaris i.e. N-hemisphere experiencing summers during December.

The vulcanic dust hypothesis is applied as effect of pyroclast which acts as aerosols manipulating the prevailing climatic setup. Commonly, the vulcanic ash with its concentration in atmosphere restricts the incoming solar radiation causing colder climatic conditions. In the global perspective, tertiary vulcanism is referred to be the cause of quaternary (that is, Pleistocene) ice-age. In the regional perspective extremely cold winters experienced in Europe in 2 consecutive years (2010 & 2011) with -40°C of grim winter conditions, for more than a month's time in continental Europe was due to huge amount of pyroclast ejected by Icelandic volcanoes in the atmosphere. This natural factor is therefore not binded in the specific time or geographical expanse.

Continent Drift: applied in absolute regional perspective, drift of the continent if has been latitudinal, it generates climate change of a specific landmass. This change has been experienced by all the habitat landmasses, though the nature & magnitude of effectivity have been different.

≠ HUMAN INDUCED FACTORS

The Inter-Governmental Panel on Climate Change (IPCC), established as the collaborated attempt of UNEP & WMO, have established the fact that the present nature of climate change is human induced. IPCC's assessment reports justify the fact that all the long lived GHGs – CO_2, CH_4, N_2O (nitrous oxide) – are emitted due to human activities. Moreover, taking into account the nature & magnitude of O_3 depletion, IPCC established that entire range of O_3 depleting substances that are halogenated hydrocarbons are induced by human activities. In the combination of increasing GHGs & depleting O_3, warming up of the climate is not just swift but also extreme. According to the 4th assessment report (2007), 11 out of 12 years, in b/w 1995 (1st assessment report)

to 2006; have been on records top warmest year for planet Earth. In addition to it, most applied parameter called climate sensitivity demarcated in 3rd assessment report projects that by 2100, surface temperature of earth will register increase upto 5.8°C adding to the present level of 15.2°C as the surface temperature (WMO). In the same time frame rise in the MSL is projected to be upto 0.9 m caused not just by ablation but also by the fact that more than 90% of the heat added to the climate system by human activity is absorbed by the oceans heating it abnormally to upto 3000 m of depth. These demarcations in the assessment reports justifies that the present nature of climate change is human induced which is not just influencing habitat but thus ecological system but has also implied multiplier effect on climate change & its effects in feedback interlinks.

HUMAN IMPACT ON HYDROSPHERE

The water sphere of the environment accounting for ~70% of the surface of the earth making earth designated as blue planet involves big range of human activity induced negative impacts. These big range of diverse impact are boldly classified into :=

(a) Modification of water quality

(b) Channelisation

→ In the modification of water quality — water pollution and eutrophication are primarily distinguished. In regards to water pollution, entire range of water bodies from fresh water to marine, standing to running — have been influenced by human activity. As maxm. of human population is confined along fertile river valleys every big river of the world is identified with depleted water quality distinguished as visible & invisible pollutants (IUCN – International Union for Conservation of Nature & Natural Resources) The visible pollutants are more identified in developing world with R. Amazon, R. Ganga, R. Chang Ziang, R. Indus as well as R. Nile incorporating variable amount of dumped garbage blocking the flow of the channel apart from destructing the quality

e invisible pollutants in comparision is applicable to leveloped world with "clean looking" rivers — Mississipi Missouri, Danube, Rhine & Thames are in the list of significantly polluted rivers. For the standing waters, water quality depletion is more correlated to eutrophication that marks the multiplication of phototrophs due to excessive supplies of nutrient rich water generating the conditions that destructs penetration of sunlight even in limonetic zone, destructing all the established aquatic ecosystem and depleting the water quality. Among the big lakes/reservoirs that are recognised by IUCN as completely eutrophied includes — Fort Peck, and Sakakwea reservoirs (USA), Kainji reservoir (Nigeria) and Nasser Lake (Egypt), Lake Zeya (Russia) and Dongting Hu & Poyang Hu (China).

The open oceanic waters with their marginal extensions largely being devoid of direct human occupance are projected with less depleted water quality. However this "lesser" magnitude is only due to bigger size of the water bodies & effective intermixing. As per IUCN

report, more than 95% of discharge from land to the marginal waters or open sea is untreated water combined of industrial as well as domestic waste water. In the developed world the condition is slightly better with maximum (70–75%) of the land discharge in water bodies is of treated water. For the open oceans ~~the~~ two consistent examples of oil-spills and nuclear waste dumping is recognised to be ~~dest~~ disaster-in-making with none of the major impact felt in the present perspective. Human impact on hydrosphere in water quality manipulation generates multiplier effects with feedback interlinks.

- Channelisation: as the cause of -ve impact of human activity on hydrosphere incorporates either divergence of water largely for irrigation purposes or taming up of natural flow for navigation purposes. The Central Asian countries specifically Turkmenistan, Tajikistan and Kajakistan in their attempt to increase irrigation potentiality, diverted the water of Amu Darya & Syr Darya which has resulted in such decrease of discharge in

te land-locked Aral Sea that it is on the verge of closing with projected lifespan of 17-18 years. It is not just a direct loss of well-developed aquatic ecosystem but is also projected to be resulting in complete absence of maritime influence in the refereed Central Asian countries desertifying them. Channelisation for increasing navigability resulting in adverse effects correlate to the lower course of R. Amazon. In the attempt of enhancing economic potentialities of a megacity in the heart of Selvas - "MANAUS" (Negro - Amazon), complete lower course of Amazon till the confluence of R. Negro have been tamed. This has made Manaus port city of Atlantic route but have resulted in substantive thinning of ERF and complete termination of developed aquatic habitat due to higher velocity generated for merchant ships to move.

{ Nigeria, Ghana, Cote D' Ivoire } Only Food Sufficient in Africa

HUMAN IMPACT ON BIOSPHERE

Human activity – caused manipulations in all the realms of the environment forms the cause of decrease in biotic diversity. Specifically, however, the causes of biodiversity depletion as outlined in IP-9-CBD) includes :

CoP_9 - CBD

Project Tiger → Since 1972

(i) Over exploitation

(ii) Habitat Destruction

(iii) Invasive Alien Species

(iv) Change of Climate

(v) Overloading of Nutrients and Pollution.

i) Over Exploitation – This formally incorporates deforestation and hunting. In case of deforestation it is temperate hardwood deciduous forest that is identified to have lost maxm of ~~aerial~~ arial exparse & it is ERF that have registered maxm loss of diversity. Deforestation on the reference of TEEB (The Economics of Ecology & Biodiversity) and REDD+ (Reduction of Emissions from Deforestation and Forest Degradation) have been significantly controlled. Moreover, range of aforestation programmes with social forestry do incorporate the compensation to the depleting natural green cover. It is, however,

that in all the 3 developing continents rate of deforestation continues to be the cause of concern which is justified with requried infrastructure and economic development for the developing countries. Over exploitation for animals compared to forests is largely restricted to ~~th~~ illegal hunting with big range of conventions designed in accordance to IUCN's Red Book providing protection to entire category of "Concerned Species". Habitat

Habitat Destruction apart from being correlated to change of climate, over loading of nutrient and pollution is also referred with desertification. UNCCD (UN Convention to Combat Desertification) defines desertification to be complete termination of biotic potential of a given location generating desert like condition. Prime causes of desertification includes —

(i) Deforestation

(ii) Unsustainable agricultural practices

(iii) Over - grazing.

It is **SAHEL** (Sub- Saharan Africa) comprised of Mali, Mauritania, Niger & Chad that is officially most desertified location of the world suffering from reoccurring famine and food ~~insecurity~~ insecurity.

The invasive alien species recognised as threat to biodiversity involves artificial introduction of exotic species in a given habitat which eventually generates threat to the prevailing endemic species. Rabbits introduced in Australia towards diversifying food resource base and Eucalyptus introduced in India under social forestary programme forms most recognised examples of invasive alien species.

Biodiversity depletion also correlates to multiplier effect with feedback mechanism to all the other spheres of environment.

Information ——————— Classical

Information + Concern ——— Modern

Information + Concern + Actions — Contemporary.

GLOBAL ENVIRONMENTAL CONCERNS

Multi-dimensional depletion of environmental quality & quantity due to human activities resulted in the beginning of global environmental concerns which also corresponds to modifications of existing environment education.

Chronologically environment education is well distinguished into classical, modern & contemporary phases. The classical phase of environment education that remained valid for lengthiest part of environment awareness was largely informative. It simply oriented towards generating, storing and sharing the information about the constituents of environment. It was in 1972 that the initiatives taken up by UNEP and UNESCO, that resulted in Stockholm Conference. It is this conference that is recognised to have marked the beginning of modern phase of environment education which apart from involving information marked the beginning of global concerns. Among the most important

conclusions drawn in the Stockholm Conference, participation of environmental clubs – Sierra Club & Club of Rome are included. Sierra Club came up with the milestone dictum that established "Sustainability" It concluded there is no blind opposition to development but there is opposition to blind development. Similar milestone conclusion, credited to Club of Rome, was in their concept of 'limit to growth'. This club argued that earth is like a spaceship with no outer source of supply. By ascertaining 'limit to growth', judicious utilisation of resources will ensure the survival of human population & in the absence of it, human popl^{n} will encounter disastrous end.

* Classical Phase
  - Informative
  - Generation, Storage & Sharing

* Modern Phase
  - 1972 Stockholm Conference
  - By UNEP & UNESCO
  - Global Concerns Begin
  - Sierra Club
    - ↳ Established Sustainability
    - ↳ No BLIND opposition to development
    - ↳ Opposition to blind development
  - Club of Rome
    - ↳ Limit to growth
    - ↳ Earth like a spaceship
    - ↳ No outer supply source
    - ↳ Judicious utilisati of resources.

Lecture 42 (Important & Contempory)

04/2014

Terra Green – Magazine (ONGC ; IPCC based)

India – Year Book 2014

Yojana , Kurukshetra → Indian Geography

It was UN commission on Environment & Development that generated the backdrop of contemporary environment education. The Earth Summit held in Rio de Janeiro , Brazil (1992) formally marked up the beginning of action by the global community towards developing sustainability. The Earth Summit primarily known for AGENDA – 21 , for the first time incorporated specifications of benchmarking i.e. ascertained targets and causes of depleting environment conditions. One of the most referred causes outlined in the Summit has been POVERTY. Fair and equitable sharing of economic and ecological space was advocated to be easiest way of developing sustainable economic growth. This Earth Summit formally is recognised to have initiated contemporary environment education as it is the legacy of Earth Summit that three global conventions represents consistent global efforts towards correcting the anamolies & generating sustainable ~~base~~ ways / base of economic development.

These 3 conventions include :=

(i) UN Framework Convention on Climate Change (UNFCCC)

(ii) CBD - Convention on biodiversity

(iii) UNCCD - To combat desertification.

* Carbon Footprint

* COP = Conference of the Parties.
MOP = Meeting of the Parties.

CDM → Clean Development Mechanism
↳ Kyoto Mechanism
↳ COP_6 - 2001 (again) in Bonn, Germany

) The UNFCCC forms the umbrella convention oriented towards reducing concentration of GHGs. It came into existence in 1994 as a voluntary convention with an established benchmark of attaining 1990-levels of GHGs by year 2000. Originally the Convention also marked the classification of the countries into 3 well-defined categories :=

(i) Annex 1 i.e. industrial countries & economies in transition involving the target of cutting down on their emission.

(ii) Annex 2 i.e. developed countries reqd. not just to cut down on their emissions but also to fund low carbon technique of the non-annexed countries.

i) Annex 3 category i.e. developing countries; not reqd. to cut down on their emission.

The COPs held for the Framework Convention on regular annual succession made the Parties to the Convention' mutually agreeing in converting the convention to a legal binding agreement. It was in COP_3 (1997) that the Convention paved way to KYOTO PROTOCOL. This protocol to the Convention also moulded the benchmarking i.e. 6 to 8 % below 1990-levels to be attained by 2008-12. The Kyoto Mechanism, also included the clause of CDM (Clean Development Mechanism) which simply implied development of techniques to utilise the cleaner sources of energy minimising emissions. In the following sequence of the development oriented towards implementing Kyoto Protocol led to the incorporation of FLEXIBLE MECHANISM based on the suggestions of the USA in COP_6 - Part II (2001), Bonn (Germany). This mechanism incorporates the clause of maintaining carbon sinks - green belt or purchasing carbon credits in place of reducing domestic emissions. This was argued to

be much more easier to implement and solving the same objective of emission reduction. The CARBON TRADING under flexible mechanism is also integrated with CDM on the basis of CER (Certified Emissions Reductions). Incorporating these clauses and setting the benchmark as 2012, it was in year 2005 in $COP_{11} - MoP_1$ held at Montreal (Canada) that Kyoto Protocol was implemented. Following this implementation the important milestone developments correlating to the integration of TEEB & REDD+ in flexible mechanism during the Copenhagen Summit (i.e. CoP_{15}) along with MRV (Monitoring Reporting Verification) incorporate in Cancún (Mexico) incorporated in CoP_{16} are included. The present scenario of Kyoto Protocol involves its extension as 2nd Committment Period where the Parties to the protocol have agreed to supplement this protocol by 2017 – 2020. In the present perspective therefore, grouping of the countries continues to be the same and as negotiated in Doha (Qatar), 2012 in COP_{18} that the length of 2nd committment period will be for 8 years with at least

China and India agreeing to take on Carbon emission reduction targets after the completion of Second committment period.

ODSs = Ozone Depleting Substances

VIENNA CONVENTION — MONTREAL PROTOCOL

In the climate change mitigation, Vienna Convention comes precisely at par with Framework Convention on Climate Change. This convention primarily targetted control of emissions of all substances that leads to the depletion of Ozone. Held in 1985 the Convention paved way to Montreal Protocol as a legal binding agreement oriented towards phasing out entire range of ODSs. Montreal Protocol was signed in 1987 & was implemented in 1989. This protocol apart from targetting the reduction of emission of all ODSs with the set benchmark of freezing ODS production and emissions b/w 2013–2015 involves multi-lateral fund as well. This fund is mobilised to assist developing countries which are parties to the protocol to comply with the control

measures. This fund is supported by UNEP, UNDP, UNIDO (UN Industrial Development Organisation) and World Bank. In accordance to IPCC's 4th AR (2007), ozone has been stabilised – justifies the success of Montreal Protocol.

BIODIVERSITY PROTECTION – 'CBD'

As the legacy of Earth's Summit (1992), CBD evolved as the umbrella convention oriented towards protecting biodiversity at all the dimensions and scale. The convention came into being in 1993. It recognises biodiversity as genetic diversity, species diversity & ecosystem diversity. The convention incorporates 3-fold objectives of :=

(a) Conservation of biodiversity

(b) Sustainable use of biodiversity

(c) Fair & Equitable sharing of the benefits arising from utilisation of biodiversity.

This voluntary agreement is regularly negotiated by the Parties of the convention in the CoPs held ~~every~~ every second year. It was in CoP9 (Bonn, Germany – 2008) that the parties to the conventions agreed upon five threats to biodiversity (mentioned earlier).

CBD: NAGOYA PROTOCOL:

It was in CoP_{10} held at Nagoya (2010) that the convention paved way to Nagoya Protocol as a legal binding agreement to ensure the availability of genetic resources along with ensuring fair and equitable sharing of the benefits arising from utilisation of these resources. With only 92 parties to the convention signing Nagoya Protocol, it is not recognised to be synonym to the convention. However, the demarcated Aichi biodiversity targets for 2020-2025 in Nagoya CoP was given recognition in the last held CoP_{11} - 2011 (Hyderabad, India) referred to as Hydrabad Pledge.

Aichi Biodiversity Targets (2020-25)

Includes 5 strategic goals :=

a) Recognising the causes of biodiversity loss by mainstreaming biodiversity across governments & societies

b) Reducing direct pressure on biodiversity and promoting sustainable use

c) Improving the status of biodversity at all the three levels- genetic, species and ecosystem diversity.

(D) Enhancing the benefits to all arising from biodiversity and ecosystem services

(E) Enhancing participatory planning and capacity building in decentralised manner.

Difference b/w CBD and Aichi Biodiversity ⇒ Time Boundation	*LMOs - Living Modified Organisms

⇒ CBD: CARTEGENA PROTOCOL :=

The CBD incorporates specific dimension of CARTEGENA PROTOCOL ~~of~~ on Biosafety which is recognised to be extra-ordinary meeting of CBD oriented towards safe development, utilisation, handling, transportation of LMOs so as they don't generate threat to the natural biodiversity. This protocol was adapted in year 2000, is a legally binding protocol which establishes: advanced informed agreements that is the procedures of the countries ensuring that countries are provided with relevant information necessary to make informed decisions before importing LMOs in their territory. Along with it, cardegena Protocol establishes biosafety clearing house (BCH).

This is a voluntary clause of exchanging the information (experience) on LMOs and assisting the countries in the implementation of the Protocol.

In year 2004, CBD adopted protected areas as its part in the entire range of wildlife refuge, national parks, biospheric reserves or world heritage convention and MAB (Man and Biosphere) — sites. Since its adoption under program of work (PoW), ~6000 new protected areas have been added, ~ accounting for 13% of land territory and 6% of aquatic environment. Under CBD, protected area is recognised to be cornerstone of biodiversity protection. Beyond this umbrella convention, global initiatives to protect biodiversity also includes **CITES**, **CMS** and **Wetland Convention** in the priority list.

CITES — Convention on International Trade of ~~dg~~ Endangered Species

CMS — Convention on Migratory Species

CITES

The convention came into being by the resolution passed by IUCN, way back in 1965. However it came into force in 1975. It provides protection to entire range of specimen enlisted in IUCN Red Book to reduce the possibility of their extinction due to international trade. At present, the convention is providing variable degree of protection to 30,000 different species in accordance to their position in the Red Book.

RED BOOK:

I. Extinct (E)
   Extinct in Wild (EW)

II. Critical (C)
    Endangered (E)
    Threatened (Th)

III. Least Concern; as of now no protection
     In future it may need protection

CMS:

This Convention targets the protection to entire migratory species belonging to terrestrial aquatic as well as aerial organisms. It incorporates the classes of MoU (Memorandum of Understanding) for the migratory species that have big range of migration as Siberian Crane, 7 varieties of marine turtles including Olive Ridley

turtle. It also includes legal binding clause in the case of smaller range of migration as European Bats, Gorilla Agreement* or African-European water birds, as important examples. The convention, also refered as **Bonn Convention** came into force in 1985.

Wetland Convention

The Ramser Convention dating back to 1981 forms the Convention that orients the protection of aquatic habitat & organism. It is been implemented as intra-national action with international cooperation. Under this Convention, entire range of wetlands are included. Presently, some 2000 Ramser sites are identified in world.