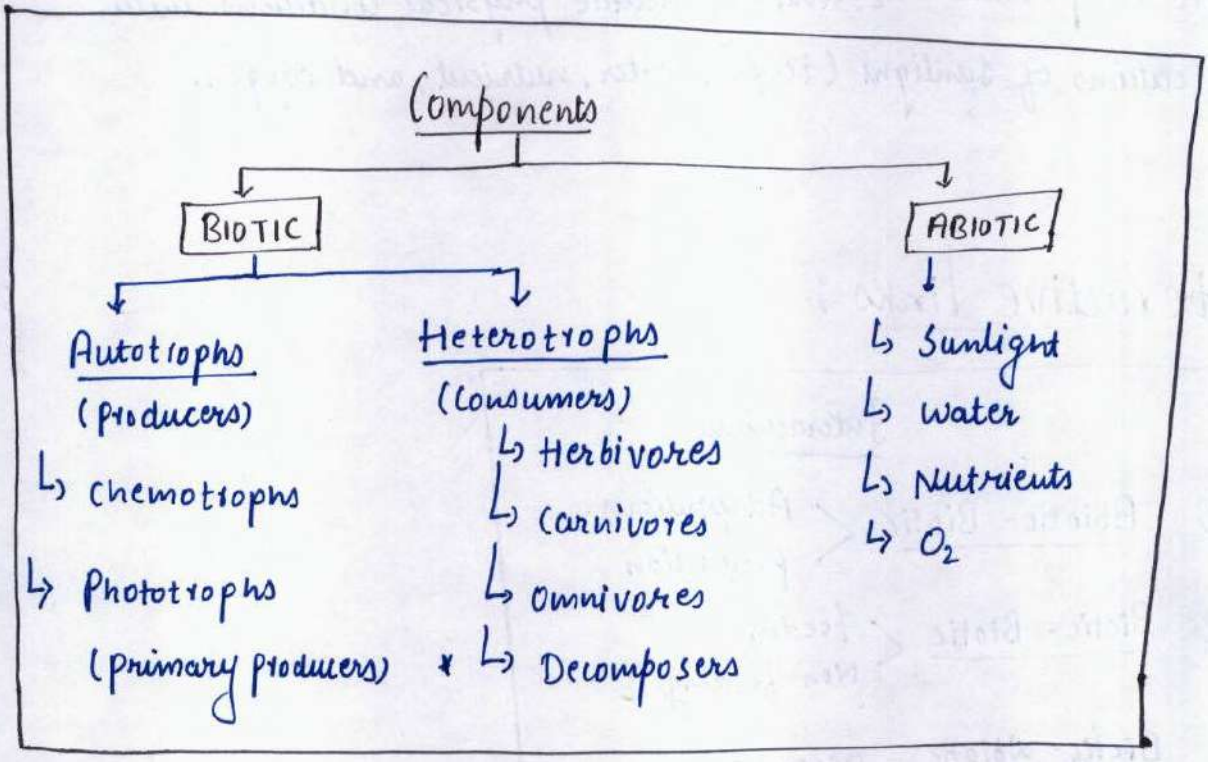
The chemotrophs produces food energy & matter by the process of chemosynthesis which do not require Sunlight.

The phototrophs in comparison includes all green plants that produces food, energy & matter involving process of photosynthesis that have mandatory requirement of availability of Sunlight.

** It is only phototrophs that apart from being autotrophs feeds heterotroph population.



Heterotrophs - represents the biotic component that are consumers i.e. they depend on other organisms for their requirement of food, energy and matter. This category of biotic components includes:

- Herbivores - called primary consumers as they directly feed on primary producers.
- Carnivores - In comparison are those heterotrophs which have secondary dependence on primary producers thus are also called secondary consumers.

Omnivores - includes those consumers which have both direct and indirect dependency on primary producers for their food, energy & matter requirements.

* Decomposers represents special category of consumer population as it derives its food, matter & energy from all the other biotic components largely as dead remains or biotic excreta.

* Abiotic component: Essentially include physical conditions with specifications of sunlight (temp.), water, nutrient, and oxygen.

* Interactive links:

Interactions

① Abiotic - Biotic < Adaptations / production

② Biotic - Biotic < feeding / Non-feeding

③ Biotic - Abiotic - Decomposition

1] The ideal ecological system is identified with 3 defined categories of interactive links.

2] The links denote sustenance of nutrient cycles & thus the functioning of ecological systems.

3] The preliminary interactive link is considered to be Abiotic - Biotic links that includes both Adaptations & production.

(a) Adaptations forms more universally applied abiotic biotic link as it corelates to all the biotic components of a given ecological system.

→ Adaptations is largely specified in the reference of two principal abiotic determiners that are temperature & water (including salinity). The temperature range of the habitat is identified to be less than 0°c (tundra) to more than 100°c (Hydrothermal vents). It is this range that is being applied to distinguish b/w Stenothermal and Eurythermal organisms.

The Stenothermal organisms are identified with smaller range of temperature required for their habitat, that is distinguished from Eurythermal organisms that have bigger temperature range as their habitat. e.g. Human being.

→ e.g. Polar bear → more vulnerable

→ In terms of water the characterstics of adaptations applied to plants includes: Xerophytic & hydrophytic adaptations i.e. for water scarce & water surplus conditions respectively.

In reference to salinity it however relates to Stenohaline & Euryhaline adaptations.

** → Adaptations of organisms in reference to the physical environment corelates to homeostatis. Homeostatis invalve all the processes that makes the organism maintain constant internal environment inspite of changes in the external environment. It is with reference to homeostatis that adaptations of organisms is specified with:

- Regulators &
- Conformers.

* Regulators include those organisms which maintains homeostatis. It is thus related to thermo regulation and osmotic regulation (Stands for the process that organism uses to maintain water balance avoiding excessive gain or loss of water that is maintaining osmotic pressure). * thermo regulation - maintain body temperature.

** All mammals represents regulation as their adaptation. It is therefore that they correlate with bigger geographical range of survival. (Eury organisms).

* Conformers - are the specimen that cannot maintain constant internal environment, they tend to change both body temperature & osmotic pressure with changes in surrounding. (they are more fragile)

** more than 95% of animals & all plants are conformers. Ideally therefore conformers proves to be Steno organisms practically however they involve range of other adaptations that increases their geographical range of survival as Hybernation, Suspension & Migration.

(b) Production:

This Abiotic-Biotic link relates only to producers involving specifications of primary producers. It is defined to be the process of converting solar energy & soil or water nutrients into food, energy & matter in the availability of water & oxygen.

The presence of green plant in any geographic habitat justifies validity of this interactive link however amount of production significantly varies in the determining influence of:

Av

✱ Fundamental Principles of Ecology :

1] Ecology is defined to be the discipline that is engaged in analysis of interactive relation which relates to both organisms with their surroundings & organisms among themselves.

2] Fundamentals of ecology thus is directly related to the life bearing sphere BIOSPHERE.

3] BIOSPHERE is defined to be narrow zone of contact b/w land, water & air which provides Habitat.

** Habitat is defined to be that part of environment which supports life. It involves both specified & generalised perspective of use.
(Biosphere)

4] Biosphere the life bearing sphere is identified with complicated interactive relations b/w Abiotic factors i.e. identified at six defined inter related hierarchy or ranks, these include : Gene, cell, organ, organism, Population & Biotic community. Biosphere as a complicated biological system not just involves individual perspective of each level of biological systems but also interactive links persisting between them. At every level of the system generation & transfer of food, energy & matter commonly prevails.

** The highest hierarchial biological system called ecological system or ecosystem is thus comprised of all the five lower levels of biological system.

Biological Systems (Hierarchy)
(Odum)

Biotic Components	Gene	cell	organ	organism	Pop'n	Biotic community
Interacts with Abiotic factors leading to	↕	↕	↕	↕	↕	↕
	ENERGY & MATTER					
	↓	↓	↓	↓	↓	↓
System	Gene system	cell system	organ system	organism system	Pop'n system	ECOLOGICAL system

** Population is the term applied to denote total number of individuals of a given specimen. e.g. human population.

** Biotic community incomparison is the term applied to denote total number of specimens living in a geographical environment sharing resources and having interactive links.

The Eco. Ecological system as the highest hierarchial biological system is comprised of range of components and diverse interactive links b/w them.

The components of ecological system is boldly categorised into biotic and abiotic categories.

* The biotic component are inclusive of autotrophs & heterotrophs

The Autotrophs are considered to be producers of food, energy & matter alongwith being self feeders. The autotrophs are subcategorised into two defined subcategories called chemotrophs & phototrophs.

- Availability of sunlight
- Availability of water
] → Major determiners

- Season cycle
- age of the plant
] → Minor determiners

Production (process) — Productivity (amount of stored energy) → Primary productivity (PP) (Producers) → Secondary productivity (SP) (Consumers)

Primary productivity (PP): Gross PP (Total) > Net PP (GPP - Respirational losses)

Secondary productivity (SP): GSP (Total) > NSP (GSP - Rspinl losses)

Productivity is defined to be amount of stored food, energy & matter per unit time and area.

The average biospheric productivity is 320 dry gms / m^2 / year involving big range of 2000 dry grams / m^2 / year in wet tropics to only 3 dry gms / m^2 / year in cold deserts & Hamada deserts.

Productivity thus involves positive relation with production however is applied both to producers (primary productivity) and consumers (secondary productivity).

(2) BIOTIC - BIOTIC link:

→ This interactive link of the ecological system is within the biatic community.

→ It incorporate two defined constituents feeding & non-feeding interactive link.

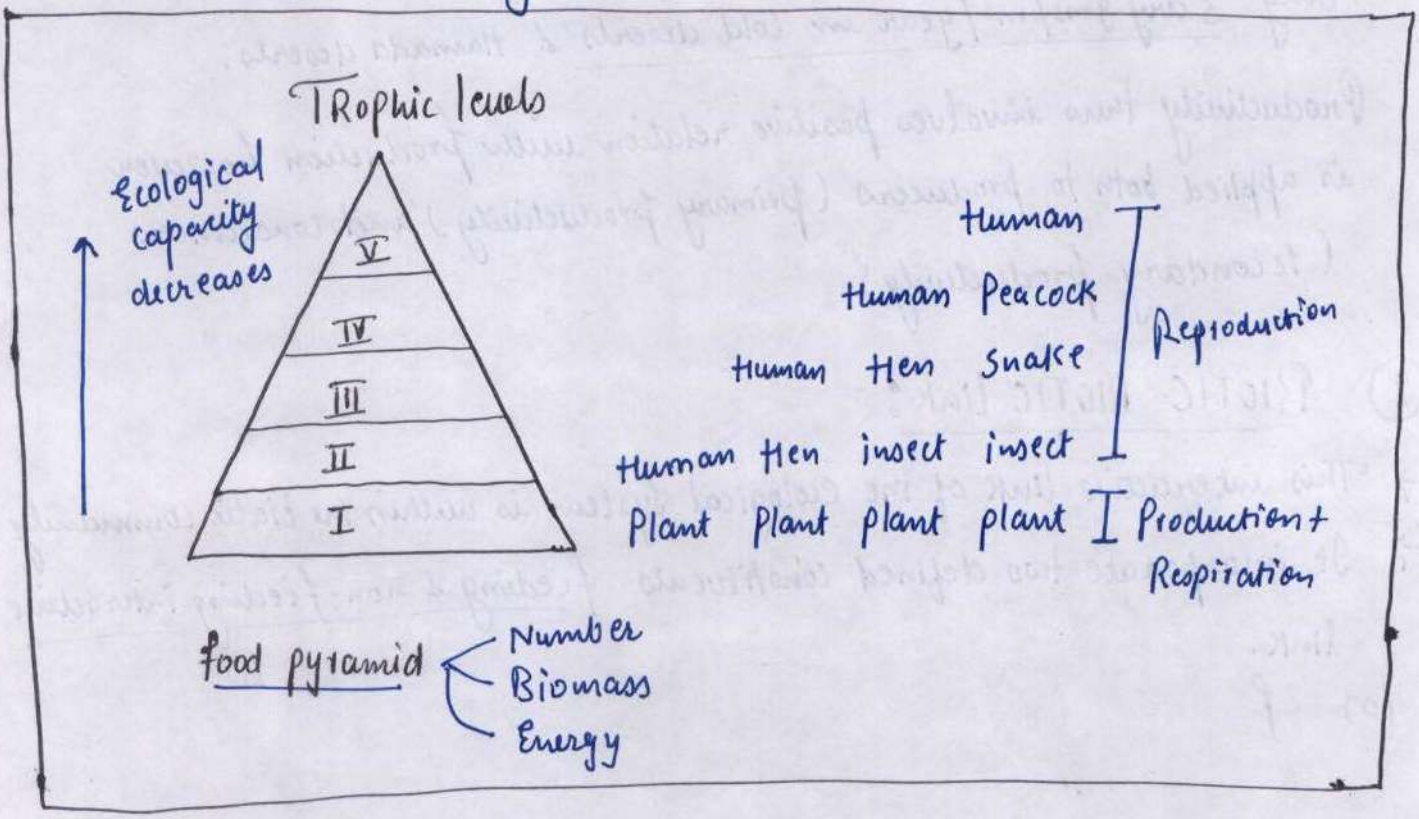
(x) f

(a) Feeding interactive link relates to **trophic level** which is defined to be arrangement of organisms in their respective positions based on the feeding mode.

→ Trophic level I is always occupied by phototrophs in comparison the heterotrophs can occupy more than one trophic levels.
It is therefore that production is only applicable to trophic level I however respirational loss is applied to all the trophic levels.

→ With increase in trophic level therefore feeding capacity or ecological capacity decreases which justifies

- Practical number of trophic levels not more than 4 to 5.
- **food pyramid** i.e. population of specimen occupying lower trophic levels to be larger than those occupying higher trophic levels.
- With increase in sign of latitude restricted number of trophic levels restricts biodiversity.



The feeding interactive link is also defined with prey-predator interrelation & parasatism.

Prey predator interactive relation: though represents ecological capacity as associated with the food pyramid it is distinguished as it do not include primary producer. —

Parasatism in comparison also forms example of feeding interactive link which is distinguished from prey predation as it do not involve loss of life.

** Parasatism as relates to parasite living on the body of the host organism it make the variant example of Symbiosis.

*(b) Non-feeding inter link:

1] This interactive link is primary related to functioning of ecology as a system as there is complete absence of feeding equations among the involved specimen.

2] These non feeding links are bod boldly categorised into.

(i) Beneficial

(ii) Detrimental

(iii) Neutral

(i) Beneficial interactive link is largely associated with Symbiotic relation or Symbiosis. This interactive relation is defined to involve living together with no loss faced by interactive specimen.

It incorporate:

(a) Mutualism i.e. when both the interactive specimen gains.

(b) Commensalism i.e. when one interactive specimen remains neutral while the other specimen tends to gain

* Symbiosis thus is correlated to facilitative type of specimen interaction in the given ecosystem

(ii) Detrimental interactive link in the non-feeding category is essentially associated with interference i.e. a specimen restricting genesis, growth or survival of other specimen.
It also involve competitive relation that induces detrimental effect on both the interactive specimen. This interactive relation is essentially prevails in Intra trophic level. It is identified to be more stronger as Intraspecific i.e. among the individuals of the same specimen due to absolute same requirement of habitat.
As Interspecific it represents comparative weaker dimension as requirement of habitat differs.

This interactive relation is essentially observed in the light of GAUSE'S PRINCIPLE OF COMPETITIVE EXCLUSION, originally this principle emphasize that in the influence of generated competitive relation inferior specimen will gradually die out.
It was eventually amended (thus made more practical) that this interactive relation will make inferior specimen adjust with lesser share of habitat compared to superior counterpart.

Non feeding

1. Beneficial - Symbiosis → Mutualism, commensalism
2. Detrimental Competition → Inter specific, Intra specific
3. Neutral - Amensalism, Neutralism

(iii) Neutral non-feeding interactive link:

Is identified when the specimen in a given ecological system are neutral to each others existence.

It essentially thus relates to LIFE HISTORY DIFFERENCES (LHO) existing between the specimen. validity of this interactive link is thus specified with seemingly neutral interactive link do involves smaller scale perspective of defined roles in the developed ecological system and thus influencing each other. (Passive linkage)

* a) Amensalism - Defined to be that interactive link where the two specimen involves one to be absolute neutral to the existence of other. However, other is experiencing harmful effect due to its existence.

Type of Interaction	Effect on specimen 'x'	Effect on specimen 'y'	Example
Neutralism	0	0	Wolves & lichen
Amenalism	0	-	Penicilium (0) & Bacteria (-)
Commensalism	+	0	Tiger (0) & Golden Jackal (+)
Competition	-	-	Lion & Cheetah
Mutualism	+	+	Pollination b/w Insects and Flower
Predation or parasitism	+	-	praying mantis (+) & bumblebee (-)

(3) BIOTIC - ABIOTIC LINK:

1] It relates to the process of Decomposition thus involving Specified category of heterotrophs the decomposers.
In Grazing food chain this interactive link represents completion of nutrient cycle.
It is however that in the Saprophytic / Detrital food chain it represents beginning of nutrient cycle.

CHRONOLOGICA DEVELOPMENT OF ECOLOGY:

1] Development of Biomes or ecological systems involves variable range of chronological extensions. It is this analysis of development that is recognised as Succession.
Successions are classified into two prominent types : Primary succession & Secondary Succession.

(a) Primary Succession -

(i) It is defined when in the lifeless habitat life begins to evolve. In reference to the available habitat it is distinguished as Hydrarch Succession (that marks genisis in shallow water) & Xerarch succession (that marks genesis in bare ground).

(ii) The primary succession technically involve two different types of evolution:
(a) Divergent evolution.
(b) convergent "

(a) Divergent evolution is defined when genetically similar specimen are being subjected to different stresses and opportunities leading to different types of adaptation.

(b) Convergent evolution in comparison is defined when genetically different specimen are subjected to similar stresses & opportunities to adapt with similar life forms.

(iii) The primary succession involves range of developmental stages called Serel/Seral stages which marks its beginning with pioneer community & projects maximum diversity of specimen & interactive links that can be supported by habitat as climax community.

** The term applied specifically for the plant succession in different developmental stages are called Hydrosere and Xerosere.

[B] Secondary Succession:

1] Are also ideally related to multiple sere/seral stages and can relate to climax community.

2] It however is distinguished as it begins after destruction of climax community.

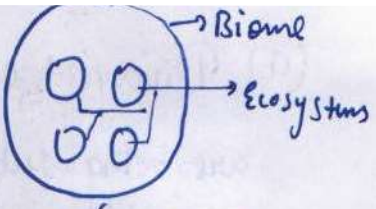
3] Both the destruction & regenesis involves natural & human component.

4] In this succession existence of soil forms additional difference.

5] The succession is also defined with FASTER PACE OF GROWTH compared to primary succession.

6] BELUKAS i.e. regenerated forest in the areas of shifting agriculture and ALFALFA i.e. substituted grasses to campos are excellent examples of secondary succession.

* Types of BIOMES / ECOSYSTEM :



1] The term Biome is applied to denote biological provinces (regions) that projects substantive homogenity in the life forms interactive links and also adaptations.

within the biotic provinces / biomes wide spectrum of ecosystems however can exist.

2] for the life bearing planet biotic provinces or biomes are principally categorised as <u>acquatic Biomes</u> & <u>Terrestrial Biomes</u>.

I. Aquatic Biome:

1] for the blue planet earth aquatic biome accounts for maximum geographical stretch.

2] Development of ~~aq~~ aquatic habitat is regulated by availability of <u>Sunlight</u>, <u>nutrient</u> & <u>dissolved oxygen</u>.

3] Being 3 dimensional habitat it projects:

(a) Aquatic biodiversity decreasing with increase in Sign of latitude.

(b) <u>Longitudnally</u> the <u>margins</u> (i.e. offshore locations) proves to be more productive and diverse than open water primarily due to <u>dual nutrient</u> (sourced from land as well as water).

(c) In reference to <u>depth</u> aquatic ecosystems are analysed both in the context of <u>prevailing lifestyle</u> & in the context of <u>availability of Sunlight</u>.

The lifestyle of aquatic System are boldly categorised into 3:

(i) <u>Planktonic</u> that represents drifters with phytoplanktons being the primary producers

** The other primary producers includes rooted plants that includes <u>Periphytes</u> (submerged plants) and

DIRECTION

Meso / Macrophytes (that are emerged plants).

(ii) The Necktons includes swimmers that is entire range of fin fish & shell fish, with primary or secondary feeding characteristics.

(iii) Benthos - that represents attached lifestyle that are further distinguished b/w Sesile (stationary / immovable) & motile (that are mobile as swinging vegetation on land).

Based on the prevailing lifestyle the vertical habitats are distinguished as:

(i) Pelagic i.e. off the bottom &

(ii) Benthic i.e. on the bottom.

4] as this categorisation of vertical habitat do not clearly provides presence or absence of sunlight it is therefore that vertical habitats are classified as Photic i.e. sun lit & Aphotic i.e. non-sunlit or dark.

5] Photic Zone relates to both production & respiration whereas the Aphotic Zone is only related to respiration thus:

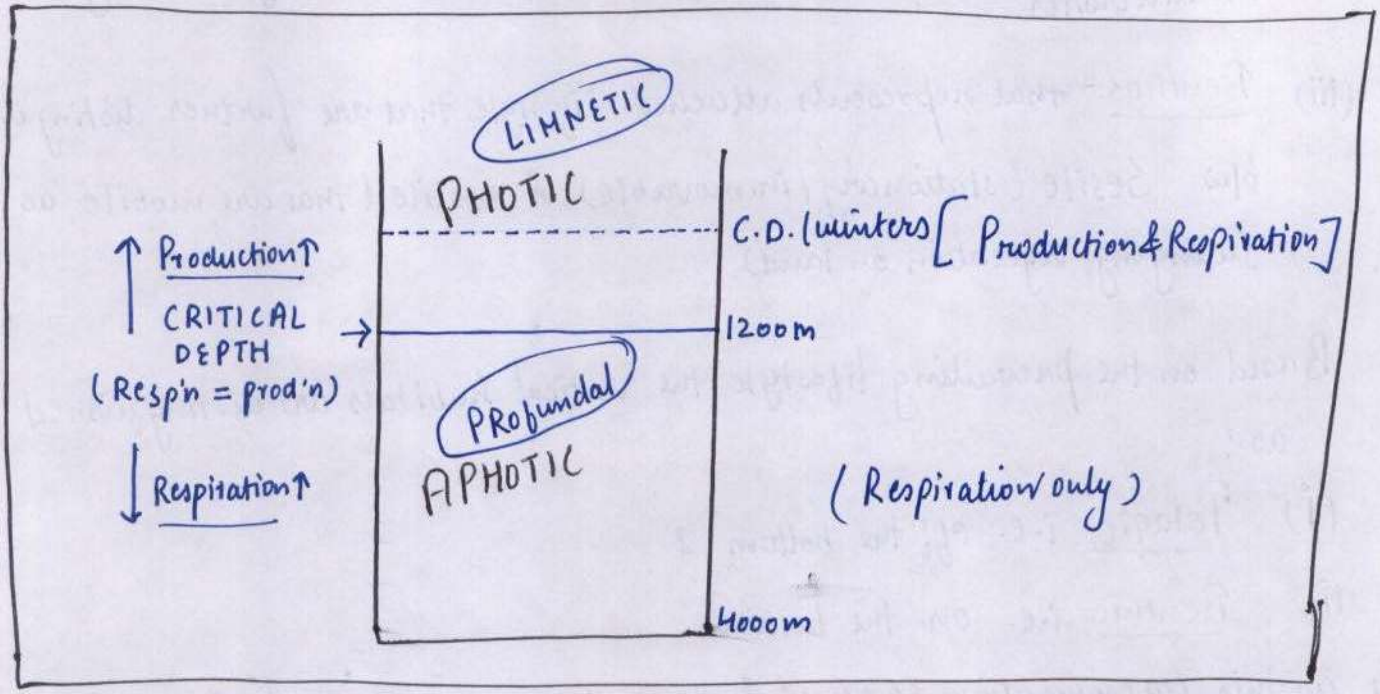
Aquatic Biodiversity decreases with increase in depth.

The vertical habitat is also related to:

→ CRITICAL Depth i.e. the boundary b/w Photic & Aphotic depth.

- located at approximate 1200m of depth.
- it represents the level where production & respiration are in theoritical balance.
- It relates to aquatic BLOOM during Spring (as per seasonal Variation in its depth and according adjustments of planktonic life style).

→ The photic zone in freshwater* ecosystem is called Limnetic zone whereas Aphotic zone is called Profundal zone.



I. Lifestyles
- Planktonic
- Necktonic
- Benthos
  - Sensile
  - Motile

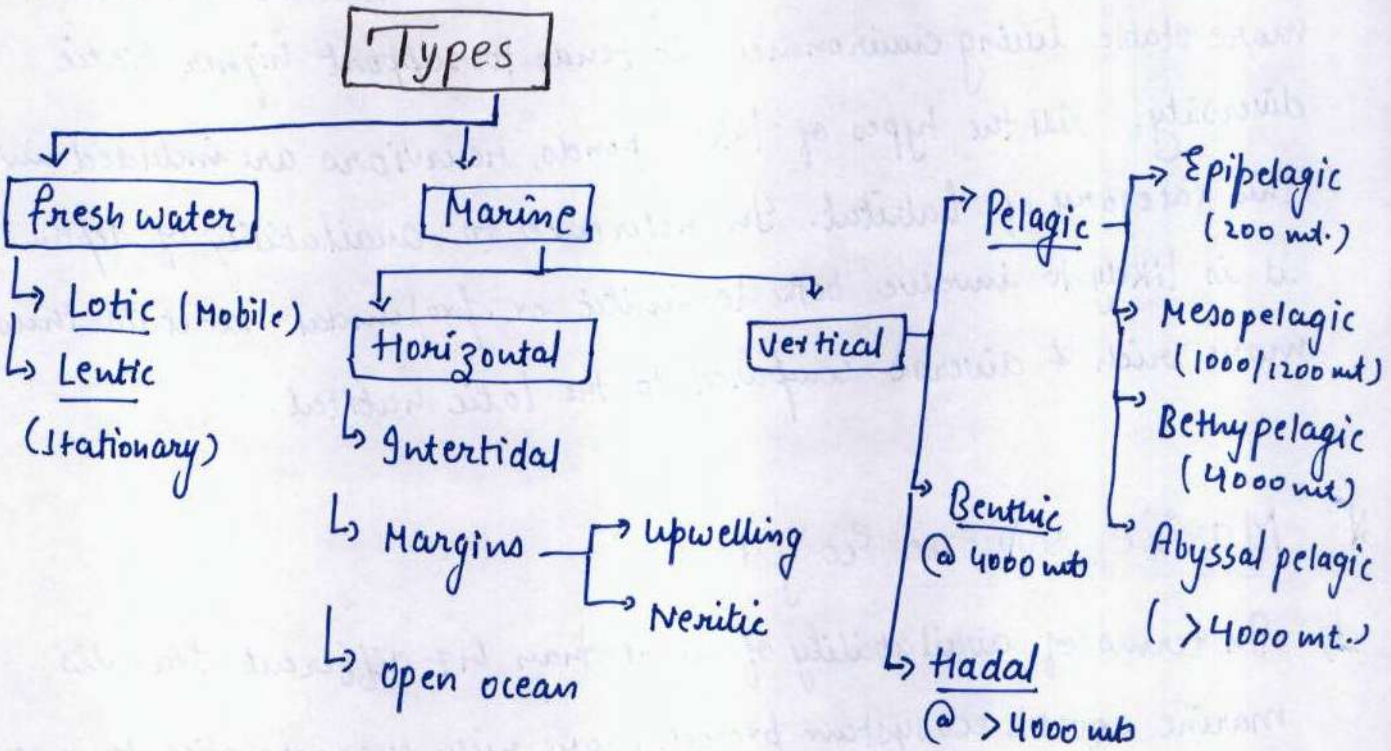
II. Habitats (vertical)
- Pelagic (off the bottom)
- Benthic (on the botton)

III. Availability of sunlight
- Photic
- Aphotic

** In aquatic ecosystem inverted pyramid more commonly exist compared to upright pyramid as in this ecosystem production is depth dependent though respiration is independent of depth.
It is therefore that heterotrophs tends to outnumber autotrophs in this ecological setup.

* Types of aquatic System:

Based on aquatic habitat aquatic ecosystems are categorised into two major types of ecological setup.



* Fresh water Ecosystems:

1] In the absence of recognisable amount of dissolved salts fresh water substantially lacks in availability of nutrients thus proves to be less productive and less diverse than marine ecosystems.

2] This category of ecosystem includes two subdivides the Lotic habitat & the Lentic habitat.

i) The Lotic habitat denotes mobile water wherein the mobility is considered in one single direction. Being mobile it corelates to unstable environment restricting production productivity thus biotic diversity.

** As running velocity of an active channel decreases in less gradient area it makes latic habitat more relate to leminitic further restricting the ~~biotic di~~ biodiversity (profundal habitat is not ruled out along cut bank i.e. pool).

ii) The Lentic habitat or stationary freshwater habitat as is corelated to more stable living environment it tends to support higher biotic diversity. All the types of lakes, ponds, reservoirs are included in this category of habitat. In reference to availability of depth it is likely to involve both leminitic or profundal habitats thus more rich & diverse compared to the lotic habitat.

* Marine Aquatic Ecosystem:

1) In terms of availability of more than 47 different Sea salts marine aquatic ecosystem projects more rich characterstics to that of freshwater ecosystems.

2] It is however that in both longitudinal & vertical dimensions it corelates to big diversity of habitat and thus biodiversity. longitudnally i.e. horizontally inspite of constant photic environment there is recognisable habitat diversity and thus ecosystem diversities involving.

(a) Intertidal habitat -

(b) Margin habitat - This habitat is distinguished as offshore habitat with dual nutrient source combined with availability of sunlight & oxygen.
It is thus characterised with higher productivity & biotic diversity
Subdivideds as:

(i) Upwelling Zone - Confined only along east margins of the oceans

(ii) Neritic Zone - Continental shelf habitat, it is Neritic habitat that proves to be more diverse as it additionally provide safe breeding ground (by restricting predators) as its habitat characterstics.

(c) Open ocean -

→ with increased distance from continent decreased availability of terrestrial nutrient though makes open oceanic habitat less productive thus less diverse than the margins. Total production do remains high in reference to involved size.
It is open ocean habitat that is vertically subcategorised into stratas of habitat. These stratas can be distinguished as:

(a) Photic Habitat - that relates both to production & respiration.

(b) → Planktonic & Necktonic lifestyles.
→ Epipelagic forms true photic zone with sustained availability of sunlight throughout the year

→ Mesopelagic however represent Disphatic & Euphotic habitat it involves summer concentrated planktonic lifestyle.

** It is therefore that this vertical habitat is corelated to aquatic Spring (Blooms) & proves to be Less productive & diverse than Epipelagic

(b) Aphotic habitat - Inspite of consistent lack of availability of Sunlight thus complete absence of primary production this habitat is identified with four different stratas in absolute accordance to increasing respiration thus decreasing diversity with increasing depth.

These vertical habitats include: - Bathypelagic
- Benthic
- Abyssal pelagic
- hadal habitats.

all these habitats relates to Necktonic & Benthos lifestyle (including both Sesile & motile wherein Sesile is Specified only on Benthic & Hadal habitats).

** Hydrothermal Vents:

1) Newly discovered aquatic ecosystem. Hydrothermal Vents are Variable Sized fissures that exist in Hadal or Benthic location.

(connected to the warmer interiors of the earth it is characterized with consistent ejection of Sulphur rich hot water (with temperature of more than 200°C).

commonly recognised as Black Smokers these involves favourable habitat for survival of chemotrophs with validity of production process called chemosynthesis.

The chemotrophs like WORMS & CALMS absolutes lacks in the capacity to feed heterotrophs they do not influence aquatic biodiversity.

* TERRESTRIAL ECOSYSTEM:

1] The two dimensional land habitat is regulated of its biotic potentials by availability of sunlight, water & nutrients derived from land or soil.

2] As the principle determiners of this habitat is sunlight & water. five & sub categories are distinguished on the basis of their availability:

(i) The tundra Biome.
(ii) The Desert Biome.
(iii) The forest Biome.
(iv) The Grassland Biome.
(v) The Savanna Biome.

(i) Tundra Biome -

1] Highest latitudnal terrestrial Biome.

2] It is thus deficit in the availability of sunlight.

3] It is however that brief prevailing summer that marks rise of temperature above 0°c..

melting of surface ice with subsurface remaining permanently frozen generates water surplus characteristics.

4] In the Northern hemispheric tundra the PHOTOTROPHS thus are characterised with two defined types of adaptation: Suspension and floatage (lack of availability of favourable growing season phototrophs are only green patches with complete absence of developed parts of plants. e.g. Mosses & Lichens

** Franc Joseph land forms northern limit of Summer mosses

→ the HETEROTROHS though also depict suspension as insects they are dominantly recognised with migration so as to escape grim climatic conditions during winters, polar bear, taiga antelope & Siberian crane forms common example.

** In the application of ALEN'S RULE → adaptation this habitat is completely devoid of smaller sized organisms moreover existing organisms → big organisms have smaller body parts as exposed body parts (ears, legs etc.)

[** tundra is perennial Biome not seasonal
↳ Moesses & lichens suspend activities during winters
↳ Southern hemisphere (Penguins live throughout the yr.)]

** The Southern hemispheric tundra projects its uniqueness as it do not support phototrophs moreover the perennial dwellers penguin & (carnivore) thrives throughout the year with no suspension of their biotic processes.

(Nokternal adaptation)

Ecosystem

	Habitat Diversity	Bio diversity	Niche Diversity
forest	Highest	High	low
Tundra	Low	Low	Low
Desert	High	low	highest (Realised) → Most fragile

Work to be done — Workforce — Load

Niche

Role played by an organism in an ecosystem

Fundamental (Ideal) (what should be) — Realised (Actual) (what is)

(ii) Desert Biome :

1] This terrestrial biome projects combination of surplus insolation with defficiency of water.

2] It thus depicts to be the example of less productive biome. (more than tundra)

3] The desert biome collectively involve highest realised — making it most fragile terrestrial Biome.

4] locationally this biome is subcategorised into two defined categories Tropical & subtropical deserts. Though in both the deserts phototrophs projects similar adaptations, tropical desert involves more diversity of phototrophs.

The phototrophs adaptations involves Xerophytic i.e. adapted to consistent water scarcity.

Phereatophytic i.e. deep seated roots so as to avail water from subsurface water sources.

Succulents i.e. holding the capacity of sucking & storing water in their roots. e.g. Aloe vera
↓
Cactus, Bushes

Mesquite plant (among the bushes)

Acacia

Senegal (tree variety)

(BWR) → Kashi, Sasche, Hotan (China)

.m though is typical to both tropical & subtropical desert it of a xerophyte as it relates only to oasis (permanent fresh water zones in desert).

* Heterotrophs:

Higher primary production thus ecological capacity in the tropical deserts represents higher levels of heterotroph diversity which includes insects (ants, spider, reptiles) wide range of snakes & lizards. Grazing community (sheep, Goat, camel) and carnivorous heterotrophs as desert foxes.

The heterotrophs adaptations essentially includes:

→ Thick skin coating i.e. to protect themselves from grim heat waves conditions.

→ Big Ears so as to ease body heat (as that of Kangaroo rats)

→ Nocturnal adaptability i.e. becoming passive during day time & hunting out for prey during night (Rodents, Bats).

The subtropical desert being significantly insolation deficit alongwith experiencing grim winter conditions projects substantially less primary production & productivity thus less feeding capacity supporting only grazing community e.g. Yak, Gazelle, Tibetan Antelopes makes prominent example.

Thick skin coating is the dominating adaptation of heterotroph (to protect themselves from grim winter conditions).

(iii) Forest Biome :

1] In the combination of favourable sunlight & water forest biome accounts for more than 70% of terrestrial biospheric biomass.

2] Developed in well defined terrestrial habitat it is subcategorised into 3 prominent categories :

(a) Rainforest.
(b) Taiga forest.
(c) Deciduous forest.

(a) The Rainforest :

- → lowest latitudinal forest.
- → Relates to surplus availability of sunlight & water.
- → Involves densest diversity of vegetation.
- → Are evergreen forests
- → Vegetation adaptations in this closed forest involves
  - Shallowest roots
  - Broadest leaves
  - Exceptionally tall height, creating densiest foliage (leaf cover)
- → As sun rays hardly penetrates the forest floor these are dark gloomy forests with perennial waterlogged conditions.
- → Ideally four defined vertical stratas of vegetation prevails in these forests called : Emergent layer
  Canopy layer
  Understory layer
  Forest floor layer
- → Prominent

→ Prominent locations includes:

- Salvas of Amazon basin & forest of congo basin

→ Mahogony, Ironwood, Ebony, Balsam, Rosewood forms prominent tree variety.

→ Liana is the commonest Epiphyte (requires physical support to grow).

→ The dark gloomy waterlogged forest floor substantially lacks in regeneration capacity leading to thining of density of plants.
The heterotrophs in these forests dominantly includes insects, reptiles, (biggest range of snakes & pythons) and Apes with an absolute Arboreal adaptation (that are tree dwellers).

(b) Taiga forest:

→ Highest latitudnal Biome.

→ confined only in Northern hemisphere.

→ Are evergreen forest involving pure standing evergreen plants:

→ Phototroph adaptations includes shallow roots, tall trees, needle shaped leaves and overall conical structure so as to restrict nesting of eyes.

→ These are also called coniferous forest / Boreal forest.

→ Prominent trees - Pine, Spruce & fir.

→ Heterotrophs includes polar bears, taiga antelopes, reindeer adapted to hibernation (long winter sleep) & migration.

(c) Deciduous forest:

→ Well developed, substantially diverse & extensive terrestrial forest biome.
→ Principally known for pure standing deciduous plants with density of vegetation decreasing with increase in sign of latitude.
→ Accordingly the forest biome is subcategorised as:

(i) monsoonal Hardwood deciduous:

→ Involves some undergrowth.
→ Prominent Varieties of trees includes - Teak, Sal, Mahogony and Sandalwood.
→ Bigger diversity of heterotrophs including - insects, reptiles, herbivorus (Elephants, Squirrels), Carnivores (lion, tiger, cheetah, leopard, foxes).

(ii) Temperate Hardwood Deciduous:

→ Have no undergrowth
→ Pure standing hardwood trees as - Oak, Maple, Chestnut, walnut.
→ Sparser Variety of heterotrophs as herbivores (squirrel), carnivorous foxes.
→ Towards the wetter margin temperate hardwood deciduous develops rain forest called [Laurel] i.e. domoninantly known for tallest trees of the world - Redwood alongwith evergreen hardwood plants like Beeches & Kauri° relates to this habitat.

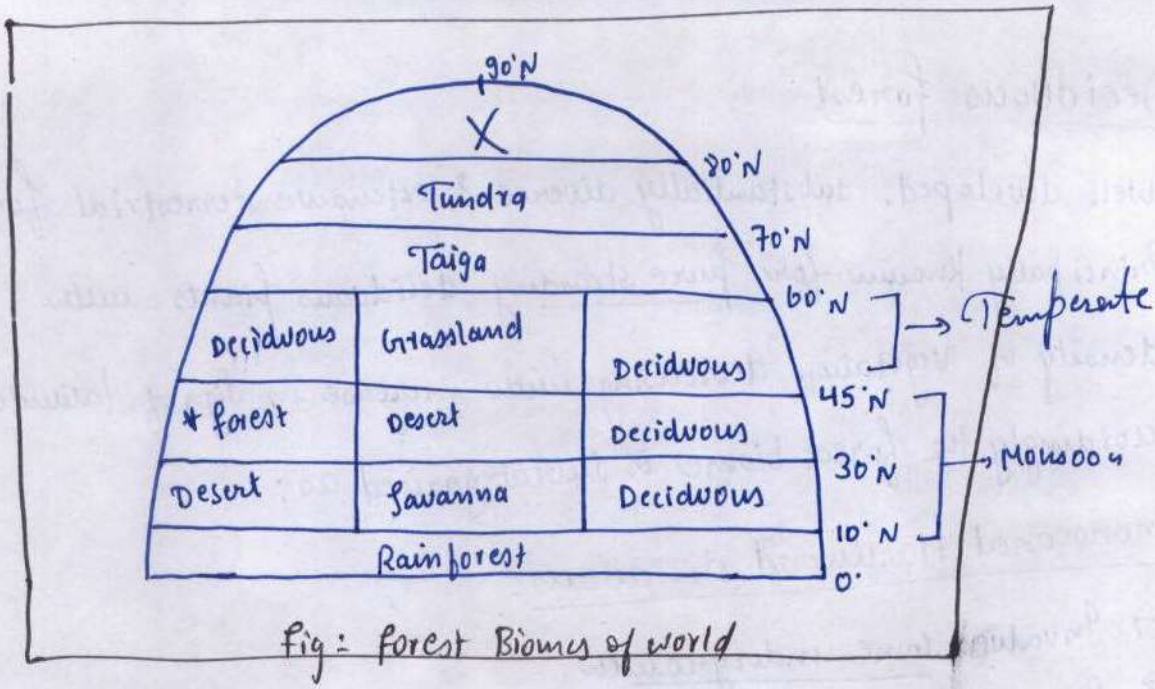


fig: Forest Biomes of world

** Sclerophyll Biome:

→ The special type of forest biome relates to mediterranean climatic region called sclerophyllo biome.

→ prevailing long hot summer drought with dependable winter concentrated precipitation.

→ projects unique adaptation of plants that includes

- Deep Roots
- Short stunted height
- Thick small glossy leaves, with evergreen plants.

→ All citrous variety of fruits bearing plants: fig, olive, maqui, chappral are prominent plant variety

→ with restricted precipitation, restricted primary production relates to limited heterotroph diversity in both herbivorous & carnivorous category.

(iv) Grassland Biome:

1] In the continental interiors of temperate latitude thus with higher range of annual temperature & lesser amount of annual precipitation.

2] The habitat supports only grasses (complete absence of trees)

3] The developed grasses are categorised into:

(a) Steppes:

→ Are shorter grasses
→ Ranging in height in b/w 10-20cm.
→ confined in semi arid location that is precipitation in range of 25-50cm.
→ It involves: North American Parraries.
Russian steepes
Kirghiz "
South African Velds.
Australian downs, as examples.

(b) Prairies:

→ These are taller grasses height ranging b/w 40-60cm
→ confined in subhumid climate with precipitation 50-75 cms.
→ It involves: German steepes.
Argentina pampas
Newzealand canterbary plains.

4] The grassland biome ~~tes~~ depicting lesser primary productivity thus lesser feeding capacity supports only grazing community including squirrels, Rabbits & Bison

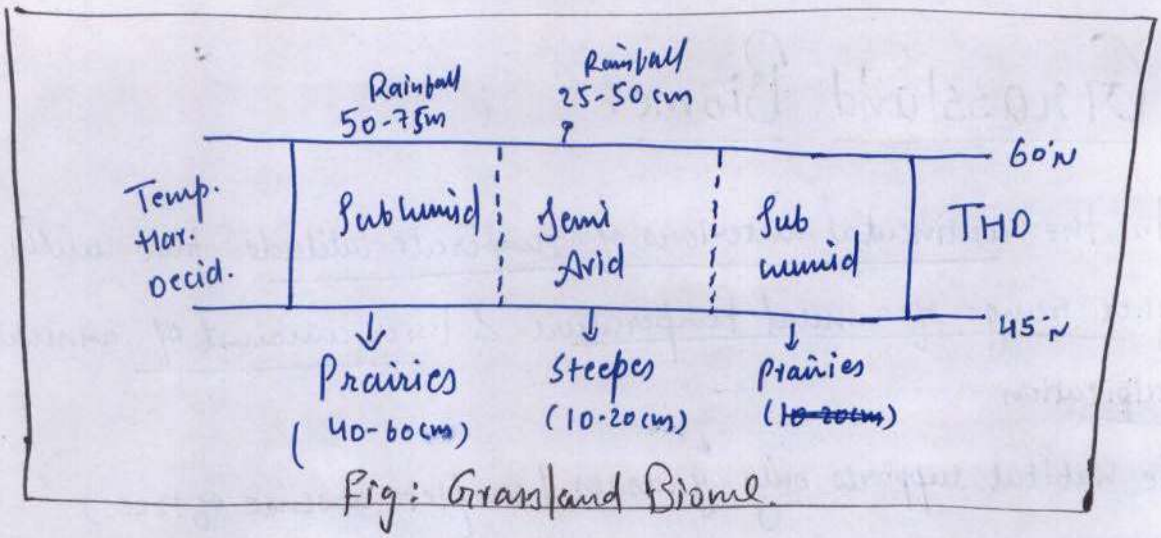


Fig: Grassland Biome.

(V) Savanna Biome:

1] Tropical continental Biome.

2] which combines both the habitat that is of forest & desert.

3] The phototroph variety thus includes - woodland (Sparser forest)

- xerophytes
- tall grasses as Bamboos, Tufts & Runners

(these grasses invalve height b/w 1.8 m to 3m) representing excellent transition b/w trees & grasses).

The Vertical feeding pattern is thus applicable in Savanna making it adobe of wildlife

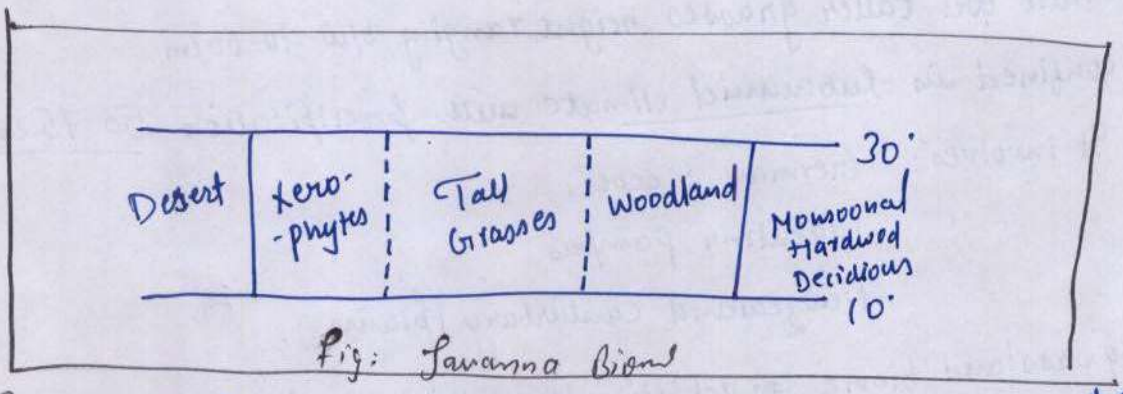


Fig: Savanna Biome

* Ecotone - It is spatial transition b/w the two neighbouring biomes (only)
→ It marks its validity both in latitudinal & regional perspectives

* Additional terrestrial Biomes:

1] This category incorporate two defined constituents Montane Biome and Island Biome.

a) The Montane Biome: forms 3rd dimension of terrestrial biome representing altitudnal variations in developed habitat & thus biotic diversity. It is regulated by:

- → latitudnal location of mountain
- → Height of mountain
- → Sun bearing slope
- → Maritime influence

(b) Island Biome:

(i) It represents unique type of terrestrial biome due to its segregation from the mainland.

(ii) The Island biodiversity is essentially regulated by

(a) Its size, that tends to determine availability of habitat and thus biotic carrying capacity.

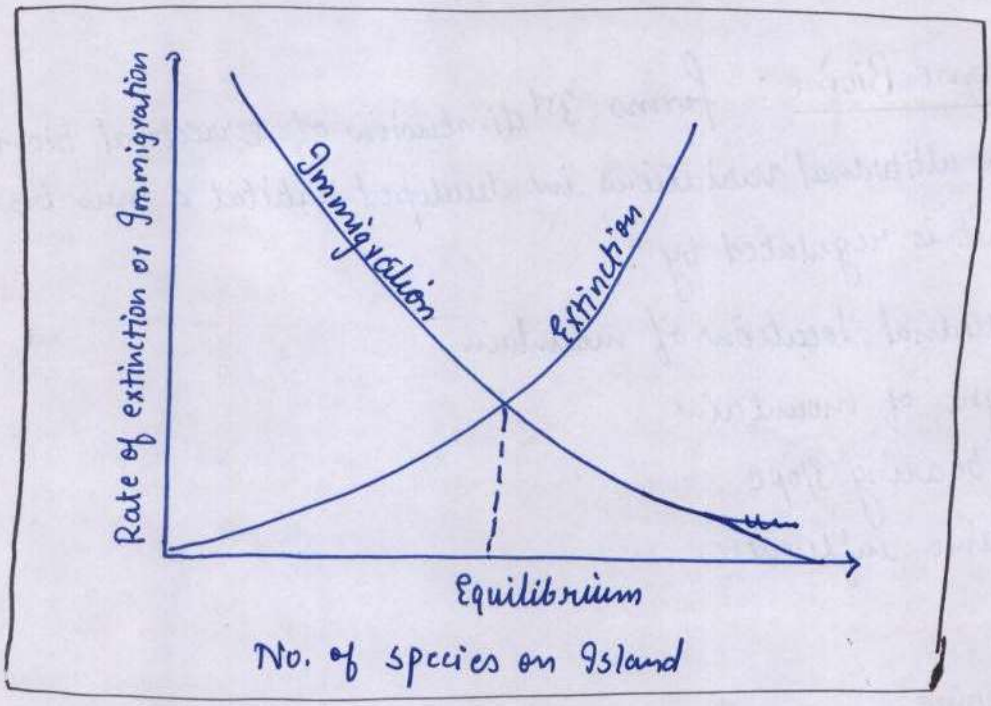
(b) Its distance from mainland as Islands near the mainland is likely to experience more immigration enriching species diversity.

(c) latitudnal location of the Island

** The theory on Insular (Island) Biodiversity proposed by Robert Mc Arthur & Edward wilson additionally identifies that the number of species in any Island reflects the balance between i.e. equilibrium b/w:

→ Rate at which new species (exotic species) influx in the Island and ∞ adapt to survive.

→ Rate at which established population (endemic specimen) becomes extinct or leaves the Island.



* Characterstics of Island Biodiversity always tend to depict its Isolated characterstics compared to the mainland restricting immigration of terrestrial organisms. It is therefore that unique specimens are identified in Island biotic diversity as Marsupials the animals having pouches to carry their young ones (Kangaroos) along with Koala the herbivorous animal that feeds on Eucalyptus tree typical in Australian Biome.

It is this uniqueness combined with:

- Lesser competition
- More mutualistic biatic links
- Restricted geographical range.
- Rapid development by human interferend
- Exp Thermal expansion of ocean
- Multiplying increase in frequency, magnitude & intensity of Climate induced hazard.

that makes biodiversity of Island highly vulnurable.

Questions:

I. Climatic regions
1. location
2. Climatic conditions.

II. Vegetitation Regions:
1. Location
2. Climatic cond.
3. Vege'n.

III. Wildlife (Heterotrophs)
1. Loc'n
2. Climate
3. Veg'n
4. Heterotrophs.

IV. Biomes:
1. loc'n
2. Climate
3. Soil
4. Veg'n 5. wildlife.

V Major Environmental Regions:
(1-5)
6. Human Ecological adaptations

* World Vegetation Type:

World Vegetation

Tropical (0°-45° N/S)
- Rainforest
- Monsoonal Hardwood
- Savanna / Woodland
- Desert
- Sclerophyll
- Littoral

Temperate (45°-60° N/S + 60°-70° N)
- Hardwood deidious
- Laurel
- Grassland
- Taiga

Tundra (70°-80° N)

* Littoral tropical vege'n:

1] Also called intertidal vege'n.

2] It is considered to be neither ~~to~~ true aquatic nor true terrestrial vegetation type.
It denotes absolute example of tree variety making it relate to like land vegetation. However in the consistent requirement of saline water it relates to like aquatic vegetation.

3] This vegetation ~~is~~ type is locationally characterized into: onshore & offshore categories.

(a) Onshore littorals: includes coconut palm and screw pine as prominent plant variety.
→ They are adapted to sequential inundation.
→ As their habitat involves stable land it involves defined plant adaptation i.e.: shallow sparse roots
- narrow tall trunk
- sparse ~~crown~~ crown density (top leaf portion)
→ This vegetation has universal presence in all the tropical coastal areas.

(b) Offshore littorals: includes varities like Mangroves, Sundris, Keora.
→ they are adapted to perrenial inundated environment.
→ In the absense of stable land they project unique adaptation that includes: - Broad trunk
- Shooting branches
- dense crown density
& densiest shallow roots that involves of potential of trapping suspended mud in order to generate stable platform.

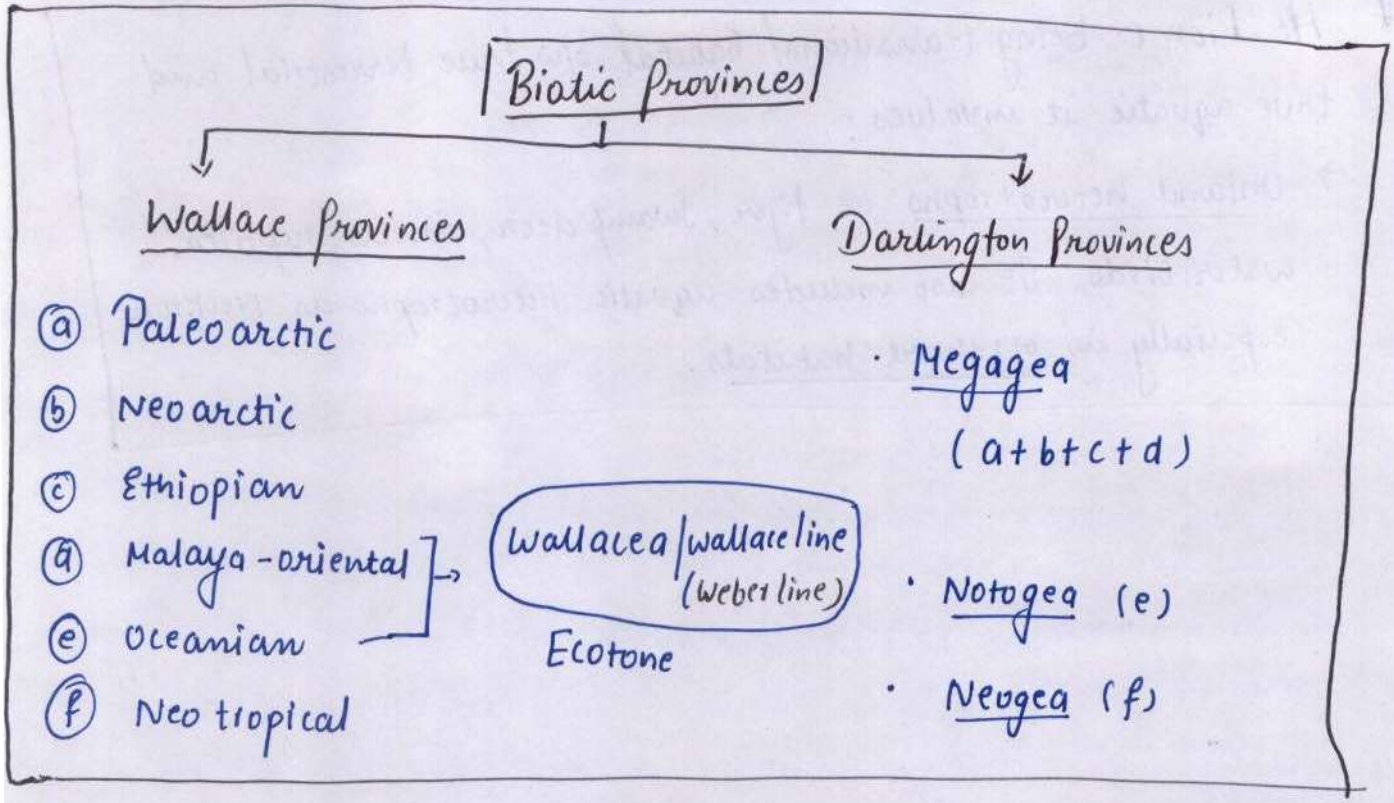
→ These are confined only along wetter coastal areas.

** As Biome being transitional habitat b/w true terrestrial and true aquatic it involves:

→ Onland heterotrophs as tiger, Swamp deer, insects, reptiles, water birds. It also includes aquatic heterotrophs as Necktons especially in offshore habitats.

* Zoogeography :

DIRECTION



1] The Zoogeographical studies is the study of Biomes (essentially terrestrial biomes). however in regional perspective.

2] It involves Six biatic provinces outlined by wallace based on his analysis of evalutionary history of organisms in different parts of the world. He distinguished :

(a) Paleoarctic :

→ i.e. Eurasia.

→ principally involves Tundra biome, Taiga biome, hardwood deciduous biome, Grassland biome and continental desert biome.

[Refer details from previous]

(b) Neoarctic :

→ North America except central America.

→ Principal biome: Tundra, Taiga, Grasslands & deserts.

→ Minor biomes includes: Temperate hardwood deciduous, Screllophyll.

c) Ethiopian Biotic provinces:

→ Includes maximum of Africa & Arabian peninsula.

→ Included biomes are: Rainforest biome, Savanna biome and tropical desert biome.

→ Minor biomes include: Monsoonal, grassland & screllophyll.

(d) Malaya-oriental biotic province:

→ Confined in South, South east Asia.

→ Prominently includes: Monsoonal & Rainforest biome.

→ Minor biome is Savanna.

Refer Map

SMS The world's most recognised Ecotone called Wallacea belongs to east Indies projecting transition b/w Malaya oriental and Oceanian provinces. As proposed by wallace called Wallace line it involves Borneo Island to be the changover Island.

Modified later by weber thus called Weber line however identifies only Irian Jaya to be representing Oceanian characteristics (rest of East Indies denoting malaya-oriental)

e) Oceanian / Australian biotic province:

→ Dominantly includes oceania thus combines major biomes as: Tropical desert, Tropical Savanna & Grassland (with uniqueness of insular biodiversity)

(f) Neotropical biotic province: Is latin American (minus mexico)

→ Major Biomes - Monsoonal, Rainforest, Grassland, desert & Savanna

In 1947 Darlington attempted reclassification of biotic provinces.

Based on the similarity of heterotrophs in the evolutionary history involving both convergent & divergent evolution, he identified

→ **Megagea biotic province** as the biggest & most diverse including Eurasia, Malaya-oriental, North American & Ethiopian provinces.

→ He recognised Oceanian i.e. Insular biodiversity as **Notogea province**

→ Latin American region in comparison was recognised as **Neogea province**

* SOIL GEOGRAPHY:

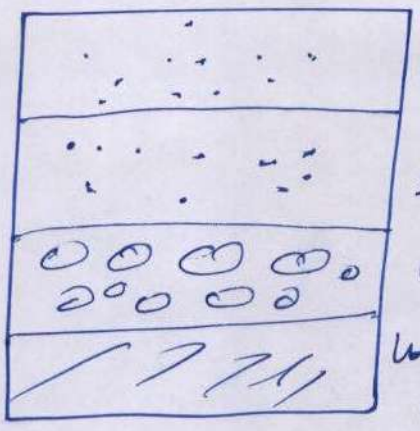
1] The topmost layer of lithosphere i.e. dynamic & complex mixture of minerals & humus is called soil.

2] The compositional constituent of soil are boldly categorised into: principle nutrient & bulk increasing substances.

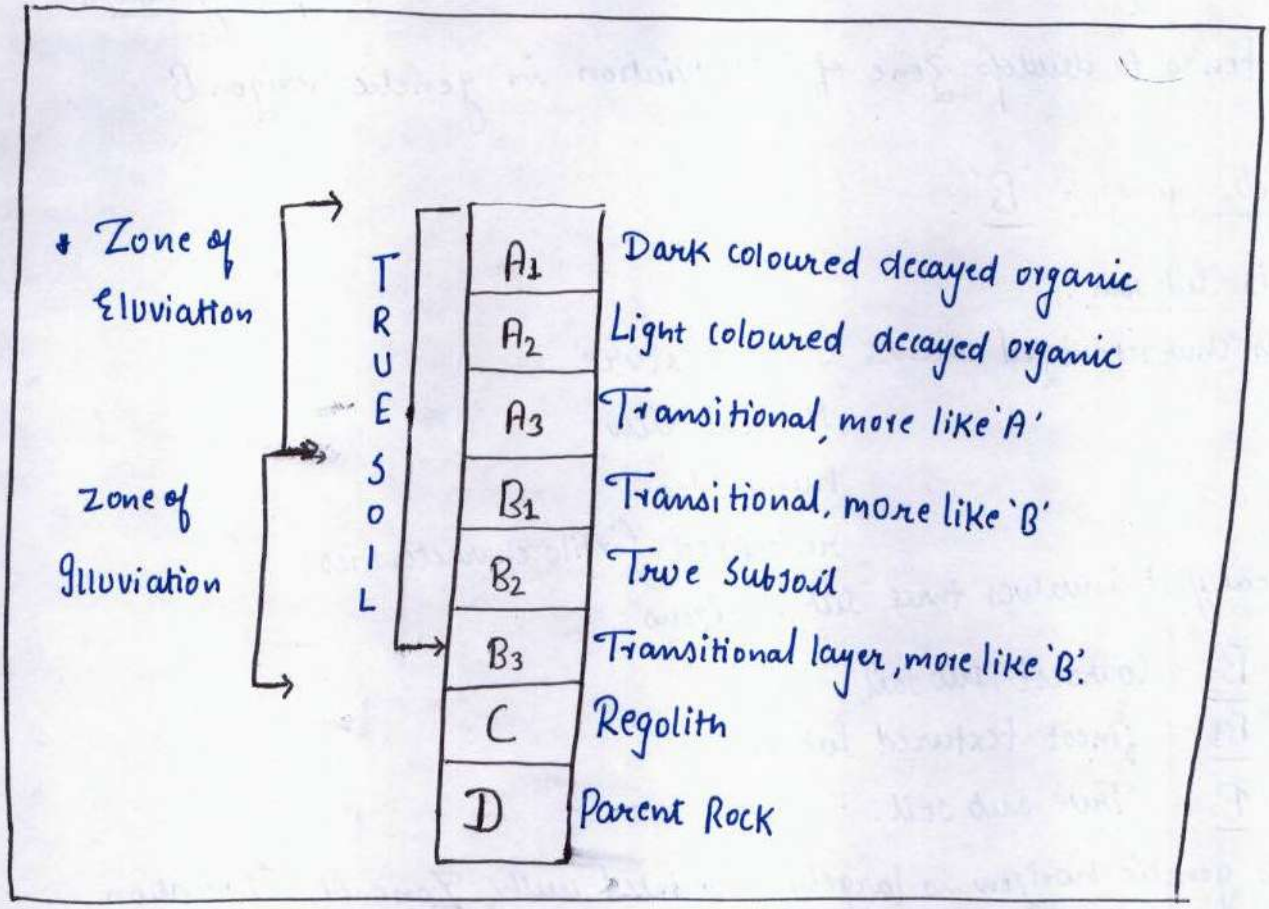
→ The principal nutrient forms the fundamental determiner of soil fertility this include calcium, Nitrogen, Phosphorous, Potash and humus (i.e. decomposed organic matter).

→ The bulk increasing substances in comparison includes the constituent that are present in every soil as they make principal building material of lithosphere however they do not have similar prominence in determining soil fertility. It includes: Silica
Aluminium
Iron

* Soil Profile:



* Soil Profile:



(i) The term SOIL PROFILE is applied to denote chronological sequence of development of soil.

(ii) Ideally soil profile includes four genetic horizon:

(A) Genetic Horizon 'D':

→ It is called parent rock or unweathered rock layer.

→ Inspite of being rocky layer it is included in soil profile as the composition of parent rock tends to determine composition of eventually developed soil.

(B) Genetic horizon 'C'

→ It is called Regolith i.e. weathered rock material.

Apart from providing compositional characterstics to the soil this gentic horizon is related to be the source area of capillary action that tends to develop zone of Illuviation in genetic horizon B.

(C) Genetic horizon 'B':

→ It is sub soil.

→ It is characterized with: Coarse texture
Mineral rich
humus less
restricted fertile characterstics.

→ Ideally it involves three sub horizons:

- B_3 - Coarsest sub soil
- B_1 - finest textured subsoil.
- B_2 - True sub soil.

→ This genetic horizon is largely associated with Zone of Eluviation i.e. accumulation of translocated material that can include capillary action in drier climate or PERCOLATIONAL TRANSLOCATION in humid regions.

(d) Genetic horizon 'A'

→ It is top soil.

→ It is characterized with fine texture
- Mineral rich
- humus rich
- fertile horizon.

→ Ideally the top soil involves three genetic horizons:

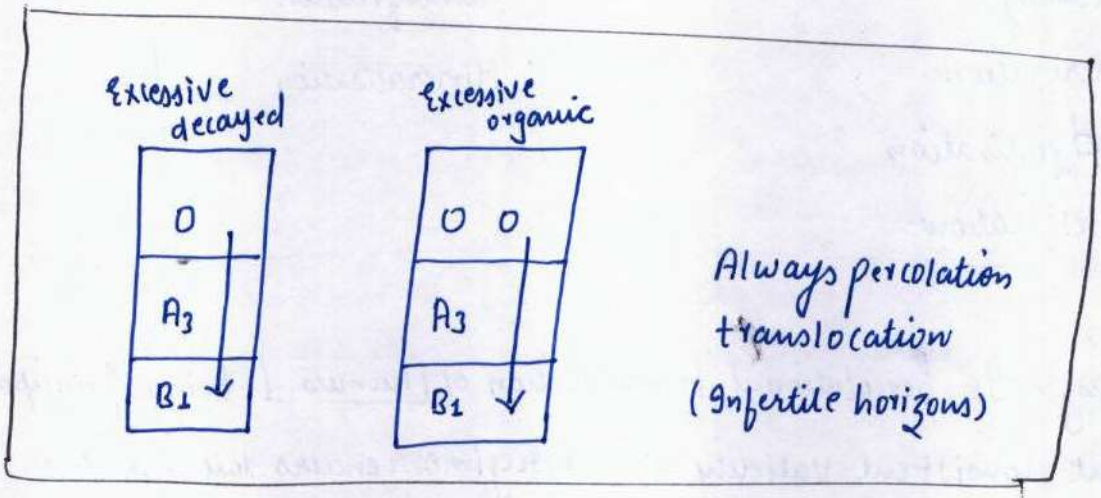
- A_3 - Coarsest top soil with partially developed humus thus least fertile topsoil
- A_2 - Light coloured decayed organic that depicts moderate levels of availability of humus making it moderate in its fertility level.

* A_1 - Dark coloured decayed organic which tends to incorporate fully developed humus finest textured soil thus most fertile genetic horizon.

BMS

It is during wetter season the top soil can be subjected to percolational translocation making it relate to Zone of Eluviation.

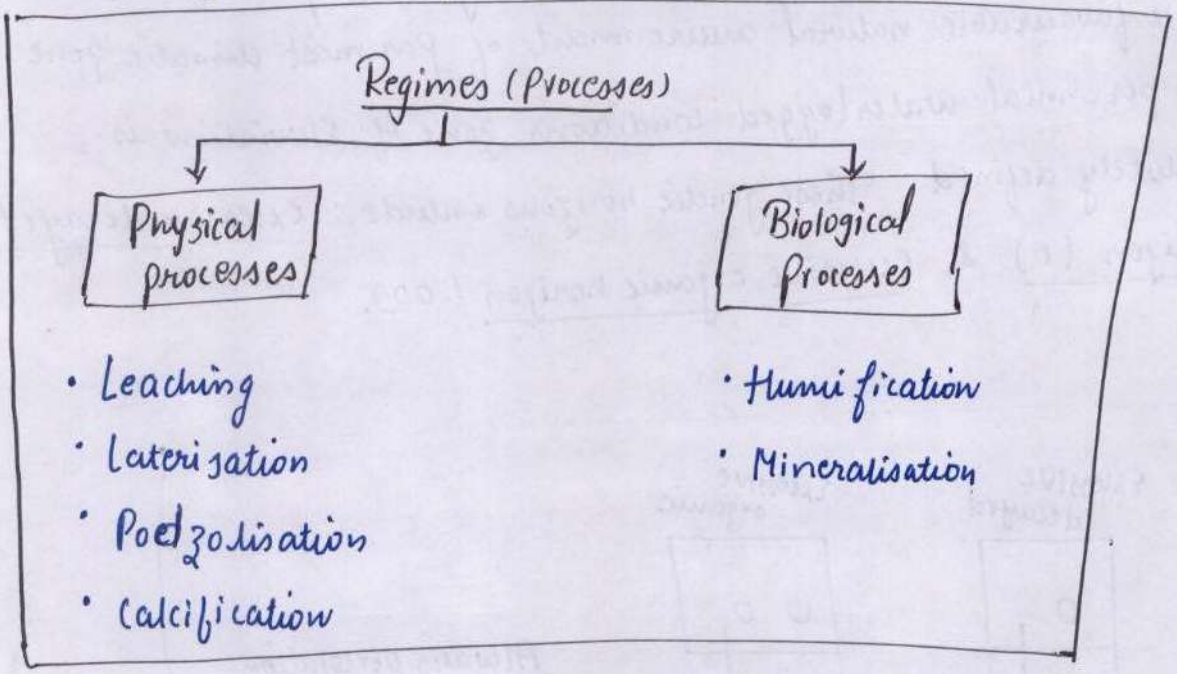
The Infertile genetic horizons that tends to get develop in the extreme and unfavourable natural environment of par moist climatic zone with perennial waterlogged conditions zone of Eluviation is absolutely defined. These genetic horizons include : excessive decayed horizon (O) & excessive organic horizon (OO).



* Soil forming Regimes :

1] Regulated by prevailing natural conditions specifically climatic conditions. genetic horizons of soil tends to experience variable range of soil forming processes or regimes that tends to modify the nature of soil fertility.

These regimes are categorised as:



1) Leaching - Is percolational translocation of [humus] being principal nutrient consistent validity of this regime renders soil infertile

2) Laterisation It is percolational translocation of [silica] the bulk increasing mineral consistency of this process tends to generate concentrated availability of aluminium & Iron oxides making soil acidic thus infertile

3) Podzolisation - It represents the regime that is completely devoid of physical movement of minerals It thus involves concentrated presence of silica in the top horizon generating infertile soil.

(4) Calcification - This regime relates to capillary action and thus movement of sub surface calcium towards the surface. As this process ensures availability of calcium the principal nutrient in soil, it tends to increase soil fertility.

** However excessive calcification converts soil to be alkaline or saline thus infertile.

(5) Humification - Is the biological process involving production of humus i.e decomposed organic matter. Being principal nutrient this process always increases soil fertility.

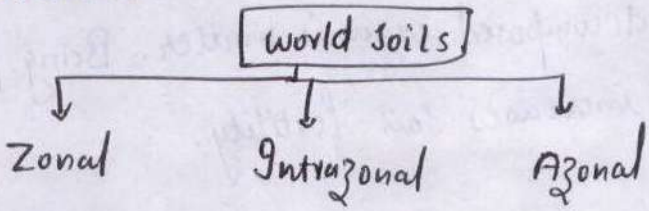
6) Mineralisation - Is the biological process that involves completion of nutrient cycle (grazing food chain). (biotic → converted to abiotic) It always relates to the development of O (excessive decay) genetic horizon rendering soil infertile.

* for soil to be fertile it should have neutral PH.

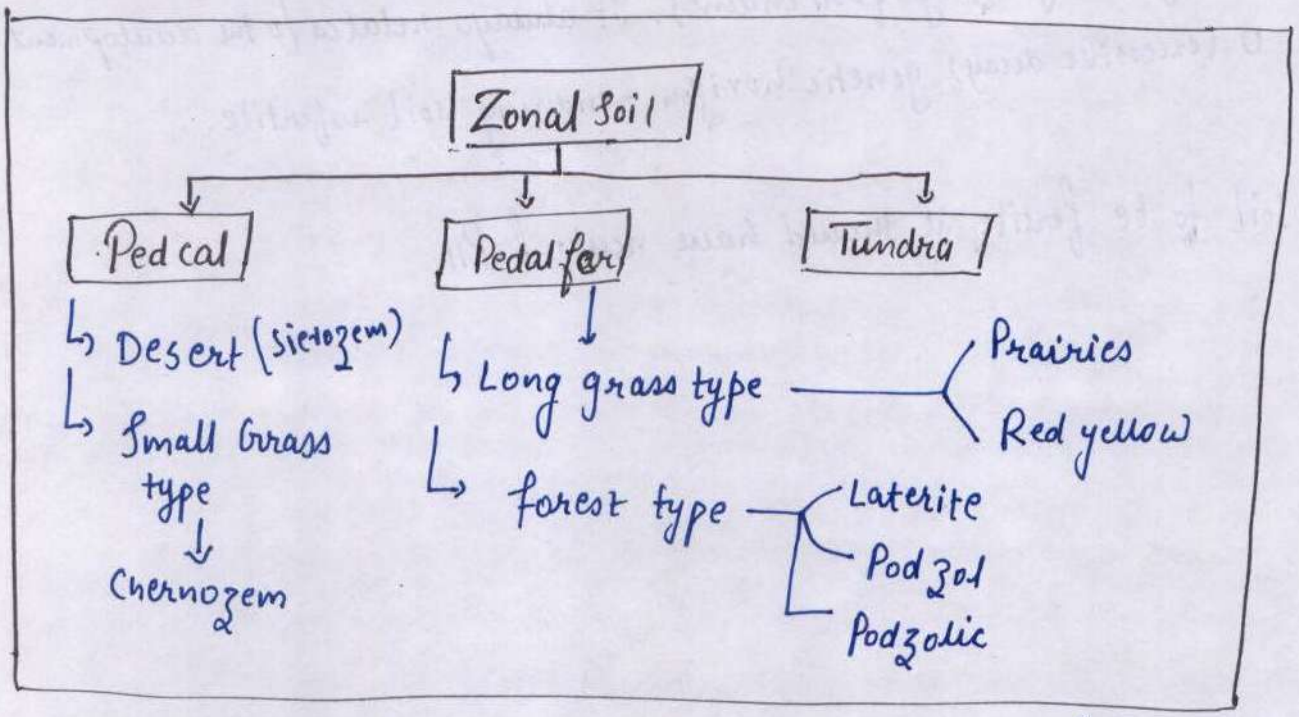
* World Soil types:

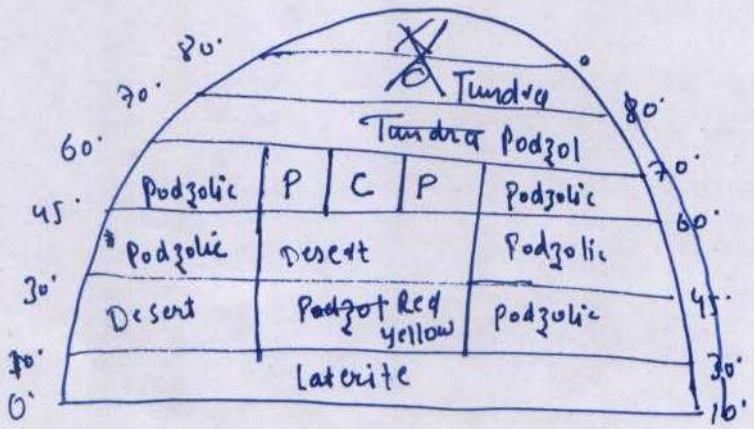
1) Diversity of prevailing biomes combined with diversity of soil forming regimes that include climatic conditions, structural variations, relief induced diversity & agents of gradation results in wide spectrum of developed soil types outlined at variable scales.

2) The identified soil categories includes:
   i) Zonal soil
   ii) Intrazonal soil.
   iii) Azonal soil.



(I) Zonal Soil:





Fertility: (decreasing order)
1) Chernozem
2) Prairies
3) Red yellow
4) Sirozem
5) Podzolic
6) Podzol
7) Laterite
8) Tundra

1) Zonal soil → The planetary level soil that are classified on the basis of prevailing soil forming regimes (that in turn is regulated by prevailing climatic conditions). This soil type however is subcategorised on the basis of prevailing vegetation.

2) The demarcated categories include
   A) Pedcal soil
   b) Pedalfer soil
   c) Tundra soil.

(A) The Pedcal soil: Is the soil type that is rich in calcium i.e. applicable to calcification as soil forming regime.
Based on the prevailing habitat thus vegetation it is subcategorised:
   (i) Desert soil
   (ii) Small grass type soil.

(i) Desert soil: called **Sierozem**
is defined to be coarse textured, Mineral rich, humus less fertile soil though with restricted fertility primarily due to coarser texture and lack of humus.

(ii) Small grass type soil: called **Chernozem**
in comparison relates to fully developed soil profile with dark coloured decayed organic layer (A_1).
It is thus popularly called **BLACK EARTH**.
favourably combining finest texture, fully developed humus, Mineral rich with (specification of calcium) it denotes most fertile natural soil of world.

corrosponding to Bread Basket (North America) & wheat triangle (Eurasia)

DIRECTION

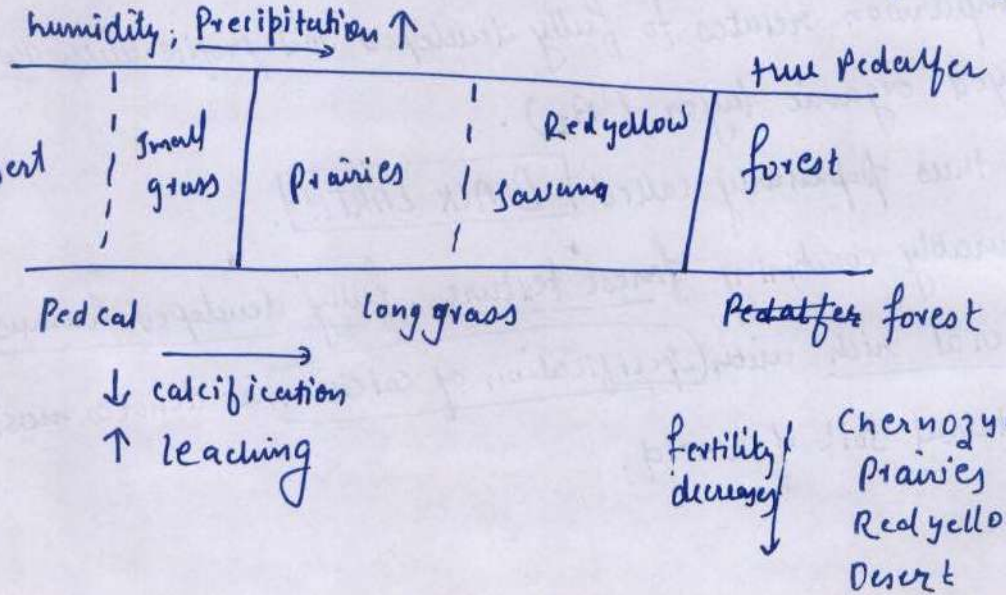
(B) Pedalfer Soil:

1) This Zonal Soil category represents Significantly humid climate thus Stronger influence of Leaching & laterisation.
2) Based on the standing vegetation this Soil type is being categorised as
   (i) Long grass type soil.
   (ii) forest soil.

(i) Long grass type Soil:

→ This Soil type is practically transitional type b/w true pedcal and true pedalfer.
→ It incorporate prairie & Red yellow Soil which projects well developed ecological systems thus well developed genetic horizons of Soil.
→ The fertility difference of the developed soil thus is essentially the outcome of effective regime, it is therefore:

- Prairie soil being more like pedcal has higher fertility than.
- Red yellow (Savanna Soil) which is more like pedalfer



DIRECTION

(C) Forest Soil:

1) Ideally considered to be relating to humid & par humid climate this entire category of soil depicts to be true Pedalfer.

In the specifications of conditions involving three defined forest biomes three different soil types are distinguished these include:

(i) laterite soil.
(ii) Podzol soil.
(iii) Podzolic soil.

(i) Laterite Soil:

→ It makes absolute match of leached laterite soil applicable to Equatorial rainforest with perennial waterlogging.

→ This infertile acidic soil also involves excessive organic (OO) genetic horizon projecting its infertility.

(ii) The Podzol soil in comparison ← ~~A3~~ is highest latitudinal forest soil that combines negligible supply of organic matter (pure standing evergreen plant)

(A3) negligible decomposition
limited development of top soil with rich silica.

All these factors combine to make Podzol less infertile than laterite soil.

(iii) Podzolic Soil:

→ Soil of hardwood deciduous forest.
→ It is thus most well distributed forest of world.
→ As it combines favourable organic matter supply with decomposition It makes most fertile soil.
→ The soil fertility however is less in monsoonal deciduous forest

due to increased percolational translocation

[C] Tundra Soil:

1) The highest latitudinal soil which technically involves phototroph supporting capacity as the prime reason to be given recognition as soil.
2) practically permafrost subsurface restricts even elementary weathering of rocks required for soil formation.

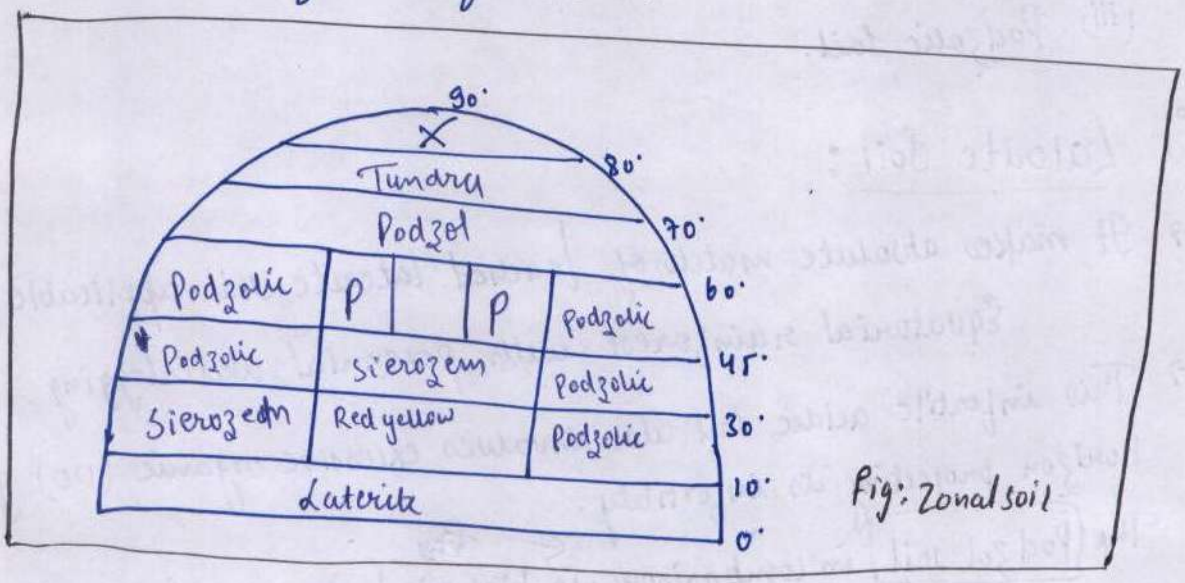
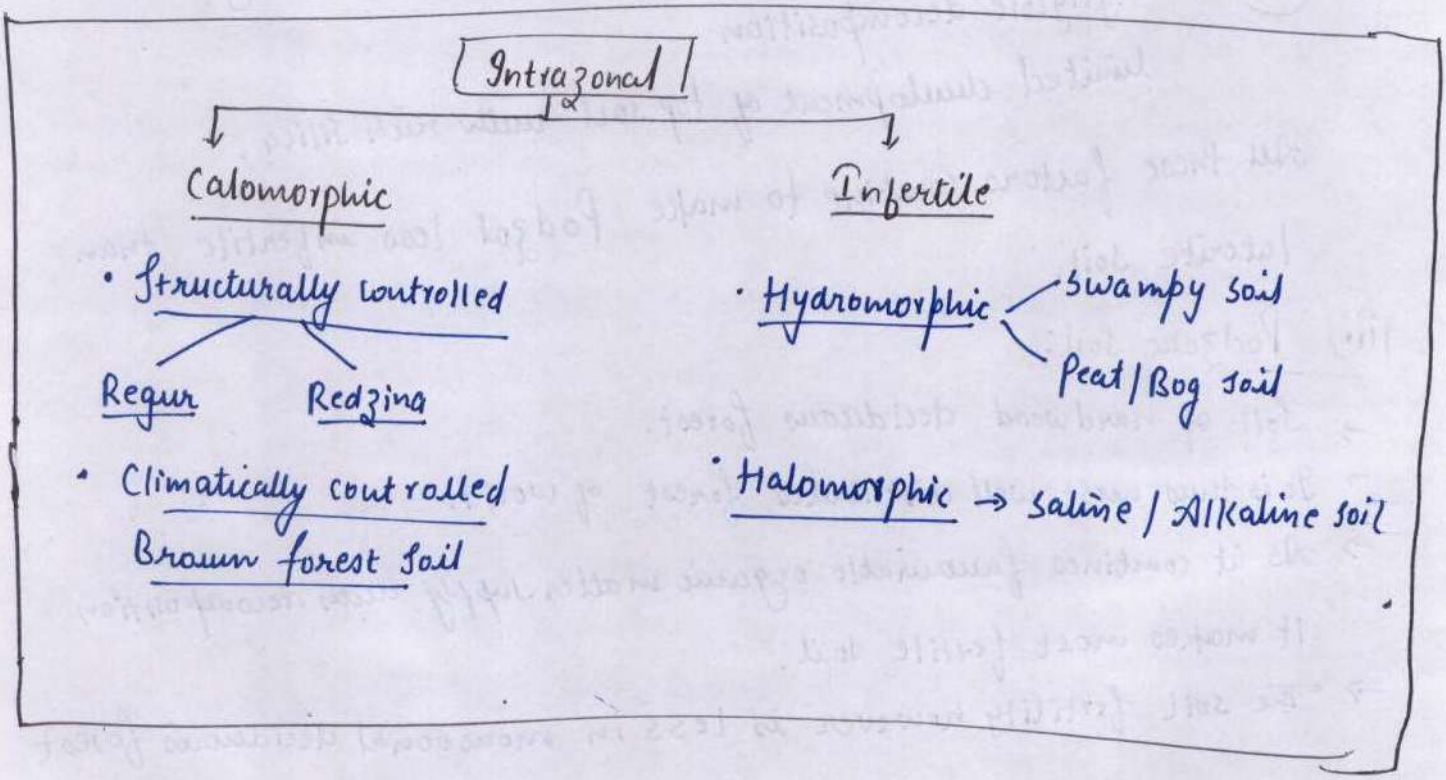


Fig: Zonal soil

II. Intra Zonal Soil:



1] Considered at larger scale this soil type largely include structural relief and specified climate related influence.

2] It is subcategorised as :
(i) calomorphic soil.
(ii) Infertile soil.

(i) Calomorphic Soil :

→ It is the fertile category of intrazonal soil that includes two defined subtypes structurally controlled & climatically controlled soil.

(a) Structurally controlled soil :

→ Are typical to defined parent rock.
→ Is subcategorised as Regur & Redzina.

* Regur soil i.e. Black soil (popularly called cotton soil with more than 2/3rd of its total area devoted to cultivation of cotton)
→ is typical to basaltic parent rock.
→ It is thus mineral rich though poor in humus
→ fine textured with water retention capacity though with development of cracks during prolonged dry season.
→ Prominent locations :- Borborema (Brazil)
→ Kordofan (Sudan)
- Yunan plateau (china)

* Redzina soil : In comparison to typical to limestone parent rock thus lacks in mineral though rich in humus representing fertility to be less than regur soil.

Prominent examples : Anatolia plateau (Turkey) → white terraces
Sabah & Sarawak province of Malaysian Borneo

(b) Climatically controlled Calomorphic:

→ Is called Brown forest Soil.

→ considered to be [Young soil] this Soil type is typically defined with Swifter genesis.

→ Though it relates to light coloured decayed organic layer (A_2) limited depth of every developed genetic horizon forms the reason for its coarse texture.

→ Such Soil type is confined in wetter margins of monsoonal forest.

(ii) Infertile Intra Zonal Soil:

→ It essentially includes extreme conditions developed by relief and or climate leading to excessive magnitude of Soil forming regimes.

a) Halomorphic Soil belonging to this category involves [excessive calcification] thus the development of saline alkaline infertile soil.

Prominent global locations includes:

- Etosa pan (Namibia)
- Mak gadik gadi salt pan (Botswana)
- Rann of Kutch (India)
- Dura crust (Australia) - nearby L. Eyre & Simpson Stuart Stony desert

(dried up parts of Rivers during summers)

(b) Hydromorphic to infertile Soil: relates to both water logging thus Swampy characterstics as in the cases of lower course of

River Lena (Russia)

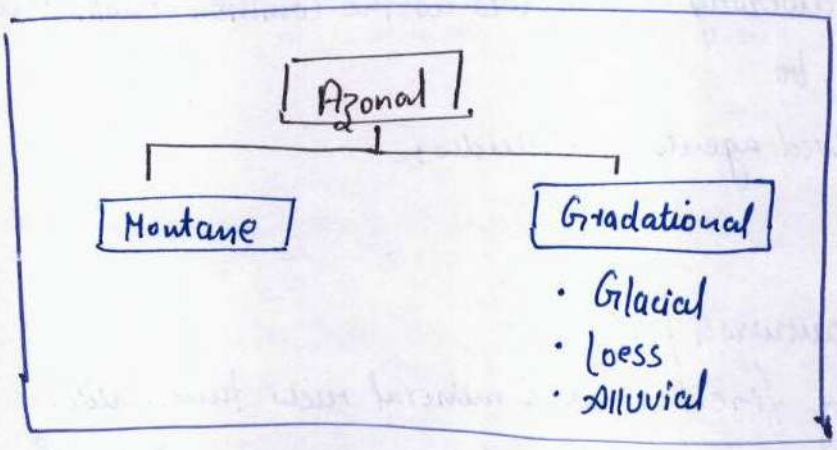
R. Mackengize (canada)

It however essentially involves waterlogged conditions in the warm humid climate facilitating excessive decomposition (o) thus infertile soil

Prominent examples include:

- Okawambo swamps (Botswana)
- Pripet marshes (Belarus)
- Pantanal Basin (Brazil) → Similar to Indian Terrai
- Gran chaco (Argentina & Paraguay)

III Azonal Soil:



1) Azonal soil is defined to be the soil type that belongs to "every geographical location" (i.e. they are not confined to single geographical location".

This category of soil is distinguished on the basis of relief & agent of gradation & thus are categorised as Montane soil & gradational soil.

2) Montane Soil:

→ largely considered as Scree / skeletal soil due to its limited depth.

→ Ideally this soil type is well drained humus rich fertile soil with only limiting factor being its limited depth.

→ Practically however this soil type is identified with altitudinal grade regulated by existing biomes thus the influence of:

- Sign of latitude
- Height of the mountain.
- Sun bearing slope.
- Maritime influence.

3) Gradational Soil:

(i) Deposited by agents of gradation this category of Azonal soil completely lacks in genetic horizons.

(ii) They all represent diversity of minerals as the common constituent regulating fertility bc

(iii) Based on the involved agents it includes:

(a) Glacial Soil:

→ It belongs to outwash plain.
→ Is significantly fine texture & mineral rich thus fertile.
→ fertility however is restricted due to waterlogged conditions & general absence of humus.

(b) Loess:

→ Is wind deposited soil which is fine textured mineral rich deposits sourced from desert but deposited outside it.
→ Significantly rich in humus it projects higher fertility than glacial soil.
→ Considered to be dust of sand as which requires consistency of prolonged deposition to generate identifiable layer this soil type have only three recognisable locations.

- Loess deposits of Hwang He basin in china i.e. largest deposit.
- Adobe deposits of Sacromento valley California, USA
- Limon deposits of German Belgian upland Europe.

(Mouth of yellow river is yellow sea - pelish yellow coloured)

(c) Alluvial Soil :

→ It is not just the most well distributed gradational soil but also most fertile in this defined category.
It is mineral & humus rich (reflecting its universal presence & habitat sustaining capacity)
Practically however fertility of alluvial soil is regulated by

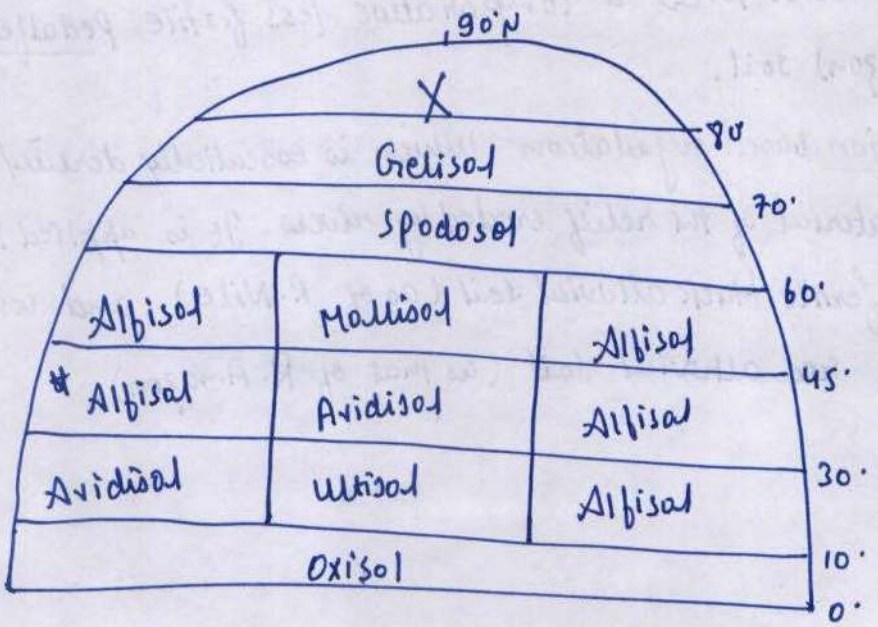
* texture - i.e. dependent on long profile of the stream. It is therefore that delta soil is more fertile than flood plain soil.
* Applicable regime / effective process i.e. regulated by prevailing climatic conditions applied to distinguish b/w more fertile Pedcal alluvial soil (as of river Nile) & comparative less fertile Pedalfer alluvial (R. Amazon) soil.
* Composition based regulation which is essentially derived from the building material of the relief eroded by rivers. It is applied to distinguish b/w more fertile black alluvial soil (as of R. Nile) and comparatively less fertile red alluvial soil (as that of R. Amazon).

* Comprehensive Soil classification Scheme:

1) United States Agricultural Dept. proposed this classification scheme originally in 1960.
2) Involving the implication of all the genetic horizons with natural & human induced modifications 10,000 different soil types were outlined.
3) These soils were organised into six defined categories called

Order soil — 12 No.
Suborder soil
Great group soil
Group soil
family soil
Series soil - 10,000 No

** 4) In biogeography it is order soil that is essentially taken into consideration. This is further subclassified by biogeographers into 3 defined categories:



Order Soils

Well developed genetic horizon

- **Grassland Soils**
  - Mollisol (Prairies + chernozems)
  - Ultisol (Red yellow)
- **Forest Soils**
  - Oxisol (laterite)
  - Alfisol (podzolic)
  - Spodosol (Podzol)
- **Other soils**
  - Aridisol (Desert)
  - Vertisol (Regur)
    - Intrazonal

Excessive decayed

- Histosol (peat/bog)
  - Intrazonal

No/Weak genetic horizons

- Entisol (Gradational soil)
  - Azonal
- Inseptisol (Brown forest soil)
  - Intrazonal
- Gelisol (Tundra)
- Andisol (lahar deposited soil)

Azonal

* Human Ecological Adaptations :

* Major Environmental Regions :

1] Human population as the constituent of ecological system forms typical example of <u>omnivorous heterotrophs</u>.

2) Being excellent examples of regulators they also represent bigger <u>geographical range</u> of habitat (representing Euryorganism).

Ecological adaptations are also specified with <u>physical appearance</u> that forms the basis of racial divide of humans. This includes:

Mongoloids
Caucasoids
Negroid races.

However with the assesement of United Nation fund for Population activities (UNFPA) 1951 that there is clear absence of pure race barring the exception of primitive 4th world communities (which accounts for less than 5% of total global population)
Validity of this adaptation is restricted.

3) Ecological adaptations is thus derived on the basis of <u>economic activities</u> in which human population is engaged which essentially reflects dictating role of nature.

BMS It is therefore that human ecological adaptations practically overlaps with major environmental regions.

4) In the reference of different environmental conditions, <u>twelve</u> environmental regions (with distinctive human ecological adaptations) can be distinguished, these include.

(i) Equatorial region:

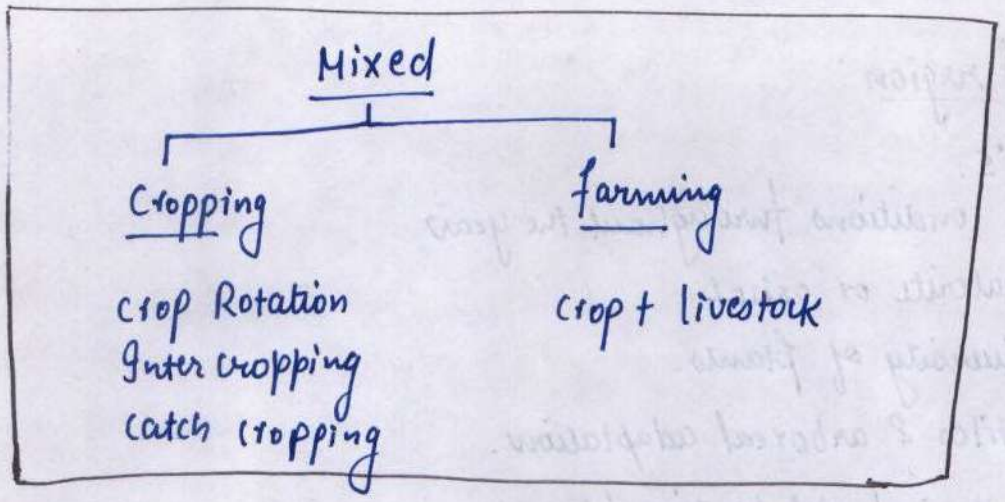
→ 10°N - 10°S.
→ Warm wet conditions throughout the year
→ Infertile laterite or oxisol
→ Densiest diversity of plants.
→ Insects reptiles & arboreal adaptation.
→ Human Ecological Adaptation (HEA):

(a) Absolute primitive involves hunting & gathering population as pygmies of Congo basin.
(b) Subsistence agriculture with prominence of paddy culture as applicable in Indonesia.
(c) Commercially found traditional plantation agriculture as Coffee in Brazil, Rubber in malaysia & Cocoa in Ghana (in cholocate industry like for Swiss chocolates).

(ii) Monsoonal Region:

→ 10°-30° N/S in east margins of land.
→ Summer concentrated prepn
→ Less fertile podzolic or Alfisol.
→ Monsoonal hardwood deciduous forest.
→ Big diversity of herbivorous & carnivorous heterotroph.
→ HEA:

(a) primitive adaptation includes Shifting agriculture as confined in Braun forest soil or Inseptisol.
(b) Dominantly mixed cropping forms human adaptation reflecting cultivable conditions throughout the year.



(iii) Tropical Savanna:

→ 10°-30° N/S in continental interiors.
→ Summer concentrated precpn.
→ Red yellow or Ultisol.
→ Woodland vegetation.
→ Adobe of wildlife.
→ HEA:

(a) The primitive category includes Nomadic herding as practised by Massai of African Savana.

(b) Livestock Ranching on subsistence basis as rearing of milch cattle in cameroon & central African Republic.

(c) Livestock ranching on commercial basis as beef cattle in Alfafa (Brazil) & Sheep rearing in Nullarbar, Australia.

(iv) Tropical desert:

→ 10°-30° N/S west margins of land
→ Perennial aridity.
→ Desert soil or aridisol.
→ Xerophytic adaptability of plants.
→ Big cars, thick skin coating & Nocturnal adaptability of heterotrophs

→ HEA:

ⓐ Primitive category is represented by Nomadic herders as Bedouins the camel herders of Sahara.

ⓑ Commercial mixed cropping in alluvial lowlands (wheat & cotton - Nile valley region, Indus, Mesopotamia).

ⓒ Crude oil extraction most found commercial activity.

(v) Subtropical desert:

→ 30-45° N/S in continental interiors.
→ Perennial aridity.
→ Des Serozem or aridisol.
→ Xerophytic adaptability.
→ thick skin coating of grazing community only.
→ HEA:

ⓐ Primitive nomadic herding as horse herders of mongolia.
ⓑ mixed cropping as in Turanian lowland of central Asia.
ⓒ Commercially evolving crude oil & natural gas extraction.

(vi) Mediterranean region: (br

→ 30-45° N/S in west margins of land.
→ long hot summer drought with winter rain.
→ special type of Podzolic or Alfisol soil.
→ Sclerophyll vegetation.
→ Sparser diversity of herbivorous & carnivorous heterotrophs.
→ HEA: ⓐ mixed commercial farming (wheat, tobacco, sheep, goat)

ⓑ Commercial horticulture (Gardens of the world).

↓
fruit, flower & vegetables

Bulgaria - roses.

(vii) Subtropical east margin (china type);

→ 30-45° N/S in east margins of land.
→ Summer concentrated rain with winter arctic frontal precipitation.
→ Alfisol or podzolic.
→ Monsoonal hardwood deciduous.
→ Bigger varities of herbivorous & carnivorous heterotrophs.
→ HEA:
  ⓐ Commercial mixed farming (with mixed cropping & milch cattle rearing).
  ⓑ Commercial fresh water aquaculture

viii) European wet west marine:

→ 45-60° N/S in west margins of land.
→ onshore westerlies throughout the year thus well distribute precp's.
→ fertile podzolic or Alfisol.
→ Temperate hardwood deciduous forest & laurel.
→ Sparser variety of herbivorous & carnivorous.
→ HEA:
  ⓐ Mixed commercial farming with absolute balance of crop and livestock. (high economic resilience for farmers)
  ⓑ Commercial marine aquaculture

(ix) Manchurian:

→ 45-60° N/S east margins.
→ winter concentrated precp'n due to arctic front.
→ fertile podzolic or Alfisol.
→ Temperate hardwood deciduous & laurel.
→ Smaller variety of herbivorous & carnivorous heterotrophs.
→ HEA: ⓐ mixed commercial farming.
  ⓑ Commercial marine aquaculture.
    └ impure necktons (only fishes) → directly consumable fishes
while in tropical it is pure necktons (via diversity).

* flex - temperate fiber crop (linen) - Russia
  ↳ grown in spring with combination of wheat.

X) Steppe Grassland :

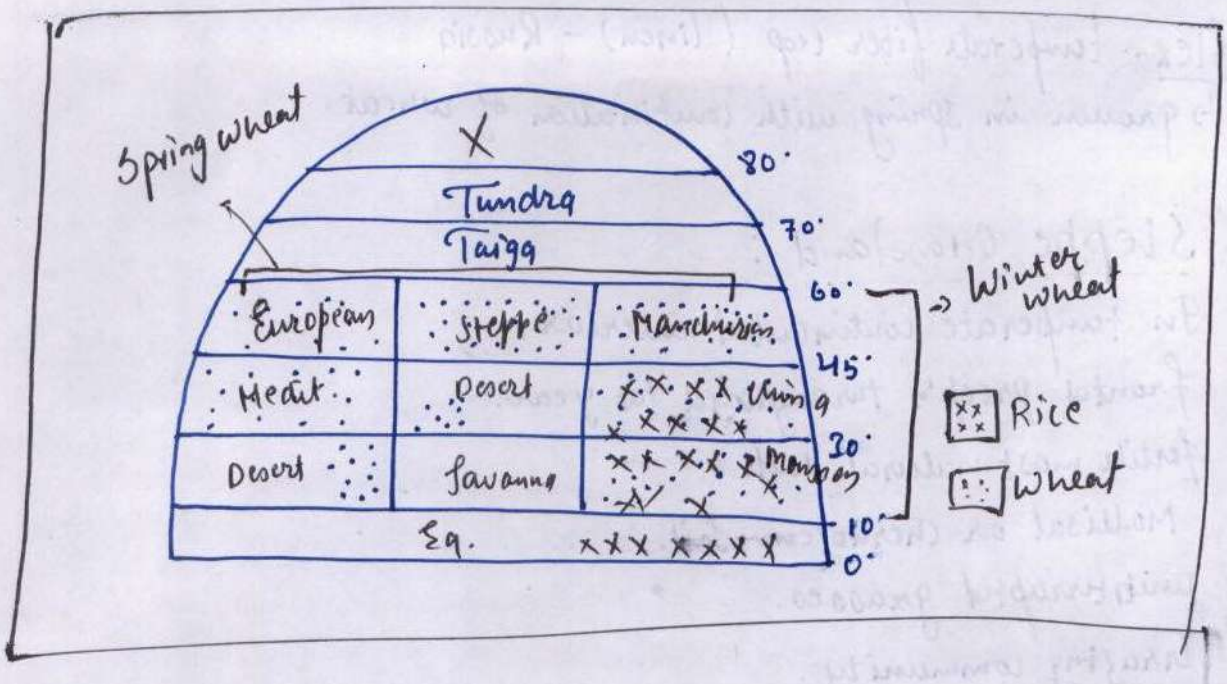
→ In temperate continental interior.
→ frontal precp'n throughout the year.
→ fertile most natural soil.
→ Mollisol or chernozem soil.
→ uninterrupted grasses.
→ Grazing community.
→ HEA :
  ⓐ Extensive commercial grain farming with both winter wheat & spring wheat. Monoculture of spring wheat in canada is distinguished from Russian spring wheat combined with winter crops as flex, oat and barley.

(xi) Taiga :

→ 60°-70° North.
→ Warm frontal precp'n upto 30 cm.
→ Infertile podzol or spodozol.
→ Softwood conf coniferous hibernation & migration adaptability.
→ HEA :
  ⓐ In commercial lumbering of softwood as in canada
  ⓑ Commercial trapping (hunting) or sea lion to aquire raw material for fur making clothes.

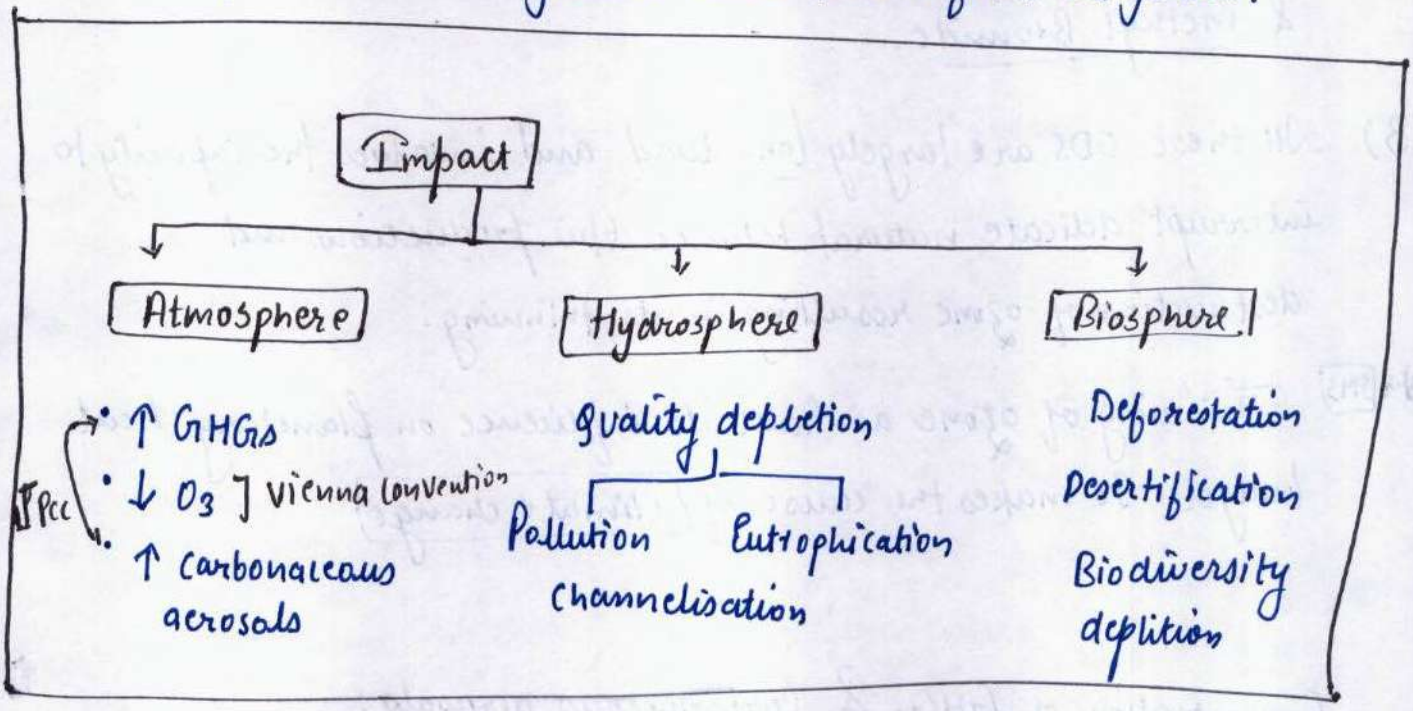
(xii) Tundra :

→ 70-80° North. → Short cool summers → tundra soil or Gelisol → floatage & suspension adaptability of phototrophs → migration as adaptability for heterotrophs.
→ HEA - involves primitive 4th world population as Eskimos (hunting & gathering) and Somaieds (reindeer herder) of siberia.



* Human Impact on Environment :

1) Humans as the constituent of natural environmental setup is not just corelated to adaptations to the prevailing natural conditions but has also been prominent manipulator of the prevailing natural conditions.
2) These manipulations in all its dimensions have proved to induce detrimental impact on natural environmental conditions.
3) In order to identify the actual nature and magnitude of impact these influences are categorised into three defined categories:



I. Human Impact on Atmosphere

1) The air realm of environment is collectively influenced by human activities in terms of its compositional modifications.
2) Derived from VIENNA CONVENTION, 1985 assesements depletion of ozone (O_3) forms one of the prominent impact.

→ Naturally occuring ozone is identified b/w 20-80 km of height with densiest concentration b/w 20-35 kms called ozonosphere.

→ Ozone acts as protective layer by absorbing harmful ultravoilet rays and thus also playing significant role in planetary heat budget.

→ The assesement of Vienna convention identifies range of ozone depleting substances (ODS) being emitted by human activities.

→ The prominent ODS includes Chloroflorocarbons (CFCs), Halons, Carbon tetra chlorides (CTCs), Hydrofchloroflarocarbons (HCFCs) & methyl Bromide.

3) All these ODS are largely long lived and involves the capacity to interrupt delicate natural balance b/w production and destruction of ozone resulting in its thinning.

SMS Thinning of ozone as have its influence on planetary heat budget. It makes the cause of climate change

Concentration of GHGs & Carbonaceous aerosals:

→ forms additional impact on atmosphere

→ The dependable data table in regards to these modifications is essentially derived from inter govt.al panel on climate chang (IPCC) assesement reports.

→ Acc^n to these reports CO_2, CH_4 & NO_2 (nitrous oxide) are long lived GHGs.

N_2O

→ From among them CO_2 accounts for more than 50% of concentrated GHGs in atmosphere.

→ Burning of fossil fuels, depletion of quality & quantity of green, unsustainable agricultural practises, unsustainable solid waste managment combines to form major causes of GHGs emissions.

→ The carbonaceous aerosols largely derived from vehicular effluents and industrial pollution combined with burning of coal.
Essentially referred as black carbon & soot particle.
These are also the significant trapper of outgoing terrestrial radiation.

Their influence however varies in accordance to:
- their spectral characterstical (relates to texture of teal aerosol for sp scattering)
- " spatial heterogenity.
- " temporal heterogenity.

** Spatial heterogenity is specifically applied with ice caps which restricts their reflectance capacity thus suffer ablation due to concentration of black carbon.

* IPCC:

1) Constituted in 1989 UNEP & WHO as voluntary organisation of the members of United nations.
2) This voluntary panel have been publishing its assesement reports to avail the rational information about the causes, consequences of human induced activities in the natural setup & its mitigation approaches.

3) 1st Asses. report (1990) officially outlined CO_2 as human emitted GHG.

4] 2nd Asse. report (1995) marked the mention of all the three GHGs & carbonaceous aerosol in atmosphere by human activity.

5) 3rd asse. report (2001):

(i) organised IPCC into 3 working Groups (WGs)

WG1 - including scholars & scientists oriented toward assessing the induced changes.

WG2 - including scholars & planners assessing impact of the likely changes.

WG3 - includes planners & administrators assessing & developing mitigation & adaptation strategies.

(ii) The Climate Sensitivity was introduced to facilitate long term planning. The term is applied to denote the projection of likely impact if the GHGs are doubled of its concentration from 1990 level. It led to the conclusion that by 2100 A.D. global temperature will increase to the tune of 5.8°c & MSL will increase to the tune of 0.9m (essentially due to thermal expansion)

6) Assesement Report 4th (2007) & Ass. Report 5th (2015) have been built over the same parameters

DIRECTION

✱ Special Reports of IPCC:

1) IPCC publishes special report on the request of its party members with focused orientation.
2) Among the published special reports:
   (i) SREX (special report on Extreme climate events) & SREEN (Spl. Repo. on Renewable energy sources)] 2011
   (ii) Special report of Global warming @ 1.5°c - 2018 (WG1 & WG2)
   (iii) Special report on Oceans (ryosphere in changing climate, 2019 (WG1 & WG2) [Indian ocean Dipole]

✱ Climate change:

1) The term is applied to denote modifications in the prevailing climatic conditions (normal climatic conditions).
2) These changes involve two defined set of causes with their respective consequences. These cause include:

Climate Change

Anthropogenic Causes

- Modifications in atmospheric constituents
- Land use change

Natural causes

- Solar output variations → Sunspot, Solar flare
- Milankovitch cycles → Eccentricity, Obliquity, Precession
- Volcanic dust hypothesis
- Continental drift

Anthropogenic causes & consequences:

1) Modifications in atmospheric constituents is essentially leading to more attainment of insolation as well as more trapping of outgoing terrestrial radiation leading to modifications in atmospheric temperature thus:

(a) Change of climate - which represents both global warming & global dimming with unprecedented change in climatic conditions for a given location or for a given point in time.

(b) Increasing climate induced hazard i.e. increase in frequency, intensity, & duration & size of hazards like heat wave, cold wave, floods, droughts, cyclonic circulations etc. with variable magnitude of vulnerability.

(c) Destruction of habitat which ranges from change of the snowline increased ablation thus discharged, thermal expansion thus rise in water level, alongwith change in the temperature & precipitation range disturbing regeneration potentials of specimens.

(a) Growing food insecurity: agriculture & water resource being related to each other & to the prevailing climate is likely to experience multiplying uncertainty with regular crop failure or crop destruction adversely influencing supplies to the food basket multiplying food insecurity.

(e) Increase in size, frequency & area of vector borne diseases.

(Paris - fashion capital)

The multiplying health hazard relating to climate change is essentially associated with vector borne diseases that have extended in almost entire tropical latitude with multiplying types (naturally marks their concentration in equatorial climates).

* Natural Causes

1) Throughout the geological history evidences of climate change have been derived from evolution, development & decline of different life forms.

2) These changes are essentially related to elaborate length of geological time and thus have less intensive effect (compared to human induced changes).

Among the prominent natural causes:

(A) Solar Output Variation: In accordance to this hypothesis in the periodicity of 90,000 years - 1,00,000 to years recognisable variations in the solar output have been influencing solar radiation thus insolation & climate for planet earth.

These variations are identified as Solar flare phase i.e. the phase of surplus production leading to interglacial periods.

Solar spot phase i.e. restricted production thus glacial period.

(b) Milancovitch cycles:

Siberian scholar Miltun milancovitch proposed three defined cycles that have regulated natural causes of climate change in cyclic or semi cyclic nature, includes.

(i) Eccentricity - referred to the orbital eccentricity of planet earth around sun. It implies periodicity of 1 lac years changing the shape of earth's orbit from being elliptical to circular modifying the attainment of insolation amount thus change of climate

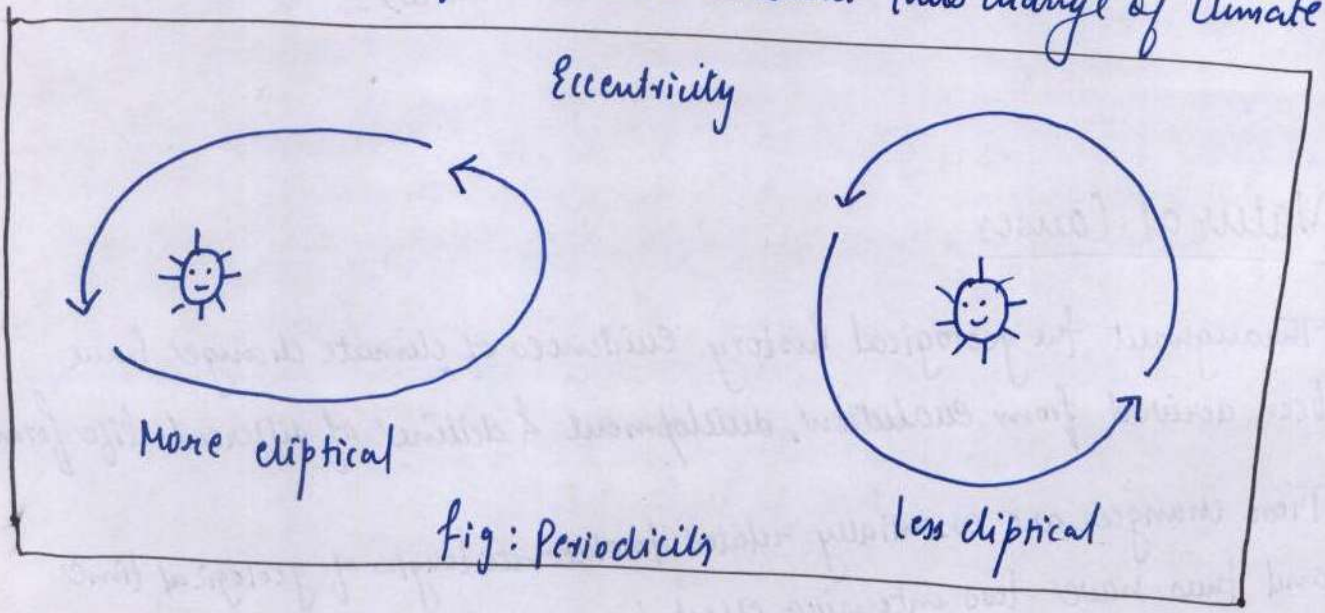


fig: Periodicity

(ii) Obliquity: This cycle involves periodic change in the axial tilt of planet earth. In the approximate range of 41,000 years the axial tilt changes b/w 21.5° to 24 1/2° (with present axial inclination being 23.5° influencing the attainment of insolation thus climate).

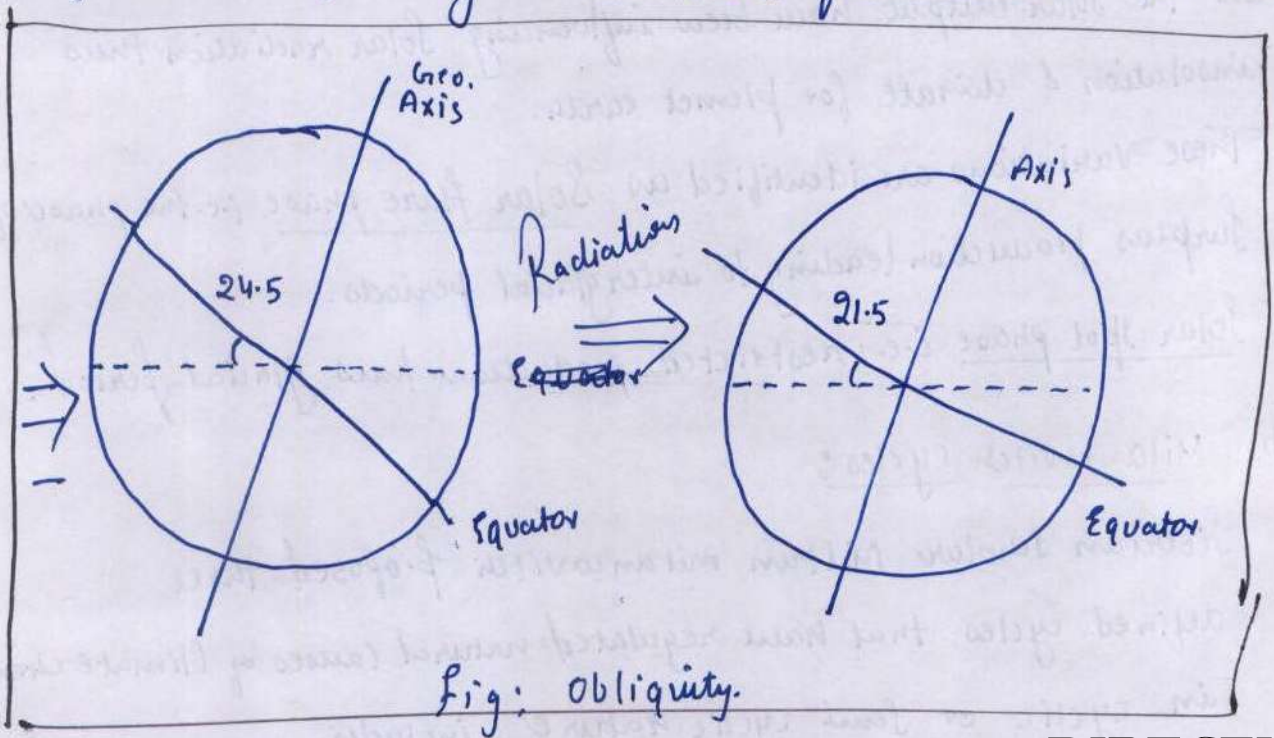


Fig: obliquity.

(iii) Precession- Precession cycle incorporate periodicity of 12000 yr - 24000 yrs This cycle is related to change in the axial allignment i.e. north pole in place of pointing Polaris i.e. North star will start pointing Vega star.

In the influence of this cycle there will be absolute change in the Season cycles of northern & Southern hemisphere (that b/w 21st March - 23rd sept. northern hemisphere will experience winter).

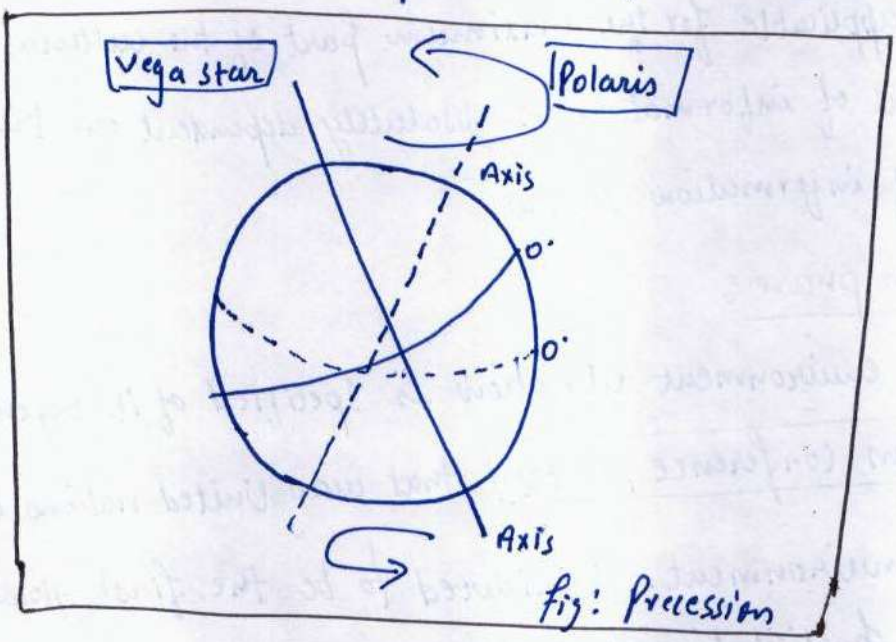


fig: Precession

(C) Volcanic dust hypothesis:

It represents concentration of amount of pyroclast leading to modification in scattering thus net attainment of insolation.

It is in the implication of this hypothesis that pleistocene ice age is related to cenozoic vulcanism.

(d) Continent drift: Applied to Specific region (rather than entire planet) this natural cause corrosponds to apparent radical changes in the earth's climatic latitudes throughout the geological history of planet earth.

* Global Environmental Concerns:

1) The environmental concerns in the global perspective is recognised as environment education.

2) The genesis & growth of environment education have been in gradual chronological sequence that is ideally classified into 3 phases:

(A) The Classical phase: It is considered to be informative phase that remained applicable for the maximum part of the cultural history. Here the nature of information is absolutely dependent on the requirement of information seeker.

(B) The modern phase:

This phase of environment education is specified of its beginning with **Stockholm conference, 1972** that was United nations conference on human environment. Considered to be the first global conference with sizeable participation of developing countries. It moulded the nature of environment education from informative to the beginning of global concerns.

These concerns are essentially reflected in:

Sustainability & limit to growth as globally accepted course of action.

✓ ~~Trust~~

* **Sustainability** The term is applied to denote judicial course of action that takes into consideration legitimate natural rights of every stakeholder.

Distinguished from preservation and more compatible to conservation, Sustainability derives itself from the four interrelated principles of ecology functioning these includes:

i) Reliance on solar energy
(ii) Biotic diversity.
(iii) population control.
(iv) Nutrient cycle.

Proposed by participating Sierra club Sustainability as constituent of environment education distinguished frontier ethics from Sustainable ethics.

Frontier ethics derives itself from human technological capacity making it more stronger & capable compared to other biotic constituents.

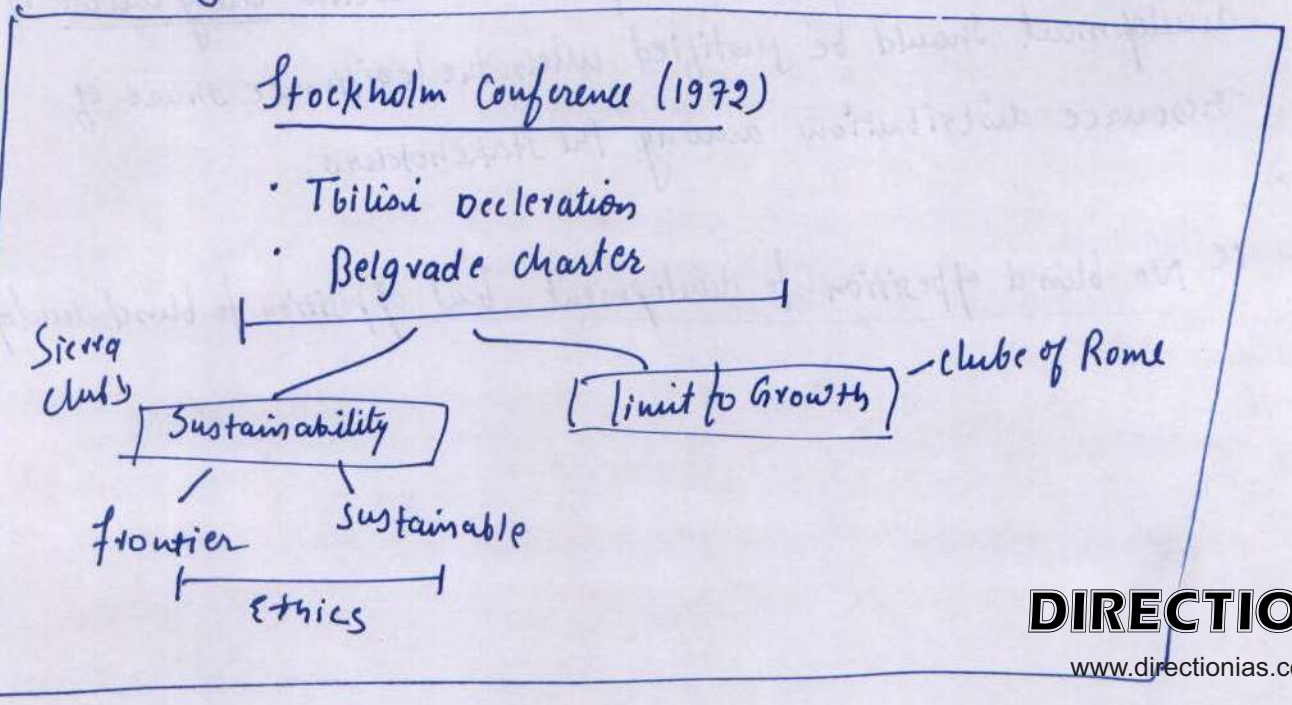
Sustainable ethics in comparison emphasises on being more capable should relate to being more responsible wherein every course of development should be justified with the legitimate share of resource distribution among the stakeholders.

"No blind opposition to development but opposition to blind development"

Frontier Ethics		Sustainable Ethics
1. Pollution cleanup	⇒	Pollution prevention
2. Waste disposal	⇒	Waste prevention (3R)
3. Protecting species	⇒	Protecting habitat
4. Environmental degradation	⇒	Environmental restoration
5. Increasing resource use	⇒	Less resource waste
6. Population growth	⇒	Population stabilisation
7. Depleting or degrading natural capital	⇒	Protecting natural capital

✱ Limit to Growth:

Credited to Club of Rome this approach of sustainable development emphasise that in order to being judicial in the course of resource utilisation and thus development there is compulsion of ascertaining limits to growth



* Tbilisi declaration & Belgrade charter: were the conclusions drawn of the stockholm conference which practically failed in generating any defined practical action.

[C] The CONTEMPORARY PHASE:

1) Marked its begenning with united nations conference on environment & development i.e. Earth SUMMIT, Rio de Janerio, 1992.
2) It is in earth summit that environment education practically enriched from being informative, from being concerned about depleting environment to begenning of action by global community towards mitigation & adaptations.
3) In the legacy of this conference three major outcomes justifies it, these includes:
   (i) United Nations Framework Convention on Climate Change (UNFCCC), 1994
   (ii) United Nations convention to combat desertification (UNCCD), 1994
   (iii) Convention of Biological diversity (CBD), 1993

✱ Climate change Mitigation & Adaptation :

1) The global climate change in integration to entire range of causes & consequences is proven to be irreversible (IPCC).
2) Global community therefore is oriented towards generating the means of mitigating & adapting to the induced changes.
3) This corelates to two prominent conventions :
   UNFCCC & Vienna convention.

(i) UNFCCC :

1) This umbrella convention on climate change mitigation & adaptation strategies corelates to the division of the parties of convention into three categories (Valid till date) these include :
   - Annex I countries : these are industrial countries & economies in transition as European Union that have legal commitment to cut down on their domestic emissions.
   - Annex II : It includes developed countries like USA involving dual responsibility of cutting down on domestic emissions & funding low carbon techniques to the non-annexed countries.
   - The non annexed are the developing economies as BRICS which are not required to commit to any emission reductions till elementary levels of economic infrastructure is developed.
2) The developed modalities to favourably attain mitigations & adaptations includes : (a) Clean Development Mechanism (CDM) with Certified emission reduction (CER)

that is considered to be most relevant & practically implemented mitigation approach as it involved substitution of conventional means of energy to cleaner source.

** created the begenning of carbon trading.

(b) The flexible Mechanism in comparison forms the technique with higher practicality which permits annex countries to fund low carbon techniques for non-anexxed countries or purchase carbon credit in lieu of (in place of) cutting down on their domestic emissions.

3) Integration of Green as flexible mechanism failitated participation of small developing tropical & equatorial countries in carbon trading. Invaluing the economics of ecology and biodiversity TEEB & P Reduction of Emission from deforestation & forest degradation comprehensive (REDD+).

→ Carbon Sinks were integerated in flexible mechanisms.

- with larger number of participant countries in carbon trading

→ Monitoring reporting verification (MRV) System was initiated.

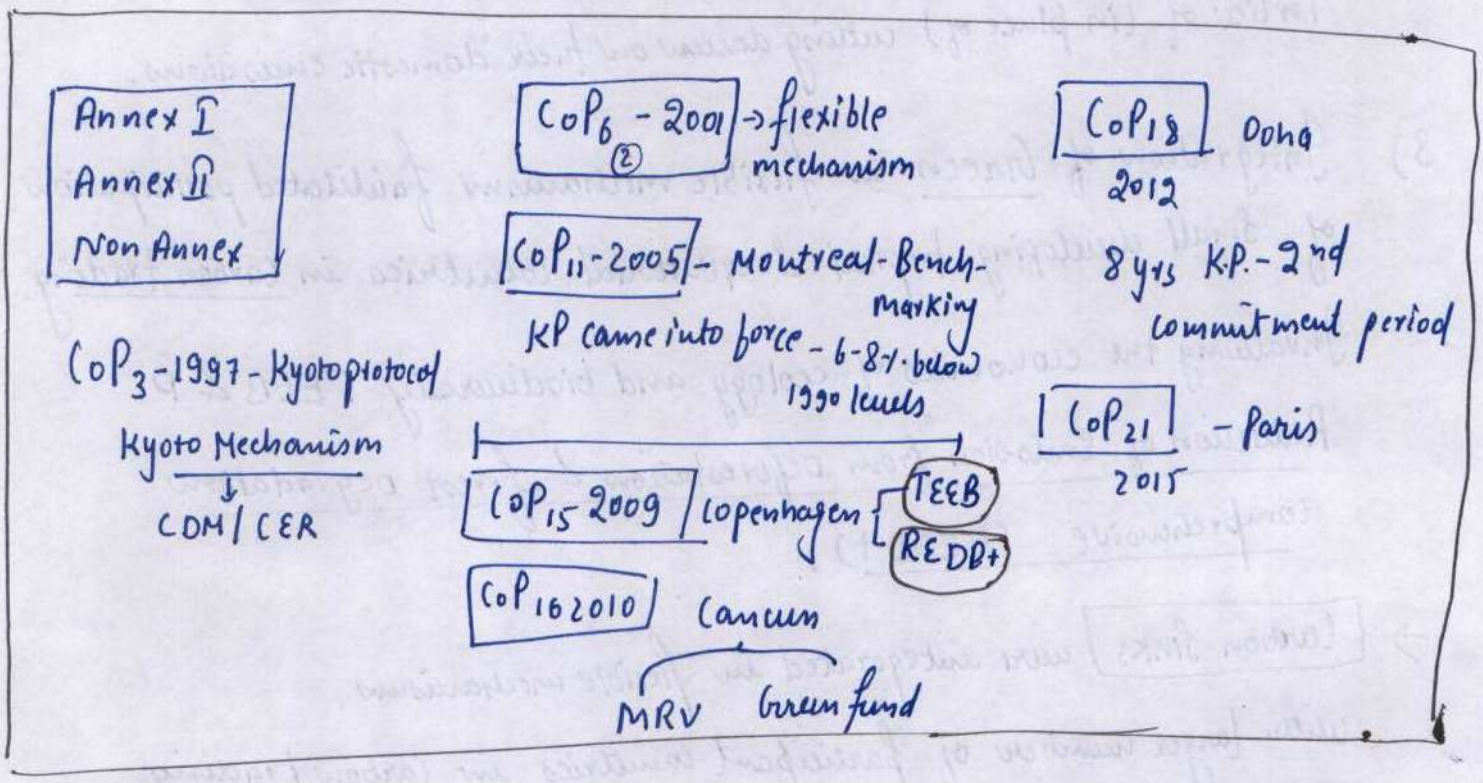
4) Extended as 2nd commitment of period of 8 years (2012-2020) Kyoto protocal involves the benchmarking (target) of attaining GHGs, concentration 6-8% below 1990 levels by 2020.

CoP21 - Paris, 2015 : generated Paris agreement i.e. likely to substitute Kyoto protocal beyond 2020.

In its present frame it involves :

→ Shared but differentiated responsibility (intended Nationally Determined contribution (INDC))

→ changed benchmarking i.e. containing global temperature increase at 1.5°C from pre industrial times.



[* PMR - carbon trading in domestic]

(ii) Vienna Convention:

1) Initiate 1985 towards freezing & reducing ODs, the convention led to legally binding montreal Protocol (came into force 1989).

2) With Stability of ozone practically attained the convention is considered to be successful reflecting the benefit of:
   (a) lack of centrality of ODS in economic activities than GHGs.
   (b) Multilateral fund contributed by United Nations Environ. Prog (UNEP) UN Development program (UNDP), World Bank, UN Industrial organisation (UNIO) to provide financial support to the developing countries in their compliance to montreal protocol.

3) Kigali agreement: Is the additional attachment to Montreal protocol centred around HCFCs (& methyl Bromide) that are considered to be less effective ODs than CFCs (& also CTCs).

→ The Group 1 countries as USA have freezed the production in 2018 and involves the target of reducing HCFCs to 15% of 2012 levels by 2036.

→ Group 2 countries as China, Brazil have to freeze HCFCs by 2024 & have to reduce HCFCs concentration to 20% of 2021 level by 2045.

→ Group 3 countries as India have to freeze HCFCs by 2028 & have to reduce HCFCs ~~cont~~ Concentration by 15% of 2028 level by 2046-47.

II. Human Impact on Hydrosphere & Biosphere :

1) The water realm of environment hydrosphere involves human influence of detrimental dimension that are principally categorised as: Quality depletion & channelisation (UNEP).

2) * Quality Depletion is essentially related to Pollution & Eutrophication.

In regards to Pollution UNEP considers two dominant indicators of water pollution in global assessment Biological oxygen demand (BOD) Coliform counts (contributed by untreated human excreta discharged in water). It also stratified distinction b/w Inland water pollution & Marine pollution.

The Inland water pollution as combines direct impact of human settlement & their smaller size reflects their higher detrimental characteristics which is largely the outcome of discharge of untreated water from domestic & Industrial areas alongwith unabated dumping of Solid waste.

The marine aquatic environment both in reference to their size & distance from human settlement reflects Lesser levels of polluted water. It however relates to multiplying number of challenges including

- → Oil Spills
- → Marine accidents.
- → Microbeads pollution (Great Pacific garbage patch).
- → Dumping of hazardous waste.
- → Dumping of Plastic waste.

The term Eutrophication is applied to denote water quality depletion that is largely the outcome of artificially injected blooms.

This results in excessive growth of phototrophs generating imbalance in the aquatic ecosystems. Complete decline in the Necktonic creatures with absence of penetration of sunlight not just terminate the aquatic habitat but also depletes the water quality.

Prominent examples of Eutrophied water with near complete destruction of habitat includes:

Fort Peck
Sakakwa reservior] USA → due to extensive commercial grain farming.

L. Naseer] Egypt

L. Kainji] Nigeria

~~Donting Hu~~ Dongting Hu
Poyan Hu] China.

→ Human impact on hydrosphere also includes Channelisation

UNEP identifies the term to relate to both diversion of water & enhancement of navigability leading to modifications in aquatic habitat & related challenges.

In terms of diversion Amu & Syr Darya of Turanian lowlands have led to the closing down of Aral Sea i.e. not just the destruction of existing aquatic habitat but also the climate change in the Central Asian countries completely restricting cultivation.

↳ Gnaira gandhi feeder canals.

The navigability with its detrimental influence of channelisation is excellently related to lower course of R. Amazon beyond the confluence of R. Negro. In order to enhance commerciality of Manaus as Sea port of Atlantic route, this has led to (lowering the course) termination of R. meandering destructing leminitic habitat, increasing water pollution & also thinning of Selvas in the catchment area.

* Biosphere:

The life bearing Sphere involves detrimental effect of human activities not just reflecting the generalised imprint of impact on atmosphere & hydrosphere but also much specified impacts that includes:
Deforestation, Desertification & Biodiversity depletion (IUCN & UNEP).

- Deforestation Is the term applied to denote depletion in both quality & quantity of green. Specified with forest biome it reflects overexploitation that has led to maximum areal loss of temperate hardwood deciduous forest.
  - → Maximum decline of species in equatorial rainforest.
  - → from among the other forest vegetation it is littoral that are majorly influenced by habitat destruction which is due to increasing pollution & thermal expansion of water.

* Desertification - Is defined to be all the unsustainable practis leads to depletion of biotic potentials of a given habitat gener desertified conditions.

→ land degradation, quality & quantity loss of soil, Salinization, Eutrophication, over grazing, deforestation forms the causes of desertification.

* UNCCD:

1) Mobilised in 1994 as a legally binding convention that is primarily oriented towards land & soil managment.
2) With 196 parties it is considered to be one of the largest global convention.
3) In the present perspective it orients towards land degradation neutrality, (2018-30) with bottom-up strategy.
4) In order to fulfill land degradation neutrality 3 fold corelated task have been mobilised:
   (a) Maintain or restore soil fertility.
   (b) Mitigate & control drought effects.
   (c) Efficient transfer of technology from developed to developing region.

aiming at maintaining the dynamics of land, climate & biodiversity.

DIRECTION

Biodiversity depletion:

1) The term biodiversity is essentially related to genetic diversity, Species diversity & ecosystem diversity.
2) The multidimensional impact of human activities on the biotic diversity leading to its depletion is specified as HIPPCO

H (Habitat destruction) - Is essentially related to all the detrimental effects that is induced by human activity on environment with direct or passive effect on natural habitat of organisms.

I (Invasive Alien Specimen) It is implied to denote both exotic natural specimen and living modified organisms (LMOs) or Genetically modified Organisms (GMOs).

The natural exotic specimen artificially introduced in a given habitat when generate the threat to the endemic varieties they are called Invasive Specimen e.g. Eucalyptus in India, Rabbits in Australia.

The challenge of invasive Specimen is substantially enlarged in the use of biotechnology with LMOs & GMOs involving proven threats to the natural biotic diversity.

P (pollution) It is applied to depict multiplying concentration of pollutants in air, water & soil which apart from destructing favourable habitat required for survival of organisms.

Also challenges their capacity to reproduce as well as their life expectancy.

** Entry of pollutants in the food chain & its eventual concentration with increase in trophic level called bio accumulation & bio magnification has evolved as significant challenge for the natural habitats & organisms.

DIRECTION

P (population) Applied to human population that involves such cascading course of growth that it has led to excessive pressure on the natural resource base.

This constituent is assesed as $I = PAT$ equation wherein Impact 'a' is not just considered to be outcome of total population but also affluence and technology.

The term affluence is applied to depict desired level of living which always induces detrimental impact on environment (stronger than the impact of total population).

Technology in comparison is related both to detrimental influence as well as sustainable approaches of growth.

C (Climate change): It involves every aspect of dimming & warming with genesis of hazards that are significantly multiplying challenges to natural biodiversity.

O (over Exploitation): This is largely implied with deforestation & illegal hunting of animals beyond their natural capacity to replenish.

In the impact of HIPPCO biotic community is experiencing surpassing of resilience (resilience is applied to denote the capacity of biotic community to revert back any extreme natural or human induced factors).

It is surpassing of resilience that is swiftly leading to biodiversity depletion.

** IPPC's WG-2 (Ass. Report 5) identifies that surpassing of resilience will put more than 50% of the known specimen subjected to threat of extinction by 2100 (based on climate sensitivity).

* Global Biodiversity-Conservation Strategies :

1) Specifications of biodiversity conservations marked up its beginning with mainstreaming of principles of sustainability after Stockholm conference in the approach of biodiversity conservation. Among the prominent global initiatives towards biodiversity conservation - Convention on Biological Diversity (CBD) forms example.

(1) ✓ CBD (1993)

1) convention came into being in 1993 & successfully mainstreamed biodiversity by giving recognition to [ecosystem services].

(A) The Ecosystem services are defined to be range of support with/without monetary benefit provided by ecosystem that ensures healthy human survival, these include :

(a) Provisioning services i.e. the resources derived from natural vegetation or animals with direct monetary significance wood, nuts fruits being example.

(b) Regulating services - it includes the services of ecosystem that involve protection from natural hazards, purification of air & acting as carbon sinks.

** It is the carbon sink characterstics that've attained monetary edge in the non-conventional markets involving Carbon trading.

© Cultural Services - It essentially relates to traditional forest dwellers towards their complete cultural dependence on the natural setup.
Ecologically it is significant for Sacred grooves that provides the posibility of explorations of absolute virgin stands of existing vegetation & biotic community.
Economically it has evolved to be the significant constituent with Spiritual tourism or ecological tourism.

(d) Supporting Services - These services involves conditions required for the growth of plants or genesis of soil without which human existence is not possible. It is however not included in any defined monetary benefit.

The ecosystem services faulitated excellent mainstreaming of biodiversity that is reflected in maximum of the parties to the convention (170/192) to have mobilised National Strategic Biodiversity Action plans (NSBAPs)

* (B) POWs - (PAs) - 2004

2) It is as the constituent of National biodiversity action plan that Protected areas (PAs) were integrated in the functioning of CBD. PAs includes National Parks & Wildlife Sancturies that are collectively considered to be cornerstone of biodiversity protection.

3) With integration of PAs in CBD since 2004 substantive increase in their number have facilitated 13% of terrestrial and 6% of marine environment as PAs in world.

Integration of PAs involved Specifications under Programme of Works (POWs) that includes:
↳ of strategies w.r.t. to the area.

(i) POW on Marine & Inland fresh water ecosystems.
(ii) POW on Arid areas.
(iii) POW on forest biodiversity.
(iv) POW on Montane biodiversity.
(v) POW on Island biodiversity.
(vi) POW on traditional knowledge i.e. giving recognition to the practicality of biodiversity conservation as approached by traditional forest dwellers for generations.

[CoP in CBD are held every 2 years]
* Prefecture - political subunits in Japan.
[* Hyderabad Pledge.
CoP12 - India.]
Voluntary commitments not legally binding.

(c) CoPs - Binneal CoP of CBD facilitated two prominent outcomes

(a) Demarcation of ~~n~~ threat to natural biodiversity by by human activities (CoP9 - Bonn, 2008) HIPCO.

(b) Outling Aichi Biodiversity Targets (CoP10 - 2010)
↑ Aichi prefecture

The biodiversity targets forms the 1st benchmarking in the convention oriented towards attainment of 5 strategic goals to be achieved by 2020-2025 these includes:

→ **Strategic Goal A** i.e. to identify the causes of biodiversity loss & mainstreaming biodiversity accross the governments & society. It is inclusive of four targets (of 20 total targets on biodiversity protection):

1) understand values
2) Mainstream biodiversity (ecosystem services)
3) Adress incentives
4) Sustainable production.

→ **Strategic Goal B** - it includes reduction of direct pressure on biodiversity & promoting sustainable use. It is inclusive of 6 targets:

(5) Halve rate of loss
(6) Sustainable fisheries
(7) Manage within limit (limit to growth)
(8) Reduce pollution
(9) Reduce invasive specimen.
(10) Minimize reef loss

→ **Strategic goal C** - Is to improve status of biodiversity by Safeguarding ecosystem species & genetic biodiversity. It includes 3 targets:

(11) Protected areas (target to increase 17% of land & 10% of aquatic area under PA).
(12) Prevent extinctions
(13) Conserve gene pools.

→ **Strategic Goal D** - It aims at enhancing availability of benefits to all from biodiversity & ecosystem services.

It includes 3 targets:

(14) Restore ecosystem (provides 4 diff. services)

(15) Enhance Resilience

(16) Implement Nagoya protocol.

** Nagoya protocol was the attempt to incorporate legally binding dimension to CBD oriented towards ensuring availability of genetic resources with fair & equitable sharing of the benefits arising from it among the stakeholders.

Maximum parties to the convention (including India) however ratifies it on voluntary lines

→ **Strategic Goal E** - It is to enhance implementation through participatory planning & Knowledge management for the biodiversity targets. It includes 4 targets:

(17) Revise NBSAPs

(18) Respect & conserve traditional ecological knowledge.

(19) Improve knowledge.

(20) Mobilize resources.

** The CoP14 (Egypt, 2018) carried forward Aichi biodiversity targets. However have integrated health with biodiversity as a new component.

(D) Cartegena Protocol on Biosafety:

1) The extraordinary meetings centred around GMOs & LMOs.
2) It was signed as legally binding agreement in the year 2000 & came into force in 2003.
3) It aims at ensuring that the production, utilisation & transportation of LMOs & GMOs do not influence natural biodiversity.
4) It thus establishes:

(a) Advanced Informed agreement (AIA)
It forms the mandatory clause in trading of LMOs i.e. ensuring that potential exporter is providing all the relevant information to potential importer of LMOs.

(b) Biosafety ~~Clearing~~ Clearing House Mechanism (BCH):
It is a voluntary clause that aims at ensuring sharing of experience among the member so as to minimize repitition of challenging use of LMOs and maximize beneficial use of biotechnology.

Other Conventions:

(2) Convention on International Trade of Endangered Specimens (CITES) (1975)
(3) TRAFFIC (Trade related Analysis of flauna & faura in Commerce) (1976)

-> both these conventions involves IUCN's initiative
-> with the protection granted in accordance to the status of specimen in IUCN's Red book.

→ both these legally binding convention aims at ensuring that the trade of the specimen do not increase their vulnerability further.

* IUCN's Red Book

1) organises the involved specimen into 3 categories:

I. Most concerned includes:

a) E (Extinct) which means specimen lost

b) EW (Extinct in wild) Stands for specimen left out in captivity only.

II. Moderately concerned:

a) Cr (critical) which means extreme high risk of becoming extinct in wild.

b) En (Endangered) - which means high risk of becoming extinct in wild.

(c) Th (threatened)/Vu (vulnurable) – that means extreme high risk of becoming critical.

III. Least concerned.

(4) CMS (convention on Migratory Species), 1983

i) Popularly referred as [Bonn convention] it aims at ensuring protection of migratory specimen in their ~~on~~ entire migratory corridor.

(ii) It is based on the range of migration that CMS is implemented as legally binding (Smaller range of migration) e.g. African elephants, polar bear, Gorilla agreement. (terrestrial migrations) And MoU (Memorandum of understanding)- for bigger range of migration) e.g. Aerial (Siberian crane) & aquatic seven varities of marine turtles including olive Ridley turtle.
↳ 9 flyways of world.

⑤ Wetland Convention: (1971)

i) Popularly referred as Ramsar convention.

ii) It is being implemented as International Cooperation & Intranation Action covering all the wetlands with natural or human genesis fresh water or saline possessing water logged characterstics in perennial perspective.

Biodiversity - Conservation Strategies.

① CBD (1993)
- ⓐ Ecosystem services
- ⓑ PoWs - PAs (2004)
- ⓒ CoPs - Aichi BD targets
  Nagoya protocol
- ⓓ Cartagena Biosafety Protocol

② CITES, 1975

③ TRAFFIC, 1976

④ CMS, 1983

⑤ Wetland convention, 1971