Environmental/Ecological Factors

Factors of Locality

The Environment

- In ecology we study the reciprocal relationship between an organism or a group of organisms and its environment.

- The natural place where organisms or communities of organisms live is called habitat.

Principals of Relationship between Organisms & their Environment

1. Everything influencing the life processes of an organism constitutes its environment.
2. Environment in a habitat may be considered into biotic and abiotic components and the activities of the organisms are influenced by the combined effects of various environmental factors.
3. An organism is a component of the environment and the materials and energy required for the maintenance of the body and sustenance of life of organisms constitute the abiotic environment.
4. An organism cannot exist in vacuum.
5. Life is the energy exchange process between the organism and environment and death means cessation of the exchange process.

6. The environment requirements of different organisms differ from individual to individual and also with age and need.

7. Life activities are influenced by that environmental component which occurs in minimum quantity (Liebig's law of limiting factor). A minimum quantity of every essential element is necessary for the growth of an organism. In other words, the growth of an organism is limited by whatever essential element is in short supply, regardless of whether the total amount required is large or small.

8. Life activities of an organism are influenced by the minimum or maximum quantity of the environmental component or factor, as for example, nutrients, light, temperature, moisture. Based on this principle Shelford founded the law of tolerance.

9. Tolerance limits of an individual for different environmental factors may be different.

10. An organism may show different tolerance limit for a particular environmental factor in different habitats and at different age and stage of life history. (Law of optimum) increase in the availability of a nutrient, whether a mineral element or an inorganic molecule, does not produce an unlimited increase in productivity.

11. Organisms having wide tolerance limits for many environmental factors are widely distributed.

12. An organism is a product of nature (genetic set-up) & nurture (environmental upbringing). The inherited qualities are unfolded in proper environment.

13. Organisms react with the external stimuli caused by the environmental changes. The reactions may be exhibited by movements (migration) or adaptational changes in the body or physiological activities. All such adaptations have survival value.

14. Widely distributed species are adapted to various habitat conditions by evolving ecotypes.

15. Every habitat has potential to support a certain number of organisms. This is known as carrying capacity of the habitat. Knowledge of carrying capacity is essential for proper management of the habitat.

16. Energy flow from the sun to the plant to the other organisms and then to the space is always unidirectional.

17. Energy and space relationships of the organisms cause niche differentiation within the habitat which brings about ecological stability in the community life. In any habitat a community is born, it grows with passage of time and through succession it is stabilized to form a climax community.

18. Life on the earth exists in a thin mantle or layer around the earth. This layer forms the biosphere.

19. The biosphere is not uniform structure and it consists of several life supporting habitats called **ecosms** or **ecosystems**.

20. An ecosystem has **producers** (plants), **consumers** (animals), and **decomposers** constituting the **biotic component**, and life supporting matter & energy which constitute the **abiotic component**.

21. In any ecosystem the stability is conditioned by :

(i) Fixation and transfer of energy in the organisms at various levels.

(ii) Conversion of abiotic components (nutrients & energy) into organic structures which adds to the biomass. The abiotic components are replenished through weathering of the lithosphere, atmospheric movements and biogeochemical cycling of nutrients.

22. Energy flow, synthesis of matter and balanced relationship of biotic & abiotic components in an ecosystem are regulated through ecological processes.

- Factors of locality determines the type of forests
  - *Effective climatic, edaphic, topographic and biotic conditions of a site which influence the vegetation of the locality*
  - *Climatic factors*
  - *Topographic factors*
  - *Edaphic factors*
  - *Biotic factors*

CLIMATIC FACTORS

- **Climate-Climatology**
  - Average weather condition
  - Light
  - Atmospheric temperature
  - Precipitation & atmospheric humidity
  - Pressure & humidity
  - Air, Atmosphere
  - Wind

LIGHT

- Light is the most essential abiotic factor without which no life can exist.
- It is non-lethal limiting factor both at the maximum and minimum levels.
- The chief natural sources of light are sunlight, moon-light, star light and the light producing or luminescent organisms.
- Of these sunlight has the greatest ecological significance.

Cont..

Light affects may physiological activities of the plants. Light affects the following aspects of plant life:

- 1. **Photosynthesis:** out of total solar energy reaching the earth, only about 2% is used in photosynthesis and about 10% is used in other physiological activities.

2. Respiration: There is no direct effect of light on the respiratory activity in the plant body. Indirect effect is much important because in presence of light the respiratory substrates are synthesized. Under certain conditions , such as, in shade and under water, the light becomes a limiting factor and the photosynthesis is not sufficient for effective growth.

- Under such conditions, the rate of photosynthesis is just sufficient to meet the need of respiration. This is called *compensation point.* At this point, the dry weight of plant does not increase. The compensation point differs in different species and in different individuals of the same species at different ages.

Cont..

- In many plants the respiratory rate increase with the increase in the light intensity. Ranjan and Saxena have studied the effect of light intensities on respiration rate in many plants and have shown that respiratory rate could increase in *Canna, Nerium and Bougainvillea* with the increase in light intensity.

- The rise and fall of respiration rate may be due to the effect of light on the permeability of plasma membrane, change in the viscosity of the protoplasm and photo-oxidation of enzymes. The permeability and viscosity increase with the increase in light intensity up to certain optimum.

- 3. Opening and closing of Stomata and in Transpiration: Mostly the stomata remain opened in the light and closed in the dark. Light brings about phosphorylation and conversion of starch into soluble sugars in the guard cells and thereby increases their osmotic pressure which, in turn, causes inflow of water in the guard cells. The increase in the turgidity of guard cells causes widening of gap between two guard cells.

- The opening of stomata increases the gaseous exchange and also increase the rate of transpiration during day period. Increase in the light intensity above the optimum shows detrimental effects because the increased transpiration in the intense light is injurious to plant

4. Growth and Flowering of Plants: Light shows many fold effects on the growth of the plants. Growth of plants depends especially on the intensity, quality, duration and direction of light.

- High intensity of light inhibits the production of auxins or growth hormones and consequently it influences the shapes and sizes of plants.

- Plants growing in darkness or insufficient light produce maximum amount of growth hormones as a result of which they are elongated with slender pale yellow stem and small leaves.

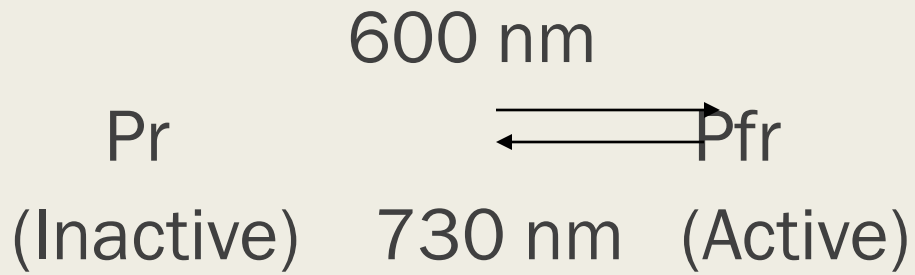
- **Duration of light is also very important.** Actual **duration or length of the day (Photoperiod**) has been shown to be important factor in the growth and flowering of wide varieties of plants. The controlling effect of the photoperiod is known as **photoperiodicity.** The plants have been classified into three well defined groups on this basis:
- **(i) Long day Plants:** Plants which bloom when the light duration is more than 12 hours per day, as for example, radish, potato, spinach, etc.
- **(ii) Short day Plants:** Plants which bloom when the light duration is less than 12 hours per day, as or example, cereals, tobacco, cosmos dahelia, etc

Cont..

(iii) Day Neutral Plants: Plants which show little response to length of day light, as for example, cotton, tomato plant.

- In the **absence of light, the growth is very poor and plants show etiolation**. The stem becomes tender, narrow and long and the leaves become pale green, soft and small.
- 5. **Movement: Light affects the movement in some plants.** The stem, roots and leaves shows different response to light. This effect of sunlight on the plant movement is called **heliotropic effect**. The stem elongate towards the source of light (Positively phototropic and the roots are negatively phototropic). The leaves grow transversely to the path of light. In order to receive maximum sunlight, the leaves are oriented on the stem in such a way that they do not overlap on another.

- **6. Germination of Seeds:** The **seeds when moist are very sensitive to light.** The quantity of light needed for the stimulation of embryo varies in different seeds.
- In most cases, the red light promotes germination and far-red light inhibits germination. Investigations regarding the mechanism or seed germination in light have revealed that a pigment occurs in two reversible forms-Pr and Pfr which develop under red and far – red light. The germination depends upon the balance between two forms:



- Seeds of certain **plants require blue light for germination.** Germination of *Typha* seeds is promoted in yellow light. Yellow light counters the inhibitory effect of blue light.

- Light is an important factor in the **distribution of Plants**. Some plants grow in full sunlight, while others prefer to grow in shade. In certain species e.g. **pine young seedling are shade adapted while older seedlings and young trees do not grow well in shades.**

- Form & growth of trees
  - *Light increment*
- Light requirement
  - *Light demander*
  - *Shade bearer*
  - *Shade demander*

- **Moist temperate forests**

- Light demander - Blue Pine, Populus ciliata
- Shade bearer- Picea smithiana (Spruce), cupressus, deodar, Q. dilatata
- Shade demander- Abies Pindro (Fir), Taxus Bacata

- **Sub Tropical forests**

- Light demander– Chirpine, Q., Incana
- Shade bearer- Q.- Glauca

- **Tropical forests**

- Light Demander- Sal, Teak, Shisham, Adina, Bambax
- Shade bearer – Toona ciliata, Dalbergia Latifolia (Rosewood)

  Petrocarpus morsupium
- Shade demander- Xylia, Scheleichera, Malllotus and Jamun

Temperature

- Temperature is a variable factor which is influenced by time, season, latitude, slope, direction, soil texture, plant cover and human activities like urbanization and industrialization. It penetrates every region of the biosphere and profoundly influences all forms of life by exerting its action through increasing and decreasing some of the vital activities, such as the metabolism, behaviour, reproduction, development and growth. Temperature is a measure of intensity of heat. In terms of standard unit it is commonly expressed as degree either in Fahrenheit or Celsius scale (Centigrade).

- According to the heat requirement of plants, Raunkiaer divided the vegetation into the following types:
- (a) **Megatherms**: These are the plants of warm habitat which require high degree of heat throughout the year. They are found in areas with tropical climate e.g. plants of deserts.
- (b) **Mesotherms:** These are the plants of habitat which is neither very hot nor very cold. These plants cannot stand extremely high or low temperatures and they are found in tropical and subtropical habitats.

- (c) **Microtherms:** These are the plants of cold or temperate habitat and require low temperature for their growth. Such plants grows in subtropical areas at high elevations where temperature conditions are less extreme.
- (d) **Hekistotherms:** These are the plants of cold and alpine regions. They do not thrive well in heat and can withstand long and very severe winter.

- Many plants are very sensitive to temperature. The sudden fall in temperature is injurious because plant tissues are badly affected by it
- Forests suffer from night frost on the east side where the sun rays strike very early in the day.
- As an adaptation against frost the starch of plants changes to fats or oils in the autumn. They fatty oils depress the freezing point and thus increase the power of resistance in plants against frost. The leaves of plants in the coldest lands store fats.

- The process by which temperature range of plant is lowered in order to get crop is called *vernalization*.
- This practice is very common in cold countries.

- **Temperature**

- Altitude, latitude,
- Distance from sea
- Winds
- Mountains
- Soil temperature- natural regeneration and seeds

- Penck using precipitation-evaporation ratio, has classified the climate as follows:
- (i) **Arid**- It is characterised by the condition that evaporation is greater than precipitation.
- (ii) **Arid- Humid-** When evaporation is more or less equal to precipitation.
- (iii) **Humid-** When evaporation is lesser than precipitation.
- The total rainfall, especially the distribution of rainfall throughout the year is one of the leading feature of climate. Rainfall map of the world corresponds very closely with the distribution of great vegetation zones of the world

- Sudden and heavy rains are not so beneficial as are moderate and continuous rains because in the heavy rains a large amount of water is lost from the surface of soil as run off and the soil is eroded.
- Rainfall is determined largely by geography and pattern of large air movements of weather systems. When the moisture laden winds blow from the ocean towards the high mountain they deposit most of the moisture on the ocean-facing mountain slopes with a resulting '**rain shadow**' and produce dry conditions on the other side.

- The higher the mountain the greater is the precipitation of moisture over it. This is the main reason why deserts are usually found behind high mountains. The deserts are also found along the sea coasts, where wind blows from large interior dryland areas rather than off the ocean.
- The amount of rainfall in different localities largely determines the nature of vegetation therein. The following tabulation gives a rough idea about the plant communities that may be expected in regions with different amounts of annual rainfall.

Annual rainfall	Vegetation
1. 0 to 13.24 cm	Desert
2. 13.25-35.1 cm	Semi-arid grassland
3. 35.2-63.5 cm	Dry subtropical grassland, savanna (a grassland with scattered or scattered clumps of trees- a community type intermediate between grassland and forest) and open woodland.
4. 63.6-114.3 cm	Humid subtropical forest
5. 114.4- 203.2 cm	Tropical rain forest

- Snow, which may lie on the ground to form a valuable protective blanket and also a reserve of water, is apt to limit the growing season by its melting.
- Hail, a special type of precipitation during the summer season in the form of small ice pieces, may cause serious injuries, especially to young crop.

- The atmospheric humidity directly influence the form and structure of the plants. It directly affects the transpiration rate of the plants. In dry atmosphere transpiration rate increase and as a result of this the water content of the leaf tissues decreases and the leaves wilt temporarily.
- Water requirements of different plant species differ considerably. Some species, on one extreme, thrive well in the region with an annual precipitation of 10 cm while some, on the other extreme, grow only when they are submerged in water. On the basis of their water requirements, the plants are grouped into three ecological groups:

(i) Hydrophytes	Plants adapted to aquatic.
(ii) Xerophytes	Plants adapted to grow in dry lands where water content is low.
(iii) Mesophytes	Plants living in the habitat that usually shows neither an excess nor a deficiency of water.

Climate	Characteristics features of climate	Vegetation
Temperate Climate	Cold and moist with well marked seasonal and diurnal fluctuation, average annual rainfall more than 762 mm(30”), warmest month above 10^0C.	Luxuriant vegetation in favourable situation. Trees and shrubs dominant, and herbs exceeding trees and shrubs in number.
Tropical Climate	Warm and widely humid with mean temperature of the coldest month usually 17.8^0C and rainfall very heavy (200-400 cm per annum). Frost and snowfall are usually unknown. Little or no seasonal variation.	World’s luxuriant, rain forests in the region of high rainfall. Scrubs, grassland, desert community in the region of decreasing rainfall.
Monsoon Area	It is characterised by dry and wet season. Rainfall very heavy.	Deciduous trees and shrubs.

- Frost -Internal factors, External factors

❖ Frost

- Radiation frost
  - Frost in night, Clear sky
  - Produced by loss of heat by radiation
  - Ground frost

❖ Pool frost

- Accumulation to a considerable depth of heavy cold air, flowing down into natural depressions from adjoining areas
- Hill & valley
- Convection frost

❖ Advective frost

- Frost produced by cold air brought from some where else

- Northern India
- Frost hole, Frost pocket
- **Frost injuries**
- Killing of young plants -sal regeneration is affected
- Death of plant due to damage to cells
- Injuries to crowns –pool frost
- Frost cracks
- Canker formation
- Nurseries are affected in north India
  - Dec. to Feb beginning no work

- Frost hardy
  - Acacia catechu (khair)
  - Anogeissus pendula (kardai)
  - Dalbergia sissoo (shisham)
  - Diospyros (Tendu)
  - Hardwikia Binnata
  - Madhuca indica (Mahua)
  - Orgenia
  - Chir pine
  - Toona ciliata (Toon)
  - Ziziphus
  - Morus alba
  - Chirpine

- Moderate frost hardy

  - Adina cardifolia
  - Anogeissus lalifolia (Kardhai)
  - Bambax ceiba (Semul)
  - Dalbergia latifolia (Rosewood)
  - Morus alba (Sahdoot)
  - Pongamia Pinnata (Kanji)

- Frost Tender

- Acacia arabica
- Azadaricta indica (Neem)
- Bosewellia Serrata
- Garuga Pinnata
- Tectona Grandis (Teak)
- T. Arjuna (Arjun)
- T. Tomantosa
- Shorea Robusta (Sal)

Frost occurrence

Based on mean annual temperature

- Tropical-above 75^0 F-no frost
- Subtropical – 62-75^0 F-rare frost
- Temperate – 45- 62^0 F-frost
- Alpine-less than 45^0 F-severe frost

Protective measure against frost

- Nurseries in southern aspects
- Smoky fires in nights
- Thatching the plants
- Early morning irrigation
- Plantation
- Shelter wood system

- **Drought Hardy species**

- Acacia nilotica
- Bombax ceiba (Semal)
- Bosewellia serrata
- Dalbergia lalifolia (Rosewood)
- Diospyros (Tendu)
- Hardwikia binnata
- Lagerstromia
- Lannea, Mallotus, Jamun, Ziziphus

- **Moderate drought hardy species**

  - Khair, Adina cardifolia,Albizia procera, Anogeissns pendula, Shisham, Mittrangyna parviflora

- **Drought sensitive species**

  - A. Latifolia, Maduca indica (Mahua), Mangifera (Am), Petrocarpus marsupium, Shorea (Sal)
  - Tectona grandis (Teak), T. Tomentosa and T. Arjuna

ATMOSPHERE AND AIR

- The earth is enveloped by a gaseous layer called atmosphere. Gaseous mantle forming atmosphere extends into outer space some 1000 km, or so above the earth surface.
- It is a reservoir of several elements essential to support life.
- It serves many functions including the filtration of radiant energy coming from the sun, insulation from heat less at the earth surface ad stabilization of weather and climate.

Structure of atmosphere

- There are five concentric layers within the atmosphere which can be distinguished on the basis of temperature. These are as follows :

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere and
5. Exosphere

TROPOSPHERE

- **The lowest layer of atmosphere in which man and other living organisms live is called troposphere. Troposphere is about 20 km above the earth surface.**

- **It is thin in the polar regions (about 10 km. thick).**

STRATOSPHERE

- The second layer of air mass extending about 30 km above tropopause is called stratosphere. The uppermost layer of stratosphere is called *stratopause*.

$$O_2 \xrightarrow{h\nu} 2O$$

$$O_2 + O \rightarrow O_3$$

- The above reactions are reversible. Ozone content of stratosphere is constant (?) which means that ozone is being produced from oxygen as fast as it is broken down to molecular oxygen.

- Ozonosphere is important because it absorbs ultraviolet radiations from the sun.
- The fact that the upper region of stratosphere becomes warmer with increasing distance from the earth is due to transformation of absorbed ultraviolet rays into heat (Craig 1968).
- The absorption of ultraviolet radiations by ozone umbrella is of paramount importance in the ecosystem because these radiations are prevented from reaching the earth surface where it would be lethal to living organisms. Ozonosphere also acts as a blanket that reduces the cooling rate of earth

MESOSPHERE

- it is the third layer of atmosphere next to stratospause. It is about 40 km. in height. This region is characterised by low atmospheric pressure and low temperature. The temperature begins to drop & goes on decreasing with the increase in the height and reaches a minimum of about – 95^0 C at a level some 80 to 90 km above the earth surface.

THERMOSPHERE

- Next to mesosphere is thermosphere which extends upto 500 km. above the earth surface and is characterised by steady temperature increase with the height. The thermosphere includes the region in which ultraviolet radiations and cosmic rays cause ionization of molecules like oxygen and nitric oxide (ionosphere).

EXOSPHERE

- The rest region of atmosphere above the thermosphere is called exosphere or outer space which lacks atoms except those of hydrogen and helium. This extends up to 32190 km from action. Exosphere has a very high temperature due to solar radiation.
- The earth's magnetic field becomes more important than gravity in distribution of atomic particles in the exosphere.

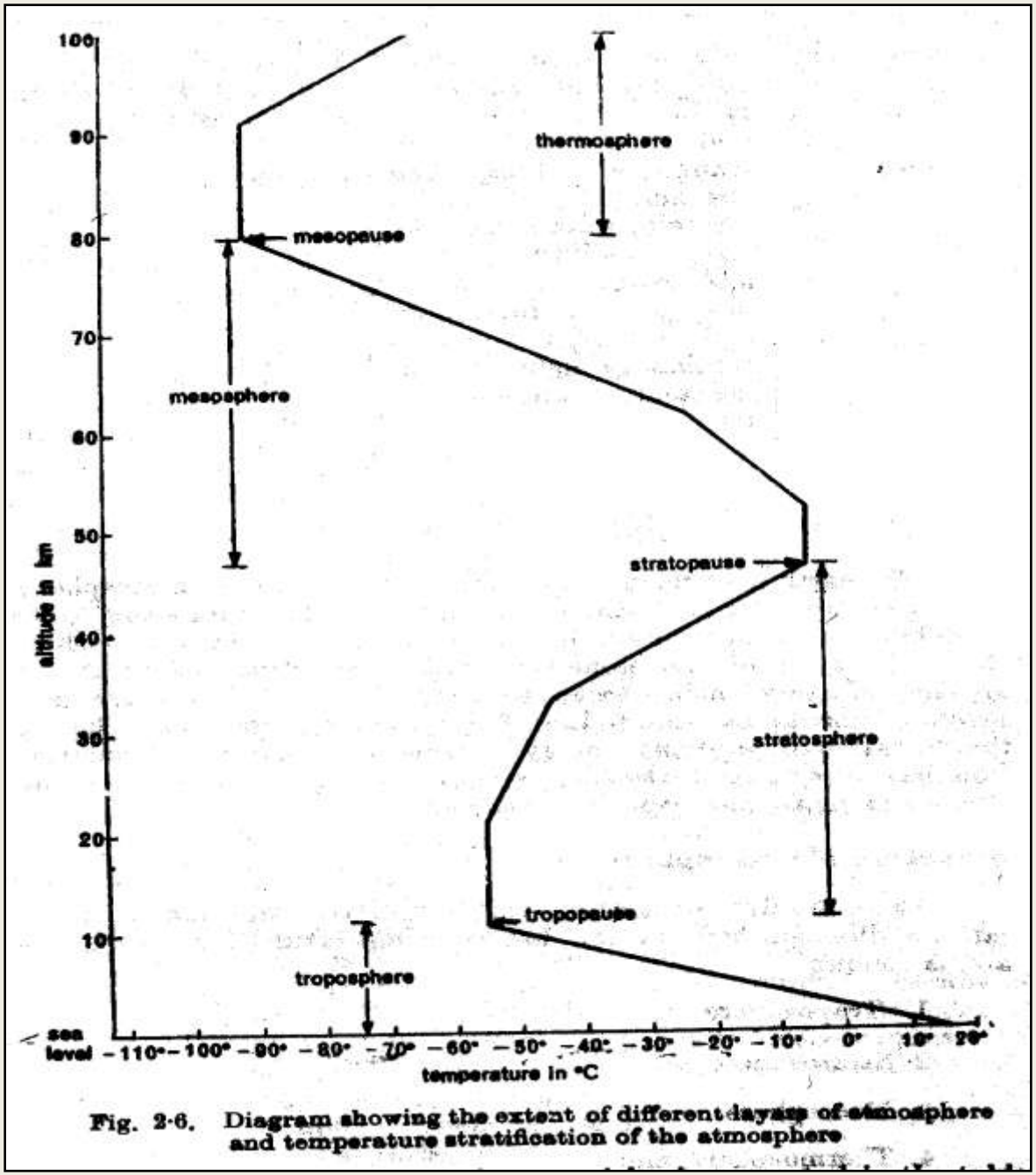


Fig. 2·6. Diagram showing the extent of different layers of atmosphere and temperature stratification of the atmosphere

Air is an ecological factor

- The gaseous mixture present in the troposphere is called air. Air moving from high pressure to low atmospheric pressure is called wind.
- It is an important ecological factor of the environment and it affects plant life mainly on flat plains, high altitudes in mountains and along the sea cost.
- wind is directly involved in transpiration, in causing various types of mechanical injuries and dispersal of pollen, fruits and seeds.

Air is an ecological factor

- It also modifies the water relations and light conditions of a particular habitat through its effect on evaporation.

- It plays both positive and negative roles in atmosphere, for instance it has drying effect upon soil and may occasionally act in opposite direction bringing in moist air that reduces the transpiration and evaporation and may actually lead to the deposition and precipitation of moisture.

Effect of air on vegetation

- The following are the important effects of wind on vegetation:-

i. Wind increases the water loss by constantly removing the air saturated with water vapour from the intercellular spaces of the leaves and bringing unsaturated air in contact with leaves and young shoots.

Effect of air on vegetation

ii. Mechanically, wind causes erosion of soil and abrasion of vegetation through removal of particles and physiologically, it decreases the growth of plants by way of reducing the moisture content of air and reducing the turgidity of plant parts on which it impinges –—moist air promotes the growth of mesophytes.

iii. In strong dry and hot winds, young parts of plants may become shrivelled and killed in a few hours and the surface of soil may become dry.

- The plants in such areas show extensive development or mechanical tissues which provide mechanical support and save the plants form wind injuries.

- In India and many other countries of the world, unchecked winds have caused total disappearance of vegetation at certain places and rendered big areas deserted. Rajasthan desert in India is spreading eastward due to unchecked wind erosion.

Physiographic Factors

- Physiographic factors are those which are introduced by the structure, conformity and behaviour of the earth's surface, by topographic features, such as elevation and slopes, by the geodynamic process, such as silting and erosion and consequently by local geology.

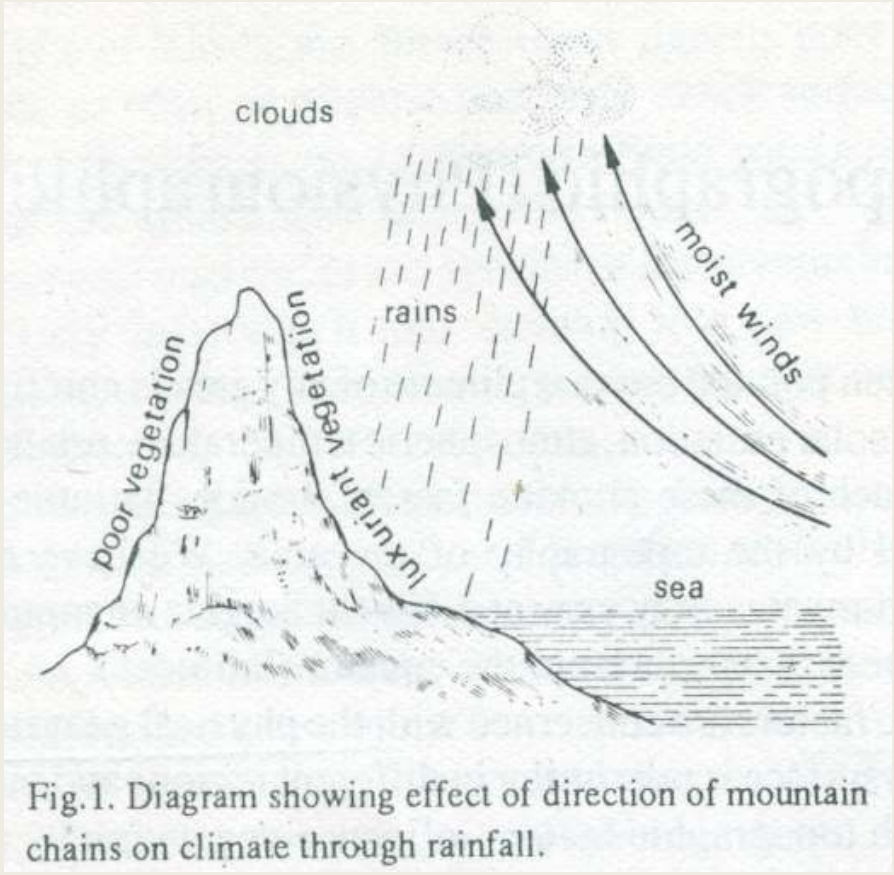


Fig.1. Diagram showing effect of direction of mountain chains on climate through rainfall.

Physiographic Factors

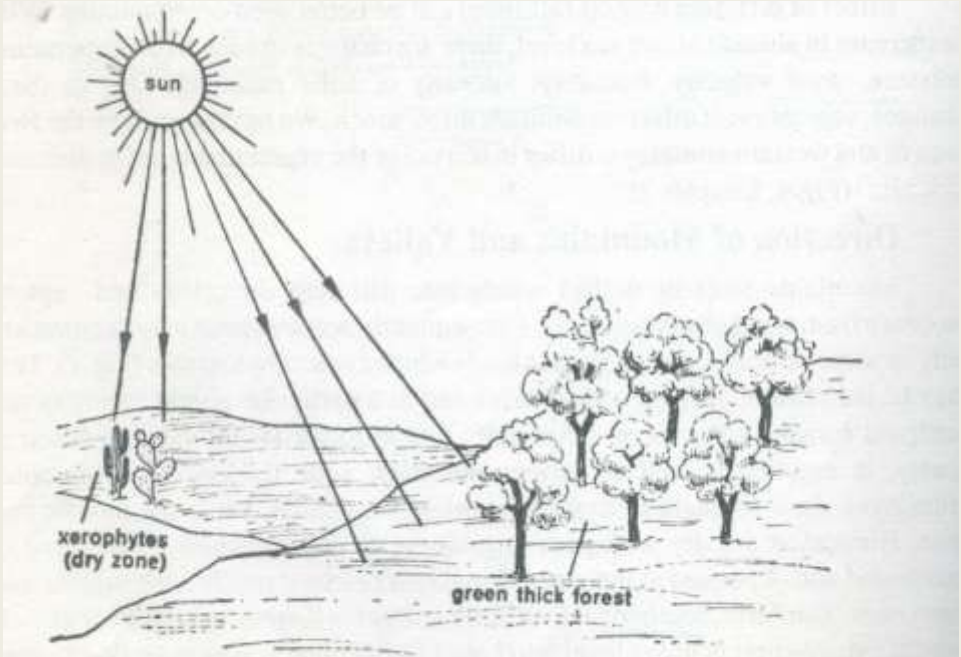


Fig.2. Diagram showing the relation of the angle of solar rays with the heating of earth's surface.

Physiographic Factors

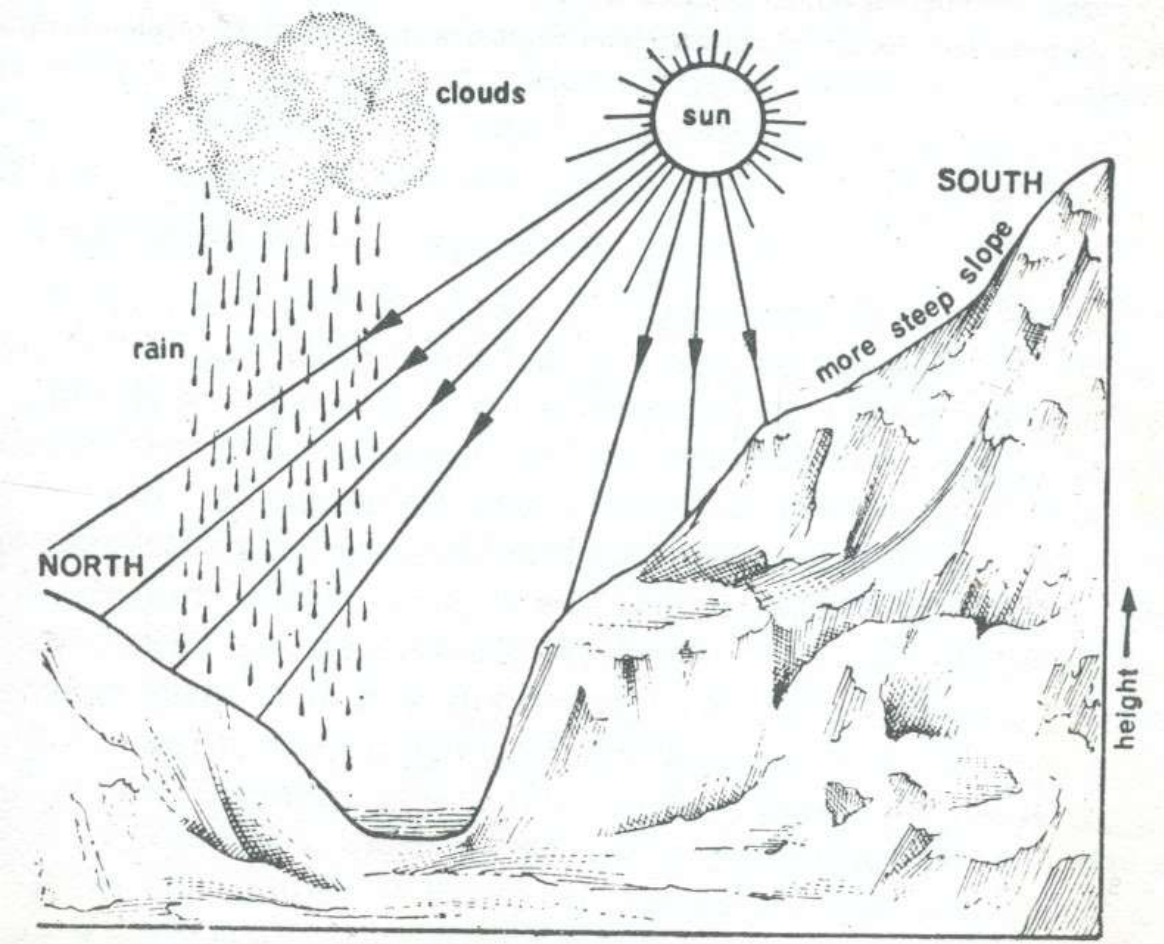


Fig. 3. Diagram showing the effect of steepness of slope on climate through light, heating of earth's surface, and rainfall.

- It has been observed that in the northern hemisphere north facing slopes tend to be more adjusted to moist conditions than the south facing ones at similar altitudes. This is so, probably, because of the effects of the solar radiations on the air and soil temperatures and consequently, on the relative humidity and evaporation and through them on the local water situation. The duration of sunlight on the south facing slope is longest. The vegetation on north facing slopes receive little or no direct solar radiations.
- Moving sand dune in desert may be cited as example of geodynamic source of physiographic change. The areas subjected to quick and continuous erosion are completely devoid of vegetation.

- ❖ Topographic Factors, Altitude, Exposure, Drainage
- ❖ Slope and Aspect
- ➢ <u>Aspect</u>
  - Direction towards which slope faces
  - Relation of a site to weather condition especially sun and wind
  - Amount of insolation
  - Southern aspects – warmer
  - Different regeneration in southern and northern aspects
  - Southern –pine,deodar; Northern – fir & spruce

- Species in Himalayas
- Northern – cooler, lower altitudes, the species occurs
- Insolation, radiation, evaporation and soil moisture
- Northern – less
- Southern – more
- Microclimate is important
- Altitude and aspect governs planting of species

Edaphic factors

- ❖ Soil
- Formation
- Weathering – physical – chemical
- Biological agencies
- Rock
- Physical properties
  - *Soil structure*
  - *Soil and water relation*
  - *Soil organic matter*
  - *Nutrients, Rock*
- Problematic soil

- Lateritic soil- rose wood, cattle, swietenia,
- Red Soil
- Black cotton soil
- Aluvial Soil
- Desert Soil
- Saline & Alkaline Soil
  - *Kankarpan*
  - *Silican pan- Pterocarpus-Marsupium*

- Sal
  - *Acidic soil*
  - *Non calcareous*
- Teak
  - *Acidic soil*
  - *Calcareous*
- Deodar & Kail
  - *Acidic soil*

- Sandy Soil- Shisham, Khair, Acacia, Cashwenut, Casuarina, Vitex
- Saline soil- Prospois, Neem, Kanji
- Swampy soil-
- Calcareous soil

Biotic Factors

- The biotic factors include the influence of living organisms, plants, animals, & microbes upon the vegetation. Any activity of the living organism which may cause marked effects upon vegetation in any way is referred to as ***biotic effect.*** The biotic effect may be both direct and indirect. It may be beneficial for the plants in some respects but detrimental in other respects.

BIOTIC FACTORS

- Plants, Insects, Wild animal, Man and domestic animals
- Plants
- Parasites
- Epiphyte – growing on but not harmful
  - *Orchids*
- Weeds – lantana and eupatorium

- Climbers – herbaceous or woody plant- climbs up trees, turning around them
- Physical support
- Sal forest – many climbers
- Climber cutting is a common operation

➢ **Man & Animals,**

- Deforestation, Fire and Grazing,
- Shifting cultivation

- Site Quality: Traditionally, foresters have divided forest lands into site quality classes.
- Site quality classes are a measure of the productivity of lands,
- In traditional forestry productivity refers only to the rate of production of stem wood.
- The forester measured productivity directly where long term records of growth in a stand were available, otherwise they relied on indirect methods of assessing site quality.
- Indirect methods could be based either on vegetation, or on factors of physical environment:

- **Vegetation of the forest**

  (a) Height of dominant trees (Site index)

  (b) Ground vegetation (Indicator species and species group)

- **Factors of the physical environment**

  (a) Climate

  (b) Soil

Site Index

- Of all indices, height growth is the most practical, consistent and useful indicator of site quality.
- There is a marked difference in the height growth of dominant trees on sites of different quality.
- The height of dominant trees on the richest site may be 3 to 4 times more than on the poorest.

- For instance in India at the age of 120, dominant sal trees attain a height of more than 35 metres on the richest sites, while less than 15 metres on the poorest.
- Height of freely growing dominant trees in a mature crop is the index which is almost exclusively used in India to denote site quality classes.
- The richest site is termed quality I, and the poorest quality IV.

•The normal correlation of height with different quality classes.

Quality Class	Height of dominant trees in a mature crop
I	35 metres and over
II	25 metres to less than 35 metres
III	15 metres to less than 25 metres
IV	Less than 15 metres

- Height of tress also gives an indication of the optimum number of trees that should be growing in an unit area.
- For a given site quality optimum number of trees in an unit area is inversely proportional to the square of height, i.e.
- $N \alpha 1/H^2$
- Where N = optimum number of trees in a

  hectare.
- H = top height or crop height.

CLASSIFICATION OF FORESTS

- Method of regeneration ;
  - High forest –seed origin
  - Coppice forest – vegetative origin
- Based on age
  - Even aged (regular)- 25% of the crop over 100 yrs
  - Uneven aged (irregular) - Selection Forest
- Composition
  - Pure forest – 80% of single species and 20% of other species
  - Mixed forest
- Objects of Management
  - Production
  - Protection

- Ownership and legal status
  - State forest –reserved, protected, village
  - Community forest
  - Village forest
  - Private forest
- Growing stock
  - **Normal**–for a given site and objects of management, is ideal w.r.t. growing stock, age, increment, yield etc.
  - **Abnormal**

FOREST COMPOSITION & DISTRIBUTION

- Gregarious habit

- Top canopy - single species
  - *Chir pine, Sal,*

- *Top canopy- several species*
  - *Blue pine deodar and spruce*
  - *Shisham & Khair*

- Gregarious under wood

– *Bamboos*

■ Tropical evergreen forests

■ Many species

– *Single spp not more than 10%*

■ Tropical deciduous forests

– *Generally 6 to 10 species*

➢ Terminalia Tomentosa, T. Ballerica, Lagerstroemia Parviflora, Sterculia urens, Adina cardifolia, Salmalia, Lannea coromandalica, Cedrala toona

- Tectona grandis, Terminalia Pariculata, T. Tomentosa, Lagerstromia parviflora, Adina cardifolia, Grewia

- **Exploitable Spp. - Only one or two**
- **Vertical mixture**
- **Chir – no under-wood**
- **Fir- Rhododendron**
- **Oak – Bamboos, Cane**
- **Sal – Mallotus (Kusum)**

Factors affecting composition

- Struggle for existence
- Rate of height growth
- Growth habit
- Shade tolerance
  - *Seedling competition - Artocarpus, Dipterocarpus*
  - *Power for shade tolerance*
  - *In Tropical forests*
  - *Top canopy deciduous*
  - *Middle canopy evergreen*
  - *Sal, malloltus*
  - *Dry deciduous forests –Adadhota and Cassia in middle canopy –evergreen*

- Relative growth rate
  - *Light demander and shade bearer*
  - *Rosewood & Teak*
- Recovery from injuries
  - *Coppicing power*
  - *Fire injury*

- Sal, chir pine – fire resistant
- Combination of Oak, blue pine- where fire occurs chir pine comes
- Adventitious roots of ziziphus

- Root suckers -Shisham, Butea, Tendu,
- Fire resistant bark
- Thick and smooth sappy bark like Salmalia spp.
- Heat conductivity -Deodar is affected
- In tropical wet evergreen forests- fire damage converts the forests into grass lands

- ❑ Grazing damage
- ❑ Resistance in Teak with tannin content
- ❑ Holeptelia – Sour smell
- ■ Adaptation to climate & soil
- ■ Frost
- ■ Reproductive powers

Table : Some major weed species of India's Wildlife Protected

Scientific Name	**Habit**	**Localities etc.**
Prosopis juliflora*	**Woody shrub to 5 m**	**Drier western India, Gangetic plains of UP**
Lantana camara*	**Woody shrub to 3 m**	**Widespread in Indian mainland south of Himalayas**
Tiliacora racemosa	**Woody climber**	**Mainly in north**

Eupatorium adenophorum*	**Herb to 0.8m**	**Himalayas**
Eupatorium odoratissima*	**Herb to 2.0 m,**	**South peninsula**
Mikania scandens*	**Climber**	**Moister east**
Parthenium sp. *	**Annual herb**	**Widespread**
Cassia tora	**Annual herb**	**Widespread to 1500m**

Achyrantes asperqa	**Annual herb**	**Widespread to 1500 m**
Strobilanthes sp.	**Gregarious perennial**	**Widespread in hill ranges**
Adhatoda vasica	**Woody subshrub to 2 m**	**Mainly in north**
Imperata cylindrica	**Cotton grass, perennial**	**Moister areas**

Species marked* are exotic to India.

ADVANTAGES

Cover areas which are barren, often on the fringe of the forests, forming a near impenetrable barrier for human use.

Some other consumptive uses also in practice

Weed control

i. Chemical control - never

ii. Remove the cause of weed infestation.

iii. Encourage the growth of non-weed species/fast growing natural species to cover light demanding weeds *eg Lantana*, cutting off light

iv. Eradication

- Annuals: cutting before seed setting
- Woody perennials :

  Uprooting - small areas at a time

v. Planting after eradication eg. *Arundo donax* after *Lantana.*

(ii) Arid grasslands

Velavader N.P. - One of the best Black buck population

Cynodon - *Sporolobus* pastures - 'royal grassland reserve' 1950's - inflow of cattle- invasion of P. juliflora: Black buck declined.

Protection : Population increased but P. Juliflora firmly established.

Removal of P. juliflora- major management activity

Some benefits: pods are nutritionally valuable dry season food; Protection to Indian wolf.

(iii) Alpine meadows

- Temperate grass - sedge & forbs species

  heavily exploited by transhumance domestic livestock

  Total Protection: Dachigam NP - spread of *Juniperus* sp.

  Valley of Flowers NP- Spread of *Persicaria polystachya* ??