[First Draft Only]

[Suggestions from participants yet to be incorporated]

Sub Theme 3

Weather, Climate and Ecosystems

Introduction

Weather and climate are important physical environmental factors which influences the ecosystems. The term Ecosystem deals with the biotic (living) and abiotic (nonliving) components within the environment along with the factors interacting each other. An ecosystem can be as large as an ocean or as small as a local pond. Ecosystems provide people with food, goods, medicines, and many other products. They also play a vital role in nutrient cycling, water purification, and climate moderation.All weather and climatic paramerters affect the ecosystem elements in various ways. In turn, biotic elements influence the development of microclimate in an ecosystem. Human activities also affect weather and climate which now has come to reality leading us to the perceived global climate change.

Weather and Climate have profound effects on ecosystems and the habitats that support life on earth. The variation of temperature, humidity and precipitation the quality of water, soil forming process directly will influence the floral growth and faunal composition. Even though smaller changes are taking place in weather conditions a fairly high impact may be observed on natural resources. Changes are expected to alter the makeup and functioning of ecosystems, as well as some of the critical benefits that ecosystems provide to people. Fast changes in the climate can threaten ecosystems that have already been weakened by other human activities such as pollution, development, and overharvest etc.

Biodiversity is the living component of any ecosystem. Although species have adapted to environmental change for millions of years, a quickly changing climate could require adaptation on larger and faster scales than in the past. Those species that cannot adapt are at

risk of extinction. Even the loss of a single species can have cascading effects because organisms are connected through food webs and other interactions.

The timing of many natural events, such as flower blooms and animal migrations, is linked to climate factors such as temperature, moisture availability, and amount of daylight. Changes in weather patterns and extreme events associated with climate change can disrupt these natural patterns. These isruptions, in turn, can affect seasonal behavior and interactions among species. For example, if birds migrate and lay eggs too early, hatchlings might not have an adequate food supply. While some animals and plants will successfully adjust life-cycle patterns to changing weather pattern cues, others might not be so successful. Climate change can alter where species live and how they interact, which could fundamentally transform current ecosystems. Impacts on one species can ripple through the food web and affect many organisms in an ecosystem.

India's weather and climatic conditions are naturally controlled by its geographical locations and hence the parameters of weather vary from place to place. Due to such variations the vegetation type, soil quality and water quality also vary from place to place.

Weather and Climate variability have various significant parameters such as Rain, Temperature, Wind and Humidity that inflict impact on the abiotic and biotic nature on earth. These parameters have effect on the occurrence, abundance, seasonality and behavior of living organisms as well as quality of air, water and soil. It has direct or indirect effect on the various ecosystems. When some of these ecosystems are available every where in India some will be restricted to very specialized locations.

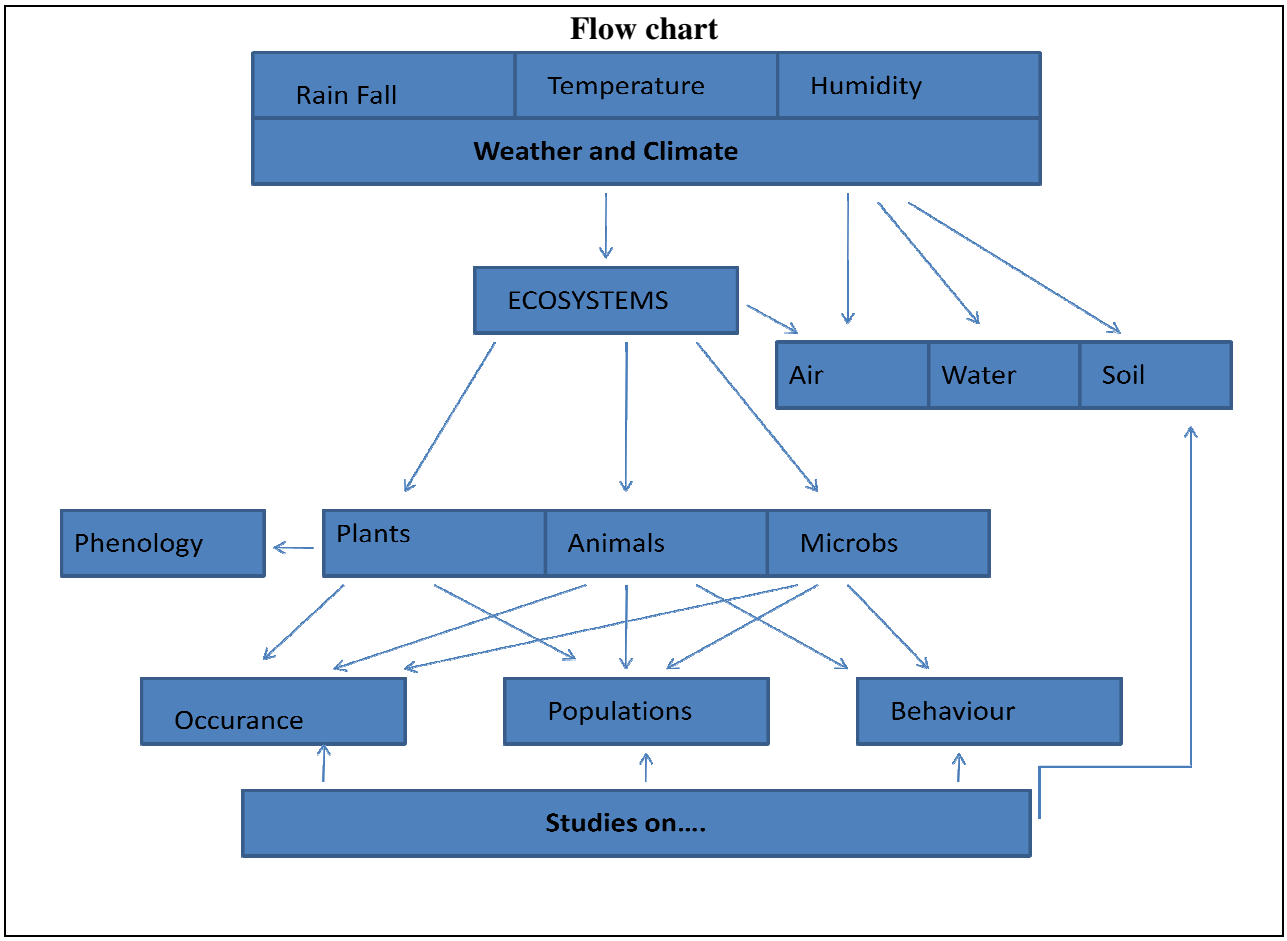
Types of ecosystems

Terrestrial ecosystems
Forest ecosystem – Various types of forests across the country
Agricultural ecosystem _ various crop systems across the country
Grassland – Secondary, rarely the primary grass lands in many parts of the country
Desert ecosystem – Ex: Thar desert in Rajastan
Hill and mountain ecosystems : Ex: Himalayas, Western & Eastern Ghats, North Eastern Hills, Aravali, Vindya-Satpura etc
Iceland ecosystems : Himalyas

Aquatic ecosystems
Pond, Lake, River ecosystem Temporary Wetlands : most parts of the country
Mangroves, Marine, , Estuaries and Lagoons : Costal area

Logical framework

Weather and climate variability affect the phenology of plants, occurrence of various floral and faunal elements populations of different species and in the manifestation of many behavior of animals. The consequences of climate variability at a macro level could be manifested as disasters also such as floods, droughts, unprecedented rains, inconsistencies in seasonal temperature etc on various ecosystems.



We need to understand and observe the changes in weather parameters as well as the changes in biotic and abiotic parameters around us. This will enable us to study the effect of the weather/climate on ecosystems. For example in pond ecosystem the intensity of rain will change the level of water, change the pH level, turbidity and so on which in turn influence the biological activities such as growth of grass, flowering, population of insects, fishes and birds. They also behave in different ways. Systematic observations, measurement and analysis make us understand the functioning of ecosystem in better way. To understand the effect of weather and

climate on the life on the surrounding or vice versa the children's projects should begin with asking significant questions to that effect.

Different component and aspects to be covered under this subtheme

1. The various components contributing to the weather and climate conditions such as temperature, pressure, wind, precipitation and humidity are important for the study depending on the question under study.
2. Biotic components such as flora, fauna and microbs in a given ecosystem
3. Abiotic component such as air, water and soil.

Project Examples

1. **Influence of vegetation cover on microclimate**

The microclimate in simple term refers to the modified climate of a small area which can be different in temporal and spatial scale from the climate of the region. The microclimate is modified by vegetation cover, industrialization, development of human settlement and any other intervention in the land use pattern. Tree plantation restricts incoming radiation and has a cooling impact on the microclimate. Trees also act as shelterbelts and reduce desiccating effect of wind. Vegetation cover greatly modifies the soil environment in long run which is a vital component of the microclimate. Modification of microclimate is the perceptible and immediate effect of anthropogenic intervention in land use system. A basic understanding of microclimate will help the students to conceive the possible impact of land use change.

Objective

To understand the microclimate of an area

To study the influence of vegetation cover on microclimate

To have a comparative study of microclimate under different land use system

The experiment may be divided in two components

(A) Field study - monitoring microclimate of different land use system

(B) Development of workable model to understand the concept of microclimate

Part A: Field study - monitoring microclimate of different land use systems

Methodology

Select different land use systems in the surrounding locality

a) Crop land

b) Barren land

c) Forest land/Orchard

d) Settlement areas and any other typical land use system.

Two simply measurable parameters: temperature and evaporation are selected. This can be improvised by incorporating additional indicators.

- Keep circular leak proof open pan of ½ m diameter and 50 cm depth at the representative place of each land use system. Fill with water up to 30 cm depth. Cover it with wire net.
- Keep the thermometers in suitable places to measure soil temperature, water temperature (of the pan) and air temperature in these sites. Care should be taken to avoid direct radiation on the bulb of the thermometer.
- Record the temperature observations three times daily at early morning (say, 7 am), mid day (say at 12 to 2 pm) and during evening (say, 6 pm) over a period of 4 months at weekly interval.
- Record the depth of water from these pans at weekly interval and add water as per requirement during the period of study
- Collect the soil samples from each site at 10 cm depth 3 days after each rain event. Take the fresh weight (immediately after collection) and again by drying the same sample at 105 ^{0}C for 24 hours in an oven. Calculate the moisture content as below -

$$\textit{Soil moisture content} = \textit{(Fresh soil weight} - \textit{Dry soil weight)/Dry soil weight}$$

The impact on soil evaporation can only be perceptible if soil types are same because the soil type (textural class) is a major driving factor for water release from soil for evaporation

Important note: It is a group activity. Time synchrony has to be maintained for observations at different field sites. Each student may be assigned one site for diurnal observation.

Relevance:

Note the difference in temperature and evaporation rate from each observation site. These parameters are easily perceptible but important indicators to define a microclimate of a place. Mark, how human intervention changes the microclimate. This will give help the students to understand the microclimate and in broad sense demonstrate how anthropogenic intervention is responsible for modification of the climate on the earth surface.

Part B: Understanding the concept of microclimatic

Materials required

- Earthen pot (6 Nos)
- Seedlings (Fast growing plant depending local suitability)
- Card board & Ply board
- Thermometer (2 Nos)
- Open pan of 20 cm diameter and 5 cm depth

Methodology:

- Take 6 earthen pots. Make a whole at the bottom of each pot.
- Fill the pots with one thin layer of small stones at the bottom and the rest with soil
- Plant one seedling in each pot and water regularly.
- Make two model houses using card board / ply board
- Place one model house in the middle of 6 pots and one house in open area
- Measure the temperature of the roof top of each house (using thermometer) at 15 days interval starting from the date of planting.
- Place the open pan near each model house and keep 2 cm depth of water in each pan. Add water to each pan after drying.
- Note the temperature difference between the two situations
- Note the time required to dry up the water from each pan

Relevance:

This project will give a direct experience to the students about how plantation helps in ameliorating the microclimate. Maintaining the plants from sowing to subsequent growth will induce the association of students with the plants and will help in understanding the concept of

microclimatic modification at the same time. Hands-on learning process will be an interesting and effective method.

Note: <u>These two exercises (part-A & part-B) may be considered complimentary to each other</u>

2. Effect of weather on soil fauna

Introduction:

Soil is one of the most diverse habitats on earth and contains one of the numerous assemblages of living organisms. Soil biota includes bacteria, fungi, protozoa, nematodes, mites, collembolans (springtails), annelids (earthworms), macro arthropods (insects, woodlice) etc. The primary role of soil biota is to recycle organic matter that is derived from the above ground plant based food web. Weather has a profound effect on

Objectives:

1. To observe and document some visible life forms present in the land.
2. To record the seasonal variation and the type of biodiversity present in the soils of varying productivity levels.
3. To study effect of rainfall and soil temperature on soil fauna

Methodology:

Sampling of soil and soil fauna:

Sample should be taken from the root zone of plants. Collect soil samples with specific quadrat . Take sample from different locations within the area and mix together. Collect the soil and place it in a ziploc bag. It should not be touched with hands. Separate soil samples will be collected for some physico-chemical analysis viz. texture (feel method), colour, pH etc.

To study the organisms in the soil:

1. Larger animals can be easily separated(Earthworms, beetles, etc)
2. To catch small arthropods, take a Tullgren funnel. Set a piece of ¼ inch rigid wire screen in the bottom of the funnel to support the soil. Half fill the funnel with soil, and suspend it over a cup with a bit of anti freeze or ethyl alcohol in the bottom as a preservative. Suspend a light bulb (25 W) for about 4-5 days over the soil to drive the organisms out of the soil. Animals will move away from the light and heat and fall down in the cup placed below.

   [we can give a figure of the funnel and separation of insects here]

Observation:

Date

Time:

Weather: Sunny/ Rainy /Cloudy etc.
Sampling area:
Characteristics of the soil:
Sample size:

Sample no.	Type of organism	No. of individual	Remarks

Performing this study a student can realize the possibility of using the soils in industry and how quality of raw materials influence end product quality. The magnitude of large scale destruction of good quality of soil through other purposes can also be assessed.

Analysis:

1. Appropriate data sheet may be created for soil fauna.
2. Abundance of different species or relative density could be analyzed from the data collected using following formula.

$$\text{Abundance} = \frac{\text{Total no. of individuals of the species in all the sampling units}}{\text{No. of sampling units in which the species occurred}}$$

$$\text{Relative density} = \frac{\text{Total no. of individual species}}{\text{Total no. of individual in all species.}} \times 100$$

5. Seasonal variation of the animals could be noted under different soil conditions.

Conclusion:

1. Significance of habitat choice by the organism can be studied.
2. Dominant species and rare species can be shown.
3. Compare the result between or among the soils.

Relevance of the project:

A comparison of soil macro fauna in different types of soil like, forest, agricultural land, and urban, eroded, etc can be shown. The analysis of results may suggest remedies for eco-restoration of the degraded land.

3. Effect of rainfall on phenology of plants

Objectives:

1. To study the phenology of plants in relation to the rainfall in an area.
2. To analyse the relation between temperature/rainfall and various pheno-phases of plants

Methodology

- Select a set of common plants species available in your locality.
- Then collect information about these species from elderly people and observation about their period of flowering, fruiting and other charateristics
- Start observations on each of these plants and record the phenology (budding, leaf flushing, flowering, fruiting, seed dispersal etc) of the plant systematically
- The data gathered thus should be tabulated analysed and compared to understanding the change in phenology of the different species.

Observation sheet:

Date: Time:

Weather: Sunny/ Rainy /Cloudy etc. Location:

Species	Number of Individuals	Phenological stage	Remarks

4. **To study the impact of climate on sacred grove biodiversity**
   Sacred grooves are the ecosystems conserved through traditional belief systems in particular localities. They have played significant role in conservation and preservation of biological resources. Students can document the changes in sacred groves through questionnaire survey and collect the climatic information from secondary sources and study the relationships.

Objectives

1. To understand the component of the sacred groves and the changes in sacred grove in last 2 decades
2. Study the changes in sacred grows with respect to the weather and climate

Methodology

- At the very outset we need to collect information from the village headman/priest and elderly people regarding existence of sacred groves in the vicinity of the study area.
- The sacred grove needs to be visited for the pilot survey along with teacher.
- During the pilot visit the main features of the grove such as the deity, belief system, use of resources and biodiversity have to be recorded.
- Then the main questions regarding sacred groves to be prepared for documentation of biodiversity and degradation.
- The historical data can be compared with the current data to make us understand the changes taking place in the sacred groves.

- Meantime the information regarding weather and climate can be collected from secondary sources and can be correlated with change in sacred grove.

List of Projects suggested

Effects of weather and claimate on Biotic Components

- Effect of the pattern of weather parameters such as Rain, Temperature, Wind and Humidity on
- Abundance of various Insects
- Changes of Behaviour of insects with respect to weather parameters
- Relationship between Dragon fly population changes and and rainfall
- Relationship of movement of social insects and weather parameters
- Behaviour of birds in relation to the weather parameters
- Behavior and movement of spider in relation to the weather parameters
- Abundance and breeding of frogs in relation to the weather parameters
- Variation in weather and climate Vs presence and absence/ abundance of plants such as weeds
- Behavior of domestic animals in relation to the weather parameters
- Seasonality of occurrence of plants
- Weather pattern and flowering of plants
- Soil Organisms and weather pattern
- Fish migration and weather pattern/ tide pattern
- Fish catch and weather pattern
- Seasonality in fish catch
- Seasonality of behavior of costal animals / tide pattern
- Weather parameters and abundance of mushroom

Effects of weather and climate on Abiotic Components

- Variable weather conditions can affect quality of air, water and soil. Some of the changes are measurable such as measuring pH amount of dissolved salts in water, organic matter in soil etc.
- Quality of air in terms of air pollutants such as Carbon dioxide, methane, NO_X content in different seasons
- Soil pH in different places/ different time.
- Water pH in different places/ different time / rain water
- Determination of dissolved minerals in different water samples in your locality

- Comparing water quality before and after rain
- Determination of organic matter present in soil in different periods of time.
- Weather and soil erosion
- Effect of light period, light intensity, atm. temperature, humidity and soil moisture on growth of plants
- Stomatal count for as surrogate for the production of Oxygen – comparison of different plants
- Calculation of Carbon sequestration in different urban and rural gardens
- Relation between Wind pattern and seed production in wind dispersed seeds.
- Relation between wind pattern and flowering of anemophilic plants.