

Ecosystem

Ecosystem – Definition and Overview

- An **ecosystem** is a functional unit of nature in which living organisms interact both **among themselves** and with the surrounding physical environment.
- These interactions involve the exchange of energy and matter, creating a balanced and self-sustaining system.

Types of Ecosystems

- Ecosystems vary greatly in size - from a **tiny pond** to a **vast forest** or the **ocean**.
- For convenience, they are classified into two main categories:

1. Natural Ecosystems

- Terrestrial Ecosystems – e.g., Forest, Grassland, Desert
- Aquatic Ecosystems – e.g., Pond, Lake, Wetland, River, Estuary

2. Man-Made (Artificial) Ecosystems

- e.g., Crop Fields, Aquarium

Global Ecosystem Concept

- Many ecologists view the entire biosphere as a global ecosystem -a composite of all the Earth's local ecosystems.
- However, due to its vast size and complexity, it is studied in smaller, manageable units.

Structure and Functional Aspects of an Ecosystem

- To understand an ecosystem, it is essential to study its structure and the flow of energy within it.
- The main components and processes are:

1. Input (Productivity)

- Energy capture from the sun, primarily through **photosynthesis**.

2. Energy Transfer

- Movement of energy through food chains, food webs, and nutrient cycles.

3. Output (Losses)

- Energy loss through degradation, respiration, and heat dissipation.

Interrelationships within Ecosystems

- Ecosystem processes create interconnected **cycles, chains, and webs**.
- These relationships ensure:
 - Continuous flow of energy

- Recycling of nutrients
- Maintenance of ecological balance

Ecosystem – Structure and Function

- An **ecosystem** is formed by the interaction of **biotic** (living) and **abiotic** (non-living) components, resulting in a self-sustaining system with characteristic structure and function.
- Understanding an ecosystem requires studying both its physical structure and functional processes.

Physical Structure of an Ecosystem

The physical structure is determined by the interaction between **abiotic** and **biotic** components.

1. Species Composition

- Identification and listing of plant and animal species in an ecosystem.

2. Stratification (Vertical distribution of species)

- Top Layer – Trees (in a forest)
- Middle Layer – Shrubs
- Bottom Layer – Herbs and grasses

Functional Aspects of an Ecosystem

All ecosystems function as a unit through **four** key processes:

1. Productivity

- Conversion of solar energy into organic matter by producers.

2. Decomposition

- Breakdown of dead organic matter into simpler substances.

3. Energy Flow

- Unidirectional movement of energy across trophic levels.

4. Nutrient Cycling

- Recycling of essential nutrients for reuse by producers.

Example – Pond Ecosystem

A **pond** is a small, self-sustaining aquatic ecosystem that clearly exhibits the four functional components.

1. Abiotic Components

- Water – Contains dissolved inorganic and organic substances.
- Soil Sediment – Rich in nutrients, found at the bottom.
- Climatic Factors – Solar radiation, temperature cycles, day length, and seasonal variations regulate biological activity.

2. Biotic Components

A. Producers (Autotrophs)

- Phytoplankton, algae, floating plants, submerged plants, and marginal plants.

B. Consumers (Heterotrophs)

- Primary Consumers – Zooplankton
- Secondary Consumers – Small free-swimming organisms (fishes, insects)
- Tertiary Consumers – Larger carnivores and bottom dwellers

C. Decomposers

- Bacteria, fungi, and flagellates (abundant in bottom sediments).

Functional Cycle in a Pond Ecosystem

1. Energy Capture

- Producers convert inorganic substances into organic matter using solar energy (photosynthesis).

2. Consumption

- Heterotrophs feed on producers or other consumers.

3. Decomposition

- Decomposers break down dead matter, releasing nutrients.

4. Nutrient Recycling

- Nutrients re-enter the system for reuse by producers.

Productivity

- A constant **input of solar energy** is essential for any ecosystem to function and sustain life.
- Plants capture this solar energy through **photosynthesis** and convert it into biomass, which supports all other organisms in the ecosystem.

Definition of Primary Production

Primary production

- The total amount of biomass or organic matter produced per unit area in a given time period by plants during photosynthesis.
 - Expressed as:
 - **Weight:** g m^{-2}
 - **Energy:** kcal m^{-2}

Productivity

- The **rate** of biomass production.
 - Expressed as:
 - **Weight per year:** $\text{g m}^{-2} \text{yr}^{-1}$
 - **Energy per year:** $\text{kcal m}^{-2} \text{yr}^{-1}$
 - Allows comparison between different ecosystems.

Types of Productivity

1. Gross Primary Productivity (GPP)

- The total rate of organic matter production during photosynthesis in an ecosystem.

2. Net Primary Productivity (NPP)

- The portion of GPP remaining after plant respiration (R) is subtracted.
- **Formula:**
 - **$\text{NPP} = \text{GPP} - \text{R}$**
- Represents the available biomass for consumption by heterotrophs (herbivores and decomposers).

3. Secondary Productivity

- The rate at which new organic matter is produced by consumers.

Factors Affecting Primary Productivity

- Plant species composition of the area
- Environmental factors (temperature, light, rainfall, etc.)

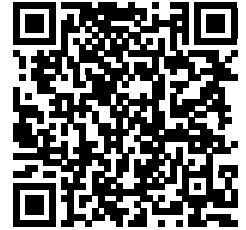


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