

Ecosystem

1. Concept and Definition of Ecosystem

The term **ecosystem** was introduced by **A. G. Tansley (1935)**. It refers to a **self-sustaining, functional unit of nature** in which living organisms interact with each other and with their physical environment.

Definition:

An ecosystem is a **dynamic complex of plant, animal, and microbial communities and their non-living environment interacting as a functional unit.**

Key features:

- Composed of **biotic and abiotic components**
- Involves **energy flow and nutrient cycling**
- Functions as an **open system** (exchange of energy and matter)

2. Structure of Ecosystem

The structure of an ecosystem refers to the **composition and organization** of its components.

A. Abiotic Components

These include physical and chemical factors that influence organisms:

(i) Inorganic substances:

- Carbon (C), Nitrogen (N), Oxygen (O), Phosphorus (P), Sulphur (S)

(ii) Organic substances:

- Carbohydrates, proteins, lipids, humic substances

(iii) Physical factors:

- Light
- Temperature
- Water
- Soil
- Climate
- pH and pressure

Role:

Abiotic components determine the **distribution, growth, and survival** of organisms.

B. Biotic Components

Biotic components include all living organisms and are functionally divided into:

1. Producers (Autotrophs)

- Green plants, algae, photosynthetic bacteria
- Convert solar energy into chemical energy via **photosynthesis**

Equation (conceptual):

Sunlight + CO₂ + H₂O → Glucose + O₂

Role:

- Primary source of energy
- Form the **base of all food chains**

2. Consumers (Heterotrophs)

Organisms that depend on producers or other consumers.

Types:

- **Primary consumers (Herbivores):** e.g., deer, rabbit
- **Secondary consumers (Carnivores):** e.g., frog, lizard
- **Tertiary consumers (Top carnivores):** e.g., lion, eagle

Some organisms may be **omnivores** (eat both plants and animals)

3. Decomposers (Reducers)

- Bacteria and fungi
- Break down dead organic matter into simpler substances

Importance:

- Recycle nutrients back to ecosystem
- Maintain **biogeochemical cycles**

3. Functional Aspects of Ecosystem

A. Energy Flow in Ecosystem

Energy flow is **unidirectional** and follows the laws of thermodynamics.

Process:

1. Solar energy captured by producers
2. Transferred to consumers
3. Lost as heat at each trophic level

Only about **10% energy** is transferred to the next trophic level (10% law).

B. Food Chain

A **linear sequence** of organisms through which energy passes.

Types:

1. **Grazing food chain:**
Plants → Herbivores → Carnivores
2. **Detritus food chain:**
Dead matter → Decomposers → Consumers

C. Food Web

- Interconnected food chains
- Provides **stability** to ecosystem
- More realistic than a single food chain

D. Ecological Pyramids

Graphical representation of trophic levels:

1. Pyramid of numbers
2. Pyramid of biomass
3. Pyramid of energy (always upright)

E. Nutrient Cycling (Biogeochemical Cycles)

Movement of nutrients between biotic and abiotic components.

Examples:

- Carbon cycle
- Nitrogen cycle
- Phosphorus cycle

Ensures **continuous availability of essential elements**

4. Trophic Levels

Each step in a food chain is called a trophic level:

Level Organisms

- I Producers
- II Herbivores
- III Carnivores
- IV Top Carnivores

Higher trophic levels receive **less energy**

5. Productivity of Ecosystem

Primary Productivity

Rate at which producers synthesize organic matter.

- **Gross Primary Productivity (GPP)** → total production
- **Net Primary Productivity (NPP)** → GPP – respiration

NPP represents energy available to consumers.

Secondary Productivity

- Rate of energy storage in consumers

6. Types of Ecosystem

A. Terrestrial Ecosystem

Land-based ecosystems:

1. Forest Ecosystem

- Dense vegetation
- High biodiversity
- Complex food webs

2. Grassland Ecosystem

- Dominated by grasses
- Moderate rainfall

3. Desert Ecosystem

- Low rainfall
- Sparse vegetation
- Extreme temperatures

B. Aquatic Ecosystem

1. Freshwater Ecosystem

- Lakes, rivers, ponds
- Low salinity

2. Marine Ecosystem

- Oceans, seas
- High salinity
- Rich biodiversity

3. Estuarine Ecosystem

- Transition zone between freshwater and marine

C. Artificial Ecosystem

- Man-made ecosystems
- Example: agricultural fields

Require **human maintenance**

7. Ecosystem Stability

Ecosystem stability refers to the ability to maintain balance.

Types:

- **Resistance:** ability to withstand disturbance
- **Resilience:** ability to recover after disturbance

8. Standing Crop and Biomass

- **Standing crop:** quantity of living matter at a given time
- Expressed as:
 - Number of organisms
 - Biomass (dry weight)

9. Functions of Ecosystem

- Maintains ecological balance
- Regulates environmental processes
- Supports biodiversity
- Ensures nutrient cycling
- Facilitates energy transfer

10. Importance of Ecosystem

- Life-support system of Earth
- Provides food, oxygen, water
- Maintains climate balance
- Supports economic activities