ECOSYSTEM
ENERGY FLOW

ENERGY FLOW:

- Usually it is unidirectional in an ecosystem. Sun light → **Producer** → **Consumer** → **Decomposer**
- Energy flow in ecosystem can be explained by two laws of thermodynamics.

(i) **First law of thermodynamics:** Energy can niether be destroyed nor synthesized but It can change in one form to another.

(ii) **Second law of thermodynamics :** When energy transfers from one level to next level then some energy is lost as heat or entropy.

Producers capture only a small fraction of solar energy flow decreases with successive trophic levels. Producers capture only a small fraction of solar energy (1-5 percent of total solar radiation), and the bulk of unutilised energy is dissipated mostly as heat. Part of the energy capture in gross production their standing crop (respiration) and for providing food to herbivores (herbivory). The unutilised net primary production is ultimately converted to detritus, which serves as energy source to decomposers.

Thus, energy actually used by the herbivore trophic level is only a small fraction of the energy captured at the producer level. On an average, in different ecosystems, the herbivore assimilation or productivity approximates 10 percent of gross productivity of producers.

The enrgy assimilated by the herbivores is used in respiration and a fraction of unassimilated energy is transferred to decomposers (eg., Faecal matter). The remaining herbivore level energy available at carnivore trophic level is again partitioned leaving a very small fraction to support the next trophic level (top carnivore).

The respiration cost also increases sharply along successive higher trophic levels. On an average, respiration in producer consumes about 20 percent of its gross productivity. Herbivores consume about 30 percent of assimilated energy in respiration. The proportion

of assimilated energy consumed in respiration rises to about 60 percent in carnivores. Because of this tremendous loss of energy at successive higher trophic levels, the residual energy is decreased to such an extent that no further trophic level can be supported. Therefore, the length of food chains in an ecosystem is generally limited to 3-4 trophic levels.

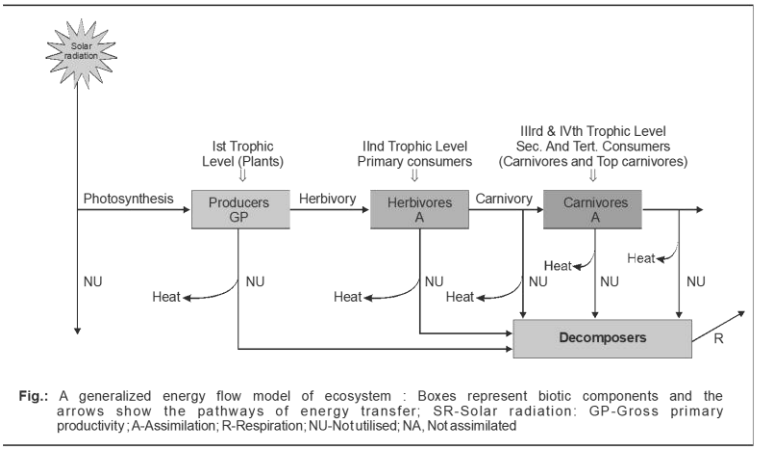

Fig.: A generalized energy flow model of ecosystem : Boxes represent biotic components and the arrows show the pathways of energy transfer; SR-Solar radiation: GP-Gross primary productivity ; A-Assimilation; R-Respiration; NU-Not utilised; NA, Not assimilated

TROPHIC LEVEL:

- **Any food level of an ecosystem or food chain is called trophic level.**

(a) Producers –T_1 **(b) Primary consumers –T_2**

(c) Secondary consumers –T_3 **(d) Tertiary consumers – T_4**

(e) Quartinary or Top consumers –T_5 **(f) Decomposers –T_6**

Parasites can present any trophic level

Food Chain

- In ecosystem every organism depends on other organism for food material and all organism are (herbivores to carnivores) arranged in a series in which food energy is transferred through repeated eating and being eaten. It is called food chain. In food chain, energy flow is in the form of food.
- In a food chain, food material or food energy is transfer from one trophic level to next trophic level.

- **Four trophic levels are present in the ecosystem, because level of energy decreases during the flow of energy from one trophic to the another trophic level.**
- **Five trophic levels** found in highly complex ecosystem in which tertiary consumer is present in between the secondary consumers and top consumer. Then the fifth trophic level (T_5) is formed by the top consumer.
- In food chain energy flow is **unidirectional** (producers to herbivores).
- Shorter food chains will provide greater energy.
- Generally the decomposers (Bacteria and Fungi) are not included in the food chain but when included then included as the last trophic level.

Type of Food Chains :

Food chains are of three types:

(a) **Parasitic food chain :** It starts from large organisms and ended on parasite/small organism.

Tree → Birds → Parasite

(b) **Detritus food Chain :** It starts from dead organic matter that is eaten by detrivores (**e.g.** earthworm) the latter is prayed by pr. carnivores that is captured by secondary carnivores.

Detritus → Earthworm → frog → snake

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Sparrow **Falcon / Hawk / Peacock**

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Falcon

(c) **Grazing food chain or predatory food Chain:** It starts from producers

(1) **Terrestrial ecosystem:**

(a) **Grass ⟶ Grasshopper ⟶ frog ⟶ Snake ⟶ Peacock / hawk**

(b) Grass ⟶ Dear ⟶ Wolf ⟶ Lion / Tiger

(c) Grass ⟶ Rabbit ⟶ Fox ⟶ Wolf ⟶ lion / Tiger

(d) Grass ⟶ Rat ⟶ Fox ⟶ lion / Tiger,

(e) Grass ⟶ Deer ⟶ Tiger / lion,

(f) Grass ⟶ Elephant.

(2) Aquatic ecosystem:

(a) Phytoplanktons → zooplanktons→ small fishes

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Large fishes.

(b) Phytoplanktons → Zooplanktons → Crustaceans

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Predatory insects

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Small fishes

↓

Large fishes

↓

Crocodile

(c) Phytoplanktons → Zooplanktons → Crustaceans

↓

Small fishes

↓

Birds – kingfisher

Note :

- In mangrove vegetation this food chain goes up to big organism.
- **Dead mangroves leave → Bacteria & fungi → Amphipds, molluscs, crabs, nematodes small fishes → fish eating birds**.
- It does not depends on **light.**
- In an aquatic ecosystem, GFC(Grazing Food Chain) is the major conduit (source) of energy flow. As against this, in a terrestrial ecosystem, a much larger energy flow through the detritus food chain (as it is small) than through the grazing food chain.

FOOD WEB

- In big ecosystem many food chains are interlinked together on different trophic levels to form food web. In food web transfer of food energy is unidirectional but from many different alternative pathways.
- In food web members of a particular trophic level obtain their food according to their choice and taste but that type of facility is not present in food chain. It means they have **more than one option or alternative for getting food.**
- **As mush as food web is complex that ecosystem is more permanent or stable,** such type of ecosystem is not destroyed naturally and continues for long time. This ecosystme is not affected by loss of any organism of any particular trophic level. **Those ecosystems which have simple food web are not very stable** it means that they can be finished at any time, if there is a change in any particular trophic level.