Rakesh Mohan rzoornc@*rediffmail.com*

ENERGY FLOW AND APPLICATION OF THE PRINCIPALS OF THERMODYNAMIC IN LIVING SYSTEM Part II

Energy Flow through Grazing Food Chain

Application of the principals of thermodynamic in living system may be well illustrated through various energy models.

*1. **Single-Channel Energy Models**:*

It is mainly based on Grazing Food Chain.

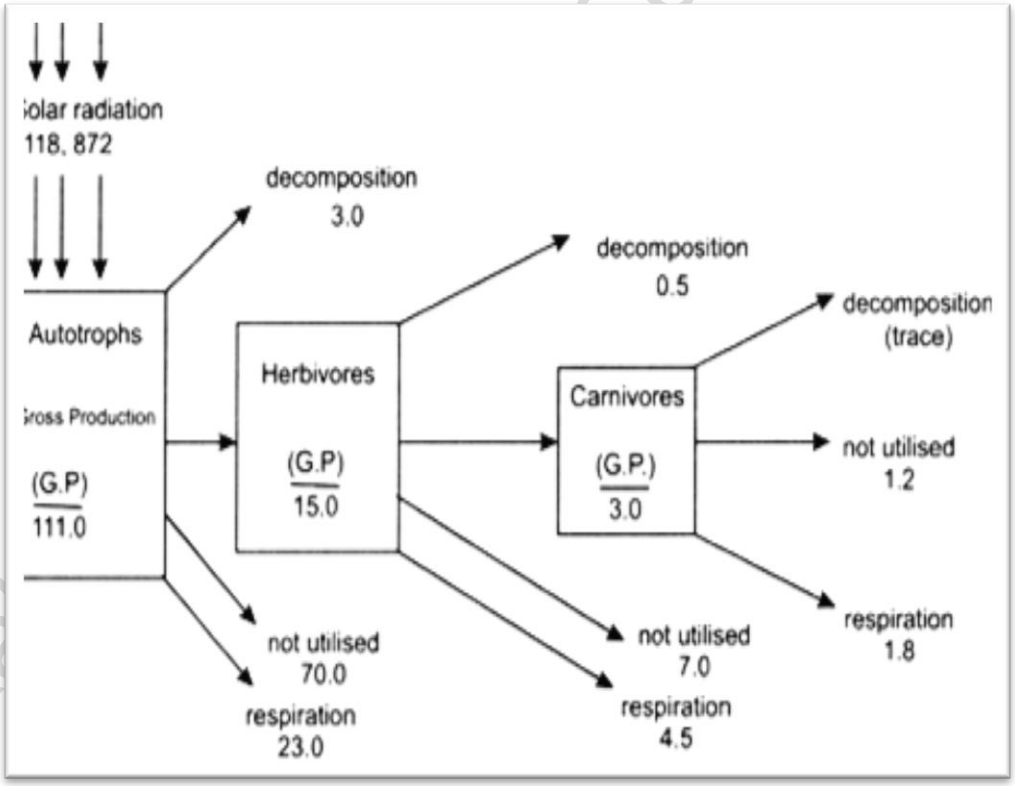
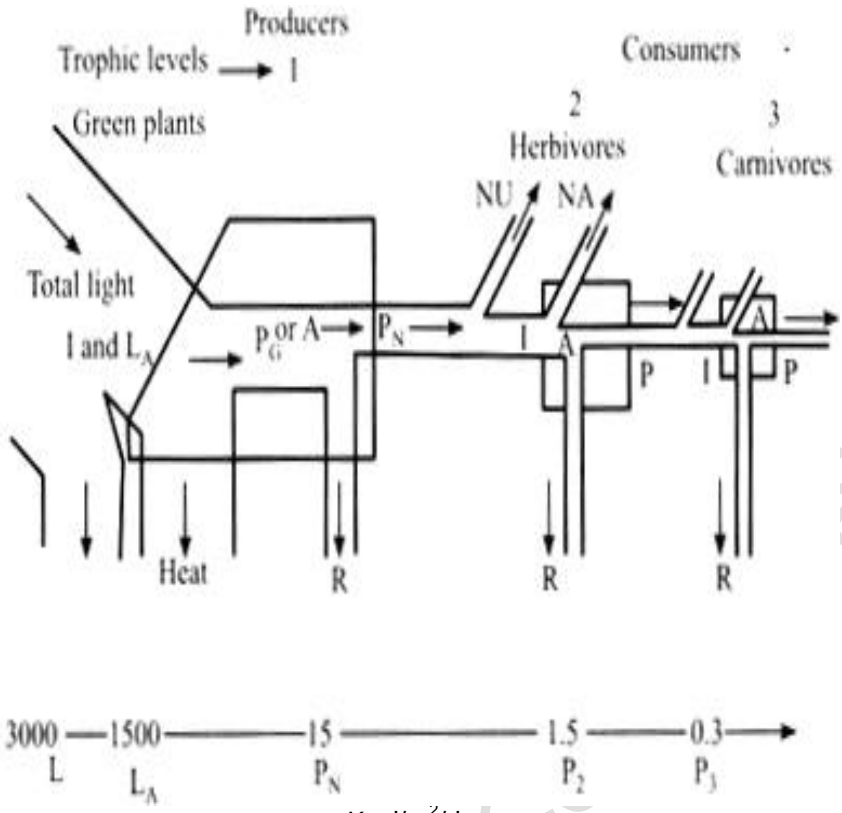


Fig – Diagrammatically representation of Energy Flow in lake for the Freshwater Ecosystem

Unit – g cal/cm^2/yr



A simplified energy flow diagram depicting three trophic levels

i. As shown in Figure out of the total incoming solar radiation (118,872 gcal/cm2/yr), 118,761 gcal/cm2/yr remain un-utilized, and thus gross production (net production plus respiration) by autotrophs is 111 gcal/cm2/yr with an efficiency of energy capture of 0.1 0 per cent.

ii. It may also be noted that 21 percent of this energy or 23 gcal/cm2/yr is consumed in metabolic reactions of autotrophs for their growth, development, maintenance and reproduction.

iii. It may be seen further that 15 gcal/cm2/yr are consumed by herbivores that graze or feed on Autotrophs-this amounts to 17 per cent of net autotroph production.

iv. Decomposition (3 gcal/cm2yr) accounts for about 3.4 per cent of net production.

v. The remainder of the plant material, 70 gcal/cm2/yr or 79.5 per cent of net production, is not utilised at all but becomes part of the accumulating sediments. (as per 2nd law of Thermodynamics)

vi. It may also be noted that various pathways of loss are equivalent to an account for energy capture of the autotrophs i.e. gross production. (**1st law of Thermodynamics**)

vii. Also, collectively the three upper 'fates' (decomposition, herbivore and not utilised) are equivalent to net production, of the total energy incorporated at the herbivores level,

viii. Again there is considerable energy available for the carnivores, namely 10.5 gcal/cm2/yr or 70 per cent, which is not entirely utilised; in fact only 3.0 gcal/cm2/yr or 28.6 per cent of net production passes to the carnivores. This is more efficient utilisation of resources than occurs at autotroph- herbivore transfer level.

ix. At the carnivore level about 60 percent of the carnivores' energy intake is consumed in metabolic activity and the remainder becomes part of the not utilised sediments; only an insignificant amount is subject to decomposition yearly.

From the energy flow diagram two things become clear.

i. Firstly, there is one-way street along which energy moves (unidirectional flow of energy). The energy that is captured by the autotrophs does not revert back to solar input; that which passes to the herbivores does not pass back to the autotrophs.

ii. Secondly, there occurs a progressive decrease in energy level at each trophic level

iii.

Energy inflows balance outflows as required by the first law of thermodynamics, and energy transfer is accompanied by dispersion of energy into unavailable heat (i.e. respiration) as required by the second law.

Thus at each transfer of energy from one level to another, major part of energy is lost as heat or other form. There is a successive reduction in energy flow whether we consider it in terms of total flow