## ECOLOGICAL ENERGETICS

The study of the energy relationships (inputs, storage, transfer and outputs) of ecosystems is called **ECOLOGICAL ENERGETICS.** Energy is the driving force of ecosystems. Organisms are accumulations of energy. Energy itself can take several forms or states. Four of these are most important:

1. **Radiant energy** – This is the energy of light and is composed of a broad spectrum of electromagnetic waves radiating from the sun.
2. **Chemical energy** – This is the energy stored in chemical compounds.
3. **Heat energy** – Heat energy results from the conversion of non-random to random molecular movements. This sort of energy is released whenever work is done. All types of work are included here, not only muscular contractions but also the complicated growth of organisms.
4. **Kinetic energy** (energy in motion) – This is energy which an organism possesses from its movement. The potential energy of chemical substances is converted to kinetic energy by means of movement when it is released to do work.

## ENERGY FLOW IN ECOSYSTEMS

Energy flow in ecosystems obeys the two laws of thermodynamics. **The first law of thermodynamics** which is also called **the principle of conservation of energy** states that energy may be transformed from one type into another, but it can never be created or destroyed. For example, light energy can be transformed into heat energy or into plant-food energy (chemical energy). In the process of transformation of light energy into plant-food energy, no energy is lost or destroyed, only its form is changed.

**The second law of thermodynamics**which is called **the principle of degradation of energy** states that no transformation of energy will occur unless energy is degraded from a concentrated form to a more dispersed form, and further that no transformation is 100% efficient.

Energy is quite different from matter in that it has unidirectional, non-cyclic passage through an ecosystem. During such a single cycle of energy flow in an ecosystem, the second law of thermodynamics shows that it is degraded as it progresses, so that it is gradually dispersed and lost to the surroundings in a non-usable form (entropy). The function of all biological systems, including crops, follows the second law of thermodynamics when solar energy ( a high-energy form) is converted into chemical energy. Plants utilize this chemical energy in the process of building their own tissue. Some of the energy being changed from light to chemical energy is lost as heat that dissipates into the surrounding environment.

**BASIC LAWS OF ENERGY FLOW**

The biotic (living) component of an ecosystem carries out two basic tasks:

1) Fixing and utilizing solar energy.
2) Conserving and recycling of mineral resources.

Energy from the sun is the ultimate driving force of all ecosystems. The collection of solar energy needed to power the entire ecosystem depends directly on the plant population. Plants themselves depend on solar energy to meet their own energy needs. Of the total collected about 25% is used for respiration, 35% for building and maintaining structure, and 35% for reproduction (seeds). Plants also produce a surplus used by the consumers and reducers/decomposers. Some animal consumers feed directly upon the plant population but others obtain their energy by feeding on the first- order consumers. In general, the amount of energy removed from the plant population by animals feeding on living plants is small, estimated at about 5%. The green plants do work with the energy of sunlight to collect nutrients from the soil and gases from the air to produce food. The food energy is passed through the system in the food chains and webs from one trophic level to the next. In this way, energy flows through the system. Ecologists have traditionally looked at this energy flow in ecosystems in the same way as other scientists have examined energy flow in other physical systems.

As the heterotrophs are unable to fix the solar energy, energy fixed by the autotrophs is made available to the heterotrophs through their food. As stated in the second law of thermodynamics, when the plants are eaten by the animals; the food is assimilated and transformed into animal tissues. This transformation is not 100% efficient and approximately 90% of the energy trapped in the plant tissues is lost from the animal body through excreta and metabolic activities and only 10% of the energy is stored in the herbivore tissue. When the herbivore is eaten by a carnivore; a third step of energy transformation takes place in the body of the carnivore and during metabolic activities and through excreta the carnivore looses a major part of the energy and approximately 30 to 50% is transformed as its body tissue.

The flow of energy through food chain from the autotrophs through herbivores and ultimately through the decomposers is a continuous process in any ecosystem. Energy input into the biota is through sunlight and the exit is in the form of heat which dissipates into the space. Within the ecosystem the energy is stored in living or dead organic parts which form food of the consumers and decomposers.