CYCLING OF NUTRIENTS IN ECOSYSTEMS

Movement and storage of energy in ecosystems are inseparable from the accumulation, storage, transfer and recycling of the chemical elements associated with this energy. Understanding one requires knowledge of the other. The study of the dynamics of these chemical elements is the focus of the ecological discipline known as BIOGEOCHEMISTRY. Energy enters, flows through, and is ultimately lost from an ecosystem. It does not cycle because it is not reused once it has been converted to heat. The chemical elements involved in this energy flow behave differently. Once they are released from their association with energy in an organic molecule, they are returned to the non living part of the ecosystem, where they may again become available for uptake by plants. Once in plants, they are reunited with solar energy in the form of a new organic molecule.

Alternatively, they may be moved to another ecosystem or may go into long-term storage. Chemicals associated with energy flow. i.e. nutrients, are therefore cycled: they are reused within the ecosystem indefinitely unless they are transferred to the cycle of another ecosystem or are converted to along-term immobile form. The cycling of nutrients in ecosystems is complex. Two simultaneous processes, MINERALIZATION and IMMOBILIZATION, are involved in nutrient cycling.

IMMOBILIZATION is the uptake of inorganic elements (nutrients) from the soil by organisms and conversion of the elements into microbial and plant tissues. These nutrients are used for growth and are incorporated into organic matter.

MINERALIZATION is the conversion of the elements in organic matter into mineral or ionic forms such as NH_3, Ca^2, H_2PO_4, SO_4^2 and K^+. These ions then exist in the soil solution and are available for another cycle of immobilization and mineralization.

The forest nutrient cycle has THREE major segments; viz:

i) the nutrient uptake;
ii) nutrient accumulation in the biomass (roots, stem, branches, leaves and other vegetation) and
iii) nutrient return.

Below is a diagram showing the pathways in typical biogeochemical cycles in natural forest ecosystems.:

PATHWAYS IN TYPICAL BIOGEOCHEMICAL CYCLES IN NATURAL FOREST ECOSYSTEMS

The nutrient storage pattern in soil, wood, litter and leaf differs in tropical and temperate forest ecosystems. In temperate regions more than 50% of the nutrients is always present in the soil, while in the tropics about 80% of the nutrients are locked up in the biomass as organic matter and only 20% is present in the soil. This situation may be due to slow decomposition rate in the cold temperate soils. Removal of temperate forest does not deplete mineral contents of the soil, while in tropical regions forest removal depletes soil of its mineral wealth by 80%. For this reason agriculture in 'forest clearings' in tropical countries fails after a couple of years as much of the minerals are removed along with the wood and the remaining portion is washed or leached away when the soil is exposed to heavy rains.