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Introduction

Ecology, the science of environmental interrelationships between organisms and environment, has now become much more important than ever before because of serious degradations in both the components of organisms and environment. There is a rapid loss of biodiversity, i.e. accelerated extinction of a wide variety of taxa and a great many have become vulnerable, rare and threatened for extinction. Equally alarming is the rate of environmental pollution, habitat degradation and global climate changes. Additionally, the erosion of ozone shield and enhancing ultraviolet-B and ozone have all led to increased importance of ecology and from biology its ramification to various other disciplines of study and human activity. Today ecology has become a household word and a concern of common man.

The evolution of life on the earth has gone hand in hand with the evolution of environment. The environmental conditions of the earth before the advent of life or at about that time was very different than what it is today. The evolution of environment has always been influenced by the organisms. Man has evolved very late in the geological history of our planet earth when the environmental conditions with respect to temperature regimes, rainfall and atmospheric gases, etc. had become nearly similar to what is found today.

Man's activities in ancient to very ancient pasts have shown in undisputed terms, his understanding of environment and its impacts on his life. He learnt to modify it for a better adjustment.

The art of producing fires, constructing houses for safety against sun, heat, cold, rain and predators, clothing, agriculture had something to do with environment. The informal ecology has been there all through the human civilization. Even as a discipline of study, aspects which we now put in ecology were studied by geographers, explorers, taxonomists, naturalists and herbal doctors (Ayurvedic system).

As a science ecology is relatively a young branch of biology which deals with the interacting system of organisms and their environment. The term *Ecology* (old spelling *Oekologie)* is of recent coinage (E. Haeckel, 1869) and has been derived from Greek words *Oikos* meaning house and *Logos* meaning the study. Therefore, ecology is the study of organisms in their natural home or habitat. Ernst Haeckel regarded ecology as the knowledge concerning the economy of nature, the total relations of animal to both inorganic and organic environment. Ecology is generally *defined as the study of plants and animals in reciprocal relationship with their environment or external world.* It appears possible that Hanns Reiter had used the term 'Ecology' before Haeckel. Even before this term was coined some of the outstanding biologists of those days has described the ecological concepts such of food chains and population regulations (Leeuwenhoek in early eighteenth century) and on biological productivity. Hilaire gave the term 'ethology' a few years before the term 'ecology' was coined to denote the study of interrelationships between different organisms. In early literature some biologists laid greater emphasis on plant communities like Frederick Clements and some on environment like Karl Friederick. V.E. Shelford too in 1929 has defined ecology as the *science of communities.*

Eugene P. Odum (1971) has defined ecology as *'the study of structure and function of nature'* or simply *'environmental biology'* F.E. Clements, known for his extensive contributions to plant ecology, has regarded ecology as *the science of community.* Famous British ecologist Macfadyen (1957) has emphasized that the purpose of ecology is discovery of the *principles which govern the relationships between 'plants or animals and their environment.* Ecology is one of the basic divisions of biology like others—morphology, physiology, cytology, genetics, taxonomy, etc. But it differs from them essentially in two ways: (1) that it always

comprehends along with organisms the non-living environment also and (2) that it deals with system of levels higher than the organisms in the biological spectrum of levels of organisation of systems of *genes, cells, organs, organisms, population* and *communities* (Fig. 1.1).

By system we mean a *unified whole made of regularly interacting and interdependent components.* Organisms on the one hand and non-living parts like material and energy, etc. on the other form the major components of the system which regularly interact among themselves and remain interdependent. Thus we have genetic systems, cell systems, organ systems and organismic systems formed by the interactions of genes, cells, organs and organisms respectively with the matter and energy flowing into them. These systems are mainly studied in other disciplines of biology like genetics, cytology and physiology. *Population systems* are formed by assemblage of a large number of individuals of any one species (populations) in a habitat in interaction with their environment and the *ecosystems* are

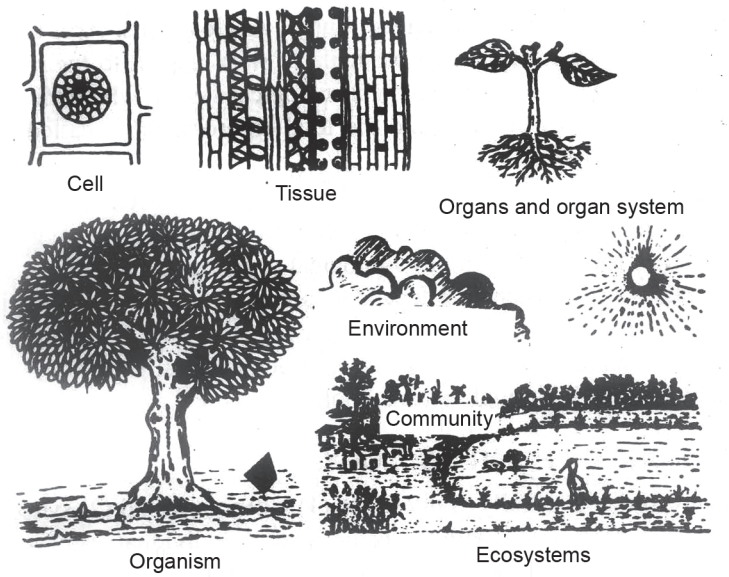

Fig. 1.1: Biological spectrum of levels of organisation. Ecology concerns mainly with the study of populations, communities, ecosystems and biosphere

formed by interaction of assemblage of a variety of populations, i.e. communities with their environment. These are the main structural and functional entities studied in ecology. Naturally populations and communities of all kinds of taxonomic entities like Algae, Fungi, Angiosperms, Arthropoda, Mammalia, etc. are studied particularly with respect to their functions in the ecosystem. The largest ecological system which includes all the organisms of earth and the total environment is called *biosphere* or *ecosphere.*

Like other divisions of biology, ecology has also been divided into plant and animal ecology. But in recent years there is a growing realization of the fact that in any biological organization the plants and animals are very much interdependent and plants and animals sharing the same habitats react with each other in many ways. Essential reference to animals as part of plant environment has, therefore, been frequently made throughout this book.

DIVISIONS OF PLANT ECOLOGY

Plant ecology is usually divided into (1) autecology and (2) synecology. *Autecology* deals with the ecology of an individual species and its population including the effect of other organisms and environmental conditions on every stage of its life cycle. *Synecology* deals with the ecology of plant communities. It involves the study of structure, nature, organisation and development of plant communities. Autecological studies of at least the more characteristic or dominant species of a community usually form a good basis for an understanding of synecology. The study of plant community structure is also *called plant sociology* or *phytosociology.* Other detailed and specialized aspects of ecology are termed variously to denote their specific nature such as *forest ecology, grassland ecology, freshwater ecology, marine ecology, desert ecology,* etc. all of which are related to the different types of habitats. *Palaeoecology* deals with organisms and their environment in the geological past; *cyto-ecology* deals with cytological details in species in relation to populations in different environmental conditions, *conservation ecology* deals with application of ecological principles for a proper

management of resources leading to high and sustained yield of useful biological materials for human welfare. Recently, the term *resource ecology* is being increasingly used and this deals with plants, animals, water and mineral resources and their judicious management. Pollution ecology deals with the problems of environmental deterioration and ways and means of keeping the environments clean. Ecosystem ecology deals with both plant and animal communities along with their total environment. In this both structure and function of the ecological systems are studied in relation to space and time. Special emphasis is laid on the flow of energy from the sun to green plants to animals and decomposers, etc. and the cycling of materials through the living systems. Ecological energetics and *production ecology* are the young branches of ecology. These deal with the mechanism and quantity of energy conversions and its flow through organisms, production processes, rate of increase in biomass of organisms in relation to space and time both by green plants (primary producers) and animals (secondary producers). This is measured in respect *of gross production* while the actual gain in production after deducting the loss due to respiration is called *net production.*

Various tools of other sciences, mathematics and statistics are increasingly applied in analysis of ecological systems. Application of radioactive materials, use of sophisticated instruments like photosynthesis systems, autoanalysers, gas-liquid chromatography, atomic absorption photometers, spectrophotometers, infrared gas analysers, flame photometers, elaborate field set up of electrical and electronic instruments to measure environmental factors, flow of energy, gas exchanges, use of computers in analysis of data, bomb calorimetry, culture of plants in environment controlled houses or phytotrons are some of the most modern means widely used in ecological research centres. Systems in ecology including analysis and modelling are the youngest but most important fields of ecology which take the help of mathematics, cybernetics, statistics and computer based programmes, etc. to translate the biological systems into the language of mathematics. Thus as in mathematical equations, the nature and extent of change in biological systems can be

predicted if this or that factor is added or deleted. This approach is holistic in which all the components are considered simultaneously instead of the factor-wise cause-effect conventional approach.

Thus we find that ecology is now a well-defined science rooted in biology, but studied with the application of very exact sciences like physics, chemistry, mathematics and computers and it has ramifications spread to diverse disciplines of sociology, anthropology, environmental sciences, medicine, technology and many others.

DEVELOPMENT OF ECOLOGY

Global Level

Before the agricultural civilization, man was essentially a hunter and food gatherer. He had mastered information on when and where to expect the presence of certain fruits, other food plants, animals that he hunted, the plants which healed the wounds, the affected bones, fever or other ailments, the plants with narcotic or drug properties, and many other things. There are excellent accounts about the natural vegetation and wild life in the Hindu epics like Ramayan and Mahabharat, preachings of Buddha and in writing of Aristotle and Theophrastus.

The formal ecology is only 150 years old. Burbour, Burk and Pitts (1980) have reviewed the progress of ecology in the western countries. F.H. Alexander von Humboldt (1769–1859), who had mastered knowledge in higher mathematics, chemistry, biology and geography, made extensive studies of the vegetation and environment, particularly through his long voyages from Europe to Peru, Mexico, Amazonia, Cuba and Venezuela. The first fourteen volumes of this book *Voyage aux Regions Equinoxialis* deal with the plants of these Latin American regions. J.F. Shouw (1789–1852) of the University of Copenhagen emphasised the importance of "temperature" factor in plant life and vegetation distribution. Kerner (1831–1898) in his book *Plant Life of Denube Basin* has given a wonderfully good account of vegetation, ideas about succession and about heritable and non-heritable variations in

populations of species. A.A.P. De Candolle, Adolf Engler and Charles Darwin made great impact on the science of vegetation in the nineteenth century.

J. Warming (1841–1924), also at the University of Copenhagen for the first time synthesized morphology, physiology, taxonomy and biogeography into one holistic branch of science. He described major vegetation types, communities, dominants and subdominant life forms, the role of soil and climatic factors like temperature and water in delimiting communities. He gave the terms: *hydrophytes, xerophytes, halophytes* and *mesophytes.* A Schimper (1856–1901) of the Strassburg and then Bonn University explained about the causes of difference in regional floras and in his book on Plant Geography. He has very much stressed on soil and climatic factors. Among the early American ecologists, H.C. Cowles (1869–1939) and F.E. Clements (1874–1945) were most outstanding. Cowles taught ecology at the University of Chicago and published works on vegetation dynamics. He organised the Ecological Society of America in 1915. Clements at first worked at the University of Nebraska and published on the phytogeography of the region and the vegetation of North America. He gave a comprehensive account of plant successions. He also described the regional formation (large units of vegetation) associations and on seral communities. Clements in co-authorship with J.E. Weaver produced one of the most widely read book on plant ecology (1929 and 1939). Gleason in 1926 criticised the ideas of Clements on succession and association.

Christen Raunkiaer of the University of Copenhagen (1934) gave the concept of life forms in plants. Sir Arthur Tansley, one of the founders and the first President of British Ecological Society (1914), gave the term **Ecosystem** (1935) and greatly influenced the growth of ecology. In France, J. Braun-Blanquet established the Zurich-Montpellier School of Phytosociology. W.H. Pearsall in UK worked on the lake ecology and among many ecologists that he trained, the two Indians *viz.* R. Misra and G.S. Puri on return to India founded the International Society for Tropical Ecology (1958) and Misra established the famous ecology centre at the Banaras Hindu University in 1937.

Eugene P. Odum of the Institute of Ecology, University of Georgia, USA has made tremendous impact on modern ecology mainly through his book *Fundamentals of Ecology* (3 editions), *'Ecology'* and *'Basic Ecology"*. He (1983) regards ecology as a 'hard' science in the sense that it involves tools of mathematics, chemistry and physics and a 'soft' science because of its root in natural sciences. Eugene, P. Odum, Howard, T. Odum, Ramon Margalef, Bernard C. Patten, George M. Van Dyne and Kenneth E.F. Watt have given quantitative perspectives to ecology during the sixties and seventies of 20th century. Gates, H.T. Odum, R. Lindman, Helmut Lieth, R.H. Whittaker, G.M. Woodwell and J. Phillipson have made notable contributions to ecological energetics, productivity and ecological models connected with them. F.H. Bormann, G.E. Likens, G.E. Hutchinson, J.S. Olson have worked out in great details the cycling of nutrients and water. Wiegert (1976) has edited the key papers on 'Ecological Energetics' between 1942 to 1970. Bolin and Cook (1983) have edited a volume on *"The Major Biogeochemical Cycles and their Interactions"*. Ambasht and Ambasht (1990–2014) have written the four editions of the book *Environment and Pollution* and Ambasht (1998) has edited *Modern Trends in Ecology and Environment*. Ambasht and Ambasht (2003) have edited two internationally multiauthored books, *Modern Trends in Applied Terrestrial Ecology and Modern Trends in Applied Aquatic Ecology*.

On populations there are a few important books such as the *'Population Ecology: A Unified Study of Animals and Plants'* by Begon and Mortimer (1981); *'Population Biology of Plants'* by Harper (1977). *'An Introduction to Population Ecology'* by Hutchinson (1978), and *'Introduction to Plant Populations'* by Silvertown (1987). Among some of the most important books on different aspects of ecology, a few are: *Basic Ecology* by Odum (1983); *Plants, Man and the Ecosystem* by Billings (1970); *'Plants and Environment'* and *'Plant Communities'* by Daubenmire (1974 and 1968); *Concepts of Applied Ecology* by De Santos (1978); *Concepts of Ecology* by Kormondy (1996); *Aims and Methods of Vegetation Ecology* by Mueller-Dombois and Ellenberg (1974); *Terrestrial Plant Ecology* by Barbour, Burk and Pitts (1988); *Communities and Ecosystem* by Whittaker (1975); *Introduction to Plant Geography* by Polunin (1960). Majumdar, et al. (1998),

Ecology of Wetlands and Associated Systems', Heywood and Watson (1995), *Global Biodiversity Assessment'*, Margalef (1968), *Perspectives in Ecological Theory,* McKinney and Schoch (1998), *Environmental Sciences;* Perring, et al. (1995), *Biodiversity Loss;* Schulze and Mooney (eds. 1994), *Biodiversity and Ecosystem Functions.* Schulze, Beck and Muler-Hohenstein (2004) have brought out an updated edition of Plant Ecology. Ambasht and Ambasht (2019) have produced the landmark sixteenth edition of this book.

A number of ecologists have started working on pollution effects on plant life particularly those caused by industrial fumes; liquid effluents discharged in agricultural lands, rivers and sea coasts and the work are appropriately cited in a separate chapter on this aspect.

During the International Biological Programme (1964–74) many ecologists have worked on the production (biomass and energy) ecology of terrestrial, freshwater and marine ecosystems with emphasis on systems analysis. Conservation studies of biological resources are also being actively carried out in most of the centres. A series of IBP hand books have been published. In the final phase of IBP, a synthesis of World data has been done and the Cambridge University Press has published a number of volumes on IBP results in the last few years. In two volumes on grasslands a number of Indian ecologists have synthesized data on tropical grasslands.

Ecological researchers are becoming more and more applied to human welfare due to such international efforts as those of IBP, MAB (Man and the Biosphere Programme of UNESCO), UN's Stockholm conference (June 1972) on 'Human Environment' and the Earth Summit at Rio de Janeiro in June 1992 and follow up action. IUCN (International Union for Conservation of Nature and Natural Resources), Switzerland, renamed now as World Conservation Union but the abbreviation IUCN is retained. Publication of a few very important journals as *Tropical Ecology, Indian Journal of Ecology, International Journal of Ecology and Environmental Sciences,* has helped in the propagation of new ecological knowledge developed in India and other tropical regions.

Roberts S., De Santo (1978) has given the vast array of career choices that could be available to an ecologist. Depending upon his special aptitude for field or laboratory studies, for plants or animals, or for theoretical or practical work he can select any one of them. But the essential feature in ecology is that whatever the field of detailed investigation an ecologist may select, he has to know something of other components of the ecosystem. De Santo has divided the ecological hierarchy into three—*zoological, microbial and botanical* and each could be studied at three levels—*cellular, organismic and community* (ecosystem). Further the habitat could be aquatic, aerial and terrestrial and in the climatic belts of *tropical, temperate* or *polar.* Further the system could be *natural* or *manipulated* and could be *clean or polluted* and the study could be *theoretical* or *applied.* Thousands of possible combinations of career within the above matrix could be available.

Indian Level

In India ecological studies began with the descriptive accounts of forests by the officers engaged in forests services in the first two decades of the twentieth century. The first comprehensive ecological paper from Universities appeared in 1920 on the ecology of the Upper Gangetic Plains by Professor Dudgeon of Allahabad wherein he also discussed such ecological principles as the role of environment in succession of communities. With the return of Professor R. Misra to Varanasi from Leeds (UK) after his extensive researches on the ecology of English Lakes (1938), his ecological investigations on some aquatic plants (1944) ravines and eroded river banks (1944), methods of soil studies (1945) and low-lying areas (1946) and on the autecology of *Lindenbergia polyantha* (Misra and Siva Rao, 1948) were published. Phytosociological studies were initiated in the country by Bharucha and his students specially with regard to the biological spectrum of Mahabaleshwar (Bharucha and Ferreira, 1941). Puri (1950, 1951) made extensive forest ecological investigations.

On almost all aspects of ecology extensive ecological researches have, since then, been done by Professor R. Misra and his numerous students spread throughout the country.

Misra and Puri (1956) have given a general account of literature on ecology in India. Further, Misra (1957) has reviewed the progress of ecological researches in the country and Misra and Singh (1971) have again reviewed the progress of ecology in India. Ambasht, Shardendu and Sikandar (1983) have reviewed the state of aquatic climate and productivity in India.

Autecological studies of grassland and wasteland herbaceous species like *Euphorbia hirta, Euphorbia thymifolia, Setaria glauca* (Ramakrishnan, 1959), *Cyperus rotundus* (Ambasht, 1964, Tripathi, 1965), *Xanthium strumarium* (Kaul, 1959), *Alhagi camelorum* (Ambasht, 1963*), Alysicarpus monilifer* (Maurya and Ambasht, 1973) have been done. Autecological studies on several medicinal plants have also been made at Varanasi. Quite a few interesting facts and phenomena have come to light from these works. Many cropland weeds have also been intensively studied for their autecology by Misra (1969). Marwah and Ambasht (1972) and Ambasht and Chakhaiyar (1979) have studied crop-weed competition and productive structure in wheat and mustard crop communities. Ambasht (1977) and Ambasht and Lal (1977) have given an account of adaptation in weeds on Ganga river bank and the role of temperature and water in regulating seed germination and distribution of *Chrozophora rottleri*—a weed of low lying floodable lands coming up during dry phase. Lal and Ambasht (1979 a and b) have studied seed output, germination, reproductive capacity, productivity, growth analysis and energy content in *Scoparia dulcis.* Ambasht and Lal (1979) have reviewed autecological findings on weeds.

Synecological works have been done in forests, grasslands deserts, freshwaters and other specialized habitats. The Himalayan forests have been studied by Puri (1950, 1951) and Mohan and Puri (1955, 1956). Misra and Joshi (1955) and Waheed Khan (1956) have given accounts of Madhya Pradesh forests. Puri (1960) has given a comprehensive account of Indian forests in his book *Indian Forest Ecology* which has been enlarged for a three volume series of which the first has been published (Puri, Meher-Homji, Gupta and Puri, 1983). Productivity studies in forests have been made specially in the Vindhyan forests by Misra (1969b) and Singh and Ambasht

(1979, 1980). Pandeya et al. (1971) have described the forest ecosystems in the Narmada river catchment areas. In the Eastern Himalaya forest, Sharma and Ambasht (1984) have for the first time measured the rate of nitrogen fixation by different age group of root nodules bearing actinorhizal *Frankia* in the trees *of Alnus nepalensis.* They have also measured the rate of primary production in terms of biomass and energy in *Alnus* plantation forest. Ambasht, Singh and Misra (1982) have found that on the Vindhyan forest lands, solar energy fixation rate is better by grass dominated stands than shrub on tree stands particularly teak plantation stands. Sharma and Ambasht (1983) have developed a correlation factor for computing the effective ground area in productivity studies for forests on sloping habitats. More than 90% of nodules of *Alnus* after death get decomposed within one year (Sharma and Ambasht, 1986).

Grassland communities have been studied in small patches of land for phytosociology, reproductive capacity, production in relation to a variety of ecological factors especially grazing (Ambasht and Maurya 1970a, 1970b, Singh and Ambasht, 1980). The productivity of grasslands protected against grazing is found to be quite high in *Dichanthium* and *Heteropogon* grasslands (Ambasht, Maurya and Singh, 1972). A number of productivity works in India have been published in the New Delhi symposium volume *Tropical Ecology with an Emphasis on Organic Production* (Golley and Golley, 1972) from grasslands, croplands, forests and freshwaters. Singh and Ambasht (1975a, 1975b) have worked out the inter-relationships among community structure and productivity of grasslands, Ambasht and Singh (1979) have worked out interspecific associations among the grassland species. For Vindhyan Hills, Ambasht and Pandey (1981) have given detailed account of phytosociology and productive structures of *Aristida cyanantha* dominated grasslands. Misra (1983) has given a detailed account of Indian savannas. Specialized habitats such as walls (Varshney, 1968) and eroded river banks (Ambasht, 1968, 1977) have also been studied ecologically for the vegetation they support. Ambasht, Singh and Sharma (1984) have evaluated the role of riparian herbs in the conservation of soils, nutrients and water. Desert ecology has been investigated by a number of people associated with the

Central Arid Zone Research Institute in Rajasthan. Several ecologists have given accounts of freshwater vegetation (Misra, 1946, Ambasht, 1968, 1970). Varshney and Singh (1976) and Ambasht (1974, 1976) have dealt with the aquatic weeds and their control measures. Billore and Mall (1977) have made extensive studies on the biomass structure and nutrient dynamics in *Sehima* and three other grazing lands of Ujjain. Gupta and G.P. Mishra (1985) have worked out the energy budget of *Themeda* grassland at Jhansi. On a very broad regional basis for the Indian and South Asian savannas. Singh, Hanxi and Sajise (1985) have reviewed the distribution of five major Savanna types strongly governed by climate and latitude. These are: (1) *Sehima-Dichanthium,* (2) *Dichanthium-Cenchrus-Lasiurus,* (3) *Phragmites-Saccharum-lmperata,* (4) *Themeda-Arundinella* and (5) The temperate-alpine types. J.S. Singh (1973, 1976), Singh and Joshi (1979), Singh, Singh and Yadava (1979) and Singh and Yadava (1974) have made extensive contributions to Indian grassland ecology. M.K. Misra and B.N. Misra (1981, 1985) have analysed the grassland community structure in Berhampur, Orissa.

In later years there has been thrust mainly on pollution, conservation, rehabilitation and other applied aspects. Water and air pollution have been particularly studied such as the wetlands and rivers systems, and gaseous pollution due to NO_X, SO_2, HF, CH_4 production, enhanced UV-B irradiation impacts, etc.

Primary productivity of wetlands in context of global climatic change has been described by Ambasht and Srivastava, N.K. (1991). Conservation and management as well as on rehabilitation on river corridors have been studied by Ambasht (1992), Ambasht and Ambasht (1992), Ambasht and Shanker (1992), Ambasht and Srivastava (1994), and Ambasht, Kumar and Srivastava (1992, 1994). Soil erosion and movement of nutrients like nitrogen and phosphorus down the riparian slopes have been measured under the protection of vegetal covers by Kumar, Ambasht and Srivastava (1992a and b) and on water quality of rivers receiving factory effluents by Srivastava, Ambasht and Kumar (1991) and Srivastava, Ambasht, Kumar and Shardendu (1993). John Mitsch (1994) has edited a volume 'Global Wetlands, Old World and New'

which gives account of wetland ecology in different perspectives from all over the world and is based on papers presented at the International Wetland Conference in Columbus, USA (1992). Gupta (1992) has discussed the problems and reviewed the literature related to restoration of degraded watersheds. Singh (1992) has edited an excellent volume on *'Restoration of Degraded Land: Concepts and Strategies'*, in which Ambasht and Shankar (1992) have described river corridor restoration.

Abrol, Wattal, Gnanam, Govindjee, Ort and Teramura (1991) have edited a volume containing 53 papers on different problems related to *'Global Climatic Changes on Photosynthesis and Plant Productivity'*. It includes material on UV-B effects, CO_2 enhancement effects and other environmental stress effects on agroecosystems and natural ecosystems.

Ambasht (1993), Ambasht and Srivastava (1992), Srivastava and Ambasht (1994a, 1994b, 1995) have studied nitrogen dynamics in tropical trees particularly in actinorhizal *Casuarina equisetifolia* plantations.

N.K. Ambasht and Agrawal (1994) and Ambasht (1998) have reviewed literature on the impact of UV-B irradiations on crop plants and Ambasht (1993, 1994(b), 1995, 1997 and 1998) has studied the impact of its enhanced dosages under field conditions on rice, maize and sorghum crops. He treated rice plants with UV-B radiations predicted at 20% ozone depletion and found a decreased photosynthesis, accompanied with decline in chlorophyll *a, b,* carotenoid and anthocyanin contents and rise in flavonoids. The enzymatic activity of catalase declined while of peroxidase increased. Ascorbic acid content was also reduced while phenolic contents increased (Ambasht and Ambasht (2005).

The latest thrust area in the field of ecology is the conservation of biodiversity. At the Earth summit or the United Nation's Conference on Environment and Development (UNCED) in June 1992, in Rio de Janeiro, Brazil all aspects of biodiversity and problems of rapid extinction received much attention.

Reid (1992) has critically examined the issue 'Can the extinction crisis be stopped' in his paper on conserving life's

diversity, nature's variety or gene pools is recognized now as a basic requirement for sustained growth and economic development. He has outlined the scope of biodiversity conservation through creation of knowledge, awareness, ethics and input of information for actions at farm, village, forest or laboratory in bioregional, national and international levels. However, it is to be clearly understood that the present day dimensions of biological impoverishments are being driven by strong forces and they cannot be changed by the current level of restorative actions. At most this may turn out to be only stop gap measures unless advances are made in dealing with overconsumption of resources, population growth, misguided resource management, policies, and social and economic inequities (Reid 1992). Ambasht, Srivastava and Ambasht (1994), Ambasht and Ambasht (1998a, 2002) have reviewed literature on biodiversity definitions, causes of their loss and extinction, ecological and economic importance and different methods of biodiversity conservation, both *in situ* and *ex situ.* Ambasht and Ambasht (1998b and 2002) have reviewed the ecology of Indian wetlands, soil and nutrient conservation by vegetal cover and biodiversity with special reference to soil subsystem.

During the last few decades there is a major focus on ecological problems and environmental awareness. There is much need on conservation of natural resources and biodiversity. To protect our mother earth from loss of biological diversity and rapid extinction of wild life, plants and commercialization activities United Nation has declared 22nd April as Earth Day.

Due to rapid industrialization, urbanization and commercialization activities have led to a wide spread surge in pollution load, environmental degradation, habitat destruction, rapid loss of plant diversity, sudden rise in rate of extinction of many wild species and wild relatives of domesticated animals and cultivated cereals and other plants. Global climate changes creating rise in the earths temperature and CO_2 level and increased ultraviolet-B radiation (280–320 nm) at ground level. The two global conferences of the United Nation's in 1972 and 1992 and international programs of Man

and Biosphere (MAB), International Biological Program (IBP), International Geosphere Biosphere Program (IGBP), International union for conservation of nature resources (IUCN) and World wide life Fund (WWF) have focused attention of ecologist, environmentalist, NGO's Policy makers towards better conservation of our natural resources.

With the advancement of ecology the major threats identified by the United Nations Conferences on Environment and Development (UNCED) held at Rio de Janeiro are related to (1) Global climate change and (2) biodiversity losses. To conserve our biodiversity peoples participation is recommended. Biodiversity conservation has to be a continuous process with an ecologically holistic approach, economic return, educational and tourism values and sustainable characters. Pott (1992) has highlighted for environmental conservation in commercial forestry enterprises. Ambasht (2014) has focused on biodiversity loss impacts on environmental pollution and climate change.