CHAPTER I

INTRODUCTION :

FUNDAMENTALS OF ECOLOGY AND ENVIRONMENT

Ecology and Environment : Ancient and Historical Prudence

> *" Oh, mother Earth - Let your mountains clad peaks bring us happiness. On this multi-colour Indra-Gupta Prithvi, let me enjoy never ending happiness and gain ever-lasting glory without fear from defeat."*[1](sic)
>
> – Atharva Veda

The Sanskrit word for **'ecology and environment'** is ***'Paryavaran'***. Grammatically this word is a conjunction of two words i.e., ***'Pari'*** which means a **'round circle'** and ***'Avaran'*** which means a **'cover'** and, thus, ***'Paryavaran'*** means a **'cover around'**. And this covers everything above the surface of the earth, obviously, this 'avaran' or 'cover' is the concern of the **ecologists and environmentalists.**[2]

India has a long tradition of protecting and worshipping the nature.[3] Eversince Vedictimes, the main motto of social life was to have in harmony with the nature. Sages, saints and the great philosophers of India lived in forests and on mountains where they mediated and expressed in the form of Vedas, Upanishads and Smrities.[4] These ancient scriptures of Hindu religion give a detailed description of trees, plants and wild life and their importance to the community.[5]

Vedic Seers and ancient Maharishis have luminously revealed that *'God sleeps in minerals, wakes in animal, thinks in man'*.[6] This could be extended to say that God swims in fish, flies in bird, and sings in wind. Hindu mythology recognizes not only

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1. Justice Ashok A. Desai, *Environmental Jurisprudence,* (2002), in 'Prologue', p. ix.
2. Panna Lal Mundhra, *'Environment and Animals'*, published in *The Assam Tribune*, dated, December, 11, 1996.
3. Dr. I.A. Khan, *Environmental Law,* (2002), p. 22 .
4. Ibid at p. 24.
5. Vikash Vashishth, *Law and Practice of Environmental Laws in India*, (1999), p. 5.
6. Justice Ashok A Desai, *Environmental Jurisprudence*, (2002), p. 6.

omnipotence but also, therefrom, omnipresence of God. Hinduism preaches that every species and plant bear an element of God and they be treated accordingly.[7] It follows, therefrom, that damage to any part of the environment is an injury or insult to God. The entire environment was, thus, held in the highest esteem as if it represented the Almighty. Invisible God has been omnipresent. Similarly the environment is all pervasive.[8]

The ancient scriptures described the earth as **'Goddess Mother'** and held each component of nature in the esteem of demi-God, which has been the highest status, eversince known to the civilization[9] Obviously, nature maintains life and livelihood of human race and all creatures. The environment, therefore, is also a guardian of the human race. In the highest tribute, earth has been held to be both mother and father of all creatures. Atharva Veda (ancient scripture) maintains: '*The Earth is Heaven. She is at times, mother and father and product of Antariksha. Whatever has been, is being and will be created, is all due to the originator Earth*'(sic).[10] All the creations, for all the time, have been due to **'Mother Earth'**. Earth has been held to be a heavenly abode for all creatures. Earth being both father and mother, as well, renders protection, showers love and affection on all creatures.[11]

Like other creatures on the earth, humankind also continued to be nomadic and was inseparable from nature. Several centuries thereafter, man changed his life-style. They became domesticated and felt the need for food, shelter and clothes. To accomplish these needs, they started removing forest for agriculture and inhabitation. This was the beginning of human interference in the domain of environment. Man felt wounded even before, he inflicted injury to **'Mother Earth'**. As stipulated in Atharva Veda, he prayed : '*Whatever, I dig from thee 'O' Earth, may that have quick growth again. 'O' purifier, may we not injure the vital heart*'(sic).[11-A]

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7. Ibid.
8. Ibid.
9. Ibid.
10. Ibid at pp. 6-7.
11. Ibid at p. 7 .
11-A. Ibid at p. 7.

What was impressed upon was that for taking anything from **'Mother Earth'**, man holds himself guilty and prays for early recovery of the things so taken so as to relieve himself of the sin. Whatever, human being used to receive from the earth, he had to return. There had been a bondage of gratitude between humankind and environment."[11-B]

Humankind made its pledge, by submitting to the earth's benevolent command. With a deep sense of gratitude, human race expressed their indebtedness, for everything they received. As seen, Atharva Veda prescribes a prayer for the enrichment of Mother Earth :

> *"Let the Mother Earth, enriched by oceans, rivers, bounty of rains and satisfying the entire living world by agricultural products, food grains, juicy fruits, help us in establishing ourselves on its rich part of the soil"*(sic).[11-C]

'Environmental ethics' has always formed an inherent part of Indian religious precepts and philosophy.[12] Worship of nature – Sun, Moon, Earth, Air and Water – was not merely a primitive man's response to the fear of unknown, but arose from the deep reverence shown to the forces of nature which sustained and preserved human life on earth.[13] The basic tenet that underlines this deep reverence for nature is the belief that life is a singular, continuous and uniform phenomenon and even a small change in one part of the ecosystem is likely to reverberate throughout the system.[14] According to our religious scriptures, water is the lifeline of vegetation which, in turn, is the source of human life. The highest plenary existence mandates a balance of earth, water, vegetation and human life.[15]

The concept of sustainability has, since long past, been a part of our cultural,

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11-B. Ibid.

11-C. Ibid at p. 8.

12. Justice Ashok A. Desai, *Environmental Jurisprudence*, (2002), in 'Forword' written by Justice Kuldip Singh, p. xv.

13. Ibid.

14. Ibid.

15. Ibid.

religious and social ethos, in as much as, our scriptures, legends and philosophical treatises are replete with ideas similar to those prevalent today. The Upanishads emphasize use of nature without greed and cautions that no creature is superior to others and hence human beings should not have absolute power over nature.[15-A]

If we broadly classify the components of our nature, we can classify them in four categories, i.e. 1. Air, 2. Water, 3. Land, and 4. Forests and Wildlife. The entire Indian way of life was based on these four pillars of preservation and protection of these components of nature.

1. "Baiyu - raksha" i.e., preservation and protection of ambient air ;

2. "Jal-raksha" i.e., preservation and protection of water and its resources ;

3. "Bhu-raksha" i.e., preservation and protection of soil or mother earth ;

4. "Van-raksha" i.e., preservation and protection of forests and wildlife ;

The ideas of legal protection of **'ecology and environment'** are not new to Indians. The concepts of *'suraksha'*, *'nyaya'* and *'danda'* to protect and preserve the *'paryavaran'* are evident from Kautilya's **Arthashastra**[16] and the writings about the system of governance adopted by Ashoka.[17] Kautilya's Arthashastra (written between 321 and 300 B.C)[18] is a treatise on administration in which Book III and Book IV deal with Civil and Criminal Law respectively. However, a deeper study shows that the law is scattered throughout the work.

Kautilya was the Prime Minister of the Magadha Empire during the reign of Chandragupta Maurya. The Arthashastra is divided into 14 books that discuss a wide range of subjects, including administration, law, industry, commerce and foreign policy. Although, the principal provisions dealing with the environment are in Book II, some

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15-A.Dr. Dulal Chandra Goswami, *'Sustainable Development is the Answer'*, published in *The Assam Tribune,* dated, June, 5, 1997.

16. Shyam Divan and Armin Rosencranz, *Environmental Law and Policy in India: Cases, Materials and Statutes*, (2001), p. 24.

17. Ibid at p. 25.

18. Ibid at p. 23.

shlokas (stanzas) are found elsewhere in the work.[19]

In this classical book, Chanakya had imposed severe penalties for killing, entrapping or molesting dear, bison, birds and fish in protected areas.[20] Kautilya's Arthashastra bears testimony to the prevalent laws of earlier times to preserve the **'ecosystem'**[21]. Kautilya specifically says that the notified carnivorous animals, birds and aquatic animals, as well as, animals in the notified areas are neither to be caught, killed or molested. A fine was levied on one indulging in entrapping, killing or molesting fishes and birds.[22] According to Kautilya, causing pain by killing smaller animals is a cognizable offence to be punished with a fine. In case of bigger animals, the fines are to be doubled along with compensation of cost of medical care.[23] However, permission is accorded to kill a wild animal if the situation is likely to go beyond control.[24]

The Kandhar inscription speaks of the success of Ashoka's policy with the hunters and fishermen, who gave up killing animals and possibly took a settled agricultural life.[25] Emperor Ashoka forbade killing certain birds and animals and completely prohibited the slaughter of animals in the capital.[26] He emphasized compassion towards animals. He taught people to live and let live.[27] Within the empire he appointed a class of officers known as the **'rajukas'** who were vested with the authority of not only rewarding people but also punishing them, wherever necessary[28]. Ashoka's **'Fifth Pillar Edict'** declared game and fisheries laws, as early as, third century B.C.[29]

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19. Shyam Divan and Armin Rosencranz, *Environmental Law and Policy in India : Cases Materials and Statues*, (2001), p. 23.
20. P.S. Verma and V.K. Agarwal, *Principle of Ecology*, (1989), p. 538.
21. Dr. Mukta Biswas, *'Environmental Awareness in Ancient India'*, published in *The Assam Tribune,* dated, July, 3, 1998.
22. Ibid.
23. Ibid.
24. Ibid.
25. R.S. Sharma, *Ancient India,* (1990), p. 103.
26. Ibid at p. 104.
27. Ibid.
28. Ibid at p. 103.
29. P.S. Verma and V.K. Agarwal, *Principles of Ecology*, (1989), p. 538.

Sanatan Dharma has sought the best way of conservation of wild life by linking some animal with the specific god or goddess and, thereby, rendering it pious and protected. For example, python has been associated with God Vishnu, snake with God Shiva, peacock with Goddess Saraswati and Lord Krishna, owl with Goddess Laxmi, lion with Goddess Kali and so on.[30] Mahabharata and Ramayana contain many references indicating how rishis and munis conserved wildlife fauna (mostly deer and birds) around their ashrams.[31] Certain other indigenous religions of India like Buddhism and Jainism strongly advocated the ideas of non-violence and, thus, partially check the destruction of wild life by hunting.[32] Even Mughal Emperors exhibited their deep interests in wildlife of India. For the protection and preservation of game animals they created hunting reserves called *'Shikar Gaha'*.[33]

The ancient ancestors of the age of Vedas and Upanishads, the composers of Puranas and Smritishastras pointed out to the necessity of a harmonious relationship between living beings and the entire environment.[34]. To live and to enjoy life, every living being needs a proper and permissible environment.

Animals, birds, trees, shrubs, herbs, in short, **'nature'** has always been revered by the Indian people from time immemorial. People showed respect for nature, both flora and fauna, in the same way, as they showed reverence to gods and goddesses. The Hindus, through the ages, have assigned religious or respectful status to innumerable animals and birds from the tiny mouse to the mighty lion.

There are numerous stories or anecdotes that depict the importance of trees in ancient India.[35] Some stories even go to the extent of saying that *'trees are more important than human beings'* Another saying is this– ***'dusaputra samadruma'*** i.e., planting a tree

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30. Ibid.
31. Ibid.
32. Ibid.
33. Ibid at p. 539.
34. Dr. Mukta Biswas, *'Environmental Awareness in Ancient India'*, published in *The Assam Tribune*, dated, July, 3, 1998.
35. Ibid.

is equally beneficial as having ten sons.[36] The references to the plantation of trees in Mahabharata and Puranas are rich with environmental awareness. The following verse of *Brahmavaivartapurana* is perhaps capable of becoming a motto for the propagation of plantation – *'putrairvine subhaphalam na bhavet naranam, dus putrakairapitathobhaya lokanasah, etadvicarya sudhiya paripalay vrikshan'* which means that if sons, even after being a human do not perform any meritorious deeds, they are not worth having rather than giving birth to such son it is better to plant and grow tree.[37]

Ancient people prevented felling of trees without reason by levying various punishments on the defaulters.[38] Cutting away sprouts of trees and plants grown for fruits, flowers and shades in gardens and in towns was liable to be punished with a fine of six *panas*. A fine of twelve *panas* was levied for cutting down a small branch. Axing down a big branch invited a penalty of twenty four *panas*. Cutting down the stem was punished severely. A more severe punishment was awarded if a plant was uprooted.[39] Manu prescribed expiations of reciting the Vedic *mantras* to purify one self in case one cuts down the herbs.[40]

During the vedic age, '*yajnas*' were conducted for purification of air. In ancient time, *Agnihotra*-sacrifice was the best known means to protect this colourful world from air pollution.[41] Cowdung, cow's milk etc., were used during this sacrifice. At present scientists are engaged in analyzing the gases evolved during the *Agnihotra* and accept that the *Agnihotra* sacrifice is one of the means to control air pollution.[42] The ancient people showed high concern towards the element of water, the vital natural resource. Rig Veda reveals that waters are **'mother par excellence'**.[43] Though guided with religious consideration, it was aimed at achieving the desired goal of keeping the environment intact.

Ancient people took some precautions to preserve natural sources of water from

36. Ibid.
37. Ibid.
38. Ibid.
39. Ibid.
40. Ibid.
41. Ibid.
42. Ibid.
43. Ibid.

getting polluted. They advised everybody not to pass excreta in water and prohibited passing of urine in water.[44] Even spitting in water was strictly forbidden.[45] Such examples explicitly state about the awareness of ancient people with regard to use of water in order to keep the environment clean. The Rishis prayed to the energy gods not to destroy energy and environment, in order to, keep the balance of nature.

The classical poet kalidasa has established his ecological faculty in his classics, such as, Kumar Sambhavam, Meghdoot, Abhigyan Shakuntalam, Ritu Sanhar and Raghubansam.[46] In kumar Sambhavam, Kalidasa talks of *'milking the earth on a long term basis by feeding and caring for the cow before we go to milk the cow'*.[47] The Upanishads emphasize use of nature without greed and cautions that no creature is superior to others and hence human beings should not have absolute power over nature.[48] Mahatma Gandhi too, expressed similar ethical and ecological concern when he said – *'nature has enough to satisfy everyone's need but not everyone's greed.'*[49] The element of sustainability is ingrained in all these words of wisdom.

Let's pray :

'O' powerful waters,
I might have violated
the laws of nature;
knowingly or unknowingly;
foolishly or imprudently;
Take away, whatever is
wong or deficient in me.[50] (sic)

— Rig Veda

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44. Ibid.
45. Ibid.
46. P.S. Verma and V.K. Agarwal, *Principles of Ecology*, (1989), p. 14.
47. Dr. Dulal Chandra Goswami, *'Sustainable Development is the Answer'*, published in *The Assam Tribune*, dated, June, 5, 1997.
48. Ibid.
49. Ibid. See also Shelly Anand, *'Climate Change, Chartering Problems'*, published in *The Hindustan Times, North-East Special*, dated, June, 5, 2002.
50. Justice Ashok A. Desai, *Environmental Jurisprudence*, (2002), in 'Preface', p. viii.

Ecology and Environment : Scientific and Legal Prudence

Life does not occur in a vcacuum. Every living organism is surrounded by materials and forces which constitutes its environment and from which it must derive its needs.[51] Thus, for its survival, a plant, an animal, or a microbe can not live completely sealed in an impervious skin or shell but requires from its environment - a supply of energy, a supply of materials, and a removal of waste products. For these basic requirements, each living organism has to depend and also to interact with different non-living or abiotic and living or biotic components of the environment. The abiotic environmental components include basic inorganic elements and compounds, such as, water and carbon dioxide, calcium and oxygen, carbonates and phosphates and an array of organic compounds, the by-products of organism's activity or death. They also include such physical factors as soil, rainfall, temperature, moisture, winds, currents, and solar radiation with its concomitants of light and heat. The biotic environmental factors comprise plants, animals, and microbes, all of which interact in a fundamentally energy-dependent fashion.[52]

'Ecology' is the scientific study of the inter-relationship of living organisms - plants, animals and microbes with each other and with their physical environment.[53]. It mainly concerns with the directive influences of abiotic and biotic environmental factors over the growth, distribution, behaviour and survival of organisms.[54] In otherwords, **'ecology'** is the science which investigates organisms in relation to their environment and a philosophy in which the world of life is interpreted in terms of natural processes.[55]

The term **'Environment'**, which etymologically means - **'surroundings'**, is considered as a composite term for the conditions in which organisms live and, thus, consists of air, water, food and sunlight which are the basic needs of all living beings

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51. P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 3
52 Ibid.
53. Southwick (1976), Ibid at p. 5.
54. Herreid II (1977), Ibid at p. 3.
55. Woodbury (1955), Ibid at p. 4.

and plant life, to carry on their life functions.[56] The environment also includes other living things, temperature, wind, electricity etc. In other words, environment consists of both biotic and abiotic substances.[57] Environment creates favourable conditions for the existence and development of living organisms.[58]

The term **'organism'** refers to an individual unit constituted to carry on the activities of life. It is a dynamic biological unit which is greatly influenced by an enveloping and fluctuation environment.[59] For a given organism, the **'environment'** includes all the surrounding physical and biological factors with which it interacts. The **'factor'** is any external force, substance, or condition that affects organisms in anyway. Thus, environment is the sum total of everything that directly influences the animal's chances of survival and reproduction.[60]

Environment is a very broad concept. Everything that affects an organism during its life time is collectively called its **'environment'**.[61] The inter-dependence and inter-relationship of living organisms - plants, animals and microbes with each other and with their physical environment may be expressed in a befitting manner in the diagram, as indicated, below.

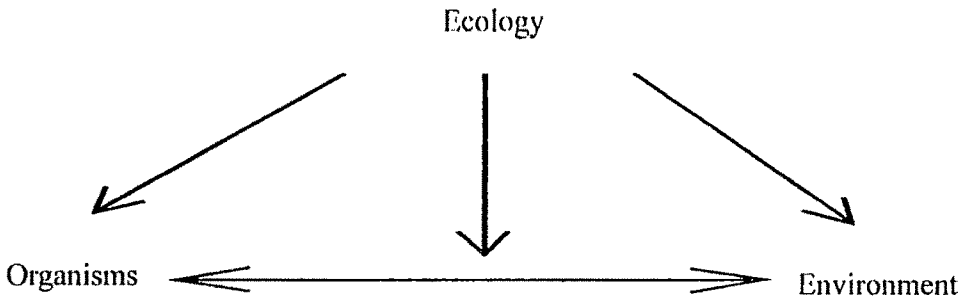

Figure 1 : Ecology is the study of animals and plants in their relations to each other and to their physical environment.

The inter-dependence of different organisms in biosphere can be easily understood

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56. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. ENV- 3.
57. Ibid.
58. Ibid .
59. P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 5.
60. Ibid.
61. S. Mukherjee and A. Ghosh, *Environmental Studies*, (2000), p 15.

considering the following example. In atmosphere, the levels of oxygen and carbon dioxide entirely depend upon living organisms of the earth. Green plants use carbon dioxide for photosynthesis and, in return, release oxygen to the atmosphere. On the other hand, animals inhale oxygen during respiration and give out carbon dioxide. Thus, a continuous set of interactions take place among the living organisms of the biosphere.[62] Besides, all the living organisms depend upon the abiotic environment (air, water and land). The abiotic environment is linked to living organism in terms of energy flow and various bio-geochemical cycles. So, living organisms depend upon air, water and land for their survival and entire unit is responsible for the existence of living organism or biosphere.

Origin of the Term Ecology :

The first author of the term **'ecology'** is uncertain. However, many Biologists grant credit to the German Zoologist Ernst Haeckel.[63] who used the term as *'oekologie'* in 1866 to refer to the inter-relationships of living organisms and their environment. In fact, a few years earlier, in 1857, Henry David Thoreau had also spoken of ecology among other fields of biology and natural history, but he apparently did not provide a definition of the term.[64]

The word **'ecology'** comes from two Greek words *'oikos'*, meaning 'household' or 'home' or 'place to live' or ' habitation' and *'logos'* meaning ' discourse' or ' study'.[65] Thus, literally ecology deals with the organism and its place to live. Basically, organism's place to live is its environment, so ecology is also called **'environmental biology'**.[66]

Definition of the Term Ecology :

Conventionally, ecology has been defined variously by different classical and modern ecologists with different viewpoints. Quite oddly, no universally accepted

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62. S. N. Tripathy and Sunakar Panda, *Environmental Studies*, (2001), p. 15.
63. P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 3.
64. Ibid.
65. Ibid at p. 4.
66. Ibid.

definition of ecology has been formulated by any ecologist sofar, and for the better understanding of scope, limitation, purpose, and mode of study of different ecological phenomena, one has to go though following chronologically arranged definitions[67] of ecology.

Ernst Haeckel (1866) defined ecology *'as the body of knowledge concerning the economy of nature – the investigation of the total relations of animal to its inorganic and organic environment'*. An American Plant Ecologist, Frederick Clements (1916) considered ecology to be *'the science of community'*. British Ecologist Charles Elton(1927) defined ecology as '*the scientific natural history concerned with the sociology and economics of animals*'. Taylor (1936) preferred to define ecology as *'the science of the relations of all organism to all their environments'*. A much broader definition of ecology of Allee et al., (1949) considered ecology as '*the science of inter relation between living organisms and their environment, including both the physical and biotic environments, and emphasizing inter-species, as well as, intra-species relations*'. G.L. Clarke (1954) defined ecology as *'the study of inter-relations of plants and animals with their environment which may include the influences of other plants and animals present, as well as, those of the physical features*'. Woodbury (1955) regarded ecology as *'the science which investigates organisms in relation to their environment : a philosophy in which the world of life is interpreted in terms of natural processes*'. British Ecologist A. Macfadyen (1957) defined ecology as *'a science which concerns itself with the inter-relationships of living organisms, plants and animals, and their environment'*. Likewise, S.C. kewndeigh (1961, 1974) defined ecology as *'the study of animals and plants in their relation to each other and to their environment'*.

Further, Andrewartha (1961) defined ecology as *'the scientific study of the distribution, and abundance of organisms'*. G.A. Petrides (1968) defined ecology as *'the study of environmental interactions which control the welfare of living things, regulating their distribution, abundance, production and evolution*'. American Ecologist Eugene

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67. Ibid at pp. 4-5.

Odum (1971) preferred to define ecology as *'the study of the structure and function of ecosystems or broadly of nature'*. C. J. Kerbs (1972), considered Odum's definition of ecology as quite ambiguous and instead of it, he provided a modified version of Andrewartha's definition of ecology, which defined ecology as *'the scientific study of interactions that determine the distribution and abundance of organisms'*.

Certain modern ecologist have provided somewhat more broader definitions of ecology.[68] Thus, M.E. Clark (1973) considers ecology as *'a study of ecosystems or the totality of the reciprocal interaction between living organisms and their physical surroundings'*. Pinaka (1973) defined ecology as *'the study of relations between organisms and the totality of the biological and physical factors affecting them or influenced by them'*. Southwick (1976) defined ecology as *'the scientific study of the interrelationships of living organisms with each other and with their environments'*. He further elaborates his definition of ecology by saying that *'it is the science of biological interactions among individuals, populations, and communities; and it is also the science of ecosystems – the inter-relations of biotic communities with their non-living environments'*. R.L. Smith (1977) prefers to consider ecology as *'a multidisciplinary science which deals with the organism and its place to live and which focuses on the ecosystem'*.

Specialized Fields of Ecology :

To understand the basic principles that can be applied to the human welfare (applied ecology), it becomes necessary to make detailed study of various aspects of ecology. Thus, there have developed many specialized fields of ecology,[69] which have been shown in Figure 2.

1. **Fresh Water Ecology** :

The study of organisms of freshwaters like ponds, lakes, rivers, streams etc.

2. **Marine Ecology** :

The study of organisms of marine environment as seas, oceans etc.

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68. P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 5.
69. P. D. Sharma, *Elements of Ecology*, (1987-88), p. 21.

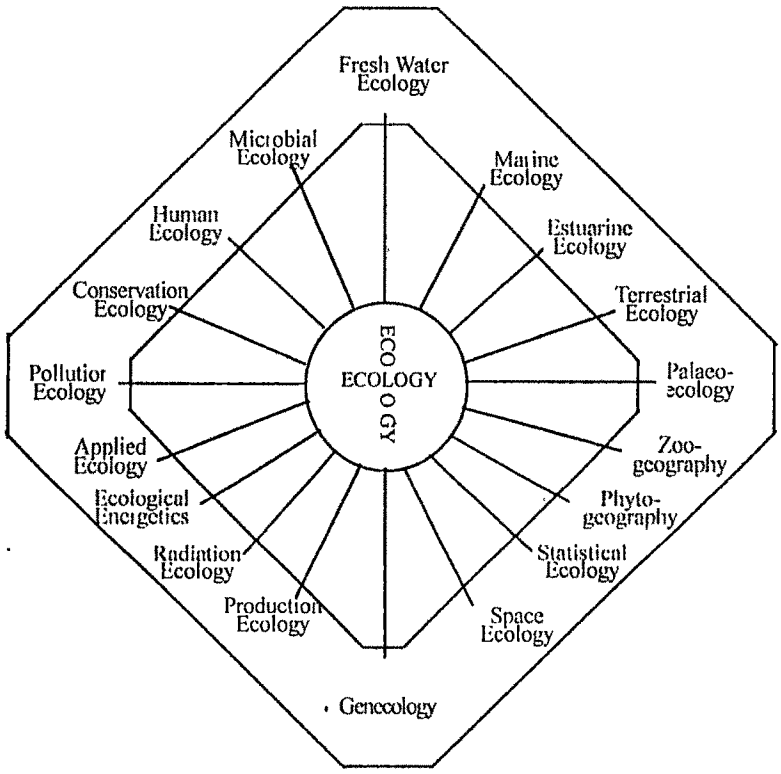

Figure 2 : Hypothetical diagram showing major specialised fields of ecology.

3. **Estuarine Ecology** :

The study of organisms in estuarine points. An estuary may be designated as a confined arm of the sea situated at the mouth of a river. It comprises of both sea water and fresh water.

4. **Terrestrial Ecology** :

The study of organisms of such terrestrial habitats as grasslands, croplands, forests, deserts etc. These days even such specialized fields as forest ecology, grassland ecology, desert ecology etc., are also developing as independent specialized areas of terrestrial ecology.[70]

5. **Palaeoecology** :

The study of environmental conditions and life of the past ages, to which palynology, palaeontology and radioactive dating have made notable contributions.

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70. Infra notes 121, 125, 127.

6. **Zoogeography** :

The geographic distribution of animals.

7. **Phytogeography** :

The geographic distribution of plants. Both zoogeography and phytogeography collectively constitute Geographic Ecology or Ecogeography. It concentrates on the study of geographical distribution of animals and plants, and also of palaeoecology and biomes.

8. **Statistical Ecology** :

Statistical studies on populations, sampling techniques, and community problems. Systems ecology is the modern branch of ecology which is particularly concerned with the analysis and understanding of the function and structure of ecosystem by the use of applied mathematics, such as, advanced statistical techniques, mathematical models, characteristics of computer sciences.[71]

9. **Space Ecology** :

It is a modern sub-division of ecology which is concerned with the development of partially or completely regenerating ecosystems for supporting life of man during long space flights or during extended exploration of extra-terrestrial environments.

10. **Genecology** :

The study of variations of species based upon their genetic potentialities.

11. **Production Ecology** :

It deals with the gross and net production of different ecosystems like freshwater, seawater, agriculture, horticulture etc., and tries to do proper management of these ecosystems, so that maximum yield can be get from them.[72]

12. **Radiation Ecology** :

It deals with the study of gross effects of radiations and radio active substances over the environment and living organisms.

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71. P.S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 11. See also P. D. Sharma, *Elements of Ecology*, (1987-88), p. 22.

72. Ibid at p. 10.

13. **Ecological Energetics** :

The study of flow and conservation of various forms of energy in different kinds of ecosystems.

14. **Applied Ecology** :

It deals with the application of ecological concepts to human needs and, thus, it includes following applications of ecology : wild-life management, range management, forestry, conservation, insect control, epidemiology, animal husbandry, aquaculture, agriculture, horticulture, land use and pollution ecology.

15. **Pollution Ecology** :

The study of pollution[73].

16. **Conservation Ecology** :

Conservation is one of the most significant application of ecology. It avoids unplanned development which breaks ecological, as well as, human laws.

17. **Human Ecology** : [74]

It involves population ecology or man and man's relation to the environment, especially man's effects on the biosphere and the implication of these effects for man.

18. **Microbial Ecology** :

The studies of various principles that govern the distribution of micro organisms as algae, bacteria, fungi etc., in nature. This area is referred to as microbial ecology. Sometimes we study each of these micro organisms under different specialized fields as fungal ecology, algal ecology, bacterial ecology etc..

Scope of Ecology :

The scope of ecology is quite vast. Present day problems of varied nature in human life are directly or indirectly very much related to ecology, as their solution needs an ecological knowledge.[75] These days, ecology has been contributing very much to socio-

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73. Infra notes 179-A –248.
74. Infra notes 143-179.
75. P. D. Sharma, *Ecology and Environment*, (1997), p. 2.

economic, political and other similar policies of the world. It is so common to find references of ecology in socio- economic writings, magazines, weeklies and daily news papers. There are inter dependencies not only between ecology and other areas of plant sciences, but also between ecology and physical, as well as, social sciences. Ecology, indeed, plays an important role in human welfare. This is primarily a field subject and modern ecology is concerned with the functional inter dependencies between living things and their environment. Taylor (1936), in an attempt to define ecology, has very rightly pointed out the scope of ecology by stating that *'ecology is the science of all the relations of all organisms to all their environments'*.[76] Ecology plays an important role in the conservation of soil, forest, wildlife, water supplies etc. The international problem of environmental pollution also needs **ecological assistance.**[77]

Fundamentals of Environment :

The word **'environment'** comes from a French word *'environ'* or *'environner'* meaning 'around', 'round about', to surround, 'to encompass'[78]. It is used to describe everything that surrounds on organism.[79] Thus, environment is a complex of so many things (light, temperature, soil, water etc.,) which surrounds an organism. Any external force, substance or condition, which surrounds and affects the life of an organism, in any way, becomes a **'factor'** of its environment. These factors have been variously called as environmental factors, ecological factors or simply factors and may be living (biotic), as well as, non-living (abiotic). The sum of all these living and non-living factors makes the environment of an organism. The place, where an organism lives - habitat, indeed, presents a particular set of environmental conditions – **'The environmental complex'**.[80]

Ecological studies, thus, reveal that an organism's environment is the sumtotal of

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76. Ibid at p. 3.
77. See generally Padma, *'International Liability for Transboundary Pollution- A Critical Appraisal'*, *Souvenir and Conference Papers*, Vol. I, organized by the Indian Society of International Law : International Conference on International Law in the New Millennium : Problems and Challenges Ahead (4 to 7 October, 2001), pp. 12-30.
78. S. Mukherjee and A Ghose, *Environmental Studies*, (2000), p. 1.
79. Ibid.
80. P. D. Sharma, *Elements of Ecology*, (1987-88), p. 25.

physical and biological factors, to which it remains totally adapted and to which it continuously interacts for its survival.

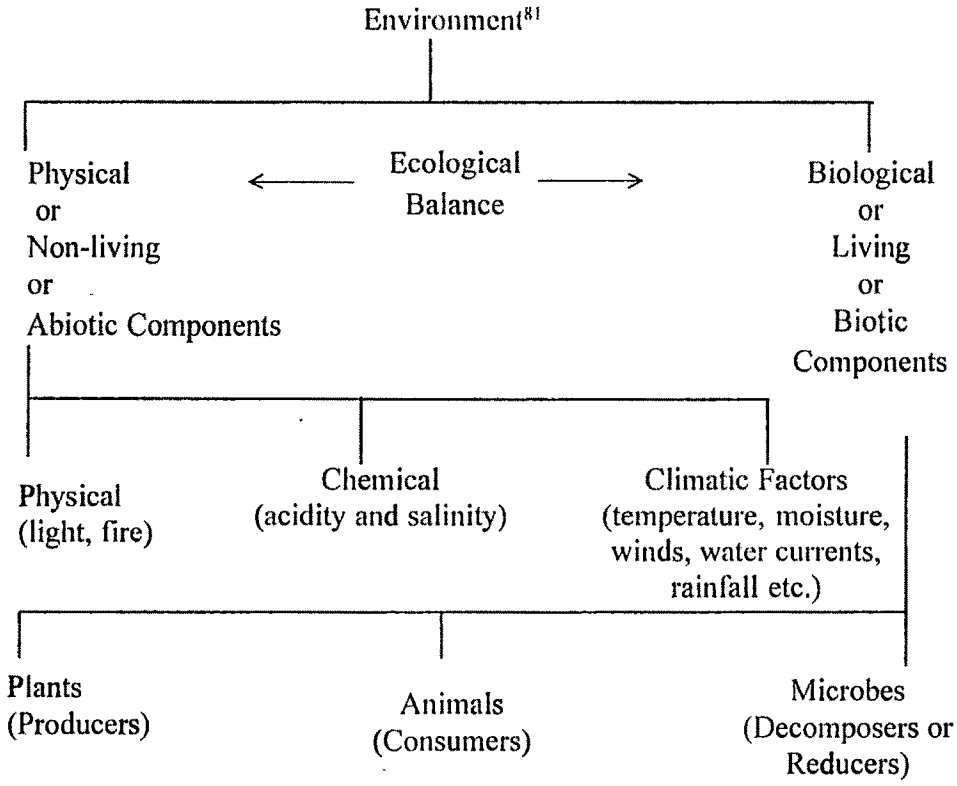

Figure 3 : Environment refers to the external conditions in which an organism lives.

However, environment is viewed with different angles by different environmentalists and accordingly, it can be defined, in a number of ways, For example :

1. *"Environment is anything immediately surrounding an object and exerting a direct influence on it".*[82]
2. *"Environment refers to the sumtotal of conditions which surround man at a given point in space and time."*[83]
3. *"Environment is the representative of physical components of the earth*

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81. Environment is the sumtotal of everything that directly influences the animal's chances of survival and reproduction [P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 5].
82. P. Gisbert in A. Panneerselvam and Mohana Ramakrishnan, *Environmental Science Education*, (2000), p. 1.
83. C. C. Park (1980) in B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p.ENV-3.

wherein man is the important factor influencing his environment."[84]

4. *"Environment is the sum of all social, economical, biological, physical or chemical factors, which constitute the surroundings of man, who is both creator and mouldier of his environment."*[85].

5. *"Environment is a holistic view of the world as it functions at any time, with a multitude of special elemental and socio-economic systems distinguished by quality and attributes of space and mode of behaviour of biotic and abiotic forms."*[86]

6. *"Environment is an external force which influences us".*[87]

From the above definitions, conclusion may be drawn in this regard that environment includes not only physical and biological factors but also economic, social, cultural, and political factors. Environment consists of an inseparable whole system constituted by physical, chemical , biological, social and cultural elements which are interlinked individually and collectively in myriad ways.[88]

In the beginning, the environment of early man consisted of only physical aspects of the planet earth (land, air and water) and biotic components but with the march of time and advancement of society, man extended his environment through his social, economic and political functions.[89]

Social Environment :

Man is always surrounded by society, because he is a social being. This society remains with him from birth to death.[90] Man is, by nature and by necessity, a social animal.[91] He loves company and abhors lonelines and this dislike for loneliness coupled

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84. A. Goudie (1984), Ibid.
85. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p.ENV- 3.
86. Ibid.
87. E. J. Ross in A Panneerselvam and Mohana Ramakrishnan, *Environmental Science Education*, (2000), p. 1.
88. Supra n. 85.
89. Dr. I. A. Khan, *Environmental Law*, (2002), p. 9.
90. A. Panneerselvam and Mohana Ramakrishnan, *Environmental Science Education*, (2000), p. 1.
91. Sibnath Chakravarty, *An Introduction to Politics*, (1991), p. 22.

with his craving for company has made him a gregarious animal. The community building nature of man is not only due to his love for company but also due to his hunger for affection of parents, love of his kinsmen and neighbours and for collective enjoyment of various recreations and social functions. Of the factors contributing to the sociability of man, the importance of the need for self-protection which group life more effectively ensures can hardly be overestimated. Thus, nature impels and necessity compels men to lead a social life.

But, it must be borne in mind that society grew not all on a sudden nor by the conscious effort of one single individual but it evolved gradually out of the needs of man. As man is becoming more and more intelligent and civilized, he is becoming more and more conscious of the need for a social life and with the growth of this consciousness, the hold of society on the individuals is growing from more to more. From his birth to his death, society regulates the life of man in various ways.[92]

Economic Environment :

Economic environment refers to all those factors or forces which contribute to economic impact on the man, his activities and his region. Resources, industrial production, population, agriculture, infrastructure and the various stages in the economic development like economic conditions, economic policies, economic planning, economic philosophy, economic system and trade cycle – are major internal and external factors which make up the total economic environment.[93]

Availability of resources and the technology to exploit them play most significant role in economic development or economic environment of a region. As the distribution of natural resources, due to geographical factors is uneven, the resources have become concentrated in some specific regions only. These gifted regions have exploited these resources for their economic developments and have come to be known as developed countries.[94] Examples of such countries are U.S.A., France, U.K. etc., where as, the other

92. Ibid.
93. R. V. Mudliar and Others, *Environmental Studies*,(1996), p. 10.
94. Ibid.

regions which had poor resource concentration and which are still in developing stage have come to be known as developing countries. So it is economic environment of a region or country that decides its status i.e. developed or developing.[95]

Population factor has its own say as regards economic environment of a region, as more resources are needed to feed more mouths. This requires more exploitation of resources which not only hampers the resource reserves but also affects the eco-system of that region.

However, a stable economic environment does not always help the mankind. The main disadvantage of it being its impact on the physical environment. Economic environment also plays an important role in the political process of a region. It could be said that both economic, as well as, political environment are interdependent on each other. Both East Germany and West Germany serve as best example of inter dependence of political and economic environment. The East Germany with her poor economic environment was left with no other alternative other than merging with West Germany which had strong and stable economic environment.[96]

Every human activity necessary for economic development affects the local, regional or global environment. The effects may be of short term or long term in nature. In the present situation, the problems like depletion of forest, the extinction of rare species of flora and fauna, the global warning etc., are some of the major environmental problems, the world is facing on various levels today. The industrialization, the agricultural development, the extraction of various energy and other resources etc., which contribute to economic environment of the region, are some of the main factors responsible for deteriorating the quality of the physical environment.

Cultural Environment :

Cultural environment is the man-made environment or man made landscape. It may also be called as humanised land scape[97]. The cultural environment is the imprint

95. Ibid.
96. Ibid.
97. Ibid at p. 11.

of man's activities, his occupation and utilization of physical resources for his own benefit. All man-made features, such as, buildings, settlements, roads, plantations etc., are called cultural features. Cultural environment is a social product. It is an achievement of human group cooperation. We may call this cultural environment as a social environment or socio-cultural environment or even social heritage. As per the passage of time man has acquired technical and scientific knowledge. Through this powerful tool, he is changing fast the physical environment into cultural land scape. Cultural environment have their roots in the natural environment and in the cultural level of the different human groups. As the natural environment differs from place to place, cultural environment also should differ from place to place, hence human activities and achievements depend not only upon natural environment but also upon man made environment. Culture develops on nature, it means it has its roots in nature. Cultural environment is only human adaptation and adjustment to natural or physical environment. In otherwords, man as per his knowledge and capacity, super-imposes culture on nature. It goes on piling one after another, and grows in size and importance. Sometimes, it becomes difficult to trace back the link with the physical base. As an example, we have changes in many villages of India. Cultural environment is simple and more directly connected with physical base in the early stages, but becomes more complex and indirect as the human society grows up in knowledge and size. At this stage, the natural environmental quality starts degrading and the question of ecological disorders and natural imbalance crops up. Ecological disorder is the direct result of human action, partly through his numbers and partly through his skills. All actions of men are not wise or far-sighted and hence it leads to environmental crises. The various ecosystems are showing signs of progressive deterioration because of man's hasty, negligent, unplanned actions which ultimately leads to environmental degradation.

Political Environment :

Political environment refers to the influence exerted by the three main political institutions, namely, legislature, executive and judiciary. It helps to shape, direct, develop

and control many of the human activities including his business activities. The legislature which frames the law, controls the physical environment, e.g., antipollution laws. The executives also called as government, implement whatever is decided by the legislature and finally the judiciary plays the role of a watch dog to ensure that both the legislature and the executive, function in public interest and within the boundaries of the Constitution. A stable and dynamic political environment is a must for the development of mankind.[98]

The type of government plays a significant role in political environment of a country, as it is guided by certain firm policies of its own. The type or the form of government may be democratic, communist, dictatorial, monarchy etc. Any change in the form may be counter productive and may affect the nation from several angles i.e., economic, business, socio-cultural, physical etc., as all these segments are interdependent.

Segments of Natural Environment :

From ecological point of view, the intimately local and immediate surrounding of the organism is called '**micro-environment**' while the '**macro-environment**' is the sumtotal of the physical and the biotic conditions existing external to the organism and its micro-environment.[99] The environment as a whole consists of four segments.[100] These are : 1. Atmosphere; 2. Hydrosphere; 3. Lithosphere; 4. Biosphere.

Atmosphere :

We can not see air, but we can feel it, when it is moving. The cover of air that envelopes the earth is known as the atmosphere. In otherwords, atmosphere is the protective thick gaseous mantle, surrounding the earth, which sustains life on earth and saves it from unfriendly environment of outer space. It extends to a height of about 1600 kilometres from the earth's surface.[101] The atmosphere is a reservoir of several elements essential to life and it serves many purposes and functions. It contains life saving gases like oxygen for human beings and animals, and carbon dioxide for plants

98. R. V. Mudliar and Others, *Environmental Studies*, (1996), p. 13.
99. P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 6.
100. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. ENV- 16.
101. Ibid.

to perform the process of **photosynthesis**. The atmosphere is mobile, elastic and both compressible and expansible. Air is compressible (unlike water) and can be squeezed into a much smaller space. It is elastic and has weight and also exerts pressure. Although we do not feel, the pressure of air is about 7 kilograms on every 6 square centimetres of our bodies.[102]

Atmosphere also serves many functions. For example, it absorbs most of the cosmic rays from outer space and protect living things form their harmful effects. It, thus, filtrates the radiant energy from the sun. It also maintains the heat balance of the earth. The atmosphere absorbs infra red radiation emitted by the sun. It also absorbs energy re emitted from the earth in the form of infra red radiation.

Structure of Atmosphere :

There are five concentric layers within the atmosphere, which can be differentiated on the basis of temperature and each layer has its own characteristics. These include the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere.[103] (Figure 4)

The Troposphere :

This atmospheric layer lies closest to the earth's surface and it is the lowest layer of atmosphere in which man alongwith other organisms live. It extends to a height from 8 km. (near the poles) to 18 km. (near the equator).[104] *Tropo* means change or turning. This refers to the action of winds which keep the troposphere in constant motion. Almost all changes we experience in our daily weather occur in this layer of atmosphere. The troposphere, the basal part of the atmosphere is the most important zone for organisms and is composed mainly of oxygen, carbon dioxide and nitrogen, alongwith traces of other inert gases. This zone is characterized by a steady decrease in temperature with increase in height at the rate of about 6.5 ^{0}c per killometre.[105] Towards the upper levels

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102. Ibid.

103. Ibid at p. 17.

104. Ibid.

105. S. N. Tripathy and Sunakar Panda, *Fundamentals of Environmental Studies*, (2001), p. 3.

of troposphere, the temperature may decrease upto - 60 ^{0}c. This top of troposphere, which gradually merges into the next zone, is known as '**tropopause.**'

The Stratosphere :

The stratosphere lies above the troposphere. In fact stratosphere is the air mass extending from the tropopause or upper most level of the troposphere, to the stratopause (i.e. upper most level of the stratosphere) about 50 km. above the surface of the earth.[106] In stratosphere, the temperature rises from a minimum of about - 55 ^{0}c to maximum of about 5 ^{0}c, but within it the temperature is almost constant in vertical direction and does not decrease as it does in the troposphere. Because of the very low temperature, there are virtually no clouds, dust or water vapour.

The stratosphere is rich in '**ozone**', which absorbs harmful ultraviolet radiations from the sun. Ozone acts as a protective shield for life and earth from injurious effects of sun's ultra violet rays. In fact, ozone forms a well marked ozone layer, called '**ozonosphere**' within the statosphere. The reason that the stratosphere becomes warmer with increasing distance from the earth is that the U.V. radiation absorbed by the ozone is transformed into hear. For the ecosystem, the ozone layer is of great importance, because it absorbs the U.V. radiation and prevents the latter from reaching the surface of the earth, where it may be lethal to most living organisms.[107] Upper layers of stratosphere form '**stratopause**'.

The Mesosphere :

Next to stratosphere, is mesosphere which is characterised by cold temperature and very low atmospheric pressure. The mesosphere extends roughly to 80 kilometres[108] and its temperature drops to about –95^{0}c to a level some 80 - 90 km. above the earth surface.[109] This level is called the '**mesopause**'.[110]

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106. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. ENV-17.
107. Ibid at p. 18.
108. Ibid.
109. Ibid.
110. 'Mesopause' is indicated by Fig. 4.

The Ionosphere or Thermosphere :

Above the mesosphere is the thermosphere or ionosphere which extends upto 500 km. above the earth surface[111] and is characterised by steady temperature increase with height from mesopause.

The Exosphere :

The upper most layer, i.e., the region of atmosphere above the thermosphere is called exosphere or outerspace. It extends to a height of 1600 km. from the earth's surface.[112] Since it is nearer to sun, its temperature is very high.

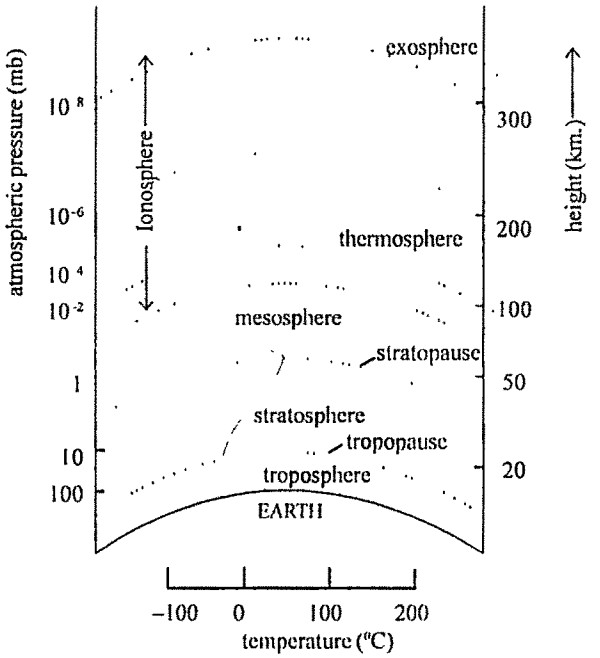

Figure 4 : Diagrammatic sketch showing the principal zones of atmosphere alongwith variations in temperature.

Hydrosphere :

Hydrosphere covers more than 75 per cent of the earth's surface either as oceans (salt water) or as fresh water.[113] Hydrosphere includes sea, rivers, oceans, lakes, ponds, streams etc. Water is essential to all life. Life was first originated in water.

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111. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. ENV-18.
112. Ibid.
113. Ibid at p. 21.

Lithosphere :

Lithosphere means the mantle of rocks constituting the earth's crust. The earth is a cold, spherical solid planet of the solar system, which spins on its axis and revolves round the sun at a certain constaint distance. The solid component of the earth is called lithcsphere, which is related with edaphic factor and includes mainly soil, earth, rocks, and mountains etc.[114]

Biosphere :

Biosphere indicates domain of living organisms and their interaction with environment i.e., the atmosphere, hydrosphere and lithosphere. Under natural circumstances, plants and animals influence each other's life directly or indirectly. Green plants, through photosynthesis accumulate life supporting oxygen in the atmosphere, animals inhale oxygen during respiration and give out carbon dioxide which is utilized by plants during starch formation.

Thus, the interactions among the organisms are 1. **Symbiotic**, and 2. **Antagonistic**. Symbiotic means **'living together'** i.e, both the species are mutually benefited and neither is harmed. The interactions where at least one of the species is harmed, is known as antagonism.[115]

Ecosystem :

The **'ecosystem'** is any spatial or organizational unit which includes living organisms and non-living substances inter acting to produce an exchange of materials between the living and non-living parts. It may be, as small as, a puddle or, as large as, the entire earth (biosphere or ecosphere).[116] Further, an ecosystem may be natural as a pond, a lake, a river, an estuary, an ocean, a forest etc., or it may be man made or artificial like an aquarium, a dam, a cropland, a garden, an orchard, a city and so on[117] (Figure 5).

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114. Ibid at p. 24.

115. Ibid at p. 30.

116. P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 100.

117. Ibid.

The term **'ecosystem'** was first proposed by A.G. Tansley in 1935,[118] who defined it as *'the system resulting from the integration of all the living and non-living factors of the environment'*.[119] Thus, he regarded the ecosystem as indicating not only the organism complex but also the whole complex of physical factors forming the environment. The term **'ecosystem'** indicates 'eco' meaning environmental and 'system' implying an interacting inter-dependent complex.[120]

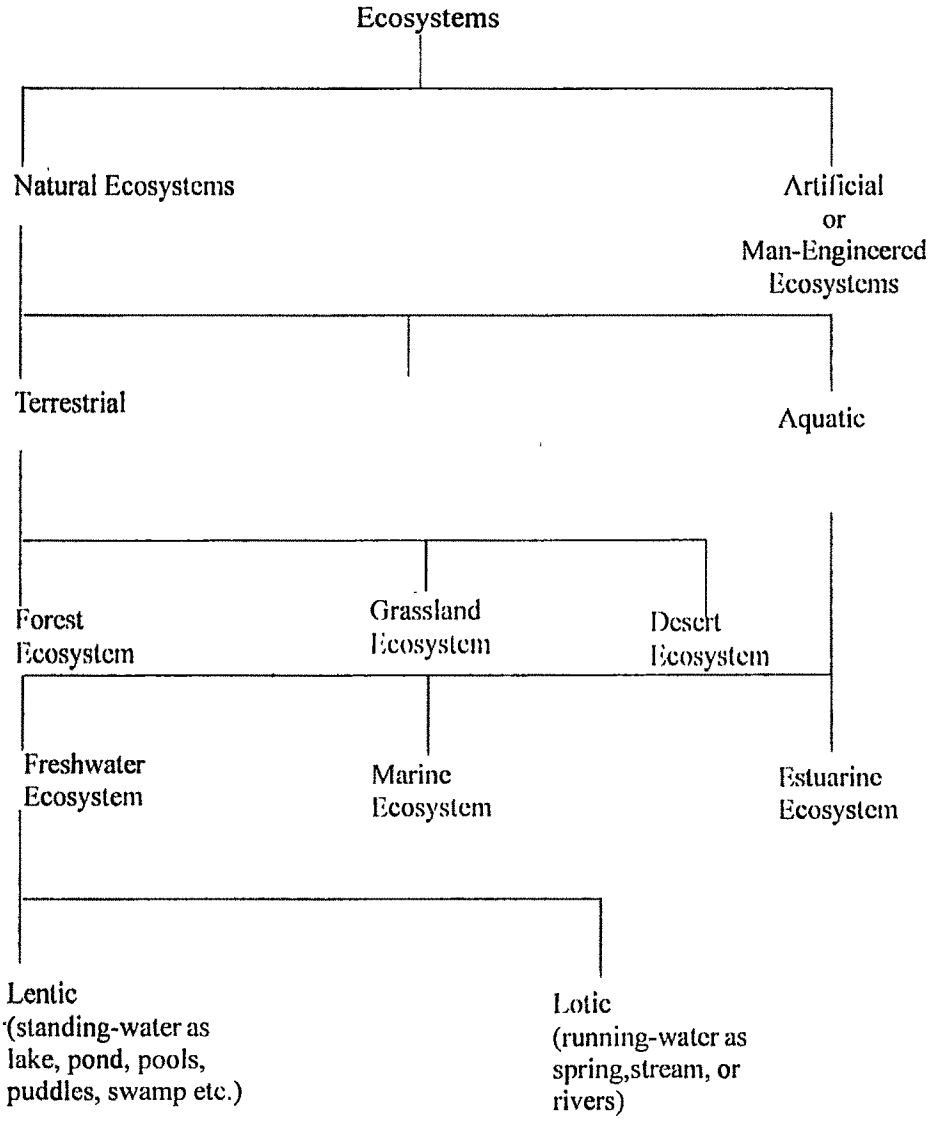

Figure 5 : Showing the kinds of ecosystem

118. H.R. Singh, *Introduction to Animal Ecology and Environmental Biology*, (1997), p. 104.
119. P. D. Sharma, *Ecology and Environment* , (1997), p. 220.
120. S.P. Singh, *Animal Ecology*, (1992), p. 6.

Forest Ecosystem :

Forests help in maintaining the ecological balance.[121] About 30 per cent of the land area of the earth is under forest cover,[122] but due to man's intervention, this area is gradually becoming smaller. In the forest ecosystem, the abiotic components are the inorganic, as well as, organic substances present in the soil and atmosphere and also mineral present in dead organic debris. The producers are trees of different species. The primary consumers are the herbivores that include the animals feeding on tree leaves as ants, flies, beetles, leafhoppers and spiders etc., and larger animals grazing on shoots and / or fruits of the producers, the elephants, nilgai, deer, moles, squirrels, fruit bats etc. The secondary consumers include carnivores like snakes, birds, lizards, fox etc., feeding on the herbivores. The tertiary consumers are the top carnivores like lion, tiger etc. The decomposers include a variety of micro-organisms including fungi, bacteria etc.[123] The forest ecosystems are of great concern from the environmental point of view. The rate of exploitation of forest by man is growing day by day, thus, causing a great concern to all nations of the world because of its impact over global climate and on several animal species.[124]

Grassland Ecosystem :

Grassland occupy about 19 per cent of the earth's surface.[125] In the grassland ecosystem, the abiotic components are the nutrients present in the soil and aerial

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121. P. Leelakrishnan, *Environmental Law in India*, (1999), p. 9. See also V. P. Agarwala, *Forests in India*, (1985), p. 3. The forest ecosystem has a great role to play in preserving the earth's environment, through the natural balancing processes. Water cycling, nutrient cycling, oxygen cycling, Co_2 cycling and humification are some of the important processes, through which the forests provide the benefit to mankind. These natural phenomena are again helped by the inter dependence of plants and animals. If forests are cleared, the first we loose the biodiversity, then we slowly loose our various resource bases. Hence loss of biodiversity is the indication as to the level of maintenance of the ecosystem. N. Mayer, an ecologist, termed the loss of 'biodiversity' as a threat to human kind next in gravity to the danger of nuclear holocaust. (K.N. Dev Goswami, *'Save the Earth for Posterity'*, published in *The Assam Tribune*, dated, July, 7, 1999).
122. H.M. Saxena, *Environmental Geography*, (1999), p. 52.
123. See generally P.D. Sharma, *Ecology and Environment*, (1997), pp. 253-254.
124. H. M. Saxena, *Environmental Geography*, (1999), p. 52.
125. Ibid.

environment. The elements like carbon dioxide, water, nitrates, phosphates and sulphates etc., are present in the air and soil of the area. The producers are mainly grasses and small trees and shrubs. The primary consumers include cows, buffaloes, deers, sheep, rabbit etc. The secondary consumers are the carnivores feeding on herbivores. These include the animals like fox, jackals, snakes, frogs, lizards birds etc. Sometimes, the hawks feed on secondary consumers, thus, occupying tertiary consumers level in the food chain. The microbes are active in the decaying of dead organic matter of different forms. They bring the minerals back to the soil, thus, making them available to producers.[126]

Desert Ecosystem :

Deserts occupy about 17 per cent of land, occurring in the regions with an annual rainfall of less than 25 centimetres.[127] The species composition of such ecosystem is much more varied and typical due to extremes of both, temperature and water factors. The producers are shrubs, especially bushes, some grasses and a few trees. Sometimes a few succeulents like cacti are also present. Some lower plants like lichens and xerophytic mosses may also be present. The most common animals are reptiles and insects, able to live under xeric conditions. In addition to them, there are also found some nocturnal rodents and birds. The **'ship of desert'**, camels feed on tender shoots of the plants. The decomposers are very few, as due to poor vegetation the amount of dead organic matter is correspondingly less. They are some fungi and bacteria.[128]

Freshwater Ecosystem :

Freshwater habitats can be divided into two categories :

(i) Standing water or lentic – lake, pond, swamp;

(ii) Running water or lotic – river, spring, stream.

Although fresh water habitats occupy a small portion of the earth's surface, they

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126. P. D. Sharma, *Ecology and Environment*, (1997) , p. 253.
127. Ibid at p. 254.
128. Ibid.

are of great importance to man because they provide drinking water, as well as, water for domestic and industrial needs.

A pond is a good example of fresh water ecosystem, which exhibits a self sufficient, self regulating system. A pond is a place where living organisms not only live but interact with abiotic and biotic components, thus, forming an ecosystem which is different from other systems. Similarly, lakes, swamps and rivers have their own ecosystems in which producers, consumers and decomposers interact and are responsible for the unique ecosystem of each.[129]

Marine Ecosystem :

Major oceans of the world, Atlantic, Pacific, Indian, Arctic and Antarctic cover approximately 70 per cent of the earth's surface. Each ocean, indeed, represents a very large and stable ecosystem. Marine environments, as compared with fresh water, appear to be more stable in their chemical composition due to being saline, and moreover other physico-chemical as dissolved oxygen content, light and temperature are also different.

The biotic components of a marine ecosystem are of the following orders :

1. **Producers** : These are autotrophs and also designated as primary producers, since they are responsible for trapping the radiant energy of sun with the help of their pigments. Producers are mainly the phytoplanktons, such as, diatoms, dinoflagellates and some microscopic algae. Besides them, a number of macroscopic sea weeds as brown and red algae also contribute significantly to primary production.

2. **Consumers** : These are heterotrophic macro consumers, being dependent for their nutrition on the primary producers. These are :

(a) **Primary Consumers** : The herbivores, that feed directly on producers, are chiefly crustaceans, molluscs, fish etc.

(b) **Secondary Consumers** : These are carnivorous fish as Herring, Shad, Mackerel etc., feeding on the herbivores.

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129. See generally P. D. Sharma, *Ecology and Environment*, (1997), pp. 222 and 248.

(c) **Tertiary Consumers** : Still in the food chain, there are other carnivorous fishes like Cod, Haddock, Halibut etc., that feed on other carnivores of the secondary consumers level. Thus, these are the top carnivores in the food chain.

3. **Decomposers** : The microbes active in the decay of dead organic matter of producers and macro consumers are, chiefly, bacteria and some fungi.[130]

Estuarine Ecosystem :

An estuary may be designated as a confined arm of the sea situated at the mouth of a river. It comprises of both sea water and fresh water.[131]

Cropland Ecosystem :

Apart from above mentioned natural ecosystems, there are also man-engineered ecosystems in which man is very much involved in their operation. One such is the **'cropland ecosystem'**, in which man has developed croplands after considering the soil, climatic and other environmental conditions. These are ecosystems of dominant crop species like wheat, maize, jowar, paddy, sugarcane, cotton, tea, coffee etc.

The abiotic components of this ecosystem include climatic conditions and mineral contents of the soil. In case of any deficiency, man use chemical fertilizers and / or water for irrigation, etc.. The various types of food grains, pluses and commercial crops are grown in these croplands, which provide food and fodder not only to man and animals respectively, but in the fields several types of animals like birds, rats, rabbits, and other smaller reptiles, insects etc., also survive. The decomposition of dead organic matter of plants and animals make the minerals available again.[132]

Species, Population and Community :

Each kind of living organism found in an ecosystem is called a **'species'**. A species includes individuals which are genetically alike and which are capable of freely inter-breeding and producing, fertile off springs. A **'population'** is a group of inter-acting

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130. Ibid at p. 252.

131. See generally P. D. Sharma, *Elements of Ecology*, (1987-88), p. 309.

132. H. M. Saxena, *Environmental Geography*, (1999), p. 54.

individuals, usually of the same species, in a definable space. Thus, one can speak of population of deer on an island, the population of fishes in a pond. An ecosystem usually contains numerous populations of different species of plants, animals and microbes, all interacting with one another as a community and with the physical environment, as well. A **'community'** or **'biotic community'**, thus, consists of the populations of plants and animals living together in a given place. For example, one refers to the community of an oak forest, a grassland, a coral reef, a desert or a pond.[133]

Ecological Niche :

Each organism in a community has a distinct **'ecological niche'**. Different species tend to live in different habitats, eat different foods and live with different life-styles. The ecological niche, thus, is a more inclusive term that includes not only the physical space occupied by an organism, but also its functional role in the community (namely, its trophic position) and its position in environmental gradients of temperature, moisture, PH, soil, and other conditions of existence.[134]

Food Chain :

From the energetic view points, the ecosystem may be divided in to three types of organisms : Producers, Consumers and Reducers (Decomposers). Plant, photosynthetic algae are the producers of the ecosystem. Animals, being either carnivorous, herbivorous or omnivorous, are consumers of the ecosystem. Reducers are heterotrophic organisms; they are fungi, bacteria that decompose dead organic matter. Thus, the ecosystem is composed of organisms eaten by or eating other organisms. The transfer of food energy from the producers through a series of organisms (herbivorous to carnivorous to decomposers) with repeated eating and being eaten, is known as a **'food chain'**. The consumer food chain includes the sequence of energy flow from producer herbivore $\rightarrow$ carnivore $\rightarrow$ reducer; the detritus food chain bypasses the consumers, going from producer $\rightarrow$ reducer.[135]

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133. P.S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 7.
134. Ibid.
135. Ibid at p. 8.

Ecological Balance :

In an ecosystem, the abiotic (non-living) and biotic (living) environmental factors keep interacting with one another to maintain a mutual balance called '**ecological balance**'.[136] If by any natural or artificial means this balance is disturbed, it leads to harmful results for mankind as a whole. Environmental studies reveal that this balance is disturbed by unlimited exploitation of natural resources, indiscriminate felling of trees, deforestation,[136-A] diversion of forest land for non-forest purposes,[136-B] killing of wild birds and animals[136-C] and pollution of every kind water, air, land etc.

The latter half of the twentieth century has generated what some environmentalists have called the '**ecological crisis**', which may be understood as the breakdown of the natural system, thus, jeopardizing the existence of living being in the universe. Life can only survive when there is a balance between different species, when there is inter-dependence between them. But the moment it is disturbed with one species taking over the others, consuming far more resources than it should and producing a waste immensely harmful for the life of others, the crisis will inevitably surface. The crisis will not be for one life system or the other, rather it will be for all, although some may be affected far more than the others. Because of ecological crisis, some species may become extinct, some may survive precariously, thus, causing imbalance in nature. It is natural synergism,

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136. 'Ecological Balance' is indicated in Figure 3.

136-A. The Gangotri glaciers, sources of the river Ganges, have been receding at an alarming rate, due to deforestation. Environmentalists fear that if urgent measures are not undertaken, a time may come when Ganges may just disappear. (*Environment Plus*, April, 22-28, 2002, p. 8, India's Weekly News Paper on Environment, published from Jorhat-Delhi, E-mail : jnpublications@hclinfinet.com).

136-B. Subansiri Project : State Government clears 865.3 hectares forest land. The first step towards setting up of the 2000 MW Subansiri Hydro-Power Project by the NHPC has been cleared with the State Government giving clearance for use of 856.3 hectares of reserved forest land for the project. The State Government endorsed its action on the ground that Subansiri Project would be the largest hydro-power project in the country (*The Assam Tribune*, March, 18, 2003).

136-C Despite the timely warnings by environmentalists and the Centre's concern to curb the illegal trade in wild life and its derivatives, the trade still goes on (*Nirmal Rallan, 'The Illegal Trade Goes On', The Assam Tribune, Sunday Reading*, July, 14, 1996). Poachers kill 495 rhinos in the State of Assam since 1985 (*The Assam Tribune*, September, 13, 2001). Within a span of 11 years from 1990 to 2001, 600 rhinos died naturally as against the death of 211 rhinos through poaching (*Environment Plus*, Jan 3-9, 2002, p. 11, India's Weekly News Paper

the dependence of one species on the other, which guarantees the continued survival of all. Its collapse is a cause of worry; it generates ecological crisis.[136-D]

The **Assam Human Rights Commission** (AHRC) has stressed the need for striking a proper balance between **economic development** and **ecological balance.** The Commission Chairperson, in a recent order, has said that it is a constitutional duty not only of the State but also of every citizen to protect and improve the environment. He said that the right to life, enshrined in Article 21 of the Constitution, includes all those aspects of the life which go to make a man's life meaningful, complete and worth living, and it also includes right to a decent environment. It would be worthy to mention that industrial development is necessary for the economic growth of the country, but the industrial growth should not be sought to be achieved by haphazard and reckless working resulting in loss of life, property and public amenities.[136-E]

Environmental Degradation :

Man being a dominant organism of most ecosystems, controls and modifies environments more extensively than any other organism. In fact, there have been significant changes in the natural environments due to man's intervention and his rapid

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on Environment, published from Jorhat-Delhi, E-mail : jnpublications@hclinfinet.com).

Census of Rhino death from 1990-2001

Year	Poaching	Natural	Total
1990	29	52	81
1991	17	74	91
1992	43	60	103
1993	35	53	88
1994	11	32	43
1995	22	48	70
1996	22	42	64
1997	12	43	55
1998	8	82	90
1999	3	43	46
2000	4	44	48
2001	5	27	32
Total	211	600	811

Source : 'Environment Plus', January, 3-9, 2002, p. 11.

136-D Vinay Kumar Srivastava, *'Ecological Crisis'*, published in *Environment Plus*, January 3-9, 2002, p. 4.

136-E Ecology protection a statutory duty (*The Assam Tribune*, May, 20, 2001).

progress in colonization, urbanization and technology. Thus, deforestation has provided land for agriculture and rural inhabitation, rural land has been converted in to urban settlements and open spaces are fast vanishing. The mass scale destruction of flora and fauna has become detrimental to **ecological balance**. Quite ridiculously, much of this environmental degradation is done in the name of economic development.[137]

In the present century, environmental degradation has emerged as a major global concern for human survival. In the opinion of the **World Commission on Environment and Development,**[138] the future is to face an ever-increasing environmental decay, poverty, hardship and an ever more polluted world. The strains of the ecological crisis are so apparent that the task to preserve and protect the environment has become the primary requisite of the economics of development.[139] Modernization is steadily transforming the nature into products. The resource squeeze has led to an ever-intensification of ecological damage. Land, water and air are being polluted every minute. Approximately 10,000 million tons of oxygen is being burned and about 24,000 million tons of carbon dioxide is being discharged every year.[140] The green revolution has turned red. Deforestation is proceeding an alarming rate depleting the genetic store. Loss of trees and plants is shaking the base of the ecosystem globally. Our world is losing almost 17

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137. P. S. Verma and V.K. Agarwal, *Principles of Ecology*, (1989), p. 518. Development basically means a complex process whereby the quality of life and personality of individuals and groups improves. It is the result of the interplay of three fundamental variables : institution, technology and environment. Environment provides natural resources and the society, being institutionally organized, utilize them by applying skills and technology (Dr. Abani Kumar Bhagabati, *'Environment and Development'*, published in *The Assam Tribune*, June, 6, 1997).

138. In 1983, the U.N. General Assembly setup a Commission - World Commission on Environment and Development (WCED), headed by Norway's Prime Minister, Mrs. G. H. Brundtland to examine the state of world environment and development beyond 2000. The report of the Commission (1987), '*Our Common Future*' noted that the human future was at a risk if we continue the current modes unsustainable development. The Commission stressed the need of integrating environment with development.

139. The new relationship between environmental health and economic wealth, is a set of views so inherently simple and obvious that it can be reduced to a single equation : What's good for the environment = What's good for the economy. Like any mathematical equation, this one makes exactly the same sense when the statements on either side of the equal sign are reversed : What's good for the economy = What't good for the environment [Michael Silverstein, *The Environmental Economic Revolution . How Business will Thrive and the Earth Survive in Years to Come*, (1995), p. 6].

140. H. M. Saxena, *Environmental Geography*, (1999), p. 68.

million hectares of forests per year and in India, it is 1.3 to 1.5 million hectares per year.[141] Mega technology has created problems of waste disposal and industrial revolution has now become a great hazard to the environment, as well as, to humanity.

Man's environment, by now, is sufficiently saturated by the complex chemical emissions, aerosols, toxic dust and radiation. **Global 2000 Report, 1980,** reveals[142] that the globe will become more crowded, more polluted, ecologically less stable and more vulnerable to disruption than the world we live in today.

Deforestation :

The phenomenon of deforestation can be explained in terms of loss of forests,[142-A] leading to imbalance in the ecosystem as a whole.[143] Deforestation symbolizes the situation of over-exploitation of natural resources. The effects of deforestation may be observed as a loss of bio-diversity,[143-A] adverse effects on

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141. *'Forests for Life'*, *The Assam Tribune Sunday Reading*, March , 21, 1999.

142. Supra n. 140.

142-A. Forests in 41,000 hectares of land in Assam were destroyed during the period from 1996 to 1999. This was disclosed by the Minister of State for Forests, Sri Pradyut Bordoloi, while replying to the debate on the cut motions on the demand for grant of Rs. 1,33,41,62,000 for the Forest Department for the year 2003-2004 (*The Assam Tribune*, March, 30, 2003).

143. S.N. Tripathy and Sunakar Panda, *Fundamentals of Environmental Studies*, (2001), p. 143.

143-A Felling of nesting trees and wanton destruction of mixed forests have been causing rapid shrinkage to natural breeding habitat of the endangered greater Adjutant Stork (called *hargila* in Assam) which have largest concentration of about 600 in Brahmaputra Valley (*The Assam Tribune*, February, 15, 2002). Illegal felling of trees in the vast tracts of reserved forests along the Assam-Meghalaya border to the south and south-west of Guwahati is going on unabated, exposing the rich biodiversity of the zone with its unique flora and fauna to the gravest possible danger. An area of 25 sq. km. of the Garbhanga Reserved Forest which is among the biggest protected areas in Kamrup district with a total area of 188.6 sq.km. has been totally degraded at Luki (*The Assam Tribune*, December, 29, 2002). Forest encroachment is also destroying ecological balance along the Assam -Arunachal border. Large scale encroachment of the reserved forests in Lakhimpur district, particularly by the people of Arunachal Pradesh, in support of the government of the neighbouring state, has threatened to destroy the ecological balance in the border districts of Assam (*The Assam Tribune*, January, 12, 1999). Forest reserves on the Assam-Nagaland border including the Nambor Reserved Forest have been destroyed by the encroachers and anti-social elements. Out of 24,000 hectares of Nambor forest land, 10,748 hectares are under the occupation of the encroachers (*The Assam Tribune*, May, 14, 1999). Perennial floods, tiger predation and human intervention in Kaziranga National Park have taken their toll on the rare species of swamp deer, whose population in the recent years has shockingly declined. The highest number of swamp deer - 756 was recorded in 1984, while in 1998, it has come down to 526, according to a census carried out by the park authorities (*The North East Daily*, August, 22, 1998).

natural phenomenon,[143-B] like rainfall, atmospheric quality, floods[143-C] and land slides, soil erosion and scarcity of timber, fuelwood, fodder and other forest products. The loss of biodiversity has resulted in extinction of many valuable plants and animal species all over the country.[144]

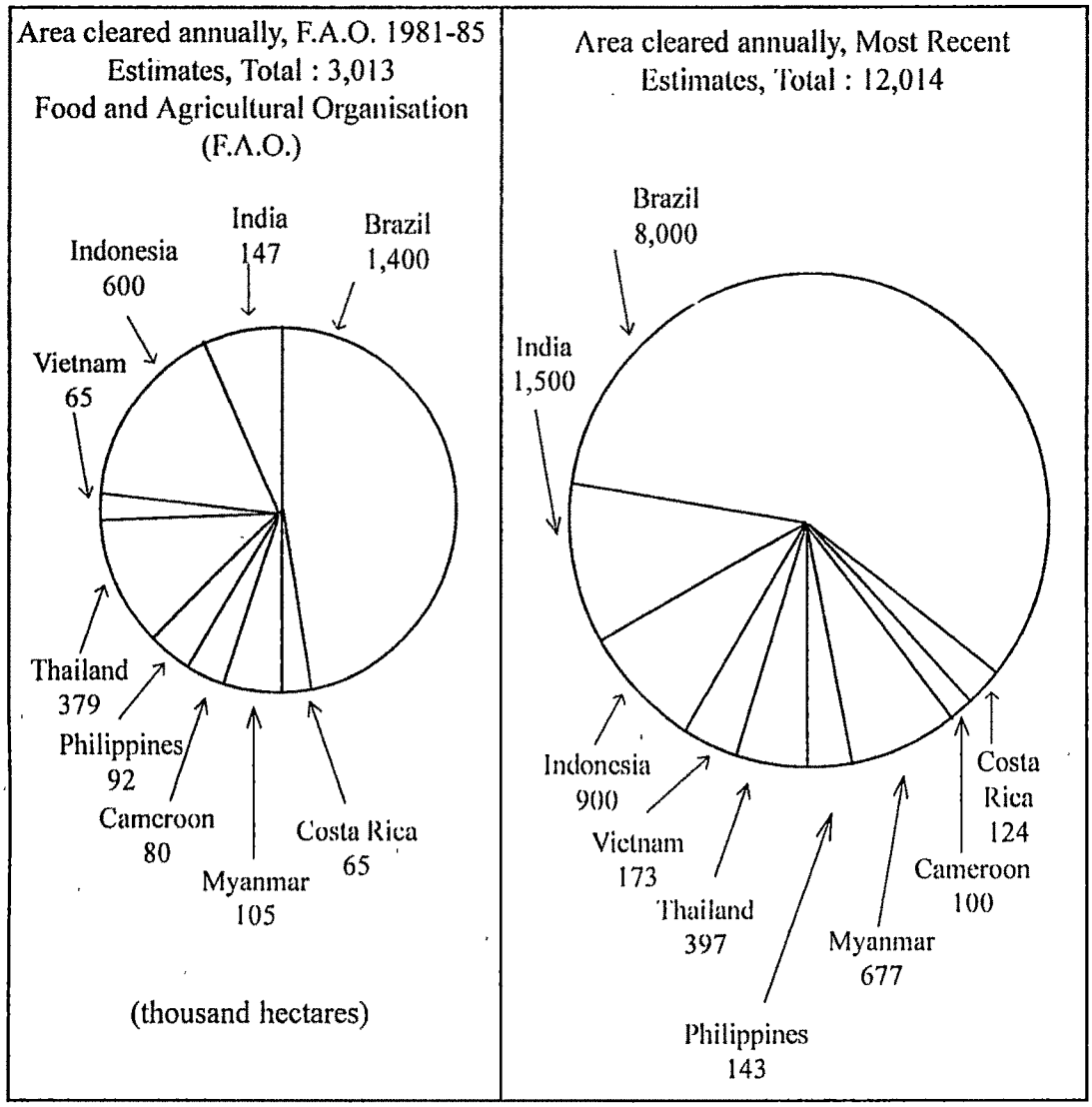

Figure 6 : Area of closed forests cleared annually in selected tropical countries [**Source : Environmental Geography : H.M. Saxena, (1999), p. 83**].

143-B. Internationally reputed experts on forest resources and scientists have recommended some urgent steps to be taken by North Eastern States to mitigate the 'catastrophic famine' that is likely to hit the region subsequent to 'gregarious flowering of bamboo' predicted to occur during 2005-2007. Scientists have predicted that gregarious flowering of bamboo will occur in an estimated area of 18,000 square kilometre in the States of Mizoram, Tripura, Manipur and parts of Assam and Meghalaya during 2005-2007. The epicentre of bamboo flowering will be Mizoram (*The Assam Tribune*, June, 13, 2002).

143-C In the year, 2003, floods hit over 18 lakhs people in Assam (*The Assam Tribune*, July, 11, 2003).

144. Supra n. 143.

Now a days tropical deforestation has become a concern of all and its impact is not only limited to the region itself, but on climatic conditions of the whole world is alarming.[145] The annual decline in forest cover in tropical counties has been depicted in Figure 6. It is clear from the diagram that in countries like Brazil, India, Indonesia, Thailand etc., the rate of annual cutting of forests is very high and has become a great problem to the environment and ecosystem.

Tropical deforestation results from a number of inter connected causes, all of which are related in some way to population growth, poverty and government policies that encourage deforestation.[146] Population growth and poverty combine to drive subsistence farmers and the landless poor to tropical forests, where they try to grow enough food to survive. Shifting cultivation leads to unsustainable farming that depletes soils and destroys large tracts of forests.[147] Cattle ranching also degrades tropical forests. Ranchers move from one area to another area and repeat a destructive process known as **shifting ranching**.[148]

Deforestation threatens all ecological systems[148-A] and undermines the fertility and stability of soils. It takes nearly 600 years to create one inch of top soils.[149] Without the protection of the forests, wind and water can carry away this precious top soil. Forests in India cover 63.85 million hectares which is approximately 19.47 per cent of its

145. H.M. Saxena, *Environmental Geography*, (1999), p. 82.

146. S. Mukherjee and A. Ghosh, *Environmental Studies*, (2000), p. 49.

147. Besides commercial exploitation through wanton felling of trees, shifting cultivation, involving the traditional slash-and-burn practice of agriculture, is widely practised in the hills of the North Eastern Region constituting a major cause of environmental degradation. Biotic pressure is also quite high to meet the growing demand for fuelwood, fodder and non-timber forest products. In a recent satellite study of the Karbi Anglong and North Cachar districts of Assam, it was found that area under current *jhum* had increased more and fourfold during the period 1986-87 and 1993-94 (Dr. D.C. Goswami, *'North-Eastern Region is in for Serious Ecological Fix'*, published in *The Oil Field Times*, 12, June, 1998).

148. Supra n. 146.

148-A. Large scale deforestation in the neighbouring State of Arunachal Pradesh is primarily responsible for the siltation in the river Brahmaputra. The Kaziranga National Park has lost around 37 sq. km. of its area due to the erosion caused by the Brahmaputra between 1967 to 1999, as revealed by the multidated satellite imagery done by the Indian Space Research Organization (ISRO) (*The Assam Tribune*, October, 23, 2001).

149. A. Panneerselvam and Mohana Ramakrishnan, *Environmental Science Education*, (2000), p. 54.

geographical area. Only 38.47 million hectares of this is dense forests, the rest consisting of 24.96 million hectares of open forests of low densities and 0.4 million hectares of mangroves.[150]

In India, deforestation is going on at a very fast rate. The story of over exploitation of forests started from **World War II**, when the British started clearing forests to meet their needs.[151] In the post independence period, the process of exploitation has been accelerated to meet developmental projects of railways, industries, mining, river valley projects, defence etc. The urbanization and expansion of agricultural activity has also contributed to the exploitation of forests.[152]

Deforestation and over-grazing have been causing tremendous land erosion and land slides. On an average, India is losing about 6,000 million tons of top soil annually due to water erosion in the absence of tress.[153] The loss worked out from the top soil erosion in 1973 was Rs. 700 crore, in 1976, 1977 and 1978, it was Rs. 889 crore, Rs. 1,200 crore and Rs. 1,091 crore respectively.[154]

India today is the poorest in the world as per capita land is concerned. The per capita forest land in India is 0.10 hectare compared to the world average of 1 hectare, Canada 14.2 hectare, Australia 7.6 hectare and U.S.A. 7.30 hectare.[155] Indian forests comprise only 0.50 per cent of the world forest area.[156] India is losing about 1.5 million hectares of forest cover each year. If this trend continues we may in the next 20 years or so reach to **'zeroforest'** value in our country.[157] During a period of 25 years (1951-1976), India has lost 4.1 million hectares of forest area.[158] Large-scale deforestation has been done for fuel, fodder, valley projects, industrial uses, road construction etc. India

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150. Ibid at p. 55.
151. H. M. Saxena, *Environmental Geography*, (1999), p. 82.
152. Ibid at pp. 82-83.
153. P. D. Sharma, *Ecology and Environment*, (1997), p. 326.
154. Ibid.
155. Ibid.
156. Ibid.
157. Ibid at p. 327.
158. Ibid.

consumes nearly 170 million tons of firewood annually, and 10-15 million hectares of forest cover is being stripped every year to meet fuel requirements.[159] Actual fuelwood consumption went up from 86.3 million tons in 1953 to about 135 million tons in 1980, indicating pressure on forests.[160] During a period of 20 years (1951 to 1971), forests have been cut for agriculture (24.32 lakh hectares), river valley projects (4.01 lakh hectares), industrial uses (1.24 lakh hectares), road construction (0,55 lakh hectares) and miscellaneous uses (3.88 lakh hectares). Thus, a total of 3.4 million hectares of forests were lost during this period.[161] Nearly 1 per cent of the land surface of India is turning barren every year due to deforestation. In the Himalayan range, the rainfall has declined 3 to 4 per cent due to deforestation.[162]

The wealth of life on earth is vanishing at a faster rate due to deforestation which is a bigger threat to the future of the earth, as well as, of mankind. Increase in soil erosion, large-scale silting or reservoirs and canals, uncertainty and decrease in rainfall, increase in temperature and the like – are the outcome of heavy deforestation. Deforestation is directly responsible for greater frequency and intensity of floods and droughts.[163] The Chart–1 given below indicates the consequences of deforestation.

According to a research study made by the **Birla Institute of Scientific Research** at Jaipur, ravage of the major mountain ranges of the Himalayas, the Aravallis and the Western Ghats, have been the cause of recurring droughts and famine.[164] In Western India, the desert is advancing into Gujarat and Haryana, creeping closer and closer to Delhi itself, The great Indian desert is advancing at the rate of almost one kilometre a year.[165] Thus, India has a new phenomenon of man-made desert. Water resources have dried up, many plant species have become extinct. Wild life has disappeared . In the long run, the areas where rich, dense forests flourished once, will turn in to deserts.

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159. Ibid.
160. Ibid.
161. Ibid.
162. Ibid.
163. S. N. Tripathy and Sunakar Panda, *Fundamentals of Environmental Studies*, (2001), p. 146.
164. Ibid at p. 147.
165. Ibid at p. 148.

Deforestation

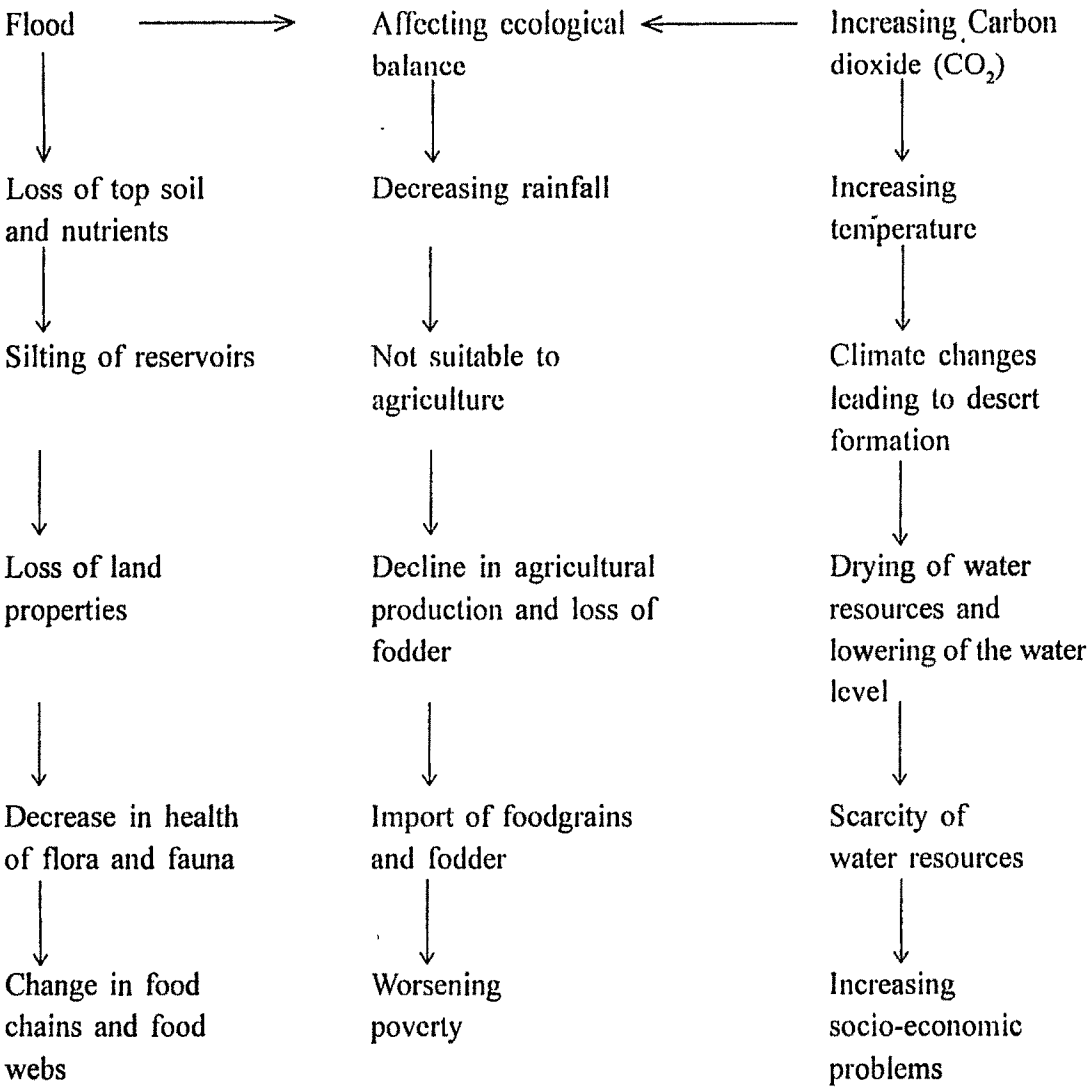

Chart 1 : Consequences of deforestation

Depletion of forests in developing countries is a complex problem that is inter-linked with population growth, poverty, illiteracy, urban migration, rural ecosystem, etc. Unable to support their growing populations, they push more and more people into the cities. The migration of **'environmental refugees'**[166] to urban areas has led to big slums, pollution and sanitation problems, epidemics, such as, malaria, and cholera and drugs, crime and violence.

In the Nilgiries (Tamil Nadu), more and more rootless migrants from the plains are pouring into the hills and most of them have settled down in ecologically sensitive

166. Ibid at pp. 148-149.

areas. They start cultivating steep hills which results in soli erosion, water run off, flash floods, avalanches, land slides and silting up dams and reservoirs.[167]

The role of tropical deforestation in global warming is well-known, accounting for 20-30 per cent of annual carbon emission world-wide.[168] Felled trees emit more carbon dioxide, as they burn or decay. When there are no trees for absorbing carbon dioxide automatically, carbon dioxide will increase in the places where trees are destroyed.

The green belt of Assam covered by innumerable species of vegetation is facing a great crisis at present due to various activities of mankind. The situation has now become critical, so much so, that unless some drastic measures are taken, Assam and the rest of the North-Eastern region will become a treeless desert like some parts of Rajasthan.[168-A] **The future of North-East India lies in its forests.**[168-B]

Assam has a forest cover of 19.26 per cent at present as against 25.2 per cent during 1980-82.[169] According to expert opinion, the minimum area of forests necessary for a tropical State like Assam should be about one-third of the total geographic area (i.e. 33 per cent).[170] We fall short of this required minimum.[170-A]

The notified forest areas that are ecologically and economically very vital for the

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167. Ibid at p. 149.

168. Ibid.

168-A.Assam's Sonitpur district has a dubious distinction for the past 6 years. This district has witnessed the fastest rate of depletion of its forest cover in the country. Some 22,000 hectares of forest land have been destroyed (*The Assam Tribune*, 17, May, 2003).

168-B. *The Assam Tribune*, June, 3, 2003.

169. Dwaipayan, *'Dwindling Forest Cover in the North East'* published in *The Assam Tribune* August, 24, 2002, p. 4. The North Eastern States have lost over 300 sq. km. forest cover since 1995 even as a Supreme Court order banning felling of trees is in vogue in the region (T.N. Godavarman Thirumulkpad Vs Union of India, A.I.R. 1997 S.C. 1228). A *State of Forest Report* (SFR) compiled by the Forest Survey of India once in every two years says the country lost 5,482 sq.km. of the forest cover. The N.E. Regions which had a forest cover of 67 per cent lost 783 sq. km. during 1993-95. Assam recorded the maximum loss of 237 sq. km. Its forest cover dwindled from 24,061 sq.km. in 1995 to 23,824 sq. km., in 1998, while Nagaland lost 70 sq.km. (*The Assam Tribune*, June, 25, 1998, p. 5).

170. *Competition Success Review*, July, 1987, p. 60.

170-A. Due to encroachment, the area under notified forests in the State of Assam has gone down to an alarming 16 per cent in terms of closed forests which is well below the norm of 33 per cent recommended by the National Forest Policy, 1998 (*The Assam Tribune*, June, 6, 2002).

state appears to be under extreme stress due to massive deforestation, large scale encroachment[170-B] and intense degradation. The scenario is evident from the fact that Nambar (South) Reserved Forest (R.F.) has merely 3.6 per cent forest cover, Doyang R.F. just 2.5 percent and Diphu R.F. just 8.2 per cent.[171]

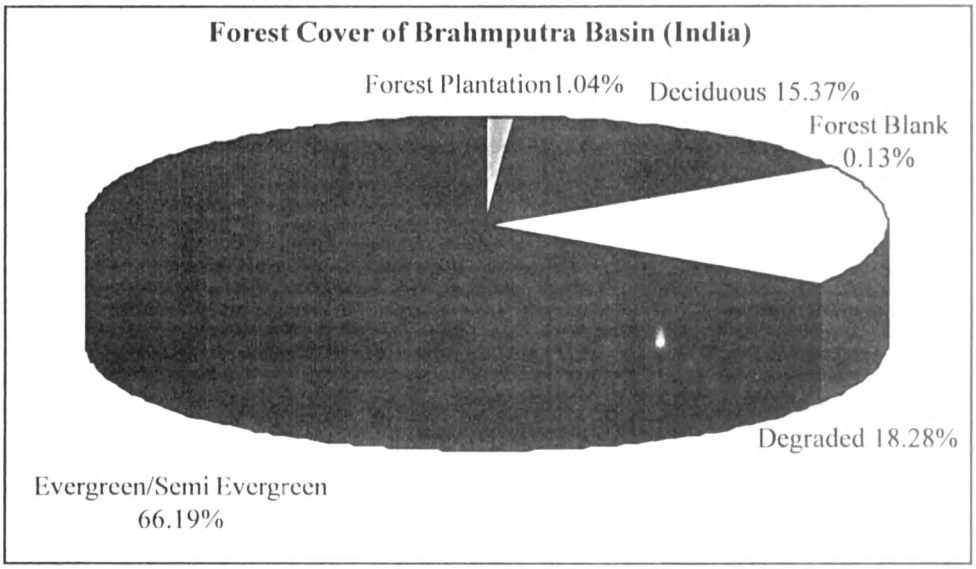

Figure-7 : Depletion of forest cover.

Source : The Assam Tribune, June 5, 1999.

The main reasons for the loss of forest cover are felling of trees, illegal encorachments[171-A] in the insurgency affected areas and shifting cultivation in the hill

170-B According to the *State of Forest Report 2001*, Morigaon and Dhemaji districts with 6.10 per cent and 7.20 per cent respectively have the lowest forest cover in the State. Karbi Anglong with 76.40 per cent along with Cachar (54.12 per cent) and Hailakandi (50.94 per cent) districts have highest forest cover in the State (*The Assam Tribune*, April, 23, 2003).

171. Dr. D.C. Goswami, '*North Eastern Region is in for Serious Ecological Fix*', in *The Oil Field Times* 12. June, 1998, p. 3.

171-A At a time when the Government and other NGOs are adopting several measures for the preservation of forest resources and the Supreme Court has imposed ban on felling of trees (T.N. Godavarman Thirumulkpad Vs Union of India, A.I.R. 1997 S.C. 1228), wanton destruction of trees in entire South Kamrup area, has been continuing unabated for the last several years (*The Assam Tribune*, June, 1, 2003). Unrestricted felling of trees and encroachment have reduced more than half of the forests in Sonitpur district that boasts of a combined territory of 13 forest reserves. According to officials of Forest Department, about 9,376 hectares of Chariduar Reserved Forest and 9,956 hectares of Gohpur Reserved Forest have been denuded by militants living in the vicinity of these forests (*The Assam Tribune*, April, 7, 2002). Assam tops the list in forest degradation. Large scale degradation of forest cover in the State, particularly in the last few years, has posed a serious threat to the environment and according to official records. Assam topped the list of states, in respect of, degradation of forest cover during the period from 1993 to 1995. According to the latest annual report of the Ministry of Environment and Forests, Government of India, during the two-year period from 1993 to 1995, the forest cover in Assam was reduced by 447 sq. km, which is the highest among the all the states in the country. As per the report, the forest cover in Arunachal Pradesh was

districts (Karbi Anglong and Cachar) of the State.[172] The State Minister of Forest has confessed that illegal felling of trees in the State is still continuing[173] inspite of the ban (T.N. Godavarman Thirumulkpad Vs Union of India, A.I.R. 1997 S.C.1228).

Environmentalist warns disaster for Brahmaputra basin people[173-A]. Dr. Dulal Chandra Goswami, who is presently the Professor and Head of the Department of Environmental Science of the Gauhati University, in one of his papers prepared for the **International Centre for Integrated Mountain Development** (ICIMOD), Kathmandu, Nepal, on the **Status of Forests in Brahmaputra Basin**, expressed serious concern over the fact that the forests in the Brahmaputra basin are under considerable pressure to meet the growing demand for firewood, fodder, timber and other forest products. The rapacious destruction of forests in the basin area can be comprehended from a simple fact that the forests in the area are axed for collecting firewood at the rate of 2.5 kg. per day per head leading to an annual consumption of 50 million tonnes.[173-B]

The total forest cover of the Brahmaputra basin in India is 1,14,992 square kilometres, while in Bhutan, the total coverage is 27,650 square kilometres. In India, Arunachal Pradesh accounts for about 60 per cent of the forest cover in the Brahmaputra basin, followed by Nagaland, Meghalaya, Sikkim, West Bengal and Assam.[173-C]

Desertification :

Destruction of biotic potential of land leads to disertification.[174] Such problem arises due to over grazing, indiscriminate felling of trees and over-exploitation of land resources.[175] Desertification is a complex process affecting more than six hundred million

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reduced by 40 sq. km. In Manipur, the forest cover was reduced by 63 sq. km., by 55 sq. km. in Meghalaya, by 121 sq. km. in Mizoram and by 57 sq. km. in Nagaland. There was no change to the forest cover in the remaining North Eastern states. (*The Assam Tribune*, September, 4, 1997).

172. Geetartha Pathak, '*Assam Forests : Six Years After S.C. Ban*', published in *The Assam Tribune* August, 9, 2003.

173. Ibid.

173-A. Depletion of forest cover. Environmentalist warns disaster for Brahmaputra basin people *(The Assam Tribune*, June, 5, 1999).

173-B. Ibid.

173-C. Ibid.

174. P.D. Sharma, *Ecology and Environment*, (1997), p. 326.

175. Ibid.

people and approximately one-third of the earth's land surface.[176] It is a process through which fertile or non-desertic land is converted into dry, infertile or desertic land. In otherwords, desertification is a process whereby the productive potential of arid or semi-arid land falls by 10% or more; and this phenomenon is caused mainly by human activities.[177] Moderate desertification is a 10-25% drop in productivity; severe desertification is a 25-50% drop; and very severe desertification is a drop of 50% or more.[178]

Desertification is a serious and growing problem in many parts of the world. The regions most affected by desertification are cattle producing areas in arid and semi-arid climates, including Sub-Saharan Africa, the Middle East and Western Asia.[179]

Pollution :

'Pollution' is an undesirable change in the physical, chemical or biological characteristics of air, water and soil that may harmfully affect the life or create a potential health hazard of any living organism.[179-A] Pollution is, thus, direct or indirect change in any component of the biosphere that is harmful to the living components, and in particular undesirable for man, affecting adversely the industrial progress, cultural and natural assets or general environment.[180]

Any substance which causes **'pollution'** is called a **'pollutant'**[181] A pollutant may,

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176. H.M. Saxena, *Environmental Geography,* (1999), p. 79.

177. S. Mukherjee and A. Ghosh, *Environmental Studies*, (2000), p. 148.

178. Ibid.

179. Ibid.

179-A. According to the Centre for Science and Environment (CSE), the city of Delhi's air kills a person every hour (*The Sunday Times of India, Eastern India Special,* New Delhi, April, 14, 2003, p. 3). Air Pollution has a significant impact on heart disease. Nearly 40,000 people die of air pollution every year in Ahmedabad, Mumbai, Kolkata, Delhi, Kanpur and Nagpur (*The Times of India, Eastern India Special*, New Delhi,, June, 17, 2002).

180. P. D. Sharma, *Ecology and Environment*, (1997), p. 416.

181. Pesticides are found in bottled water. Residues of extremely harmful pesticides have been found in popular brands of bottled water sold in Delhi and Mumbai. The pesticides identified are lindane, DDT, chlorpyrifos and malathion. They collect in the body over the years and cause cancer, attack the nervous system and weaken the immune system. This study has been conducted by the Centre for science and environment (CSE) (*The Times of India, Eastern India Special,* New Delhi, February, 5, 2003).

thus, include any chemical or geochemical (dust, sediment, grit etc.,) substance, biotic component or its product, or physical factor (heat) that is released intentionally by man into the environment in such a concentration that may have adverse harmful or unpleasant effects. A pollutant has also been defined as *'any solid, liquid or gaseous substance present in such concentration as may be or tend to be injurious to the environment'*.[182] Pollutants are the residues of things we make, use and throw away. There are many sources of such pollutants. The lakes and rivers are polluted by wastes from chemical and other factories, and the air by gases of automobile exhausts, industries, thermal power plants etc.[183]

Generally pollution is classified either according to the **'environment'** (air, water, soil) in which it occurs, or according to the **'pollutant'** (sulphur dioxide, fluoride, carbon monoxide, smoke, lead etc.,) by which pollution is caused. Sometimes, pollution is also classified into two broad categories : (a) Natural pollution, which originates from natural processes; and (b) Artificial pollution, which originates due to the activities of man.[184]

Thus, on the basis of the type of environment being polluted, we may recognize air pollution, water pollution, soil pollution etc. On the basis of the kind of pollutant involved, we may have sulphur dioxide pollution, fluoride pollution, carbon monoxide pollution, smoke pollution, lead pollution, mercury pollution[184-A], solid waste pollution, radioactive pollution, noise pollution etc.[185]

Air Pollution :

When due to some natural processes or human activities the amount of solid waste

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182. Supra n. 180.

183. Ibid.

184. P.S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 495.

184-A. India is being exposed to high levels of mercury poisoning from companies producing caustic soda and chlorine. It is according to a green rating released by former Finance Minister Manmohan Singh. The rating was undertaken by the Centre for Science and Environment (CSE). The caustic-chlorine industry is regarded as the mother of all chemical industries. Caustic soda and chlorine are used extensively to make products like plastic, bulbs, batteries and pesticides. The pollution results from the mercury cell process used in India.. An astounding 60-70 tons of mercury is released every year into our environment (*The Times of India, Eastern India Special*, New Delhi, September, 3, 2002).

185.Supra n. 180 at pp. 417-418.

or concentration of gases other than oxygen increase in the air which normally has constant percentage of different gases in it, the air is said to be polluted and this phenomenon is referred to as air or **atmospheric pollution.**[186]

The **World Health Organization** (WHO) defines **'air pollution'** as *'limited to situations in which the outer ambient atmosphere contains materials in concentrations which are harmful to man and his environment'.*[187]

H. Perkins (1974) defined **'air pollution'** as *'the presence, in the outdoor atmosphere, of one or more contaminants, such as, fumes, dust, gases, mist, odour, smoke, smog or vapours in considerable quantities and of duration which is injurious to human, animal or plant life or which unreasonably interfere with the comfortable enjoyment of life and property'.*[188]

Air pollution is generally disequilibrium condition of air caused due to the introduction of foreign elements from natural and man made sources to the air so that it becomes injurious to biological communities.

Air pollution may be described as *'the imbalance in quality of air so as to cause adverse effects on the living organisms existing on earth'.*

Thus, we can not find clean air in any part of the world. The air which we breathe is not a pure oxygen, but is contaminated with dust,[188-A] smoke and several gases in harmful proportions. According to the latest viewpoint, air pollution is defined as *'substances introduced in to the air by the activity of mankind in such concentration sufficient to cause serious effects on his health, vegetables, property or interference with the enjoyment of his property'.*[189]

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186. P. S. Verma and V. K. Agarwal, *Principles of Ecology*, (1989), p. 495.

187. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. AIR- 3.

188. Ibid.

188-A. Dust pollution is posing serious health hazard in Guwahati city. The people of Guwahati are regularly exposed to serious health hazards because of severe dust pollution and the diseases like conjunctivitis, asthma, sinus problems have become common among the citizens. The problem of dust pollution aggravates in the rainy season as the roads are covered with mud and slush even after a brief spell of rain because of the failure of the authorities concerned to keep the drains clean and to check cutting of the hills and the mud and slush, when dried up, result in severe dust pollution (*The Assam Tribune*, June, 19, 2001)

189. Supra n. 187 at p AIR- 4.

The environment magazine **'Down to Earth'**[190] reports extensively on the air pollution problems afflicting Indian cities. The following report highlights the dangers posed by **suspended particulate matter** (SPM) to public health.[191]

Death is in the Air; Down to Earth, 15, November, 1997, Page 29

"The number of people dying in urban India due to deteriorating air quality is rising every year and very little is being done to deal with pollution in India cities. A stupendous 51,779 people are estimated to have died prematurely in 36 Indian cities due to air pollution in 1995 as against 40,351 in 1991-92, a rise of 28 per cent over the three year period. Calcutta, Delhi, Mumbai, Kanpur and Ahmedabad account for 10,647, 9,859, 7023, 3,639, 3,006 premature deaths respectively. This accounts for 66 per cent of total premature deaths in India. The number of air pollution-related ailments requiring medical treatment and hospital admission have sky-rocketed to 25 million cases, indicating an increasingly ruined state of heath in India cities. The estimate was 19 million in 1991-92.

In calcutta and Delhi, cases of hospital admissions and sickness requiring medical treatment due to air pollution have almost doubled in a span of three years, crossing the five million mark in 1995. Disturbing trends are also emerging in kanpur, Chennai and Ahmedabad. The main culprit is suspended particulate matter (SPM), dust and ash particles sometimes laden with toxic chemicals. The primary sources of SPM are power plants, industrial units and auto emissions. SPM levels in the above mentioned cities are three to five times higher than the acceptable limit set by the World Health Organization (WHO). Dust particles less than 10 microns in diameter known as PM 10 and PM 2.5 – can penetrate lungs easily and are detrimental to human health. PM 10 has been associated with both premature mortality

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190. Science and Environment Fortnightly *Down to Earth*. Website : www. downtoearth.org.in
191. Shyam Divan and Armin Rosencranz, *Environmental Law and Policy in India : Cases, Materials and Statutes*, (2001), pp. 242-243.

(death from respiratory illness and cardiovascular diseases) and increased morbidity (high incidents of chronic obstructive lung diseases, especially bronchitis and upper and lower respiratory tract infections).

Evaluation of these premature deaths suggests that economic and health costs due to growing levels of SPM range between Rs. 1,747 and 7,253 crores. Similarly, estimates of the monetary losses due to sickness caused by high levels of SPM is between Rs.107 to 213 crore.

In a 1995 report titled Valuing Environmental Costs in India : The Economy Wide Impact of Environmental Degradation, World Bank (WB) Staffers Carter Brandon and Kristen Homman formulated a model to establish the relationship between air pollution and human mortality and morbidity. The model was subsequently used to assess environmental and health conditions in India. Using air quality data for 1991-92 provided by the Central Pollution Control Board (CPCB) from 290 monitoring stations in 92 Indian cities and towns, they found that air pollution results in 40,351 premature deaths in India. Calcutta, Mumbai and Delhi accounted for 5,726 (14 per cent), 4,477 (11 per cent) and 7,491 (19 per cent) respectively. Substituting the CPCB air quality data for 1991-92 by the corresponding 1995 data, the figure for number of premature deaths increased to 51,779, an alarming increase by all standards."

Children are bearing the burnt of **environment degradation**. Across the class divide, they are eating, drinking and breathing poison. And their special bodies make them most vulnerable to a host of diseases.[192] Children consume more water, food and air than adults. That's why they are more susceptible to any contamination.[193] The following report clearly indicates as to how air pollution affects health of the children.

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192. *Down to Earth*, June, 15, 2002, p. 25.
193. Ibid at pp. 26-27.

Soft Target ; Down to Earth, June, 15, 2002[194]

"More children are suffering from asthma, cancer and learning disorders than ever before. Global figures suggest that since 1990, childhood cancer rates have risen by 12 per cent, asthma in children by 17 per cent and systematic disorders by 16 per cent. But these are just conservative estimates. Developing countries like India do not have authoritative registries, and guesstimates do the rounds. 'There are few epidemiological studies conducted in India', says India's leading paediatrician H.N Billimoria Worse, even physicians are inept in diagnosing diseases. A critical review published in the journal of the American Medical Association shows that doctors in India 'under diagnose' asthma by 15 per cent.

Some indicators do throw light on this alarming increase. Some may argue though that this could be due to increased awareness. Still sample this. Children's hospitals in India increased from 22 in 1990 to 148 in 2001, according to the Directorate General of Health Services. Contribution of asthma drugs for children increased from seven per cent in 1987 to 18 per cent in 1999, says the All India Pharmaceutical Manufacturers Association. Childhood cancer cases grew from 4,124 in 1988 to 6,187 in 1996, says the recently published Cancer Registry of India. 'These figures in many ways reflect the poor environment we live in' says Anupam Sachdev, paediatric oncologist at the Sir Ganga Ram Hospital, New Delhi."

Recent research shows that the link between a degraded environment and children's health is unmistakable. '*Even in the rich countries of Europe, the major environmental impact on people are borne by children. Policies, as well as, impacts are deeply unjust and hurt the poor communities more that the rich*', says the **World Health Organization's** (WHO) latest publication '**Children's Health and Environment : A Review of Evidence**'.[195]

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194. *Down to Earth*, Vol. 11, No. 2, June, 15, 2002.
195. Ibid at p. 26.

In industrialized countries, many children die due to birth defects, that can not be explained. In U.S.A., about 6,500 children die due to birth defects, which is the leading cause of infant morbidity. While only about 20 per cent of birth defects are due to known factors, the causes for the remaining 80 per cent remain elusive. And evidence against environmental factors is mounting.[196]

Vehicular pollution caused by the explosion in the number of automotive vehicles on our roads is causing serious health problems. For over a decade now, there is no disputing that more than half the pollution load in our cities is due to automobile exhaust.[197] The Supreme Court of India slaps Rs. 25 crore fine on diesel buses. In a landmark judgment advancing the fundamental right to life, the Supreme Court on Friday, April 5, 2002, imposed and exemplary fine of Rs. 500 a day from February 1 on 8,000 diesel-run buses in Delhi for failing to convert to Compressed Natural Gas (CNG). The Court also lambasted the Union Government for ignoring the common man's health problem caused by pollution. It said the Centre seemed more interested in protecting the **'health of the polluters'**.[197-A]

One of the organizations that has played a pioneering role in creating awareness about all aspects of vehicular pollution has been the **Centre for Science and Environment** (CSE) in New Delhi. Following up on a 1991-92 World Bank study of the health effects of air pollution in 36 India cities, which concludes that high **suspended particulate matter** levels had resulted in 40,000 premature deaths each year, a CSE study in 1995 registered

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196. Ibid.

197. Vehicular emission, the highest pollutant in the capital (New Delhi) account for nearly two-third of total pollution loads followed by thermal power plants, industries and domestic sectors respectively. A study by the Central Road Research Institute (CRRI) estimates that vehicular emissions generate 64 per cent of the total pollution loads while 16 per cent is generated by thermal power plants, 12 per cent by industries and seven per cent by domestic sector. CRRI has also estimated that these vehicles account for 97 per cent of hydrocarbons, 48 per cent nitrozen oxide and 76 per cent carbon monoxide emissions in the air (*The Hindustan Times*, New Delhi, Friday, June, 5, 1998). In a landmark judgment advancing the fundamental right to life, the Supreme Court of India on April 5, 2002, imposed an exemplary fine of Rs. 500 a day from February 1 on 8,000 diesel-run buses in Delhi for falling to convert to Compressed Natural Gas (CNG). The Supreme Court said that the Government by not ensuring clean air in Delhi was responsible for causing 'far greater tragedies' than the gas leak which took thousands of lives at the Union Carbide factory in Bhopal in December, 1984 (*The Times of India, Eastern India Special*, New Delhi, April, 6, 2002).

197-A. *The Times of India, Eastern India Special*, New Delhi, April, 6, 2002.

a 28 per cent increase in this figure, a frightening 52,000 premature deaths a year that could be directly linked to the air in our cities.[198]

Global Environmental Problems :

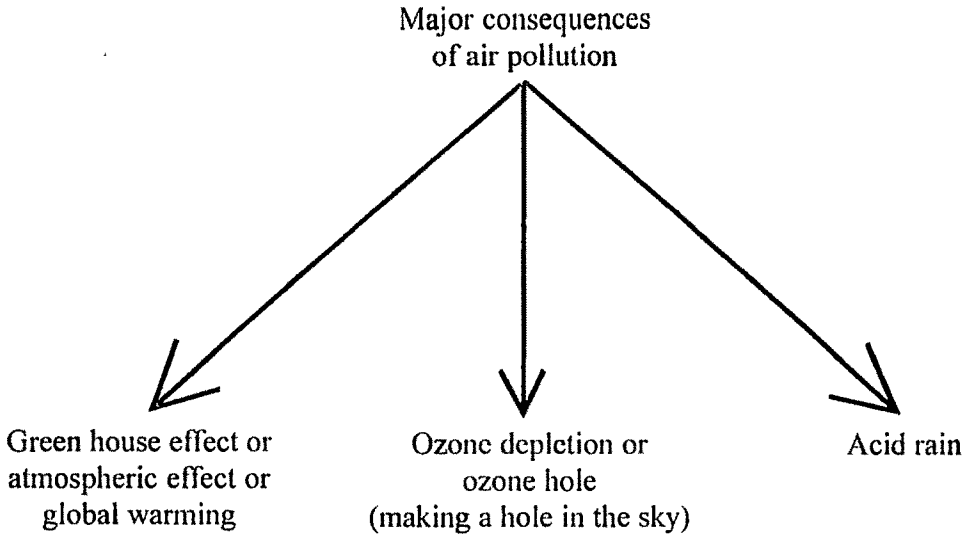

Figure 8 : Showing major consequences of 'air pollution'

Green House Effect :

Carbon dioxide is a natural constituent of atmosphere, but now its concentration is increasing at an alarming rate.[199] According to an estimate, corbon dioxide (Co_2) level rose from 290 ppm to 320 ppm (10% increase) in the troposphere over the period 1870 to 1970. The value has currently registered as 350 to 360 ppm in 1988. It is expected that Co_2 level may be doubled by 2030 AD.[200] The increased amount of carbon dioxide in atmosphere is found to increase the temperature of earth.[201] As earlier mentioned, Co_2 is confined exclusively to the troposphere.

The spectral properties of Co_2 in the atmosphere are such that it tends to prevent the long wave radiations (i.e., infra-red heat radiation) from earth from escaping in to outer space and deflect it back to earth. The latter has an increased temperature at surface. This phenomenon is called **'atmospheric effect'** or **'green house effect'** or **'global warming'**.[202]

198. *The Hindu, Survey of the Environment,* (2000), p. 108.

199. P.S. Verma and V.K. Agarwal, *Principles of Ecology*, (1989), p. 503.

200. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. AIR- 101.

201. Supra n. 199 at p. 503.

202. Ibid. Professor Norman Myers, the eminent British Environmentalist, who recently visited

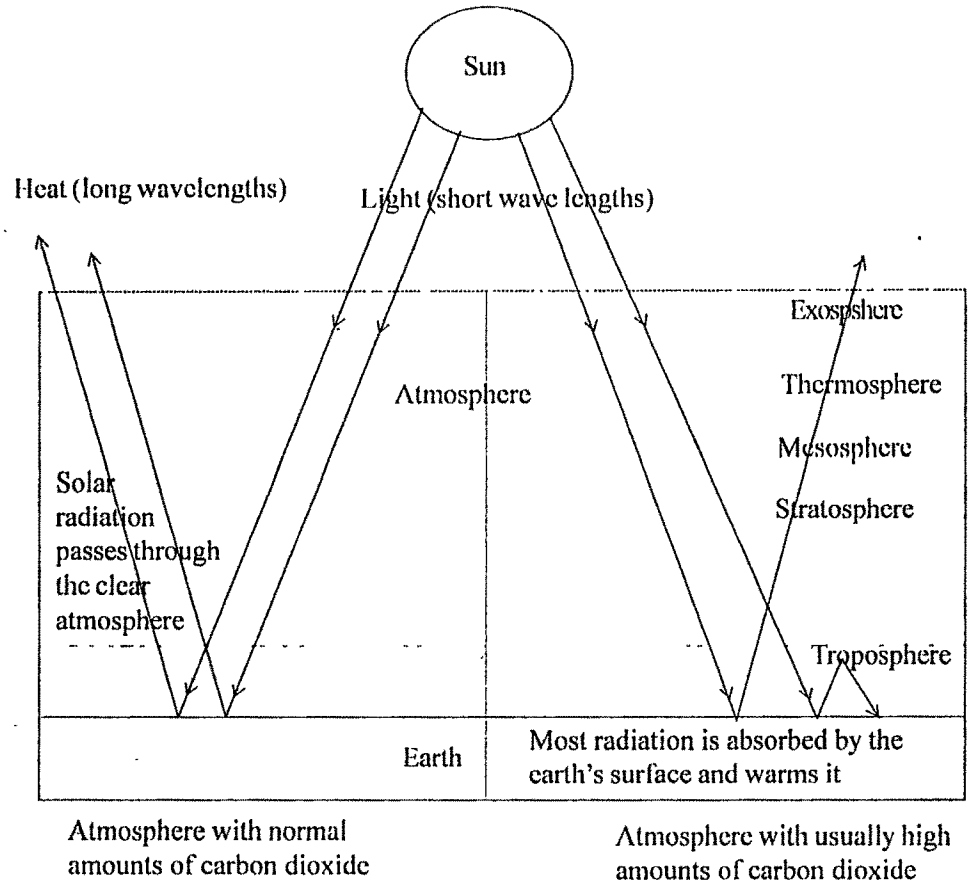

Figure 9 : Greenhouse effect of Co_2

The term **'Green House Effect'** was first coined by J. Fourier in 1827.[203] The effect is also called as **'Atmospheric Effect'**, **'Global Warming'** or **'Carbon dioxide Problem'**.

Human activities are changing the composition, as well as, behaviour of the atmosphere at an unprecedented rate. The pollutants from a wide range of human activities are increasing the global atmospheric concentration of certain heat trapping gases, which act like a blanket, trapping heat close to the surface that would otherwise escape through the atmosphere to the outer space. This process is known as green house effect, because it

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India and lectured in a few cities has presented a grim picture of the effects of global warming with the mean temperature of the earth having increased by about 1.6 degree C. If global warming continues, an increase of 3 to 4 degree C in the equatorial regions or a drop of few degrees at the poles will lead to receding mountain glaciers and melting of the polar ice caps and a rise in the sea level (D. Mukherjee, *'Tackling Global Warming Challenges Ahead'*, published in *The Assam Tribune*, May, 13, 2003). Climate change and global warming deleteriously affect infectious diseases like malaria, and India is particularly vulnerable unless it develops sustainable strategies to control the menace. (*The Assam Tribune*, 26, October, 2002).

203. B.K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. AIR- 101.

reminds some observers of the heat trapping effect of the glass walls in a horticultural green house.[204]

According to D.B. Botkin and E.A. Keller (1982), in a green house, visible light passes through the glass and heats up the soil warming the plants. The warm soil emits radiation in longer wave-lengths, particularly in the infra red. Because glass is opaque to longer wave length of infra red radiation, it partly reflects and partly absorbs infra red radiation. This mechanism keeps the green house warmer than the outer atmosphere.[205]

Thus, a **'green house'** is that body which allows the short wave length incoming solar radiation to come in, but does not allow the longwave outgoing terrestrial infra red radiation to escape.[206]

In a similar way, the earth's atmosphere bottles up the energy of the sun and is said to act like a 'green house', where Co_2 acts like glass windows. Co_2 and water vapours in the atmosphere transmit short wavelength solar radiation but reflect the longer wavelength heat radiation from warmed surface of the earth. Co_2 molecules are transparent to sunlight but not to the heat radiation. So they trap and re-enforce the solar heat stimulating an effect which is popularly known as **'green house effect'**.[207]

The 'green house effect' may, therefore, be defined as *'the progressive warming up of the earth's surface due to blanketing effect of man made Co_2 in the atmosphere'*. It is the phenomenon due to which the earth retains heat.

The scientists have reached to the conclusion that the increase in Co_2 may threaten life on earth.[207-A] Now, **United Nations Environment Programme** (UNEP) has chosen

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204. Ibid.

205. Ibid at pp. AIR- 101-102.

206. Ibid.

207. Ibid.

207-A. Intergovernmental Panel on Climate Change (IPCC), a scientific body whose reports form the basis of the official view on climate change, predicts global warming will wrap most of South Asia in a cycle of floods and drought (*The Times of India, North East Special*, October, 3, 2003). The year 2002 has been the second warmest year since 1860, extending a quarter - century pattern of accelerated global warming linked to green house gas emission (*The Times of India, Eastern India Special,* New Delhi, December, 19, 2002). The sudden collapse of a huge shelf of Antarctic ice into the sea, described by scientist as 'staggering', has reignited

the slogan **'Global Warming : Global Warning'** to alert the public on World Environment Day.[208]

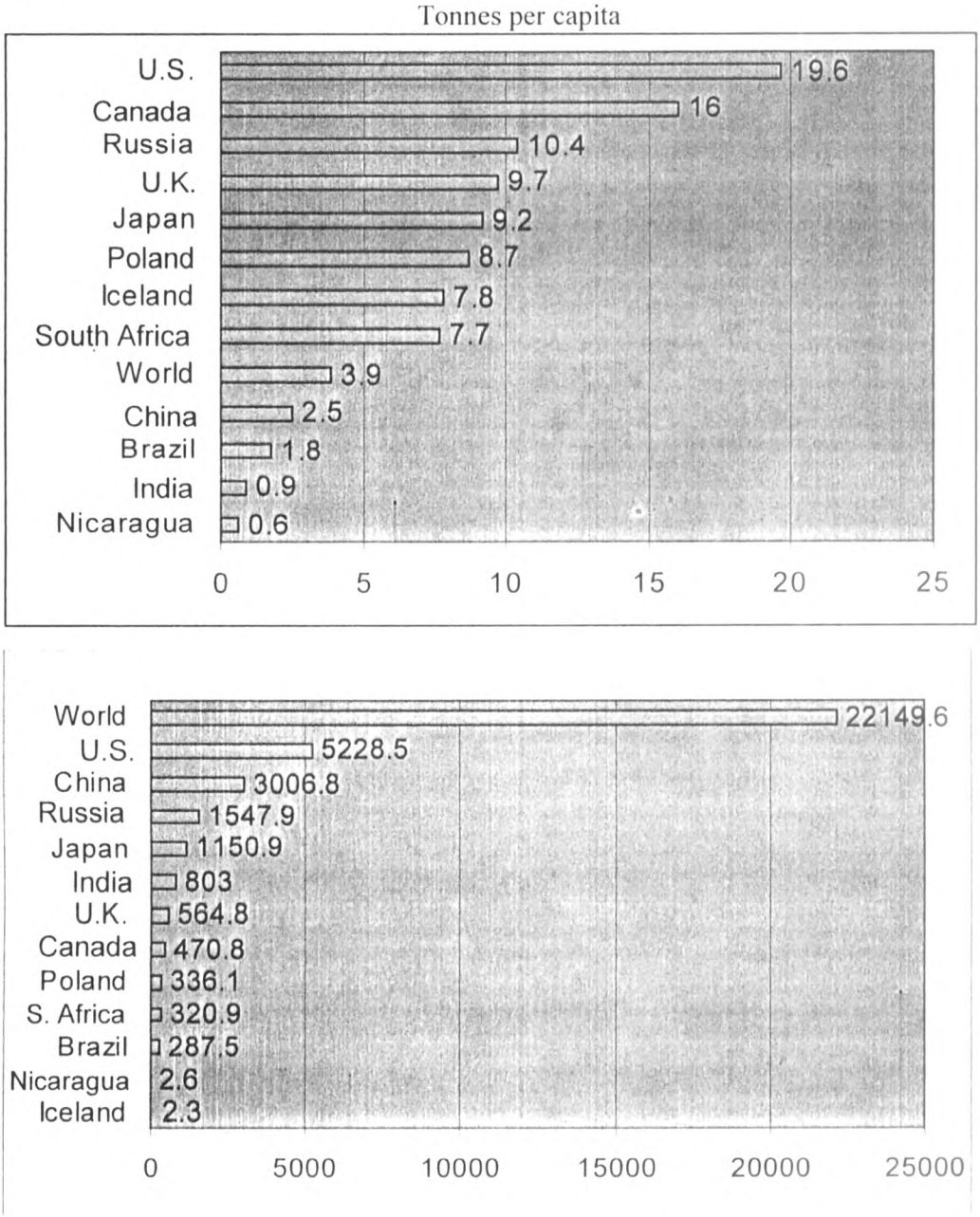

Figure 10 : Emission of Co_2 - selected countries (1995)

Source : Frontline Magazine, July, 5, 2002, p. 84

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fears of global warming and its catastrophic knock-on effects (*The Times of India,Eastern India Special,* New Delhi, March, 22, 2002).

208.Supra n. 203 at p. AIR- 108. The United Nations Conference on the Human Environment was held at Stockholm, Sweden, form 5th to 16th June, 1972. Since then, 5th June is observed as World Environment Day.

Ozone Depletion :

Ozone is present at all altitudes in the atmosphere, mainly in the stratosphere extending from 16 kms-40 kms. This upper layer of the atmosphere enveloped by ozone (16 km - 40 km) is commonly known as ozonosphere, ozone layer, stratospheric ozone layer, protective layer or ozone umbrella.[209]

This presence of **ozone layer** in the stratosphere is of vital significance for all biota, because the harmful solar radiation, such as, ultra violet rays, which are lethal to life on the earth are not allowed to enter the earth's atmosphere by **ozone layer** or **ozone umbrella.**[210] In the absence of this layer, all the ultra violet rays of the sun will reach the earth's surface and consequently the temperature of the lower atmosphere will rise to such an extent that the **'biological furnace'** of the biosphere will turn in to a **'blast furnace'**. Thus, the ozone layer strongly absorbs or blocks the short wave ionizing ultra violet rays and so protects the life on earth from severe radiation damage. Any depletion of ozone would, therefore, have catastrophic effects on life systems of the earth.[211]

Recently, the scientists have discovered that there has been significant reduction of this protective ozone layer in the stratosphere due to number of reasons. The main cause of ozone depletion is the widespread use of **chloro fluro carbons** (CFCs)[212] When CFCs were first introduced in the thirties (i.e, some 72 years ago), they were hailed as miracle chemicals because of their non-toxic, non-inflammable and stable nature.[213] They were used as coolants in refrigerators and air conditioners, in blowing plastic foams and in cleaning computer circuits. But during the last decade, they were found to be responsible for ozone depletion in the stratosphere.[214]

In the early eighties scientists reported a large hole in the ozone layer over Antarctica

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209. Ibid at p. AIR- 132.
210. Ibid.
211. Ibid.
212. Ibid at p. AIR- 120.
213. A.K. Dey, *Environmental Chemistry*, (1999), p. 39.
214. Ibid.

where ozone level dropped by 30 per cent.[215] **CFC** was the prime suspect for causing ozone depletion. It was established that one molecule of **CFC** is capable of destroying one lakh ozone (0_3) molecules in the stratosphere. Subsequently a similar hole was discovered over the thickly populated northern hemisphere.[216]

The **CFCs** are very stable on the earth. But when they slowly drift up to the stratosphere, intense UV-C radiation acts on their chemical bonds releasing chlorine which strips an atom from the molecule of ozone turning it into ordinary oxygen. The chlorine goes on to repeat the process, and, in this way, one **CFC** molecule can destroy thousands of molecules of ozone.[217]

The depletion of ozone, if not controlled, would enormously effect the ecosystem productivity, ecological stability and overall environmental equilibrium. It would also trigger several changes in the biosphere ecosystems.

Acid Rain :

'Acid rain' is an environmental problem that knows no boundaries. It has become a serious threat to water bodies like ponds, rivers, lakes and reservoirs and also to the terrestrial ecosystems like grasslands and forests.

The term **'acid rain'** was first used by 'Robert Angus in 1872.[218] Literally it means the presence of excessive acids in rain waters. Facts remain that when the atmospheric air is highly polluted containing the major pollutants like oxides of sulphur, and nitrogen and hydrogen radicals, these pollutants react with water vapour or rain droplets to form different types of strong acids like, Sulphuric Acid (H_2So_4), Nitric Acid (HNO_3) and Hydrochloric Acid (HCL) which have grave environmental impact.[219]

'Acidification of environment' is a man made phenomenon. There is now no doubt that most acids come from human activities - from cars, homes, factories and power stations etc.[220]

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215. Ibid.
216. Ibid.
217. B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. AIR- 120.
218. Ibid at p. AIR- 156.
219. See generally A.K. Dey, *Environmental Chemistry*, (1999), pp. 119-120.
220. Supra n. 217 at p. AIR- 156.

In West Germany, about 10% of the forest died and nearly 18 million acres of forests are severely effected by acid rains.[221] Forests in Switzerland, Netherlands and Czechoslovakia have also been damaged by such rains. Acid rain has already been an acute problem in North America and Europe, where it has destroyed crops and forests reducing agricultural productivity. In Canada also, the plants and trees are being destroyed by acid rain pollutants emitted by industries in Northern U.S.A.[222]

Acid rain causes extensive damage to buildings and structural materials of marble, limestone, slate and mortar etc. Limestone is attacked rapidly. The attack on marble is termed as '**Stone leprosy**'.[223] In Greece and Italy, invaluable stone statues have been partially dissolved by acid rain. The **Taj Mahal** in Agra is also suffering at present due to sulphur dioxide and sulphuric acid fume or air pollutants released from **Mathura refinery**.[224]

Water Pollution :

Water pollution is the discharge of any sewage or trade effluent or any other liquid, gaseous and solid substance into water. This contamination of water by foreign substances may be direct or indirect and likely to cause nuisance and render such water harmful or injurious to public health, safety, domestic, commercial, industrial, agricultural and other uses or to life and health of animals, plants or aquatic organisms.[225]

In India, all major 14 rivers e.g., Ganga, Yamuna, Godavari, Gomti, Kosi, Cauvery, Ravi, Sone, Chenab, Jhelum, Narmada, Mahi, Tapti and Krishna are facing acute water pollution problems. Most of the large rivers of the world are nothing but open sewers fit only to carry urban liquid wastes, half burnt bodies, poisonous pesticides and several other waste products. Many of our lakes, including Deepor Beel of Assam[225-A] and Dal and

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221. Ibid at p. AIR- 160.
222. Ibid.
223. Ibid at p. AIR- 161.
224. Ibid.
225. Ibid at p. WATER- 19.
225-A. Toxic pollutants throttle city river systems in Guwahati. The Deepor Beel, one of the largest beels in the entire North Eastern Region and the second of the Ramsar water bodies of the region, has also been receiving toxic pollutants from the industries located around it (*The Assam Tribune*, March, 7, 2002).

Nagin lakes of Kashmir have become severely polluted with foul odour, silt deposits and get chocked due to excessive algal growths.[226]

Waterborne diseases, caused by the intake of chemicals and contaminated water, affect around 3.4 million people globally. In India, around 563,000 people are affected annually, one fourth of which are children, according to the Union Ministry of Health and Family Welfare.[227]

Water gets contaminated due to sewage from households, industrial effluents, human excreta and even ground water contaminants like arsenic, fluoride[227-A] and nitrates.[228] Nine districts (out of 18) in West Bengal, India, and 42 districts (out of 64) in Bangadesh have arsenic levels in ground water above the **World Health Organization** (WHO) maximum permissible limit of 0.05 milligram per litre (mg/l).[229] In West Bengal, 2700 villages have, so far, been identified and more than 6 million people form 9 affected districts are drinking water containing more than 0.05 mg/l arsenic.[230] 300,000 people may have visible skin lesion. Samples indicate that many more may be sub clinically affected. Children in arsenic affected villages may be in special danger.[231] Although the West Bengal arsenic problem became public almost 20 years ago, there are still few concrete plans, much less achievements, to solve the problem. Villagers are probably in worse condition than 20 years ago. Even now, many who are drinking arsenic- contaminated water are not even aware of that fact and its consequences.[232]

Dipankar Chakraborti, Director at the **School of Environmental Studies**, Jadavpur

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226. Ibid at p. WATER- 17.
227. *Down to Earth*, June, 15, 2002, Vol. 11, No. 2, p. 29.
227-A. High levels of fluoride in drinking water might be even more dangerous than previously suspected. A new study by Indian scientist adds a disturbing item to the list of the likely effects of fluoride contamination - brain damage. It has long been known that fluoride contaminated drinking water can lead to stomach problems, skeletal abnormalities and discolouration of teeth. The new study shows that very high levels of fluoride can also destroy brain cells involved in learning and memory (*The Telegraph, Knowhow Health,* Monday, 17, June, 2002).
228. Supra n. 227.
229. *Down to Earth*, April, 15, 2002, Vol. 11, No. 22, pp. 30-31.
230. Ibid at pp. 32-33.
231. Ibid.
232. Ibid.

University, Kolkata, reports on the **'arsenic problem'** afflicting the State of West Bengal.[233]

Endangered Generations ; Down to Earth, April 15, 2003

"It is my contention that not only thousands of present sufferers but countless future generations are still gravely at risk from ground water contamination in West Bengal. About 40 million people in 9 districts are at risk from arsenic toxicity. Many people with moderate to severe arsenical skin lesions have been found to develop cancer eventually. Previously, it was thought skin cancer is the common type of cancer caused by arsenic. But lung, liver, colon and bladder cancers have been found among those suffering from chronic arsenic toxicity.

We have been engaged for the last 14 years in the task of surveying the magnitude of the arsenic problem in West Bengal. With every subsequent survey, there is an increase of both the number of affected villages and that of ailing person. We have noticed that, where a few years ago after analyzing hand tubewells and colouring them green (therefore, safe to drink from), a good percentage are now no more safe. Thus, with time, the contamination has increased.

Surveys are yet to be conducted on the amount of arsenic in irrigation water and consequent entry in to the food chain. We have been doing a survey for the last 3 years; rice, spinach, arun, and other items of daily diet have been found to have elevated arsenic concentration. Arsenic is slowly becoming a part of our lives .....

West Bengal and Bangladesh are the land of rivers and rains. We have totally neglected our surface water-lagoons, oxbow lakes- and rainwater. We have to implement laws and rules to control ground water extraction. We need proper water shed management with people's participation."

'Fluoride' in water is essential to protect teeth but higher levels can adversely impact

233. Ibid at p. 34.

health. Ground-water contamination due to floride affects six million children in India.[234] High fluoride content is found naturally in the waters of Rajasthan[235] and Assam.[235-A] So are nitrates.

High levels of nitrates can prove fatal for infants who drink powdered milk. Nitrates restrict the amount of oxygen reaching the brain, causing the **'blue baby'** syndrome.[236] Nitrates are also linked to digestive tract cancers and affect lungs. Cholera, another water borne diarrhoeal disease, causes death of about 700,000 people every year.[237] Needless to say, children succumb to changes be it in water or any other source faster than adults,

But diarrhoea still remains the most common symptom of water contamination. Every year, a billion children get sick with diarhoea, and for 3.3 million of those infected,[238] the disease is fatal. Rota virus, considered to be the main cause of severe diarrhoea, cause over 800,000 deaths annually in children aged less than five years in developing countries. Diarrhoea also causes over one-half of diarrhoeal death of children below the age of five in rural northern India.[239]

The environment magazine **'Down to Earth'** reports extensively on the **'water pollution problem'**, afflicting Indian villages and towns. The following report highlights the dangers posed by **'fluoride contamination'** to public health.[240]

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234. *Down to Earth*, June, 15, 2002, Vol. 11, No. 2, p. 29.
235. Ibid.
235-A. There exists evidence of fluoride contamination of ground water in parts of the city of Guwahati. According to a report of the State Public Health Laboratory here, sample of the water of a tube-well collected from Birkuchi area in the city on November, 29, 2000, contained 10.3 milligram of fluoride per litre of water, while another water sample of ring well from the same area, collected on August, 29, 2000, contained 1.9 milligram of fluoride per litre of water (*The Assam Tribune*, May, 6, 2002). Drinking water in many parts of Karbi Anglong hill district particularly in Tekalangjun, Dengaon, Ransapathar, Lungnit, Kheroni, etc., is found to be containing excessive fluoride content which has caused fluorosis among a sizeable section of population (*The Assam Tribune*, May, 25, 2003).
236. Supra n. 234.
237. Ibid.
238. Ibid.
239. Ibid. Every day 5,500 children die as a result of consuming polluted water and food (*The Statesman, International*, Saturday, 11, May, 2002).
240. *Down to Earth*, March, 31, 2003, Vol. 11, No. 21, p. 56.

Flooded with Fluoride ; Down to Earth, March, 31, 2003

"Fluoride is an acute toxin, with a rating slightly higher than lead. It is, infact, one of the most bone seeking elements known to human beings. And ground water in India shows the presence of unhealthy quantities of fluoride. A worrying scenario : daily ingestion of just 2 milligram (mg) of fluoride could result in cripping skeletal fluorosis after 40 years. Excess fluoride causes several diseases, like osteoporosis, arthritis, brittle bones, cancer, infertility in women, brain damage, Alzheimer's disease and thyroid disorders.

The very nature of fluoride increases this danger manifold. Almost half of each day's fluoride intake is retained and is absorbed by the bones and teeth. It was Gerald Cox, of the Mellon Institute in the U.S., who first found in 1938 that while 1.0 milligram per litre (mg/l) of fluoride in water prevents dental caries, over 1.5 mg/l causes mottled teeth. The Bureau of Indian standards (BIS) standard for fluoride contents is 1 - 1.5 mg/l. It is believed that levels above or below this could cause dental decay. Ironically, there is an increased incidence of dental caries, yellow teeth and twisted limbs among people of all age groups in India.

A recent publication of the Geological Survey of India (GSI) names areas that should go on fluoride red alert : Fazilka and Jalalabad in the border district of Ferozepur in Punjab; parts of Gurgaon, Rewari, Mahendergarh, Hisar, Fatehabad and Faridabad in Haryana, Unnao, Rae, Bareilly and Sonbhadra in Uttar Pradesh; Beed district in Maharashtra; Nalgonda district in Andhra Pradesh and Dindigul district in Tamil Nadu .....

Fluoride toxicity is taking its toll. There is a sharp rise in the number of people with 'yellow teeth'. Cases of arthritis are on the rise in Haryana. The fluoride content in the State's ground water is often as high as 7 to 8 mg/l. Unnao and Rae Bareilly districts of Uttar Pradesh show fluoride content between 2.9 to 15 mg/l. Dental and skeletal fluorosis, known as 'Lunjpunj' in Unnao, is rampant in these districts".

Soil Pollution :

The progress of civilization since the independence has been phenomenal, but rapid industrialization also brought with it the danger of **'soil pollution'**. Today, almost everything around us, e.g., the air we breathe, the water we drink and even the soil we grow over food on, is severely polluted.[240-A]

Modern agricultural practices introduce numerous pesticides, fungicides, insecticides, biocides, bacteriocides, fertilizers and manures, resulting in severe biological and chemical contamination of land.[241]

These agro-chemicals enter into the food chain from the soil and disturb the bio-chemical process and finally lead to serious effects on living organisms.[241-A]

However, the problem of soil pollution differs from air and water pollution in the respect that the pollutants remain in direct contact with the soil for relatively longer periods. The wide spread industrialization and increasing consumption have changed the very complexion of soil. Thus, the soil is getting heavily polluted, day by day, by toxic materials and dangerous micro organisms which enter the air, water and the food chain. For all this, man is the original and basic pollutant responsible for pollution hazards and toxic effects. Soil pollution mainly results from industrial wastes and sludges, urban wastes, radioactive pollutants, agricultural practices, chemical and metallic pollutants and biological agents.[242]

240-A.More than 800 acres of agricultural land are being used in the brick making factories in and around Khanamukh (Sonitpur district), producing more than a million bricks annually. As a result the factories have been polluting the environment and affecting the productivity of soil of the nearby agricultural lands. The underground fire in these brick kilns reduces the moisture in the soil. Further unplanned extraction of soil alters the drainage pattern of the area under operation severely affecting the agriculture (*The Assam Tribune*, April, 13, 2003).

241.According to the Project Director, Indian Council of Agricultural Research (ICAR), between 50 to 70 per cent of the vegetables are being contaminated with insecticide residues and heavy metals (*The Times of India, Guwahati-National*, April, 3, 2003). See also B. K. Sharma and H. Kaur, *Environmental Chemistry*, (1997-98), p. SOIL - 12.

241-A. The United Nations Food and Agricultural Organization (FAO) on November, 4, 2002, adopted a revised International Code of Conduct on the Distribution and Use of Pesticides aimed at significantly reducing the threats posed by Agro-chemicals in developing countries. The revised Code, adopted at an FAO meeting in Rome, promotes practices that minimize potential health and environmental risks associated with pesticides (*The Assam Tribune*, December, 17, 2002).

242.Supra n. 241.

The soil on which we grow our food is highly polluted by several pathogenic organisms and hazardous industrial effluents. Soil pollution is the result of urban technological revolution and speedy exploitation of every bit of natural resources. Recently, a report, published by SOCLEEN (Society for Clean Environment) on the ecology of the Chembur area of Bombay, has revealed how recklessly man can exploit his land and environment. In Chembur, trees without leaves, buds and flowers are commonly seen due to soil pollution. Residents of the area have complained that they can neither grow flowers on the balconies nor vegetables in their gardens. The chronic pollutants have affected the flora and fauna of their land.[243]

The chief contributors to such a polluted atmosphere are **Food Corporation of India** (F.C.I.) and **Tata Thermal Plants** which emit and add 1000 tones of toxic matters to the soil.[244]

Pesticides not only pose a potential hazard to man, animal, fish and livestock, but they severely affect the desired yield of crop and soil. Even the accepted dose of pesticides create deleterious effects on soil fertility. According to a report **'Death in the Grab of Pesticides'**, published in **Hindustan Times**, December, 30, 1992, pesticides spread most widely and alarmingly in the environment through migration. They are washed off from the crops in the water, enter water bodies, penetrate with fodder, the organisms and hence food stuffs.[244-A]

According to **World Health Organization** (WHO), more than 50,000 people in developing countries are poisoned every year and about 5000 die as a result of the toxic pesticides and other chemicals used in agriculture.[245] In India, 35,000 - 40,000 tones of

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243. Ibid at p. SOIL - 23.

244. Ibid.

244-A. Pesticides poisoning is responsible for pachyderm deaths at Nameri National Park in Assam. The doctors of the State Veterinary College investigating the mysterious death of elephants in the Nameri National Park and the Pakhoi Game Sanctuary, have confirmed the deaths due to pesticide poisoning. They have confirmed if after receiving the forensic report in which 'organophosphorus' pesticide (Demecron) has been detected in a sample of an elephant carcass (*The Assam Tribune*, September, 15, 2001). Meanwhile the Worldwide Fund for Nature (WWF) - India has expressed serious concern over poisoning of pachyderms (*The Assam Tribune*, November, 17, 2001).

245. Supra n. 241 at p. SOIL - 26.

hazardous chemicals are sprayed on the agricultural crops every year.[246]

Samples of fruits, milk, eggs and vegetables collected from various important cities in India (e.g.., Bombay, Delhi, Calcutta, Madras, Pune, Bangalore, Kanpur, Lucknow, Hyderabad etc.) have shown that they contain pesticide residues (such as DDT, dieldrin, aldrine etc.) much higher than permissible limits of human tolerance proposed by WHO.[247]

The following report published in the environment magazine **'Down to Earth'**, highlights the dangers posed by pesticides to human beings.

Pesticides Cause Parkinson's Disease ; Down to Earth, January, 15, 2003[248]

"For the first time, a study has linked human exposure to pesticides with parkinson's disease (PD)

The actual cause of PD remains a mystery till date, despite intense research about the same. Over the years, the disease has become widespread in many countries, with its symptoms ranging from stiff movements to muscle spasm.

Experiments conducted on rats using the pesticide rotenone show that if the animals are given repeated doses of rotenone, they display symptoms of PD. High levels of organochlorine compound dieldrin have also been found in the brains of PD patients.

The study was conducted on sugarcane and pineapple plantation workers of Hawali by Helen Petrovitch and her colleagues from the Honolulu - based Pacific Health Research Institute. The case of PD were identified through a review of Hawaiian death certificates and records of PD cases available with local neurologists. In all 7,986 plantation workers are studied, out of which 116 were found to suffer from PD.

The incidence of PD was found to rise with increasing years of exposure to pesticides especially chlorine and DDT, which were frequently used in the

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246.Ibid.

247. Ibid.

248. *Down to Earth*, January, 15, 2003, Vol. 11, No. 16, p. 20.

plantations. Men who had worked for more than 20 years in the plantations were found to have double the risk of PD when compared with those who had never worked on a plantation."

Poison in plantations :		
Duration of work (in year)	Total number of plantation workers	Number of workers suffering from parkinson's disease
0	5363	73
1-10	1843	24
11-20	315	7
More than 20	465	12

Table-1 : Pesticides cause parkinson's disease

Source : Down to Earth, January, 15, 2003

Ecological Imbalances in Guwahati :

Guwahati town is surrounded by beautiful hillocks varying from 100mts. to 300 mts. in height, which makes Guwahati town a unique city of India. But rapid urbanization and fast encroachment of these hillocks for last two decades have changed the ecological dynamics of Guwahati town. Due to encroachment of Guwahati Hills and their denudation by encroachers, it has led to severe soil erosion of these fragile hills. Due to loss of vegetal cover of the soil, the topsoil gets eroded under the force of rain, run off water and wind action.

The encroachment of Guwahati Hills is not only causing soil erosion, loss of vegetation and loss of top soil in the hillocks of Guwahati, but this precious soil finds its way into Guwahati town. What are the results?

(i) The drainage of Guwahati town gets clogged and the sewage and filthy water gets deposited along all the roads in Guwahati. These waterlogged roads are always a great threat for spread of any epidemic disease. They also cause great inconvenience to the public of Guwahati.

(ii) The silt and soil brought from the hills get deposited along the roads including

the National Highways causing problems for the transport and movement of vehicles. At times, due to deposited silt on National Highway, traffic gets disrupted. The expenditure involved for maintenance of National Highways, roads and drainage of Guwahati is also staggering due to deposition of silt from these eroded hills.

Reserved Forests in Guwahati (Kamrup East)

RF	Range	Area (in hectares)	RF	Range	Area (in hectares)
Khanapara	Guwahati	996.11	Apricola East	Sonapur	6,075
Amchang	„	5,318	Marakdola	„	1,426
Fatasil	„	670.44	Motapahar	„	225
Gotanagar	„	171	Chamata	„	27
Sarania Hill	„	7.99	Teteliaguri	„	120.58
South Kalapahar	„	70	Hahara (proposed)	„	458.46
South Amchang	„	1,550	Garowani	„	516
Jalukbari	„	97.7	Apricola East	„	10,622
Hengrabari	„	628	Maliata	Palasbari	345
Garbhanga	South Guwahati	18,860.58	Rani	Rani	4,370
Kawasing	Rani	998	Jarasal	„	1,256

Table-2 :

Source : The Assam Tribune, December, 15, 2002.

(iii) The cutting of hills not only leads to landslides and the spoiling of the ecological balance of Guwahati city, but encroachers have also got a great threat of getting killed through landslides due to disturbance of the fragile ecosystem of these hillocks. During October, 1991, 16 people were killed at Ganeshguri Hillside (Kacharibasti) and several houses collapsed. Again nine people were killed and 20 people seriously injured on 24, July, 1999, due to landslides in Kalapahar area. During 2001, 8 people got killed by the landslides in Geeta Nagar Hills and adjoining hillocks. Landslides and soil creeping during monsoons in the hill slopes of Sarania, Chandangiri, Kharghuli and Dhirenpara area of the city have become a regular feature there threatening the survival of the people living in

and around these areas[248-A].

(iv) Due to encroachment of Guwahati Hills, **flash floods** have become a common feature. Perhaps, the inhabitants of Silpukhuri, Chandmari and Bamunimaidan cannot forget the nightmares of April, 23, and July, 1, during the 1998 monsoons. Again on July, 24, 1999, sudden flash floods entered several hundred houses in these localities spoiling their household articles.[248-B] These are perhaps just a beginning of nightmares, which Guwahatians may have to face in the near future. In the last August, 30 (night), 2003, incident in which a young woman, Upamoni Choudhury met with a most tragic end after falling in to an uncovered drain at Gandhi Basti Railway crossing goes to show just how callous our authorities can be towards the safety and well being of the tax paying citizens.[248-C]

(v) The silt and soil brought from the hillocks not only clog the drainage but it also gets deposited in the beels like Deepor Beel, Sola Beel, Borsola Beel, Sorusola Beel etc. The result is siltation of these beels leading to their decreased water intake capacity. This has also changed the ecology of these beels and the environmentalists have warned against the change of the flora and fauna of these beels. Deepor Beel used to be one of the major attractions of Guwahati city and a centre for at least 77 species of migratory birds and 204 species of domestic birds it has now become a pool of shrinking water. Due to eutrophication, water hyacinth has occupied major portion of this shrinking lake, thereby, threatening the habitat of 281 species of birds. The situation is further aggravated by encroachment of the Deepor Beel.[248-D]

Renowned environmentalist Shri Sunder Lal Bahuguna has said, *'Man should not play with nature in the ecologically and seismically fragile region. If you play with nature then nature will play with you'*.[248-E] This holds true in the case of Guwahati town due to lack of action of the people and the Government to prevent encroachment of the Guwahati Hills, an ecological catastrophe has set in.

248-A. *Environment Plus*, April, 22-28, (2002), p. 13.

248-B. Ibid.

248-C. *The Assam Tribune*, August, 31, 2003.

248-D. Supra n. 248-B.

248-E. Ibid.

The Gauhati High Court in a case, (**Civil Rule No. 1737/1996**) filed in relation to open space, directed the Chief Secretary, Secretary, General Administration Department, Deputy Commissioner, Kamrup, Gauhati Metropolitan Development Authority (GMDA), Gauhati Municipal Corporation (GMC), State Forest Department, Tourism Department, Town and Country Planning Department and the Union Ministry of Environment and Forests, more particularly, the State of Assam and its instrumentalities to sedulously adhere to the statuary provisions and permit constructions in the river banks in particular, strictly in conformity with the modified final **Master Plan** and **Zoning Regulation** for Guwahati. The Court order passed on April, 28, 1997, by the then Chief Justice (Acting) V.D. Gyani and Justice D.N. Choudhury also said, *'Our refusal to invoke extraordinary jurisdiction under Article 226 of the Constitution shall not however be treated by the respondents as stamp of our approval of their actions'.*

Socio-Economic Consequences of Hazards :

The human, health and monetary costs of environmental damage make it a major hazard. The poor suffer the most . Environmental damage caused by air, water and soil pollution, as well as, land degradation, deforestation and desertification affects thousands of people in India every year.[249] However, the spillover contributes to other disasters, such as, floods, droughts and epidemics. Furthermore, environmental degradation makes people poor and forces large-scale migration. Environment related migration is expected to increase in India in future mainly due to climatic changes.

According to Max Martin, the direct victims of environmental change are almost always the poor.[250] They are the ones who die from disease related to air and water pollution. It is the poorest who are forced to live closest to dirty factories, busy roads, waste dumps, effluent laden rivers and stormy seas. The sad truth is that the poor people are seldom the principal creators of the damage. But they suffer most from such damages. Poverty is both a cause and a consequence of environmental degradation.[251]

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249. S. Mukherjee and A. Ghosh, *Environmental Studies*, (2000), p. 156.
250. Ibid.
251. Sir Edmund Hillary (Editor), *Ecology 2000 . The Changing face of Earth*, (1984), p. 56.

Increasing poverty and the absence of an alternative means of livelihood forces more and more poor and landless people to put extra pressure on natural resources in order to survive. As a result there is soil erosion and soil pollution.[251-A]

Especially in poor countries, environmental damage is usually a direct consequence of poverty. Majority of the population being poor, causes[252] more environmental damage due to mutually reinforcing effect between poverty and environmental damage. The poor being both the victim and the agent of environmental damage.[253]

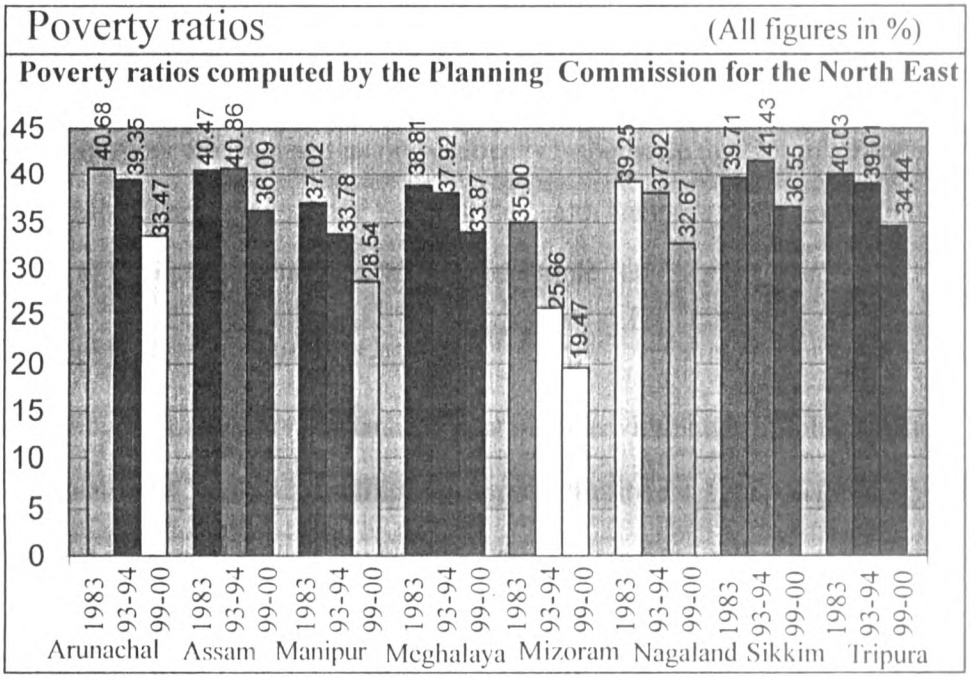

Table 3 : in the graphic is self-explanatory. This consists of proverty ratios computed by the Planning Commission for the North East for the years 1983, 1993-94 and 1999-2000 ; **Source : The Telegraph, dated , 6-8-2003**.

It is very difficult to measure the extent of damage caused by environmental hazards. But, there is no doubt that air and water pollution take a heavy toll through ill-health and premature death. Their impact is very severe on the young people, the very old and the poor. Moreover, lost labour productivity due to poor health, reduced crop output due to

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251-A. Union Environment Minister T. R. Baalu, on October, 23, 2002, while addressing the 10 day U.N. Conference on Climate Change (held in New Delhi), urged the developing countries to work for eradication of poverty and take a lead role in promoting 'sustainable development' (*The Assam Tribune*, August, 24, 2002).

252. Supra n. 251.

253. R.V. Mudliar and Others, *Environmental Studies*, (1996), p. 12.

land degradation and reduced fish catch due to water pollution together lead to diminished economic output. The end result of all these is mass poverty.[254]

According to a World Bank study, estimated environmental damages in India in 1992 amounted to about U.S. $ 10 billion or Rs. 34,000 crores (4.5% of India's GDP).[255] This figure does not give us the true picture of the extent of damages. It excludes many types of damages, such as, bio diversity loss, health problems created by industrial wastes, increased costs in providing clean water due to rising water pollution, health costs caused by cancer and so on.[256]

What is more distressing is the health cost of environmental degradation. According to one estimate, poor environment quality is directly responsible for 25% of all preventible diseases.[257] Moreover, the economic costs of the health damages due to air pollution are nearly 10% of the income generated from all economic activities in India.[258]

International Efforts and India's Concern :

Realizing the transnational characteristics of the environmental problems, the U.N. General Assembly established **Scientific Advisory Committee** in 1968, to consider holding a **Conference on the Human Environment**, later held at Stockholm, Sweden, in 1972. The **U.N. Conference on Environment and Development**, having met at Rio de Janeiro in 1992, reaffirmed the Declaration of the U.N. Conference on the Human Environment adopted at Stockholm on 16th June, 1972. Faced with alarming deterioration in the earth's vital life supporting ecosystem, world leaders further gathered at the **World Summit on Sustainable Development** in Johannesburg, South Africa, from 26th August to 4th September, 2002, to pursue new initiative to implement sustainable development and build a future of prosperity and security for their citizens.

The **Stockholm Conference 1972,** was a starting point for the India's legislations for

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254. S. Mukherjee and A. Ghosh, *Environment Studies*, (2000), p. 156.
255. Ibid at p. 157.
256. Ibid.
257. Ibid.
258. Ibid.

'ecology and environment'. Following this Conference, the Parliament of India, passed the **Water (Prevention and Control of Pollution) Act, 1974**, the **Water (Prevention and Control of Pollution) Cess Act, 1977**, the **Forest (Conservation) Act, 1980**, the **Air (Prevention and Control of Pollution) Act, 1981**, and the **Environment (Protection) Act, 1986**. Incidentally, the enactment of the **Wild Life (Protection) Act, 1972**, was coincidental with the Stockholm Conference, 1972.

In 1976, the Constitution of India was also amended with the incorporation of the subject of environmental protection in **Articles 48A** and **51A(g)**. By the same Amendment Act, the subject of **'Forests and Wildlife'** was transferred from State List to Concurrent List, so that the Central Government may also play a meaningful role in this increasingly significant area.

In the recent years, the Parliament also passed the **Public Liability Insurance Act, 1991**, the **National Environment Tribunal Act, 1995**, the **National Environment Appellate Authority Act, 1997**, the **Plant Varieties and Farmer's Rights (Protection) Act, 2001**, and the **Biological Diversity Act, 2002**.

The Supreme Court of India, has widened the scope of Article 21 (Right to life) by stipulating that a clean environment is essential to human survival. **Public Interest Litigations** have, thus, been founded on Article 21, to comprehend health hazard due to pollution. More recently, the judiciary has adopted a healthy trend of interpreting law in social context. Hitherto, the rigidity of the locus standi rule deprived the poorer section of the society from approaching the courts for enforcement of their fundamental rights against the rich and affluent class of society. Now, the Public Interest Litigation (PIL) has liberalized the locus standi rule to such an extent that it has opened new vistas for the redressal of ecological problems. Environmental pollution has been effectively tackled through PIL.

Noted **'Green Lawyer'** M.C. Mehta won the famous Magsaysay award and Goldman environmental prize for his advocacy of the law in tackling anti people and anti environment projects. M.C. Mehta, a restless spirit, is so excitable and boyish in his enthusiasm that his words spill over into each other. Almost single-handedly on the legal front he has fought

on the issue of saving the Taj from the pollution of Agra's iron foundries and the Mathura refinery, awakened courts to the irresponsibility of large corporations and the people to the merits of public interest litigation to save their lives and the environment around them.

Assam Human Rights Commission has also played an important role in protecting the right to pollution free environment. The Commission has ordered *suo motu* inquiries against a number of industries, including, Oil India Limited, Duliajan, and Oil and Natural Gas Corporation Ltd., Nazira, for polluting the environment and, thereby, violating '**right to life**' guaranteed under Article 21 of the Constitution.

Assam Pollution Control Board has also issued show cause notices, closure notices to a number of polluting industries under the provisions of the Water (Prevention and Control of Pollution) Act, 1981, and has also reviewed the NOC (No Objection Certificate) of the Numaligarh Refinery.

The Ministry of Environment and Forests, Government of India, had notified the **Policy Statement for Abatement of Pollution, 1992,** as the commitment towards restoration of the country's environment.

The **Environment Impact Assessment Notification, 1994,** makes environment impact assessment statutory for 29 categories of development projects.

And, above all, **Non Governmental Organizations** (NGOs) have played a very important role in motivating the people and creating environmental awareness among them.

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