Directorate of Distance Education

UNIVERSITY OF JAMMU
JAMMU

REFERENCE / STUDY MATERIAL

For

M.A. SOCIOLOGY

SEMESTER - IInd

ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

COURSE NO. : SOC - C - 203 LESSON NO. 1-22

Course Co-ordinator :
PROF. ABHA CHAUHAN
HOD, Deptt. of Sociology
University of Jammu.

Teacher Incharge :
DR. NEHA VIJ
P.G. Sociology
Directorate of Distance Education, University of Jammu

http://www.distanceeducationju.in
Printed and Published on behalf of the Directorate of Distance Education, University of Jammu, Jammu by the Director, DDE, University of Jammu, Jammu.

Experts involved in Script Writing

- ***Dr. Sanjay Sharma***
- ***Dr. Neharica Subhash***
- ***Dr. Nisha Sharma***

- Printed by : Khajuria Printers / 2019 /800

Syllabus of Sociology M.A IInd Semester for the examination to be held in the year May 2019, 2020, 2021 (NON - CBCS)

Course No. : SOC-C-203 **Title : Environment and Sustainable Development**

Credits : 6 **Maximum Marks : 100**

Duration of examination : 2½ hrs. **a) Semester examination (External) : 80**

b) Session assessment (Internal) : 20

Objective : The course aims to provide the students with a conceptual, theoretical and empirical background to the issues of Environment and Sustainable Development. The course seeks to understand the emergence of sustainable development, environmentalism and environmental movements from the theoretical and conceptual perspectives.

Unit - I **Concepts and Issues**

Ecology & Ecosystem; Environmental Sociology.

Global Issues: Global Warming; Acid Rain; Biodiversity Loss; Ozone Layer Depletion.

Redressal: Earth Summit; Social Construction of Environmental Problems.

Unit - II **Theoretical Approaches to Environmental Sociology**

Classical Sociological Tradition; Contribution of Catton and Dunlap - New Ecological paradigm; Giddens & Beck - Risk Theory; Ecological Modernization Theory.

Unit - III **Sustainable Development, Policies and Programmes**

Sustainable Development : Meaning and Historical Perspective on emergence of Sustainable Development;
Components of Sustainable Development : Social, Economic & Environmental; Environmental Audit; Environmental Legislation;

Role of Government and Non-government Organisations (NGO's) in Sustainable Development.

Unit - IV **Sustainable Development and Environment Movements**

Environmental Movements and Politics of Development: Chipko

Movement;

Protest Against mining (Doon Valley);

Narmada Valley Controversy;

Socio-Cultural sustainability of Developmental Projects:

Ecology, Development & Women.

NOTE FOR PAPER SETTING :

The question paper will consist of three Sections A, B and C.

Section A will consist of eight long answer type questions, two from each unit with internal choice. Each question carries 12 marks. The candidates is required to answer any four questions, one from each unit. Total weightage will be of 12 x 4 =48 marks.

Section B will consist of eight short answer type questions- two from each unit with internal choice. Each question carries 6 marks. The candidate is required to answer any four questions, one from each unit. Total weightage will be of 6 x 4 = 24 marks.

Section C will consist of eight objective type questions of one mark each. The candidate is required answer the entire questions. Total weightage will be of 1 x 8 = 8 marks.

****

PRESCRIBED READINGS :

1. Adams, W.M. 1990. *Green Development,* London : Routledge,
2. Arnold, David and Guha, Ramchandra, (eds). 1995. *Nature, Culture and Imperialism* New Delhi : Oxford University Press.
3. Bandyopadhyay, Jayanta. 2009. *Water, Ecosystem and Society : A Confluence of Disciplines,* New Delhi : Sage Publications
4. Basheer, Anisa. 1995. *Environmental Epidemiology,* New Delhi : Rawat Publications
5. Baviskar, Amita. 2006. *In the Belly of the River : Tribal Conflicts ovr Development in the Narmada Valley,* New Delhi : Oxford University Press.
6. Beck, Ullrich. 1994. *Reflexive Modernization,* California : Standard University Press.
7. Bell Michael Mayerfeld. 2012. *An Invitation to Environmental Sociology,* New Delhi : Sage Publications.
8. Bhatt, K. N. 2008. *Population, Environmetnal and Health :* Emerging Issues, New Delhi : Rawat Publications.
9. Chaudhary, Sukant K. 2014. *Sociology of Environment,* New Delhi : Sage Publications
10. Chauhan and Chauhan. 1998. *Envrionmental Degredation : Socio-Economic Consequences,* New Delhi : Rawat Publications.
11. Chhokar, Kiran B., Pandya M., Raghunathan (ed), 2004. *Understanding Environment,* New Delhi : Sage Publications.
12. Dreze Jean, Samson Meera and Singh Satyajit (ed), 2000. *The Dam and the Nation*, New Delhi : Oxford University Press.
13. Dunlab, Bultel, Dickins and Gijswijt, 2017. *Envrionmental Sociology : Classical Foundations Contemporary Insights,* New York : Rowman and Little Field Publishers.
14. Elliot, Jennifer. A. 1994. *Sustainable Development,* London : Routledge
15. Fernandes, Walter and Enakshi Ganguały Thukral (eds). 1989. *Development, Displacement and Rehabilitation : Issues for a National Debate,* New Delhi : Indian Social Institution.

16. Fisher, William, F. (ed). 1957. *Towards Sustainable Development,* New Delhi : Rawat Publication.
17. Gadgil, Madhav and Ramchandra Guha. 1996. *Ecology and Equity : The Use and Abuse of Nature in Contemporary India,* New Delhi : Oxford University Press.
18. Guha, R. 1989. *The Unquiet Woods : Ecological Change and Peasant Resistance in Himalayas,* New Delhi : Oxford University Press.
19. Guha, R. 1994. *Sociology Ecology,* New Delhi : Oxford University Press.
20. Guha, R. 2000. *Environmentalism : A Global History,* New Delhi : Oxford University Press.
21. Hannigan, J.A. 1995. *Environmental Sociology,* London : Routledge.
22. Iyer, Gopal, K. *Sustainable Development : Socio Cultural Implications,* New Delhi : Rawat Publications.
23. Iyer, Ramaswamy R (ed). 2015. *Living Rivers, Dying Rivers,* New Delhi : Oxford University Press.
24. Iyer, R. Ramaswamy. 2007. *Towards Water Wisdom : Limits, Justice Harmony,* New Delhi : Sage Publications.
25. Kemip, David, D. 1994. *Global Envrionmental Issues,* London : Routledge.
26. Krishna, Sumi. 1996. *Envrionmental Politics,* New Delhi : Sage Publications.
28. Lele, S. 1991. *Sustainable Development : A Critique, World Development,* 19(6) : 607-21
29. Mehta, Lyla. 2009. *Displaced by Development : Confronting Marginalization and Gender Injustice,* New Delhi : Sage Publications.
30. Mehta, Rani. 2014. *Sociology and Envrionmental Sustainablility,* Jaipur : Rawat Publications.
31. Merchant, Carolyn. 1994. *Ecology : Key Concepts in Critical theory,* New Jersy : Humanities Press.
32. Nadarajah, M. 1999. *Culture Gender and Ecology,* New Delhi : Rawat Publications
33. Nambiar, Prithi. 2014 : *Media Construction of Environmental and Sustainability in India,* New Delhi : Sage Publications.

34. Odum, E. P. 1970. *Ecology, Modern Biology Series,* New Delhi : Oxford & IBH,
35. Omvedt. G. Ecology and Social Movements, *Economic and Political Weekly,* XIX (44) : 1865-67.
36. Parmar, Geeta and Maheshwari. 2002. A Textbook of Energy, *Ecology, Environment and Society,* New Delhi : Anmol Publications.
37. Prasad, Archana. 2004. *Envrionmentalism and the Left,* New Delhi : Leftword Books.
38. Rashid, Ishtiaq, Hashiq, Rahman, 2008. *Envrionmental Resources and Sustainable Development.* New Delhi : Rawat Publications.
39. Rosencranz, Divan. 2005. *Environmental Law and Policy in India.* New Delhi : Oxford University Press.
40. Saxena, H. M., 2010. *Envrionmental Management,* New Delhi : Rawat Publications.
41. Saxena, H. M. 2006, *Environmental Studies,* New Delhi : Rawat Publications.
42. Sharma, P. D. 1993, *Envrionmental Biology and Toxicology,* New Delhi : Rajsons Printers.
43. Sharma, S. L. 1998. *'Sustainable Development : Socio-cultural Imperatives'* . In Y.G. Joshi and D. K. Verma (ed) Ecology and Politics of Survival, New Delhi : Sage Publications
44. Shiva, Vandana. 1991. *Ecology and Politics of Survival,* New Delhi : Sage Publications.
45. Shiva, Vandana. 1998. *Staying Alive-Women, Ecology and Development in India,* New Delhi : Kali for Women Press :
46. Shiva, Vandana. 2010. *Ecofeminism,* New Delhi : Rawat Publications.
47. Shiva, Vandana. 2017. *Who Really feeds the words ?* New Delhi : Women Unlimited
48. Singh and Mal. 2009. *Envrionmental Change and Bio Diversity,* New Delh : Rawat Publications.
49. Spaargaren, Mol and Buttel. (ed). 2000. *Environmenta and Global Modernity,* New Delhi : Sage Publications.
50. Walker, Gordan. 2016. *Envrionmental Justice : Concepts, Evidence and Politics,* New York : Routledge Publications.

CONTENTS

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure :

1.1 Objectives:

After going through this lesson, you should be able to

- Understand the term environment and its composition
- Understand environmental science and its significance
- Explain what is ecology and its subdivisions
- Understand ecosystem and its components
- Explain material cycling and energy transfer
- Understand concept of limiting factors, homeostasis

1.2 Introduction

We live on earth in different types of surroundings. This surrounding with which every living organism continuously interacts and to which it is fully adapted is the natural environment of the living organisms. The word natural environment brings to mind the broad aspects of landscape such as water, soil, mountains, deserts which can be described by physical factors such as moisture, temperature, soil texture and biological influences. We can say that environment is sum total of the living and non living components, influences and events surrounding the organism.

Environmental issues and concerns that attract human society the world over are linked to ecological perceptions of resources. The major issues of concern are exploration, mobilization, depletion and management of the natural resources. Developmental activities aimed at the welfare of humans and their living patterns, namely microbes, plants and animals, have a certain measure of impact on the ecological balance. Ecological paradigm is being used to construct ecologies to solve the complex global environmental problems like pollution, resource depletion, climate change etc. A large number of connections and relationships exist between the environment and the living organisms in nature and the essence of ecology lies in a holistic approach to the subject. However in order to understand the whole complex of ecology, let us try to understand its components.

The environment includes both living and nonliving parts. The study of the interrelationships between the living and non-living portions of the environment is the subject matter of ecology. Ecologists study the interactions between living organisms and between organisms and their nonliving environment. Understanding these interrelationships and interactions can aid in the development of useful conservation measures.

1.3 Organisms and their environments

We are aware of some relationships among organisms and their environments. For example, pollution can harm environments and therefore, organisms. The bacteria and fungi are organisms that cause diseases in other living things. Organisms and their environments interact in many ways. The phrase, "Everything is connected to everything else," describes the relationships between organisms and their environments.

1.4 Environmental Science

Environmental science can be defined as the study of the earth, air, water and living organisms and the ways in which they are interrelated with each other. In a broad sense, it is the science of the complex interactions that occur among and between the terrestrial, atmospheric, aquatic and living environments. This interrelatedness is a key aspect in the study of environmental science. Environmental sciences evolved, to a significant degree, from the study of living organisms in their natural habitat. This discipline was called natural history, and it developed into what is now called ecology.

Ecology and environment science are often viewed as synonyms but ecology is one of the disciplines of much broader area of environmental sciences. Environmental issues affect every part of our life and environmental science is very important to learn about how the earth works, how we are affecting its life support system, and how we can reduce our environmental impact?

1.5 Significance of Environmental science

Increasing human population and the degrading environment has raised a concern over a period of time. We are living in a incredibly exciting and challenging time. There is growing concern that we may have no more than 50-100 years to make a new cultural transition in which we learn how to live more sustainably by not degrading our life support system. There is a dire need of environmental revolution. During this short period we have each one of us have to work with the earth and this in turn will have enormous and long lasting impact. Each one of has a unique opportunity and responsibility to make the earth a better place to live for the future generations.

It is the need of the hour that every one should study the environment in order to contribute some thing for safeguarding the earth and our immediate environment. It is now increasingly realized that environmental science is most relevant to everyday life of man. The threat of increasing human population, environmental pollution, natural resource degradation and overexploitation, large scale modification of natural landscapes has put the survival of human race under threat. The environmental awareness among the masses will make them better citizens.

1.6 Components of Earth's Environment

The total environment can be divided into atmosphere, hydrosphere, lithosphere (geosphere) and biosphere. These divisions are interrelated and are discussed as under:

a) Atmosphere

Atmosphere is the protective blanket that nurtures living organisms on the Earth and protects them from the hostile environment of outer space. The atmosphere is the source of carbon dioxide for plant photosynthesis and oxygen for respiration by animals. As a basic part of the hydrologic cycle the atmosphere transports water from the oceans to land. Circulation of air, water vopour, and heat in the atmosphere redistributes solar energy from the equator toward the Polar Regions and water from oceans to landmasses. The atmosphere can be stratified on the basis of temperature and altitude as under:

Troposphere:

Troposphere extends from sea level to an altitude of 8-16 km. It contains about three-fourth of the atmosphere's mass, has a generally homogenous composition of major gases other than water and exhibits decreasing temperature with increasing altitude from the heat radiating surface of the earth. The upper limit of the troposphere has a temperature minimum of about -56 degree C. The homogenous composition of the troposphere is due to constant mixing by circulating air masses. The water vapour content of the troposphere is variable because of cloud formation, precipitation and evaporation of water from terrestrial water bodies. The part of the atmosphere where the negative temperature gradient of the troposphere shows constant temperature is known as tropo pause.

Stratosphere

The atmospheric layer directly above the troposphere is the stratosphere, in which the temperature rises to a maximum of about -2oC with increasing altitude. This layer extends up to 50 km from the earth surface. The heating effect in this layer is caused by the absorption of ultra violet radiation energy from the sun by ozone. The fraction of ozone is about 1000 times as great, and the fraction of water vapour only about 1/1000 as much in the stratosphere as compared to troposphere. The upper extend of stratosphere is called strato-pause.

Mesosphere

Above the stratopause is mesosphere. In this layer the temperature falls to about -92o C with increase in altitude to about 85 km. The ozone concentration in mesosphere decreases rapidly with height and decrease in temperature is due to decreased absorption of solar radiation by ozone. Mesopause separates mesosphere and thermosphere.

Thermosphere

Extending to the far outer reaches of the atmosphere is thermosphere, in which the highly rarified gas reaches temperatures up to 1200oC by the absorption of very energetic radiation of wave lengths less than 200 nm by gas species in this region.

b) Hydrosphere

We all know that three-fourth of the earth surface is covered by water. But not all the water on earth is available to us. The table 1.1 gives the distribution of water in percentage.

Table 1.1: Distribution of water present on earth

Oceans	97.3
Ice-caps	02.0
Ground water	0.68
Fresh Water lakes	0.009
Inland seas & Salt lakes	0.009
Atmosphere	0.00
Rivers	0.0001

The Hydrological cycle:

The sun's heat causes evaporation of water vapour. When the water vapour cools down, it condenses and forms clouds. From there it may fall on the land or sea in the form of rain, snow or sleet. The process by which water continually changes its form and circulates between oceans, atmosphere and land is known as the hydrologic cycle or water cycle. The same water that existed centuries ago still exists today. The water used to irrigate a field in India may have flowed down the Amazon River a hundred years ago.

The oceans, rivers, streams, lakes, ponds, pools, polar ice caps, water vapour, etc., form the hydrosphere. About three-fourth of the earth's surface (75%) is covered with hydrosphere, the main component of which is water. Water is one of the most unusual natural compounds found on earth, and it is also one of the most important. The water remains in solid (snow), liquid (water) and gaseous (water vapour) forms. Life on earth began in the seas, and water in some form or the other is absolutely essential for the maintenance of all life. Water is one of the main agent in pedogenesis (soil formation) and is the medium for several different ecosystems. It permeates the atmosphere and the outer layers, of lithosphere and has uneven distribution on earth, so that, some of the great ocean depths are approximately six or seven miles (9750 meters).

Water in its two forms i.e. salt water and freshwater, forms two chief aquatic environments of earth namely marine environment and fresh water environments. The oceans holding marine environment are two and one half times more extensive than land and provide over 300 times the living space, since they are habitable throughout their entire depth by certain groups of organisms. Water is obviously heavier than air which imparts greater buoyancy to the aquatic medium enabling organisms to float at variable levels.

c) The Lithosphere (soil): The earth is a cooled, spherical, solid planet of solar system, which rotates on its axis and revolves around the sun at a certain constant distance. The solid component of earth is called lithosphere. The lithosphere is multilayered including main layers like - crust, mantle, and outer and inner core. The core is the central fluid or vapourised sphere having diameter of about 2500 km from the centre and is possibly composed of Nickel-Iron. The mantle extends about 2900 km above the core. This is in molten state. The outer most solid zone of the earth is called crust which is about 8 to 40 km above the mantle. The crust is very complex and its surface is covered with soil supporting rich and varied biological communities. Living organisms find in the soil an environment providing food, shelter, and concealment from predators.

Soil:

The word soil is derived from a Latin word 'solum' meaning earthy material in which plants grow. The science which deals with the study of soil is called Soil Science, Pedology (pedos= earth) or Edaphology (edaphos=soil). The study of soil is significant due to various reasons. Soil is a natural habitat for microorganisms, plants and animals. Its knowledge is helpful in practices of agriculture, horticulture, forestry, etc., such as cultivation, irrigation, artificial drainage, and use of fertilizers.

d) The Biosphere

The portion of Earth that supports life is called the biosphere. The biosphere extends from several kilometers up in the atmosphere to the deepest parts of the oceans (Hydrosphere). It includes the solid portion of the land (Lithosphere) where life is found.

The area of contact and interaction between these components is important for life. Sometimes the biosphere is called the ecosphere because the three regions of the biosphere air, water, and land are connected. If chemicals, such as pesticides, are sprayed into the air, they may eventually pass into water systems or may cover the land. Fertilizers spread on the surface of the land may get into the water or air. Care has to be taken to protect all parts of the biosphere so that organisms in each part survive.

Every organism in the biosphere depends on its environment for survival. The environment supplies organisms with energy and materials for growth and repair. Plants use sunlight, water, carbon dioxide, and inorganic nutrients for photosynthesis. Animals use plants and other organisms for their supply of energy and organic matter. Fungi and bacteria get their energy and materials by decomposing dead matter and wastes.

Organisms depend on nonliving and living factors in the environment. Nonliving factors in the environment are called abiotic factors. Abiotic factors include water, soil, temperature, light, air, and minerals. Living factors in the environment are called biotic factors.

1.7 Ecology

The science of ecology deals with the study of the relationships of organisms with their environment and with one another. The term 'environment' here refers to the surrounding world, which includes all entities, both living and non-living, which surround a living entity.

The word 'ecology' is derived from the Greek words oikos, meaning household, and logos, meaning study. Thus ecology means study of life at home or the study of interconnections and interdependence of plants, animals, microbes and their environment. Because ecology is concerned especially with the biology of group of organisms and their functional processes on the land, in water and air it may also be defined as the study of the structure and function of nature. Emergence of ecology as a distinct field of knowledge dates back to the early years of the last century. In its infancy ecology was thought to be a synonym of natural history or nature study. With the more and more documentation of observations by the students of nature study, the importance of "quantification" of data came to the force. From then a number of definitions for the term has been proposed by different authors. Some of the definitions are:

1. Ecology is the knowledge of the sum of the relations of the organisms to the surrounding outer world, to organic and inorganic conditions of existence (Haeckel, 1886).
2. Ecology (Oekologie) is the study of organisms in relation to their environment (Warming,

1895).

3. Ecology is the scientific natural history concerned with the sociology and economics of animals (Elton, 1927).

4. Ecology is the science all the relations of all organisms to their environment (Taylor, 1936).

5. Ecology is the interaction of form, functions and factors (Misra, 1967).

6. Ecology is the study of structure and function of the ecosystem (Odum, 1969).

7. Ecology is the scientific study of the interactions that determine the distribution and abundance of organisms (Kerbs, 1985).

1.8 Populations and Communities

Just as cells are grouped into tissues and tissues into organs and then systems, organisms also can be put within groups. A population is a group of organisms of the same species that live in one area during some specific time. A species is considered to be a group of organisms that are capable of breeding with each other under natural conditions and producing fertile offspring. For example, mosquitoes on the surface of a pond in the spring and maple trees in a Vermont forest in the fall make up two populations.

Populations can be grouped together. All the populations of different species that interact with each other within an area make up a community. All the protists, plants, and animals that interact on a coral reef make up a reef community.

Within a community, each organism is found in a specific location. The habitat is the environment of a particular type of organism. For example, ferns are found in a moist, shady floor habitat of a forest community. The habitat of some snails is leaf litter on the forest floor. In a pond community, a frog's habitat is near the edge of the water and includes both water and land. A trout fish in the same community has its habitat in the deeper, cooler portion of the pond.

All of the biological, chemical, and physical factors of a species environment are part of its niche. The niche includes what a species needs to survive and reproduce in its environment. What organisms eat? How they get food? How they attract mates? Where they live? and What they do in their environment? make up the niche. The habitat is part of an organism's niche. A habitat is sometimes considered a species address. The niche is the lifestyle or occupation of a species.

Habitats often overlap and different organisms can be found in the same location. However, no two species can occupy exactly the same niche at the same time for very long. If they do, they begin to compete for the same basic and essential requirements. We may think that birds within a tree have the same niche. Careful observation will reveal differences such as some birds eat insects while others eat seeds; some feed beneath the tree while others feed in the tree. Some birds even get their food away from the tree. The birds may also have different methods of reproduction. They may have different mating behaviours, and they may nest in different spots.

1.9 Concept of the Ecosystem

Introduction - What is an Ecosystem?

The term ecosystem was proposed by A.G. Tansley in 1935, who defined it as 'the system resulting from the integration of all the living and non-living factors of the environment' He regarded ecosystem as including not only the organic complex but also the whole complex of the physical factors forming the environment. Thus any unit that includes all the organisms i.e. the communities in a given area, interact with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycle within the system is known as ecological system or ecosystem. Ecosystem is the structural and functional unit of ecology. Being a structural unit an ecosystem has a well-defined sub-structures and boundaries, and being a functional unit, it acts as a medium and platform for a number of processes required to maintain steady state equilibrium. A number of definitions of ecosystem are available in literature and these vary depending upon its use and the purpose for which it is used. Basically the term ecosystem originated from biology and refers to self-sustaining system. From the viewpoint of economics and sociology that are closely related to ecology, the term ecosystem refers to relationship established across different countries and industries for mutual benefits and sustenance. Ecosystem is also defined as the complex of living organisms, the physical environment and all their interrelationships in a particular unit of space. The studies of ecosystem are based on the perception that all life supporting elements, weather natural or anthropogenic are integral part of a network where the elements interact among themselves. All the ecosystems are contained within the largest of all ecosystems called the ecosphere which engulfs the whole physical earth called the geosphere and all living components called the biosphere.

An ecosystem consists of the biological community that occurs in an area, and the physical and chemical factors that make up its non-living or abiotic environment. There are many examples of ecosystems i.e. a pond, a forest or a pasture. The boundaries are not easy to fix, although sometimes they seem obvious, as with the shoreline of a small pond. Usually the boundaries of an ecosystem are chosen for practical reasons having to do with the goals of the particular study.

The study of ecosystems mainly consists of the study of certain processes that link the living, or biotic components to the non-living, or abiotic components. Energy transformations and biogeochemical cycling are the main processes that comprise the field of ecosystem ecology. Ecosystems have no size limitations. They may be as large as a desert or as small as the drops of water on a plant leaf. Plants, soil bacteria, soil nutrients, air spaces, and light and temperature are part of the interactive system within a garden.

An ecosystem is self-sustaining when three conditions are met. First, it must have a relatively constant source of energy. Sunlight supplies the energy to most ecosystems. Second, energy must be converted by a living system into chemical bond energy in organic molecules. Plants, algae, and certain groups of bacteria accomplish this through the process of photosynthesis. Third, organic matter and inorganic nutrients must be recycled for reuse. In most ecosystems, this recycling is carried out by decomposers.

An ecosystem becomes unstable when any of these three conditions is affected. For example, if the flow of energy from the sun is disrupted, photosynthesis is affected. Without the food of plants, other organisms and the plants themselves would die off. If essential nutrients are unavailable or if certain species die off, the ecosystem could lose its ability to sustain itself. To remain stable, an ecosystem needs to maintain a dynamic balance between its biotic and abiotic factors.

1.10 Levels of organization

Ecological systems are always open i.e. there is an exchange (or input - output relation) of energy and matter with neighbouring systems. Collier et al. distinguished four levels of organizations in ecological systems:

1. The level of the organism: At this level, ecological studies focus on studies of individuals and are mostly concerned with physiology, reproduction, development or behavior of individual members of a species or ecosystem.

2. The level of the Population: A population is a group of organisms of one species, living within a certain area. Such groups show characteristics which cannot be explained at the organism level. Studies of populations usually focus on the habitat and resource needs of individual species, their group behaviors, population growth, and what limits their abundance or causes extinction.

3. The level of the Communities: A community is the assembly of different populations within a certain area. Interactions between populations are very important for the composition of the community. Studies of communities examine how populations of many species interact with one another, such as predators and their prey, or competitors that share common needs or resources. So the term "population" in ecology refers to all the members of a particular species within an ecosystem, while "community" is the collection of all the different populations of different species living in an ecosystem.

4. The level of ecosystem: An ecosystem is a system in which communities interact with the abiotic environment. In ecosystem ecology we put all the levels together and try to understand how the system operates as a whole. This means that, rather than worrying mainly about particular species, we try to focus on major functional aspects of the system. These functional aspects include such things as the amount of energy that is produced by photosynthesis, how energy or materials flow along the many steps in a food chain, or what controls the rate of decomposition of materials or the rate at which nutrients are recycled in the system.

By the above definition of ecosystem, the earth itself can be regarded as one ecosystem. However, for convenience of study, it is usual to limit the extent of ecosystems to more easily recognizable units like a forest, or a lake.

Table 1.2. Realms of Ecology (Townsend, Begon and Harper, 2003):

Ecosphere (Biosphere) ↑	- all of the Earth's ecosystems together
Ecosystems ↑	- community of different species interacting with one another and with their nonliving environment of matter and energy
Communities ↑	- populations of all the different species occupying a particular place
Populations ↑	- group of individuals of the same species occupying a given area at the same time
Organisms	- any form of life

1.11 Components of an Ecosystem

All ecosystems comprise of two main 'parts': the living (biotic) part and the non-living (abiotic) part.

1.11.1 Biotic factors

The biotic components are the living organisms categorized on the basis of the mode of obtaining nutrition. Within an ecosystem, organisms that make food by photosynthesis are called producers and plants, certain protists and some monerans use energy from the sun in this process. Producers become the food and energy source for consumers. Consumers are organisms that feed on other living things. They include animals, fungi, bacteria, and some protists.

Consumers that feed directly on the producers are called primary consumers. Primary consumers are the food for the secondary consumers. Animals that derive nearly all of their food resources from plant matter are called herbivores. Secondary and higher level consumers that get most of their food from eating the flesh of other animals are known as carnivores. Omnivores eat both plants and animals.

Decomposers are consumers that break down plant and animal remains and wastes. They decay the organic matter, making its parts available for reuse. The most common decomposers are bacteria and fungi. Scavengers are animals that feed on the dead bodies of other animals. Saprobes are organisms that obtain their nutrition from plant and animal remains.

Energy flows through an ecosystem when organisms feed. Higher-level consumers are not required for an ecosystem to be self-sustaining.

Producers are called autotrophs, which mean "self-feeders" since they "feed themselves" by making food in the process of photosynthesis. Autotrophs, such as plants, convert inorganic sources of energy into organic forms. Consumers are called heterotrophs which mean "other-feeders" since they feed on other organisms. Heterotrophs require organic molecules to carry out their life functions.

1.11.2 The Abiotic Environment

Abiotic components: Various physico-chemical components of the ecosystem constitute the abiotic structure:

(i) Physical components include sunlight, solar intensity, rainfall, temperature, wind speed and direction, water availability, soil texture etc.

(ii) Chemical components include major essential nutrients like C, N, P, K, H2, O2, S etc. and micronutrients like Fe, Mo, Zn, Cu etc., salts and toxic substances like pesticides.

These physico-chemical factors of water, air and soil play an important role in ecosystem functioning. The abiotic components of an ecosystem including all the physical and chemical factors present in the ecosystem determine the types of organisms that live in a particular environment and influence the biotic components. In an ecosystem, the biotic communities interact with the nonliving environment. Abiotic environmental factors control the distribution, size, reproduction, nutrition, and overall metabolism of the living communities.

1.12 Limiting factors

The influence of the environment on plant growth can be readily seen in gardens and houseplants. Many plants grow best in fertile, well-drained soil, while others have evolved to grow in more extreme soil conditions. Some plants are shade tolerant; others thrive under lots of daily sunlight. Gardens and houseplants represent small-scale ecosystems that we can influence by changing the environment. One of the features of an ecosystem is that its growth is limited under normal conditions by competition for resources within the system and by external factors such as environmental changes. If the presence or absence of a factor limits the growth of the ecosystem elements, it is called a limiting factor. There are several fundamental factors that limit ecosystem growth, including temperature, precipitation, sunlight, soil configuration, soil nutrients etc. which play major roles in the distribution of plant and animal communities and keep on changing. These changes affect the well being and survival of the organisms in an ecosystem as they thrive as long all the essential factors for life are available. One may have tried to grow houseplants outdoors and found that the sun burned the leaves. Perhaps we have forgotten to water your garden plants and found that they had wilted or died in the summer heat.

Light

Different plant species have different light requirements. Ferns on a forest floor require shade or diffuse sunlight. Other plants, like the desert cacti, require bright light. The intensity and duration of light affects plant growth and distribution. At the equator, plants get 12 hrs of light each day. In Alaska, plants may get 22 hrs of light each day in the middle of summer and about 2 hrs of light each day in the middle of winter.

Light energy (sunlight) is the primary source of energy in nearly all ecosystems. It is the energy that is used by green plants (which contain chlorophyll) during the process of photosynthesis; a process during which plants manufacture organic substances by combining inorganic substances. Visible light is of the greatest importance to plants because it is necessary for photosynthesis. Factors such as quality of light, intensity of light and the length of the light period (day length) play an important part in an ecosystem.

- **Quality of light (wavelength or colour):**

Plants absorb blue and red light during photosynthesis. In terrestrial ecosystems the quality of light does not change much. In aquatic ecosystems, the quality of light can be a limiting factor. Both blue and red light are absorbed and as a result do not penetrate deeply into the water. To compensate for this, some algae have additional pigments which are able to absorb other colours as well.

- **Light intensity ("strength" of light)**

The intensity of the light that reaches the earth varies according to the latitude and season of the year. The southern hemisphere receives less than 12 hours of sunlight during the period between the 21st March and the 23rd of September, but receives more than 12 hours of sunlight during the following six months.

- **Day length (length of the light period):**

Certain plants flower only during certain times of the year. One of the reasons for this is that these plants are able to "measure" the length of the night (dark periods). However, it was thought that it is the day length (light periods) to which plants reacted and this phenomenon was termed photoperiodism. Photo-periodism can be defined as the relative lengths of daylight and darkness that affect the physiology and behaviour of an organism.

- **Short-day Plants**

These plants flower only if they experience nights which are longer than a certain critical length. The chrysanthemum (Chrysanthemum sp.), the poinsettia (Euphorbia pulcherrima) and the thorn-apple (Datura stramonium) are examples of short day plants.

- **Long-day plants**

These plants flower if they experience nights which are shorter than a certain critical length. Spinach, wheat, barley, clover and radish are examples of long day plants.

- **Day-neutral plants**

The flowering of day-neutral plants is not influenced by night length. The tomato (Lycopersicon esculeutum) and the maize plant (Zea mays) are examples of day-neutral plants.

The following definitions are also important:

- **Phototropism**

Phototropism is the directional growth of plants in response to light where the direction of the stimulus determines the direction of movement; stems demonstrate positive phototropism i.e. they came towards the light when they grow.

- **Phototaxis**

Phototaxis is the movement of the whole organism in response to a unilateral light source, where the stimulus determines the direction of movement.

- **Photokinesis**

Variation in intensity of locomotory activity of animals which is dependent on the intensity of light stimulation, and not the direction, is called photokinesis.

- Photonasty

Photonasty is the movement of parts of a plant in response to a light source, but the direction of the stimulus does not determine the direction of the movement of the plant.

Light requirements of plants differ and as a result distinct layers, or stratification, can be observed in an ecosystem. Plants which grow well in bright sunlight are called heliophytes (Greek helios, sun) and plants which grow well in shady conditions are known as sciophytes (Greek skia, shade).

Temperature

Temperature affects the rate of metabolic processes, reproduction, and survival of plants. Differences in air temperature create air movements that carry moisture toward or away from plants. Air temperature determines the amount of water vapor and other gases that the air may hold. Soil temperature determines the rate of water absorption by the roots of plants and the rate of root growth.

The distribution of plants and animals is greatly influenced by extremes in temperature for instance the warm season. The occurrence or non-occurrence of frost is a particularly important determinant of plant distribution since many plants cannot prevent their tissues from freezing or survive the freezing and thawing processes. The following are examples of temperature effects with ecosystems:

- the opening of the flowers of various plants during the day and night is often due to temperature difference between the day and night;

- the seed of some plants (biennials) normally germinate in the spring or summer; this phenomenon is well observed in carrots and is called vernalization;
- some fruit trees such as the peach require a cold period each year so that it can blossom in the spring;
- deciduous trees lose their leaves in winter and enter into a state of dormancy, where the buds are covered for protection against the cold;
- the seeds of many plants, e.g. peach and plum, must be exposed to a cold period before they germinate; this chilling ensures that seeds don't germinate during autumn, but after winter, when the seedlings have better chances to survive;
- in animals, a distinction is made between ectothermic ("cold-blooded" or poikilothermic) animals and endothermic ("warm-blooded" or homothermic) animals although the difference is not clear cut;
- in desert conditions are a greater temperature variation between day and night and organisms have distinct periods of activity, for e.g. many cacti flower at night and are pollinated by nocturnal insects;
- seasonal changes have also a great influence on animal life in an ecosystem; torpor in winter is common in reptiles and some mammals in South Africa, but a winter sleep occurs in bears of the northern hemisphere; some animals collect fat or other resources during favourable periods (often summer and autumn) and become dormant (this is called hibernation), there are also animals that are dormant during warm and dry conditions and this is known as aestivation; examples of such animals are snails and the African lung-fish;
- seasonal movements occur in some animals; this phenomenon is called seasonal migration, examples of such animals are migratory locusts, butterflies and various marine animals like whales, penguins and marine turtles.

Water

Species distribution depends on moisture. Some organisms are at home in rain forests where it rains every day. Others are adapted to life in deserts where water is in short supply. Well-aerated soil is filled with air passages allowing the circulation of gases such as oxygen, carbon dioxide, and nitrogen. Moisture clings to the surfaces of soil particles creating conditions that support bacteria, fungi, and protists. These soil microbes make chemical nutrients available to plants. Some microbes use up the nutrients, thus retarding plant growth.

Plant and animal habitats vary from entirely aquatic environments to very dry deserts. Water is essential for life and all organisms depend on it to survive in especially desert areas.

- **Water requirements of plants**

Plants can be classified into 3 groups according to their water requirements:

Hydrophytes: Hydrophytes are plants which grow in water e.g. water-lilies and rushes.

Mesophytes: Mesophytes are plants with average water requirements e.g. roses,sweetpeas.

Xerophytes: Xerophytes are plants which grow in dry environments where they often experience a shortage of water e.g. cacti and often succulents.

Adaptations of plants to survive without water include reversed stomatal rhythms, sunken stomata, thick cuticles, small leaves (or the absence of leaves) and the presence of water-storage tissues.

- **Water requirements of animals**

Terrestrial animals are also exposed to desiccation and just a few interesting adaptations are mentioned here:

- the body covering limits water loss e.g. the chitinous body covering of insects, the scales of reptiles, the feathers of birds and the hair of mammals;
- some mammals have few or no sweat glands and use other cooling devices, less dependant or independent of evaporative cooling;
- the tissues of animals may be tolerant to water loss e.g. a camel can live without water for long periods because its body tissues have this adaptation;
- there are also known cases where insects are able to absorb water in the form of

water vapour directly from the atmosphere for example the dew from the coastal fog is an important source of moisture for insects of the Namib.

Atmospheric gases.

The most important gases used by plants and animals are oxygen, carbon dioxide and nitrogen.

- Oxygen: Oxygen is used by all living organisms during respiration.
- Carbon Dioxide: Carbon dioxide is used by green plants during photosynthesis.
- Nitrogen: Nitrogen is made available to plants by certain bacteria and through the action of lightning.

Wind

Winds or air currents arise on a world-wide scale as a result of a complex interaction between hot air expanding and rising (convection) in the mid latitudes. This has various effects on the rotation of the earth and results in a centrifugal force which tends to lift the air at the equator. This force is known as the Coriolis force and tends to deflect winds to their left of the southern hemisphere and to the right in the northern hemisphere. Winds carry water vapour which may condense and fall in the form of rain, snow or hail. Wind plays a role in pollination and seed dispersal of some plants, as well as the dispersal of some animals, such as insects. Wind erosion can remove and redistribute topsoil, especially where vegetation has been reduced. Warm berg winds results in desiccation which creates a fire hazard. If plants are exposed to strong prevailing winds are they usually smaller than those in less windy conditions.

Soil (edaphic factors)

These factors include soil texture, soil air, soil temperature, soil water, soil solution and pH, together with soil organisms and decaying matter (Fig 1.1).

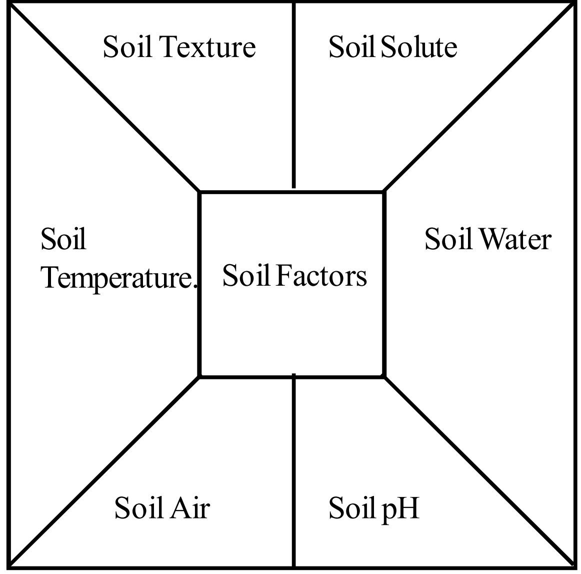


Fig. 1.1 Edaphic factors

- **Soil texture:** The size of soil particles varies from microscopic particles called clay to larger particles called sand. Loam soil is a mixture of sand and clay particles. Sandy soils are suitable for growing plants because they are well aerated, excess water drains away quickly, they warm up quickly during the day and is easy to cultivate. Sandy soils is unsuitable because they do not retain much water and soon dry out and contain few soil nutrients required for plant growth. Clay soils are suitable for plant growth because they hold large quantities of water and are rich in mineral nutrients. They are unsuitable in that they are badly aerated, soon becomes waterlogged and is difficult to cultivate; it also cold during winter. Loam soils possess desirable properties of both sand and clay - it has a high water retaining capacity, good aeration, good nutrient content and is easily cultivated.
- **Soil air:** Soil air is found in those spaces between the soil particles that are not filled with soil water. The amount of air in a soil depends on how firmly the soil is compacted. In well-aerated soil at least 20% of its volume is made up of air.
- **Soil temperature:** Soil temperature is an important ecological factor. It has been found that the temperature of soil below a depth of about 30cm is almost constant

during the day but seasonal temperature differences do occur. At low temperature there is little decay by decay-causing micro-organisms.

- **Soil water:** Soil water can be classified into three types, namely hygroscopic, capillary and gravitational water. Hygroscopic water occurs as a thin film of water around each soil particle. Capillary water is that water held in the small spaces between the soil particles and gravitational water is the water which drains downwards through the soil.

- **Soil solution:** Soil solution is the decaying remains of plants and animals, together with animal excretory products and faeces, form humus. This increases the fertility of the soil.

- **pH:** Acidity or alkalinity of soil (the pH of the soil) influences the biological activity in soil and the availability of certain minerals. Thus the pH of soil has a greater influence on the growth and development of plants. Some plants e.g.azaleas, ericas, ferns and many protea species grow best in acid soils (soils with a pH below 7), while lucerne and many xerophytes grow better in alkaline soils (soils with a pH above 7).

Physiographic factors

These factors are those associated with the physical nature of the area, such as altitude, slope of land and the position of the area in relation to the sun or rain-bearing winds. Altitude plays a role in vegetations zones. Slopes are important when considering the temperature of the soil surface on land with a northern slope, on level and on land with south facing slopes. In South Africa the south-eastern slopes face the rain-bearing winds and in some areas are covered with forest, whilst the slopes on the leeward side are in a rain-shadow and thorn scrub is often found growing on these slopes. A very good example of this is the South Eastern Wind blowing in Cape Town.

1.13 Laws governing limiting factors

1. **Lie big's "Law" of the minimum:**

Under "steady state" conditions essential material available in amounts most closely approaching the critical minimum needed will tend to be the limiting one and the concept is also known as Liebig's law of minimum. According to the law the growth of crop plants is dependent on the amount of nutrient that is available in minimum quantity. Therefore he came to the conclusion that the growth of the plants is limited by the the essential nutrients which is in short supply in relation to the needs of the plant. Liebig concentrated more on the factors such as light, temperature, nutrients and essential elements. He tried to explain the absence of some plants in shaded areas or lack of vegetation above certain altitudes on Alpes. He gave justification in terms of inadequate light, temperature or nutrients. He had the concept that the crop yields are not often limited by nutrients that are in abundant supply such as carbon dioxide and water, but by others which are needed in small quantities and are in short supply such as zinc in modern agriculture. This law of minimum is less applicable under "transient state" conditions when the amounts, and hence the effects of many constituents are rapidly changing.

2. Shelford's Law of tolerance:

V. E. Shelford in 1913 extended the concept of limiting factors to include the limiting effect of maximum as well as minimum on organisms. He proposed that a factor may be limiting not only at low quantities, but the too high quantities may also prove to detrimental to the growth and development of the organism. Thus, any environmental factor which is below the critical minimum or well above the critical maximum requirements of an organism, would certainly limit the growth of the organism in a given area. In other words the presence and success of an organism depend upon the completeness of a complex of conditions. Absence or failure of an organism can be controlled by the qualitative or quantitative deficiency of excess with respect to any-one of several factors which may approach the limit of tolerance for that organism.

Organisms have ecological maximum and minimum requirements for each environmental factor. These are limits of tolerance of the organism for that factor. According to the law of tolerance, every environmental factor has two zones i.e zone of tolerance and zone of intolerance (Nair, 1990).

i) Zone of tolerance is the zone which is favourable for the growth and development of the organisms and is composed of the parts

   a) Optimum zone which is most favourable where growth and development of organisms is maximum.

b) Critical minimum zone and is the minimum limit of any environmental factor beyond which growth and development of the organism cease.

c) Critical maximum zone is the maximum limit of any environmental factor beyond which the organisms usually cease their normal activities.

ii) **Zone of intolerance:** This zone is well below the critical minimumand above the critical maximum zones. This zone is unfavourable for the growth and development of the organisms and they can not survive here for long period.

3. Combined concept of Limiting Factors:

The presence and success of an organism or a group of organisms depends upon a complex of conditions. A more general and useful concept of limiting factor can be achieved by combining the idea of minimum and the concept of limiting factors. This is based on i) the quality of materials for which there is a minimum requirement and physical factors which are critical and ii) the limits of tolerance of the organisms to different components of the environment (Odum, 1971).

4. Conditions of existence as regulatory Factors:

Light, temperature and water are ecological important Environmental factors on land; light, temperature and salinity are the big three in the sea. In fresh water other factors such as oxygen may be of major importance. All these physical conditions of existence may not only be limiting factors in the detrimental sense but also regulatory factors in the beneficial sense - that adopted organism respond to these factors in such a way that the community of organisms achieves the maximum homeostasis possible under the conditions. Blackman (1912) said that a process is affected by many factors and rate is controlled by the slowest movement and this is known as limiting factors.

1.14 Functional aspect of an ecosystem

The functional aspect of an ecosystem may be studied in terms of

Energy flow,

Food chain,

Nutrient or biogeochemical cycles

1.14.1 Energy flow in the eco system

Energy

Energy is a main source of life, together with nutrients. The most important energy source of life on earth is , of course, the sun, but other energy inputs are cosmic radiations, the moon tides, and forces from earth it self such as gravity and heat. Secondary sources of energy which are available to ecosystems are currents, waves, streams and wind. Ecological systems tend to use high grade energy to dissipate low grade energy i.e. heat.

Green plants are able to combine CO2 and H2O into carbohydrates by absorbing light in pigment cells (containing chlorophyll):

$$\underset{\text{(From Air)}}{6\,CO_2 + 12\,H_2O} \xrightarrow{2.8MJ} \underset{\text{(to air)}}{C_6H_{12}O_6 + 6CO_2 + 6\,H_2O}$$

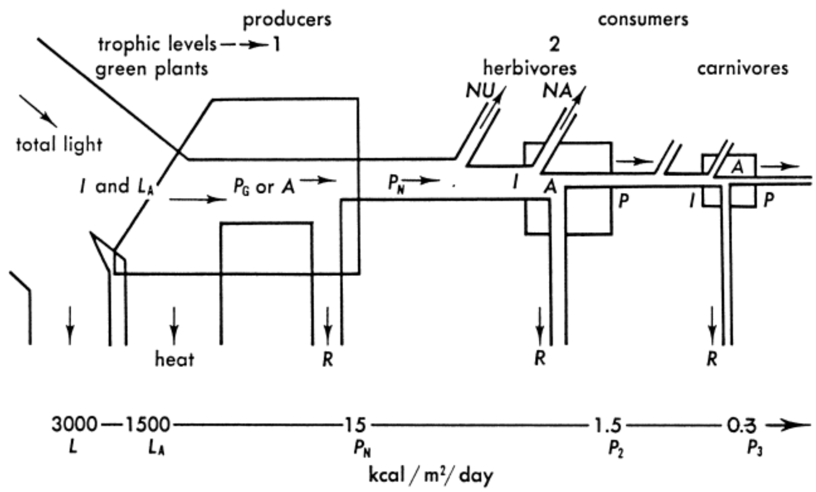
These carbohydrates, in one or another form, constitute the living tissue or biomass of the plants. However, not all energy fixed this way is retained. Plants also need energy for maintenance activities. This energy consumption is called respiration and can be generally represented as follows:

$$\underset{\text{(From Air)}}{6CO_2 + 12\,H_2O} \xrightarrow{\text{metabolic enzymes}} \underset{\text{(to air)}}{C_6H_{12}O_6 + 6\,H_2O + \text{energy}}$$

Thus accumulation of biomass in green plants (or net primary production) = energy fixed in photosynthesis - energy lost by respiration.

Usually, biological communities include what are called the "functional groupings". A functional group is a biological category composed of organisms that perform mostly the same kind of function in the system; for example, all the photosynthetic plants or primary producers form a functional group. Membership in the functional group does not depend very much on who the actual players (species) happen to be, only on what function they perform in the ecosystem.

As discussed the solar energy is converted into chemical energy through photosynthesis by plants, which also incorporate into their protoplasm a number of inorganic elements and compounds. These green plants are grazed subsequently by heterotrophs. All food materials that we or other animals consume are manufactured directly or indirectly by plants. The energy that we obtain from plants either by burning wood or by eating them, represents the solar energy trapped by the plants. We are dependent on the stored resources of solar energy (Fig 1.2).



Source: Odum, E.P. (1971)

Fig 1.2 Energy flow in ecosystem

1.14.2 Food Chains and Food Webs

In a self-sustaining ecosystem very little is wasted. Herbivores, like the grasshopper, eat the leaves of plants. In turn, carnivores like snakes or frogs eat the grasshoppers. Other animals such as hawks may eat these carnivores. When any of these organisms die, decomposers in turn, consume them. After the organisms are decomposed, their nutrients are eventually taken up and used by green plants. In this way, matter is transferred through the ecosystem. Nutrients are transferred from producers to consumers in a feeding relationship known as a food chain. Each organism that eats or decomposes another is thus a link in that chain.

Food chains are often unstable because a change in the population size of any species may affect the chain in either direction. For example, if a primary consumer depends on one plant species for its food, the loss of that species could result in the death of the consumer. As an example, giant pandas have nearly become extinct because they eat bamboo shoots almost exclusively. The supply of these plants is growing smaller because the pandas' habitat is being destroyed by humans.

Simple food chains of this type are rare in nature. Food chains are often seen in ecosystems that are attempting to re-establish themselves after volcanic activity or fires. Food chains are also seen in newly formed areas such as new islands. The various feeding levels of producers and consumers in a food chain are called trophic levels. Producers belong to the first trophic level, primary consumers the second, secondary consumers the third. In nature, most organisms rely on many different sources of food for their nutritional needs. Animals may feed on several different types of food at the same or different trophic level. Depending on the availability of the specific foods, foxes may eat mice, rabbits, berries, or insects. Sea otters eat sea urchins, mussels, and abalone. Bears eat plant parts as well as fish.

Omnivores are both primary and secondary consumers dependent upon whether they are eating plant or animal matter. Complex interrelationships begin to develop involving different trophic levels. Food chains interconnect into a more complex feeding sequence known as a food web. Food webs represent a more diversified feeding sequence and provide greater stability to the ecosystem.

The figure 1.3 portrays a simple food chain, in which energy from the sun, captured by plant photosynthesis, flows from trophic level to trophic level via the food chain. A trophic level is composed of organisms that make a living in the same way, that is, they are all primary producers (plants), primary consumers (herbivores) or secondary consumers (carnivores). Dead tissue and waste products are produced at all levels. Scavengers, detritivores, and decomposers collectively account for the use of all such "waste" , consumers of carcasses and fallen leaves may be other animals, such as crows and beetles, but ultimately it is the microbes that finish the job of decomposition. Not surprisingly, the amount of primary production varies a great deal from place to place, due to differences in the amount of solar radiation and the availability of nutrients and water.

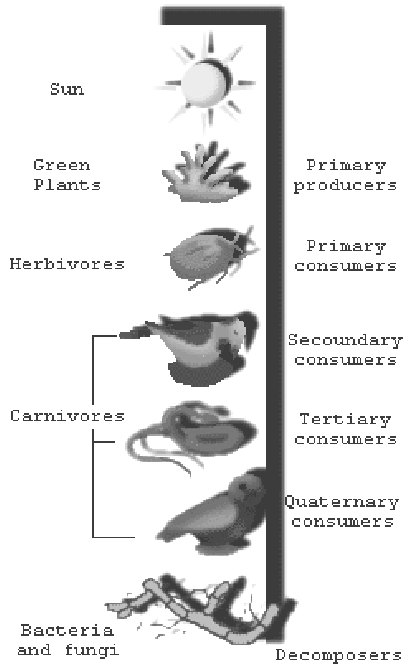


Fig. 1.3. Simple food chain

Energy transfer through the food chain is inefficient. This means that less energy is available at the herbivore level than at the primary producer level, less yet at the carnivore level, and so on. The result is a pyramid of energy, with important implications for understanding the quantity of life that can be supported.

Usually when we think of food chains we visualize green plants, herbivores, and so on. These are referred to as grazing food chains, because living plants are directly consumed.

Grass → Grasshopper → Birds → Hawks

In many circumstances the principal energy input is not green plants but dead organic matter of decaying animals and plant bodies to the microorganisms and then to detritus feeding organisms detrivores. These are called detritus food chains. Examples include the forest floor or a woodland stream in a forested area, a salt marsh, and most obviously, the ocean floor in very deep areas where all sunlight is extinguished thousands of meters above.

The organization of biological systems is much more complicated than can be represented by a simple "chain". Often, several different species may use the same item for food and one species may feed on different species of food organisms.

Food Web

A food chain represents only one part of the energy flow through an ecosystem and our ecosystem may consist of several interrelated food chains. These linkages are referred to as food web (fig. 1.4).

Food webs can be very complicated, where it appears that "everything is connected to everything else," and it is important to understand what the most important linkages are in any particular food web.

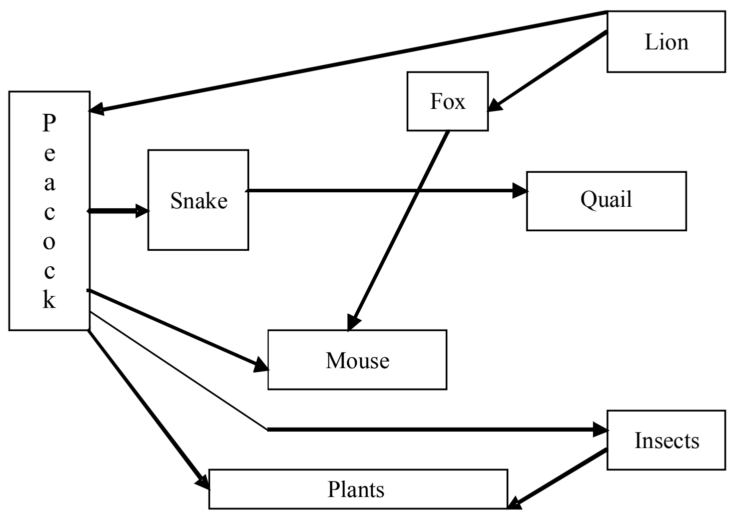


Fig 1.4. Food web

This figure 1.5, with the plants, zebra, lion, and so forth illustrates the two main ideas about how ecosystems function: energy flows and cycling of materials. These two processes are linked, but they are not quite the same.

Energy enters the biological system usually as light energy from the sun and is transformed into chemical energy in organic molecules by cellular processes including photosynthesis and respiration in the producers. This energy is transferred to consumers and is ultimately converted to heat energy to power life processes. This energy is dissipated, meaning it is lost to the system as heat; once it is lost it cannot be recycled. Without the continued input of solar energy, biological systems would quickly shut down. Thus the earth is an open system with respect to energy.

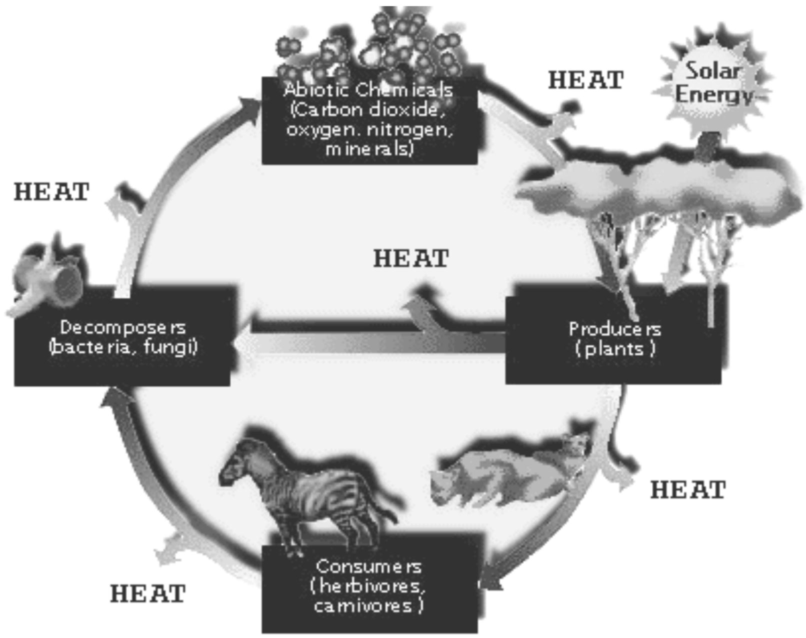


Figure1.5 Energy flows and material cycles.

Ecological Pyramids

A food chain can be represented quantatively (with numbers) in the form of a pyramid of numbers, below is one for the previous food chain (Fig. 1.6). From this graph we can see there are fewer foxes than rabbits; which makes sense because a fox must eat several rabbits to get enough energy in order to survive.

An ecological pyramid shows the relative sizes of different components at the various trophic levels of a food chain. A trophic level refers to each stage (shown as a horizontal bar on ecological pyramids). There are three types of ecological pyramid we use: Numbers, biomass and energy.

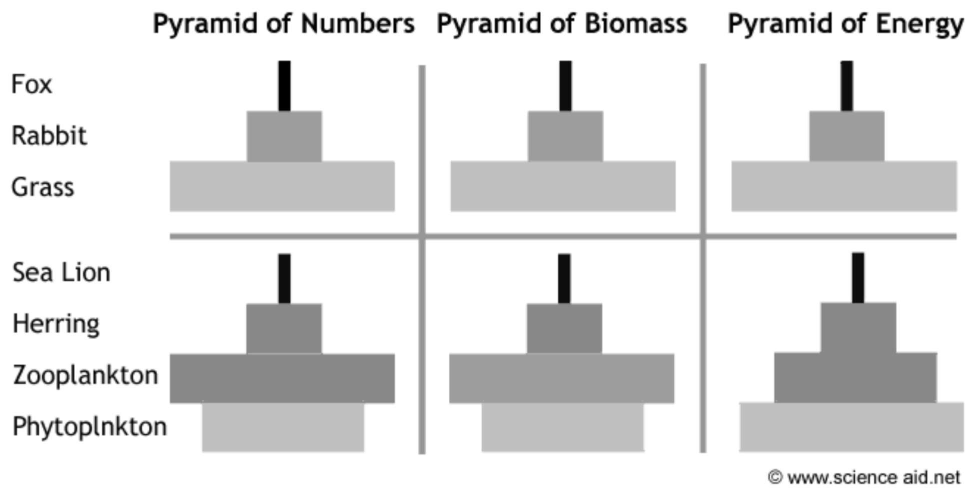


Fig. 1.6. Pyramids of numbers, biomass and energy

The pyramids of numbers show the raw number of each species at each trophic level. The top example is a typical food chain with a large number of producers but diminishing numbers of consumers. However, if the producer was a tree, followed by insects, then the bottom bar would appear small as many organisms feed on one tree. In this instance the pyramid of biomass is more useful as the tree is much larger.

In the lower example, both the pyramid of numbers and biomass show a smaller producer bar; given what was discussed under the previous heading - this does not make sense. This is because the phyto-planktons reproduce very quickly. However, when we represent this information in a pyramid of energy we get a true pyramid.

Plotting the energy will always give a true pyramid because it is impossible to create new energy so a trophic level will always be smaller than the one below it.

1.14.3 Nutrient cycling

Within an ecosystem nutrients can cycle between the biosphere, hydrosphere, lithosphere, and atmosphere. For each element, the exact pattern of cycling is quite unique and may involve a number of abiotic and biotic processes. About 20 to 30 nutrients are required for the metabolic processes in the various types of life. The most frequently used nutrients are referred to as macronutrients. Carbon, oxygen, hydrogen, nitrogen and phosphorus are the most common macronutrients and they ordinarily constitute more than 1% of the dry weight of an organism. Elements required in very small amounts are called micronutrients. Nutrients can enter or leave the nutrient store of an ecosystem through a variety of processes. In a stable ecosystem, losses of nutrients are normally small in amount. Disturbance can increase the quantity of nutrients removed from an ecosystem substantially. The main processes that add nutrients to ecosystems are weathering, atmospheric input, and biological fixation. Losses of nutrients to ecosystems can occur by way of erosion, leaching, gaseous emission, and the emigration and harvesting of biomass. The magnitude of nutrient loss to ecosystems can often be greater than inputs.

The most active interface of nutrient cycling within an ecosystem is the uppermost layers of the soil. In the soil layer, numerous types of organisms are found whose primary function in the ecosystem is to decompose organic matter. Decomposition breaks down complex organic molecules into much smaller inorganic molecules and atoms. This inorganic matter can then re-enter the ecosystem when absorbed by plant roots for metabolism and growth. The soil also receives inputs of nutrients through biological fixation, atmospheric input, and weathering.

Elements follow a circular path from the abiotic environment to organisms and back again to the environment. This two-way exchange between the living and nonliving components within the ecosystem is called a cycle. Chemicals are continuously removed from the atmosphere, water, and land. They are used by living organisms and then returned in some form to the nonliving environment. A biogeochemical cycle is the cyclic movement of chemicals between living and nonliving components of the environment. Biogeochemical cycling is also called nutrient cycling.

Organisms require various chemical elements for growth and maintenance. Earth contains only a fixed amount of these chemical elements. It is important that they be recycled quickly and efficiently. Elements such as carbon, oxygen, and nitrogen are found in large quantities in the oceans and atmosphere. These elements are often found combined with each other in these areas. Biogeochemical cycles are often classified by the storage site or reservoir of the element. Carbon, oxygen, and nitrogen participate in gaseous cycles because of their atmospheric reservoir and the fact that these elements are often found in gaseous form. The elements phosphorus, sulfur, calcium, magnesium, and copper are found bound into the solid matter of earth's crust. These elements are involved in sedimentary cycles for they are usually found in solid form in rock. The hydrologic cycle is the movement of water from sea to the land and back again to the sea. Movement of elements within and between the air, land, and water reservoirs is slower than movement of these elements between organisms.

Many elements are found combined in nature. Thus, biogeohemical cycles are often interconnected. Oxygen makes up about 20 percent of the atmospheric gases. Carbon, in the form of carbon dioxide, makes up about 0.03 percent of those gases. Oxygen is part of the water molecule. Both carbon dioxide and oxygen dissolve in water. In photosynthesis, carbon dioxide and water combine to form organic compounds. During the process, oxygen is released. Organisms use oxygen in aerobic respiration, releasing carbon dioxide and water.

Elements such as carbon, nitrogen, or phosphorus enter living organisms in a variety of ways. Plants obtain elements from the surrounding atmosphere, water, or soils. Animals may also obtain elements directly from the physical environment, but usually they obtain these mainly as a consequence of consuming other organisms. These materials are transformed biochemically within the bodies of organisms, but sooner or later, due to excretion or decomposition, they are returned to an inorganic state. Often bacteria complete this process, through the process called decomposition.

During decomposition these materials are not destroyed or lost, so the earth is a closed system with respect to elements. The elements are cycled endlessly between their biotic and abiotic states within ecosystems. Those elements whose supply tends to limit biological activity are called nutrients.

The Carbon Cycle

The carbon cycle models the movement and storage of carbon in the biosphere, lithosphere, hydrosphere and atmosphere. Carbon is stored in the biosphere as living organisms; in the atmosphere as carbon dioxide gas; in the lithosphere as soil organic matter, as fossil fuel deposits, and as sedimentary rock deposits; and in the oceans as dissolved carbon dioxide gas and as calcium carbonate shells in marine organisms.

Carbon dioxide moves from the atmosphere to producers who use it in photosynthesis. Consumers and decomposers eat the producers and each other. Carbon is passed through the food chain. During respiration, these organisms release carbon dioxide back into the atmosphere or waters. Carbon dioxide also enters the atmosphere when fossil fuels and wood are burned. Volcanic activity and the weathering of carbon-bearing rocks also add carbon dioxide.

Large amounts of carbon are found in ocean waters. It is dissolved as carbon dioxide or stored as calcium carbonate in rocks and animal shells. Carbon dioxide diffuses from the water to the atmosphere. It returns to the waters by precipitation. The remains of plants and animals may become compacted into carbonate rock. Limestone is a typical example.

Humans have altered the carbon cycle through fossil fuel burning, deforestation, and land-use change. The net result of these processes is an increasing concentration of carbon dioxide in the atmosphere.

The Nitrogen Cycle

The nitrogen cycle is one of the most important nutrient cycles in relation to terrestrial ecosystems. Most plants are limited in their growth by the availability of nitrogen despite the fact that the atmosphere is 78 percent nitrogen gas. Only a few organisms have the ability to use atmospheric nitrogen. Most organisms prefer nitrogen in the solid nitrate form. Besides the atmosphere, the other important stores of nitrogen are the soil and the organic molecules of life. Nitrogen is added to ecosystems in solid form primarily through biochemical fixation by specialized microorganisms like bacteria, Actinomycetes, and Cyanobacteria. Bacteria convert nitrogen gas into nitrate or nitrite ions, ammonia gas, or ammonium ions. Nitrates dissolve in the soil water. They are taken up by the roots of plants and used to produce proteins and other organic nitrogen molecules. These nitrogen-containing molecules pass through the food chain. Animal wastes are converted to ammonia or ammonium ions by decomposers. Ammonium ions are converted to nitrites or nitrates and used by bacteria for energy. Other bacteria may convert the ammonia, nitrates, or nitrites back to nitrogen gas.

Humans have also severely altered the nature of this nutrient cycle by generally making solid forms nitrogen more available.

The Phosphorus Cycle

The phosphorus cycle consists of two interconnecting cycles. Phosphates in the rock and soil are taken up by plants. The plants are eaten by herbivores and phosphorus passes through the food chain. The phosphates reenter the soil in the form of animal wastes. This portion of the cycle is relatively rapid and localized.

Some phosphates enter water systems and eventually find their way to the sea. Phosphates are used by algae and the algae are eaten by fish. In turn, the fish are eaten by birds. Bird waste, rich in phosphorus, is deposited on islands. Some of the phosphorus is washed into the oceans. The ocean sediments attract and bind phosphorus very tightly. Over long periods of time, phosphorus is returned to the land as mountains or islands rise from the sea bed. As the phosphorus is weathered or eroded, it returns to the oceans or is passed through the food chain. This portion of the cycle may take as long as a million years.

1.15 Homeostasis

Ecosystems have a unique property of self-regulation. The ecosystem comprising various sub-components of biotic and abiotic nature, which are inter-linked and inter-dependent, have an inherent property to resist change. That means, the ecosystems have a property to tolerate external disturbance or stress. This property is known as homeostasis. The ecosystems have a definite structure comprised of certain types of living organisms, which have a definite place and role in the ecosystem, as defined by their position in the food-web. Together, in interaction with the abiotic components, these ecosystems perform the functions of energy flow and material cycling, and finally give a desired output in the form of productivity. Every ecosystem can operate within a range of conditions, depending upon its homeostasis (capacity to resist change). Within its homeostatic plateau, the ecosystem has the potential to trigger certain feedback mechanisms which help in maintaining the ecosystem functioning by countering the disturbances. Such deviation-counteracting feedbacks are known as negative feedback mechanisms.

Such feedback loops help in maintaining the ecological balance of the ecosystem. A balanced ecosystem has basic biotic components which have evolved with time to suit the environmental conditions. The flow of energy and cycling of nutrients take place in a definite pattern in such an ecosystem, under a set of physical environment.

However, as the outside disturbance or stress increases beyond a certain limit (exceeding the homeostatic plateau of the ecosystem), the balance of the ecosystem is disrupted. This is because now another type of feedback mechanisms, which are deviation accelerating mechanisms start operating. Such feedbacks are called positive feedback mechanisms, which further increase the disturbances caused by the external stress and thus take the ecosystem away from its optimal conditions, finally leading to collapse of the system.

1.16 Different Kinds of Ecosystem

There are basically two types of ecosystems; Terrestrial and Aquatic. All other sub-ecosystems fall under these two.

Terrestrial ecosystems

Terrestrial ecosystems are found everywhere apart from water bodies. They are broadly classified into:

The Forest Ecosystem

These are the ecosystems where abundance of flora (plants) is seen and they have a large number of organisms living in relatively small areas. Therefore, the density of life in forest ecosystems is very high. Any small change in the ecosystem can affect the whole balance and collapse the ecosystem. You can see wonderful diversity in the fauna of these ecosystems too. They are again divided into few types.

Tropical evergreen forest: Tropical forests which receive an average rainfall of 80 to 400 inches in a year. These forests are marked by dense vegetation comprising of tall trees with different levels. Each level gives shelter to different kinds of animals.

Tropical deciduous forest: Dense bushes and shrubs rule here along with broad levels of trees. This type of forests is found in many parts of the world and large variety of flora and fauna are found here.

Temperate evergreen forest: These have very few number of trees but ferns and mosses make up fro them. Trees have spiked leaves to minimize transpiration.

Temperate deciduous forest: This forest is found in the moist temperate regions with sufficient rainfall. Winters and summers are well defined and with trees shedding their leaves during winter.

Taiga: Situated just south of the arctic regions, Taiga is distinguished by evergreen conifers. While the temperature is subzero for almost six months, the rest of the year it is buzzing with insects and migratory birds.

The Desert ecosystem

Desert ecosystems are found in regions receiving an annual rainfall of less than 25cm. They occupy around 17 percent of all land on the planet. Due to very high temperature, intense sunlight and low water availability, flora and fauna are very poorly developed and scarce. Vegetation is mainly bushes, shrubs, few grasses and rarely trees. Leaves and stems of these plants are modified to conserve water. The best known desert plants are the succulents like spiny leaved cacti. Animal life includes insects, reptiles, birds, camels all of whom are adapted to the xeric (desert) conditions.

The Grassland Ecosystem

Grasslands are found in both temperate and tropical regions of the world but the ecosystems are slightly varying. This area mainly comprises of grasses with very little amount of shrubs and trees. Main vegetation is grasses, legumes and plants belonging to composite family. Many grazing animals, herbivores and insectivores are found in grasslands. Two main types of grasslands ecosystems are:

1. **Savanna:** These tropical grasslands are seasonally dry with few individual trees. They support large number of grazers and predators.

2. **Prairies:** This is temperate grassland. It is completely devoid of trees and large shrubs. Prairies can be categorized as tall grass, mixed grass and short grass prairie.

The Mountain Ecosystem

Mountain lands provide a scattered but diverse array of habitats in which a large range of plants and animals are found. At higher altitudes harsh environmental conditions generally prevail, and only treeless alpine vegetation is found. The animals living here have thick fur coats fro prevention from cold and hibernate in winter months. Lower slopes commonly are covered by coniferous forests.

Aquatic Ecosystems

An aquatic ecosystem is an ecosystem located in a body of water. It comprises aquatic fauna, flora and the properties of water too. There are two types of aquatic ecosystems, Marine and freshwater.

The Marine Ecosystem

Marine ecosystems are the largest ecosystems with coverage of nearly 71% of the Earth's surface and containing 97% of the planet's water. The water in Marine ecosystems has salts and minerals dissolved in them in high amounts. Different divisions of marine ecosystems are:

Oceanic: The relatively shallow part of the ocean that lies over the continental shelf.

Profundal: Bottom or deep water.

Benthic: Bottom substrates.

Inter-tidal: The area between high and low tides.

Estuary: The semi enclosed water body which has a free connection with the open sea, thus strongly affected by tidal action, and within which sea water is mixed with fresh water from land drainage.

Coral reefs: Formed by massive colonies of tiny animals called polyps that are close relatives of jellyfish. They slowly build reefs by secreting a protecting crust of limestone.

Hydrothermal vents: where chemosynthetic bacteria form the food base.

Many types of organisms are found in marine ecosystems including brown algae, dino-flagellates, corals, cephalopods, echinoderms, and sharks.

The Freshwater Ecosystem

In contrast to the Marine ecosystem, freshwater ecosystems only cover 0.8% of the Earth's surface and contain 0.009% of its total water. There are three basic types of freshwater ecosystems:

Lentic: Still or slow-moving water like pools, ponds, and lakes.

Lotic: Fast-moving water like streams and rivers.

Wetlands: Places where the soil is saturated or inundated for at least some time.

These ecosystems are home to amphibians, reptiles and almost 41% of world's fish species. Faster moving turbulent water typically contains greater concentrations of dissolved oxygen, which supports greater biodiversity than the slow moving water of pools.

The Geography of Ecosystems

There are many different ecosystems: rain forests and tundra, coral reefs and ponds, grasslands and deserts. Climate differences from place to place largely determine the types of ecosystems we see. How terrestrial ecosystems appear to us is influenced mainly by the dominant vegetation.

1.17 Biome

The word "biome" is used to describe a major vegetation type such as tropical rain forest, grassland, tundra, etc., extending over a large geographic area. It is never used for aquatic systems, such as ponds or coral reefs. It always refers to a vegetation category that is dominant over a very large geographic scale, and so is somewhat broader than an ecosystem.

1.18 Sum up

This chapter introduces some of the basic ecological principles, from knowing the definitions of law, theory and principles, realms of ecology, interactions among species, ecological pyramid, to classifications of living organisms. The important message is that there are different interactions among plants, animals and microorganisms - all being applied by the principles mentioned above.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

2.1 Objectives

This lesson on Environmental Sociology has the following objectives:

- to provide a deeper understanding of the inherent relationship between humans and the environment;
- to lay a basic foundation of sociological knowledge in the area of environmental

issues and globalization;

- to understand some fundamental sociological issues,
- to apply basic skills in sociological theory and research to the field of environmental sociology;
- to apply theories and concepts from environmental sociology to everyday life;
- to sharpen skills of critical analysis through reading, writing, and class discussion;

2.2 Introduction

The environmental issues like global warming, depletion of the ozone layer, the export of waste to third world nations, the razing of tropical forests for cattle grazing, the loss of biodiversity, the premature extinction of the human species are discussed, debated, and hotly contested each day in newspapers, magazines, radio and television news reports and in various internet sources. These are the problems due to the way humans interact and view their environment. These problems make humankind to neglect, abuse and manipulate their surroundings with little or no regard for the consequences. Obviously, this causes many ill impacts on the inhabitants of the earth, including humankind themselves. Humans cause harm to their own natural environment and the reason they do this is a perceived understanding by humankind that they are somehow superior to nature. This behaviour seems to stem from the fact that humans forget that they are themselves a part of nature. The concepts of domination over nature and the conquest of nature are everyday reminders of this oversight. The human populations depend upon the biophysical environment for survival, and this in turn necessitates a closer look at the functions that the environment serves for human beings.

2.2.1 Functions of the Environment

The biophysical environment serves many essential functions for human populations, as it does for all other species (Daily 1997), but three basic types can be identified.

First, the environment provides us with the resources that are necessary for life, ranging from air and water to food to materials needed for shelter, transportation, and the vast range of economic goods we produce. Human ecologists thus view the environment as providing the "sustenance base" for human societies, and we can also think of it as a "supply depot." Some resources, such as forests, are potentially renewable while others, like fossil fuels, are nonrenewable or finite. When we use resources faster than the environment can supply them, even if they are potentially renewable (such as clean water), we create resource shortages or scarcities (Catton, 1980).

Second, in the process of consuming resources, humans, like all species, produce "waste" products; indeed, humans produce a far greater quantity and variety of waste products than do other species. The environment must serve as a "sink" or "waste repository" for these wastes, either absorbing or recycling them into useful or at least harmless substances (as when trees absorb carbon dioxide and return oxygen to the air). When land was sparsely populated and utilization of resources was minimal, this was seldom a problem. Modern and/or densely populated societies generate more waste than the environment can process, and the result is the various forms of pollution that are prevalent worldwide.

The third function of the environment is to provide a "living space" or habitat for human populations. Humans, like other species, must also have a place to exist, and the environment provides us our home where we live, work, play, travel and spend our lives. When too many people try to live in a given space, the result is overcrowding, a common occurrence in many urban areas (especially in poorer nations). Some analysts suggest that the entire planet is now overpopulated by human beings, although efforts to determine the number of people the Earth can support has proven to be difficult and contentious (Cohen, 1995).

When humans overuse an environment's ability to fulfill these three functions, environmental problems in the form of pollution, resource scarcities, and overcrowding and/or overpopulation are the result. However, environment not only must serve all three functions for humans, but when a given environment is used for one function its ability to fulfill the other two is often impaired. Such conditions of functional competition often yield newer, more complex environmental problems.

Competition among environmental functions is especially obvious in conflicts between the living- space and waste-repository functions, as using an area for a waste site typically makes it unsuitable for living space. When an area is used as a garbage landfill or hazardous waste site, for example, people don't even want to live near it (Freudenburg, 1997). Likewise, if hazardous materials escape from a waste repository and contaminate the soil, water, or air, the area can no longer serve as a supply depot for drinking water or for growing agricultural products. Finally, converting farmland or forests into housing subdivisions creates more living space for people, but it means that the land can no longer function as a supply depot for food or timber (or as habitat for wildlife).

2.2.2 The Evolution of Environmental Problems and environmental sociology

Understanding above discussed three functions played by the environment provides insight into the evolution of environmental problems, or the problematic conditions created by human overuse of the environment. In the 1960s and early 1970s when awareness of environmental problems was growing rapidly in the United States, primary attention was given to air and water pollution and to litter- problems stemming from the environment's inability to absorb human waste products as well as to the importance of protecting areas of natural beauty.

There is a growing awareness that in order to understand and solve the dire environmental problems facing our planet we need to examine the underlying social, psychological, political and economic forces driving human behavior.

Environmental Sociology brings the sociological perspective and sociological methods of analysis to this broadly cross-disciplinary topic of environmental issues. Environmental sociology is typically defined as the study of relations between human societies and their physical environments or, more simply, "societal - environmental interactions" (Dunlap and Catton 1979). Such interactions include the ways in which humans influence the environment as well as the ways in which environmental conditions (often modified by human action) influence human affairs, plus the manner in which such interactions are socially construed and acted upon.

'Earth Day 1970' is often said to represent the debut of the modern environmental movement. What most distinguished Earth Day however was its symbolic claim to be 'Day One' of the new environmentalism, an interpretation which was widely embraced by the American mass media which afforded the environmental issues an instant and widespread recognition.

When Earth Day inaugurated the 'Environmental Decade' of the 1970s sociologists found themselves without any prior body of theory or research to guide them towards a distinctive understanding of the relationship between society and environment. While each of the three major classical sociological pioneers - Emile Durkheim, Karl Marx and Max Weber - arguably had an implicit environmental dimension to their work, this had never been brought to the fore, largely because their American translators and interpreters favoured social structural explanations over physical or environmental ones (Butte 1986). From time to time, isolated works pertaining to natural resources and the environment had appeared, mostly within the area of rural sociology, but these had never coalesced into a cumulative body of work. In a similar fashion, social movement theorists gave short shrift to conservation groups, leaving historians to explore their roots and significance.

In classical sociology there was very little work done in this field, and there are some evidently problematic assumptions that were made about our place in nature. There is more work being done these days, and the majority of that work is concerned with modifying previous modes of study and sociological views of the environment.

Sociologists play a critical role in understanding and resolving environmental problems because the sociological perspective is unique and useful for examining environmental problems. It focuses on how social institutions and cultural practices influence behavior rather than attributing behavior to the characteristics of the individual. Although many people view environmental issues as technical problems that require the expertise of only biologists, chemists, physicists, and engineers to understand, sociologists recognize the essentially social nature of environmental issues. Sociologists analyze the social causes and consequences of technological choices, policy decisions and economic production processes affecting resource scarcity and environmental degradation.

The development of Environmental sociology as the sub-discipline was the shift from a "sociology of environment" to an "environmental sociology." While the former refers to the study of environmental issues through the lens of traditional sociology, the latter encompasses the societal-environmental relations (Dunlap and Catton, 1979; Dunlap and Catton, 1994).

2.3 Contribution of rural sociology and rural sociologists towards environmental sociology

It has often been observed that the majority of the earliest contributors to contemporary environmental sociology were either self-identified rural sociologists, or else sociologists who worked in cognate specialty areas (especially the sociology of development and community studies) and who interacted frequently with rural sociologists. The prominent pioneers of environmental sociology during the 1960s and early 1970s who were rural sociologists included scholars such as D. Morrison, D. Field, R. Burdge, S. Albrecht, and W. Andrews. The scholars such as W. Burch, W. Catton, R. Dunlap, A. Schnaiberg, R. Gale, and W. Firey, having rural sociological interests, were also among environmental sociologists.

The rural sociological contribution to environmental sociology has been substantial. No doubt environmental sociology did not emerge 25 or so years ago, but rather was a field created in substantial measure through the amalgamation of several pre-existing areas of scholarship, most of which were actively contributed to by rural sociology. For example, what is now thought of as natural resource sociology (sociological research on parks and leisure, public lands management and policy, land use planning, and the like) predated contemporary environmental sociology, and became one of its earliest tributaries during the early 1970s (Burch, 1979). Much of the natural resource sociology community shifted its attention to social impact assessment by the mid to late-1970s. Likewise, much of the community studies tradition in rural sociology that survived the behaviourist turn of sociology and rural sociology in the 1950s and 1960s (Buttel et al., 1990) had been focused on resource-dependent communities such as farming, logging, and fishing communities. Sociological analysis of resource-dependent communities was the second major tributary leading to modern environmental sociology. The roles played by these two tributaries are central and according to Field and Burch's (1988) environmental sociology is not as new or novel as many claim it is.

A third tributary of modern environmental sociology was the social movements research tradition, from which several scholars began to devote attention to the emerging environmental movement as this movement sprang on the U.S. social scene following Earth Day, 1970. For example, one of the first major research anthologies in environmental and resource sociology, Social Behavior, Natural Resources, and the Environment (Burch et al., 1972), was largely devoted to research from a social movements, collective behavior, and public opinion perspective on modern environmentalism and resource management issues. While the social movements field is not generically tied to rural sociology, many of the most influential analyses of the environmental movement were undertaken by persons who otherwise identified as rural sociologists (see, e.g., Burch et al. 1972; Gale 1972; Harry et al. 1969; Morrison 1973, 1976; Morrison et al. 1972). A fourth tributary of contemporary environmental sociology was that of neo-Durkheimian human ecology (Micklin 1984); as with the social movements tradition, a number of rural sociologists interested in environmental issues were trained in this tradition, even though human ecology is not generically associated with rural sociology.

Rural sociology has been amply represented among the four main tributaries of environmental sociology. In addition, it is useful to note that over and above the lineage of environmental sociology to some of the major specialties within rural sociology, one can attribute to rural sociology a more overarching quality that caused it to be particularly hospitable to sociology of environment and natural resources. Environmental sociology is ultimately a sociology built on recognition of the material bases of social structure and social life. It could be argued that rural sociologists, because many of the phenomena they study such as resource management, resource extraction, the exigencies of space, and the genesis and impacts of technologies are material and/or biophysical ones, were more prepared than their counterparts elsewhere in sociology to embrace a view of social structure and social life as having crucial material and biophysical dimensions.

2.4 The Failure of Geographical and biological Determinism

In the nineteenth century, the effects of the geographical environment on the human condition, was a topic of considerable scholarly interest. Perhaps the leading geographical determinist was the British historian Henry Thomas Buckle, author of "The History of Civilization in England". Buckle was greatly influenced by the writing of the seventeenth - century French Philosopher, Montesquieu and by several German geographers, notably Karl Ritter. His central thesis was that human society is a product of natural forces, and is therefore susceptible to a natural explanation. Buckle believed that the influence of the geographical environment is most direct and therefore strongest upon 'primitive' people but declines with the advance of modern culture. He ascribed particular sociological significance to the visual aspect of nature: if the natural environment is awe-inspiring in its beauty or terrifying in its power of destruction, it overdevelops the imagination; if it is less formidable, a more rational intelligence prevails. England, with its gently rolling hills and domesticated farm animals, represented a prime example of the latter.

Buckle's geographical theory of change was widely read and quite influential in intellectual circles in the nineteenth century. For example, the economist, Thomas Nixon Carver used. The History of Civilization in England in his sociology course at Harvard long before that university had a formal department of sociology, while William Graham Summer, widely regarded as the first American sociologist, became interested in Buckle's work while studying theology at Oxford.

A second leading geographical determinist was Ellsworth Huntington. In his principal sociological works, "Civilization and Climate", "World power and Evolution" and "The Character of Races", Huntington attempted to establish a series of correlations between climate and health, energy and mental processes such as intelligence, genius and willpower. Having divined the parameters of an 'optional climate' he then attempted to prove that the rise and fall of entire civilizations such as that of ancient Rome follows the shift of the climatic zones in historical periods

In assessing the worth of this 'geographical school', Sorokin (1964) refers to its fallacious theories, its fictitious correlations and its overestimation of the role of the geographical environment, but at the same time be cautious that 'any analysis of social phenomena which does not take into consideration geographical factors is incomplete'.

The natural world also entered into early sociological discourse through the Darwinian concepts of 'evolution,' 'natural selection' and the 'survival of the fittest". In Darwin's theory, those plants and animals which are best suited to adapt to their environment survive, while those which are less well equipped perish. The survivors pass on their advantages genetically to subsequent generations. Darwinism was seized upon by many of the early conservative sociological thinkers who applied its principles (not always accurately) to the human context. The most prominent social Darwinist was the English social philosophers, Herbert Spencer, who proposed and evolutionary doctrine which extended the principle of natural selection to the human realm. Spencer bitterly opposed any suggestion that society could be transformed through educational or social reform rather, he believed that, if left alone, progress would evolve in a gradual fashion.

Summer was Spencer's greatest academic discipline in America, introducing his own concept of the 'competition of life' whereby humans struggle no just with other species for survival in the natural universe but also with each other in a social universe. Applying his theory to the laissez-faire capitalism of the day, Summer legitimated the triumph of the 'robber barons', millionaire industrialists who made their money in banking, railroads and utilities through sharp and ruthless dealing. They were, summer claimed, 'a product of natural selection' who would move society forward on the road to progress.

Both these 'single factor theories social change' were rejected by mainstream sociology for largely the same reasons. By the 1920s the evolutionary laissez-faire doctrines of the nineteenth century had given way to a new emphasis on social planning and social reform. 'Meliorism' - the deliberate attempt to improve the well-being of members of society - flew in the face of the social theories which viewed social causation as unalterable, whether due to geography or biology.

Furthermore, by this time the foundation of sociological theory had shifted. Many sociologists had come to accept psychology as the foundation of sociology in place of Physics or biology. This was especially evident in the social psychological tradition established by Mead, Cooley, Thomas and other American 'symbolic interactionists' who emphasized that the reality of a situation lies entirely in the definition attached it to by participating social factors. This definition' in turn, was socially shaped, as in Cooley's concept of the 'looking glass self'. Physical (and environmental) properties became relevant only if they were perceived and defined as relevant by the actors (Dunlap and Catton 1992/3 : 267).

Increasingly, the failure of social Darwinism and to a Lesser extent the inability of geographic determinism to ever get off the ground, led to a strong aversion to explanations which used biological - environmental explanations. This opposition to biological currents was similarly evident in sociology's sibling discipline. Anthropology After his move to the United States in 1989, Franz Boas, widely recognized as the founder of American cultural anthropology, responded to the rising tide of eugenics, 'scientific' racism and other manifestations of biological determinism by elevating culture to a primary role in individual and societal development, dwarfing both the physical environment and biological inheritance. This emphasis on cultural processes was carried on in this century by such well-known anthropologists as Margaret Mead and Ruth Benedict. Culture, in fact, came to be valued as the key influence on all aspects of human society.

Ironically, while sociology rid itself of biological explanation, it hung on to a distinctly biological terminology. Functionalism, the leading sociological theory of the 1950s in America, carried forward Durkheim,s idea that society constituted a social ' organism' which was constantly having to adapt to the outside social and physical environment. Its equilibrium or steady state could be knocked out of kilter by various disruptive events but, ultimately, it would return to normal just as the human body recovers from a fever. Dickens (19920 has noted that functionalists theorists, especially their dean, Talcott Parsons, might have gone further and actually developed a theory of social evolution in a environmental context which stressed how biological inheritance permitted humans to both adapt to the natural world and to change it. This potential, however, was never developed, leaving environmental factors as marginal elements in sociological explanation.

2.5 Towards an Environmental Sociology: 1970 to 1995.

In the post quarter-century, sociologists have shown as more concern / interest in the environment than was the case in the past. By the mid - 19th century all three of national sociological associations in the United States (American Sociological Association, Rural sociological Association, society for the study of social Problems) had established sections relating to environmental sociology (Dunlap and Catton 1979). Special issues on environmental topics have appeared in a number of sociological journals, for example, Sociological Inquiry (1983), Journal of Social Issues (1992), Qualitative Sociology (1993), Social Problems (1993), Canadian Review of Sociology and Anthropology (1994). The Annual Review of Sociology had twice (1979 and 1987) featured essays, on environmental sociology as well as pieces on energy and on the sociology of risk. Furthermore, in 1993, Shirley Lasha's presidential address to the Southern Sociological Society was entitled 'Environmental Sociology and the State of the Discipline.

In Europe, stimulated by the emergence of the 'Greens' as a political force, much of the early work on environmental topics dealt with environmentalism and the environmental movement (Dunlap and Catton 1992-3: 273). One exception to this was the Netherlands where nodes of activity in environmental sociology formed early on around questions pertaining to agriculture and risk assessment. In Britain, past interest in the environment has been explicitly theoretical, weighting the relationship between society and nature against classical sociological perspectives on social class and industrialism. More recently, empirical research on environment topics has begun to flourish in the UK, in part due to the stimulus provided by the Global environmental Change programme set up by Economic and Social Research Council (ESRC), which has under-written an impressive array of conference, study groups and symposia.

Interest has also begun to build internationally. In 1992, the Environment and society group within the International sociological Association merged with a second Social Ecology group to form Research Committee 24 Environment and Society, with a combined membership of over two hundred members, many of whom are environmental sociologists. At the 1994 World congress of Sociology in Bielefeld, Germany, seventeenth sessions were scheduled encompassing a total of 114 papers on matters relating to the environment and society, while at the 1993 Centennial congress of the International Institute of Sociology in Paris there were working sessions on the topic of 'Environmental Risk and Disasters'.

In the late 1970s, Catton and Dunlap undertook a crusade to convert sociologists to their New Ecological Paradigm (NEP) which was meant to cross-cut the established divisions within sociological theory. This new paradigm was an academic analogue of green thinking in general, advocating an approach which was less 'anthropocentric' (human-oriented) and more 'ecocentric' (humans are only one of many spices inhabiting the earth). Buttel (1987) describes their efforts as nurturing a set of 'lofty intentions' where in environmental sociologists ' sought nothing less than the re-orientation of sociology toward a more holistic perspective that would conceptualize social processes within the context of the biosphere. Catton and Dunlap acknowledged that they failed in this endeavour but claim that they never fully expected to achieve this kind of disciplinary conversation. Both Buttel and Catton and Dunlap observed that the environmental sociology field faltered during the Reagan era. However, while Bund pessimistically referred to environmental sociology as having become just another sociological specialization' Catton and Dunlap suggested that the resurgence of interest in environmental issues in the 1990s, especially those which are global in scope, has stimulated renewed interest in environmental sociology in the United States as well as internationally.

What the field still lacks is a seminal work which could lift environmental sociology into the mainstream of debate in the broader field of sociology. One such theoretical soliloquy is Ulrich Beck's book "The Risk Society". Beck, a sociologist of institutions, has approached the subject of environmental risks more from the perspective of a macro-sociology of social change than from a paradigm that is rooted specifically in environmental sociology. Nevertheless, Beck's argument has bee widely noticed and has provoked considerable discussion both within and beyond the confines of environmental sociology. By contrast, Catton and Dunlap's HEP (Human exemptionalism Paradigm-NEP (New Ecological Paradigm) distinction in the most influential theoretical insight within the area of environmental sociology to date-has failed to generate much excitement outside of this new specialty area and as siblings in psychology, political science and environmental education.

In the meantime, it probably makes sense to embrace Elizabeth Shove's (1994) notion that sociologists can make a positive contribution to the environmental debate by both incorporating and engaging. The former suggests that pockets of environmental research can enrich mainstream sociological theory even if they do not as yet have the capacity to transform the discipline as a whole. The latter recognizes that there is much to gain in applying the sociological imagination to the extra-disciplinary study of contemporary environmental issues, for example, through political economy models or via the sociology of science and knowledge. Unfortunately sociologists far too often end up as 'underlabours' in this Endeavour, being viewed as supporting actors in a cast dominated by natural scientists and environmental policy-makers.

2.6 Theoretical Approaches to Environmental Sociology

A continuing problem for sociologists researching the environmental has been to define to what constitutes the main object of study. In their 1979 review article, Catton and Dunlap pinpointed the distinctive core of the field as a 'new human ecology' which focuses on the interaction between the physical environment and social organization and behaviour. When it came to identifying areas of research in environmental sociology, however, they allowed a number of topics (the 'built' environment, natural disasters, social impact assessment) which seemed to stretch the parameters of the field rather than no narrow them. Eight years later, Buttel (1987) cited five key areas of environmental sociological scholarship : (1) Catton and Dunlap's 'New Human Ecology' (2) environmental attitudes, values and behaviours : (3) the environmental movement (4) technological risk and risk assessment : and (5) the political economy of the environment and environmental politics, but they did not attempt to locate any common theoretical thread in this diverse menu. A major consequence of this blend of topics and approaches is the absence of any solid consensus of the theoretical base for environmental sociology: the ambiguity resulting from a theoretical vacuum has significantly undermined the legitimacy of this specialty area.

In many estimation, there are two distinct problems that are centrally addressed in the existing literature on environmental sociology (1) The causes of environmental destruction, and (2) the rise of environmental consciousness and movements. Rather than classifying theories of environmentalism' or those describing the 'society nature relationship' it makes more sense to discuss past theoretical approaches to the environment and society separately under each of these two headings.

2.7 Causes of Environmental Destruction

In explaining the causes of widespread environment destruction on our planet two primary approaches have been offered: the ecological explanation as embodied in Catton and Dunlap's model of 'competing environmental functions; and the political economy explanation as found in Alan Schnaiberg's concepts of the 'social environmental dialectic and the 'treadmill of production'. As Buttel has noted, both approaches view social structure and social change as being reciprocally related to the biophysical environment but the nature of this relationship is depicted very differently.

Ecological Explanation

The ecological explanation for environment destruction has its roots in the field of 'human ecology' which was dominant within urban sociology from the 1920s to the 1960s.

Urban ecology was first pioneered by Robert Park and his colleagues at the University of Chicago in the 1920s. Park was well acquainted with the work of Darwin and his fellow naturalists, drawing on their insights into the interrelation and interdependence of plant and animal species. In his discussion of human ecology. Park begins with explanation of the 'web of life', citing the familiar nursery rhyme. The house that Jack Built, as the logical prototype of long food chains each link of which is dependent upon the other: Within the web of life, the active principle is the 'struggle for existence' in which the survivors find their

' niches' in the physical environment and in division of labour among the different species.

If Park had been primarily interested in the natural environment for its own sake, he might have realized that human intervention in the form of urban development and industrial pollution artificially broke this chain thereby upsetting the biotic balance'. In fact, he did acknowledge that commerce, in progressively destroying the isolation upon which the ancient order of nature rested, has intensified for struggle for existence over an ever-widening area of the habitable world. But he believed that such changes had the capacity to give a new and often superior direction to the future course of events forcing adaptation change and a new equilibrium.

Biological ecology was principally source from which Park borrowed a series of principles which he applied to human population and communities. In doing so, however, he notes that human ecology differs in several important respects from plant and animal ecology. First, humans are not so immediately dependent upon the physical environment, having been emancipated by the division of labour. Second, technology had allowed humans to remark their habitat and their world rather than to be constrained by it. Third, the structure of human communities is more than just the product of biologically determined factors; it is governed by cultural factors, notably an institutional structure rooted in custom and tradition. Human society, then, in contrast to the rest of nature, is organized on two levels; the biotic and the cultural.

This portrait of the nature-society relationship clearly contravenes many of the tents of Catton and Dunlap's New ecological Paradigm. It emphasizes human's exceptional characteristics (inventiveness, technical capability) rather than their commonality with other species. It gives priority to the influence of social and cultural factors (communication, division of labour) rather than biophysical, environmental determinants. Finally, it downplays the constraints imposed by nature by celebrating the human capacity to master it.

Park, his colleagues and students applied their principles of human ecology to the processes that create and reinforce urban spatial arrangements. They visualized the city as the product of three, such processes (1) concentration and deconcentration (2) ecological specialization and (3) invasion and succession. The building blocks of the city were said to be 'natural areas' (slums, ghettoes, bohemias), the habitats of natural groups which were in accordance with these ecological processes. The city was depicted as a territorially based ecological system in which a constant Darwinian struggle over land use produced a continuous flux and redistribution of the urban population. Nowhere was this more evident than in the 'zone in transition'. An area adjacent to the central business district, which went from a coveted residential district to a blighted area characterized by low rent tenants, deviant activities and marginal business.

Much of the early criticism of human ecology rested not on its failure to explore the interdependence between the human environment and the natural environment, but rather in what was perceived as its culture to adequately account for the role of human values in residential choice and movement. In the late 1940s, a socio-cultural critique of mainstream human ecology briefly lit up the landscape if American sociology. Pirey (1947) used the example of land use in central Boston to demonstrate that symbolism and sentiments where as important if not more so, then standard ecological principles in accounting for the shape of the city. Similarly, Jonassen presented the history of settlement and relocation of Norwegian immigrants to the New York City area a evidence which ethnic groups consciously choose a specific type of residential environment on the basis of values which they bring with them as a type of cultural luggage. Jonassen's research might have been the launching pad for a body of research on the origins of environmental perceptions but the main thrust of his argument was rather to discredit the economic determinism which characterized the orthodox ecology of the day.

While cultural ecology, per se, never became dominant, it did force more traditional human ecologists to take greater account of social organizational and cultural variables. This was evident in O.D. Duncan's POET (Population-Organization-Environment-Technology) model (1961) which was depicted as an 'ecological' complex' in which: (1) each element is interrelated with the other three, and (2) a change in one can therefore affect each of the others. The POET model was a trailblazer in providing insight into the complex nature of ecological disruptions even if it failed to give sufficient weight to environmental constrains. For example, in a casual sequence suggested by Dunlap, an increase in population (P) can create a pressure for technological change (T) as well as increased urbanization (O), leading to the creation of more pollution (E). While it was still rooted in orthodox human ecology, nevertheless. Duncan's POET model with its use of the human ecological complex at time 'came close to an embryonic form of environmental sociology'.

The ecological basis of environmental destruction is probably beast described in Catton and Dunlap's own 'three competing functions of the environment'

Catton and Dunlap's model specifies three general functions which the environment serves for human beings : supply depot, living space and waste repository. Used as supply depot, the environment is a source of renewable and non-renewable natural resources (air, water, forests, fossil fuels) that are essential for living. Overuse of these resources results in shortages or scarcities. Living space or habitat provides housing, transportation, systems and other essentials of daily life. Overuse of this function results in overcrowding, congestion and the destruction of habitats for other species. Which the waste repository function, the environment serves as a 'sink' for garbage (rubbish), sewage, industrial pollution and other byproducts. Exceeding the ability of ecosystems to absorb wastes, results in health problems from basic wastes and in ecosystem distribution.

Furthermore, each of these functions competes for space, often impinging upon the others. For example, placing a garbage landfill in a rural location near to a city both makes that site unsuitable as a living space and destroys the ability of the land to function as a supply depot for food. Similarly, urban sprawl reduces the amount of arable land which can be put into production while intensive logging threatens the living space of native people.

In recent years, the overlap, and therefore conflict, among these three competing functions of the environment has grown considerably. Newer problems such as global warming are said to be stem from competition among all three functions simultaneously. Furthermore, conflicts between functions at the level of regional ecosystems now have implications for the global environment.

There are several very attractive features to Catton and Dunlap's competing functions of the environment model. First and foremost, it extends human ecology beyond and exclusive concern with living space - the central focus of urban ecology-to the environmentally relevant functions of supply and waste disposal. In addition, it incorporates a time dimension: both the absolute size and the area of overlap of these functions are said to have increased since the year 1900.

At the same time, there are problems with the model. As it is the case with the urban ecology of Park and the Chicago School, there is no evidence of human hand here. It says nothing about the social actions involved in these functions and how they are implicated in the overuse and abuse of environmental resources. Above all, there is no provision for changing either values or power relationship. The former is especially puzzling, since one would have thought that Catton and Dunlap would have attempted to link their ecological modelto the new human ecology as emphasized in the HEP-NEP contrast. Finally, one cannot help comparing the longitudinal features of the Catton-Dunlap model to Beck's (1992) depiction of the transformation from an industrial to an industrial risk society. Both models recognize some of the same features: the increasing globalization of environmental dangers, the rising prominence of output or waste-related elements as opposed to input or production-related ones. However, Beck's model is ultimately more exciting because it centrally incorporates the process of social definition. Beck's criticism of environmental risk assessment, i,e. that ' it runs the risk of atrophying into a discussion of nature without people, without asking about matters of social and cultural significance', is equally applicable to Catton and Dunlap's competing functions of the environment.

Political Economy Explanation

Purveyors of the political economy explanation, by contrast, are quite clear about who they blame for the destruction of the environment: advanced industrial capitalism and its search for wealth, power and profit. It follows from this that 'environmental issues are fundamentally social class issues' (Cable and Cable, 1995) in which the corporation and the state line up in opposition to ordinary citizens.

If the ecological explanation traces its pedigree to the human ecology of the Chicago School, the political economy approach draws its inspiration from the nineteenth- century writing of Karl Marx and Friedrich Engel's. Marx and Engel's were only marginally concerned with environmental degradation per se. but their analysis of social structure and social change has become the starting point for several formidable contemporary theories of the environment.

Marx and Engel's believed that social conflict between the two principal classes in society, i,e. capitalists and the proletariat (workers) , not only alienates ordinary people from their jobs but it also leads to their estrangement from nature itself. Nowhere is this more evident than in 'capitalists agriculture' which puts a quick profit from the land ahead of the welfare of both humans and the soil. As the industrial revolution proceeded through the eighteenth and nineteenth centuries, rural workers were removed from the land and driven into crowded polluted cities while the soil itself was drained of its vitality. In short, a single factor, capitalism was held responsible for a wide range of social ills from the over-population and resource depletion to the alienation of people from the natural world with which they were once united. Marx and Engel's saw the solution as the overthnow of the domina system of production, capitalism and the establishment in its place of 'rational humane, environmentally unalienated social order.

Marx and Engel's argue for the establishment of a new relationship between people and nature. However, it is not entirely clear what form such a relationship should take. In the work of the more nature. Marx, this seems to follow a distinctly anthropocentric direction depicting humans as achieving mastery over nature, in no small part because of technological innovation and automation. By contrast, in Marx's early work the concept of the humanization of nature is proposed. This suggests that humans will develop a new understanding of and empathy with nature. A key question here is whether this new understanding would be used solely for human emancipation or whether it would take a more ecocentric from in which the powers and capacities of non-human species would ne enhanced. In the former case, the humanization of nature might, in fact, be deployed to eliminate species and organisms which threaten human health (Dickens 1992 : 86). As Martell (1994: 152) observes, the texts of the early Marx are too complicated and contradictory on ecological concerns to be the basis for a fully fledged theory of environmental protection; it may be more useful to pursue this project through other sources or frameworks.

Contemporary Marxist theory emphasizes not only the role of capitalists but also that of the state in fostering ecological destruction. Both elected politicians and bureaucratic administrators are depicted as being centrally committed to propping up the interests of capitalists investors and employers. While the incentive here if partly material i,e. corporate campaign contributions, future job offers, public servants, politicians and capitalists producers are said to share an 'ethic' which accentuates capitalist accumulation and economic growth as the dual engines which drive progress. This, they argue, holds for all political levels from the global system to the local community.

Within environmental sociology, probably the most influential explanation of the relationship between capitalism, the state and the environment can be found an Alan Schnaiberg's book, The Environment From Surplus to Scarity (1980) Drawing on stands of both Marxist political economy and neo-Weberian sociology, Schnaiberg outlines the nature and genesis of the contradictory relations between economic expansion and environmental disruption.

Schnaiberg has depicted the political economy of environmental problems and policies as being organized within the structure of modern industrial society which he labels the treadmill of production. This refers to the inherent need of an economic system as continually yield a profit by creating consumer demand for new products, even where this means expanding the ecosystem to the point whereby exceeds in physical units to growth or its 'carrying capacity'. One particularly important tool in fuelling this demand is advertising, which convinces people to buy new products as much for reasons of lifestyle enhancement as for practical considerations. Schnaiberg portrays the treadmill of production as a "complex self - reinforcing mechanism' in which politicians respond to the environmental fall-out created by capital intensive economic growth by mandating policies which encourage yet further expansion. For example, resource shortages are handled not by reducing consumption or adopting a more modest lifestyle but by opening up new area to exploitation.

Schnaiberg detects a dialectic tension which arises in advanced industrial societies as a consequence of the conflict between the treadmill of production and demands for environmental protection. He describes this as a clash between 'use values'; for example, the value of preserving existing unique species of plants and animals, and 'exchange values' which characterize the industrial use of natural resources. As environmental protection has emerged as a significance item on the policy agendas of governments, the state must increasingly balance its dual role as a facilitator of capital accumulation and economic growth and its role as environmental regulator and champion.

From time to time, the state finds it necessary to engage in a limited degree of environmental intervention in order to stop natural resources from being exploited with abandon and to enhance its legitimacy with the public. For example, in the progressive era of American politics in the late nineteenth and early twentieth centuries, the US government responded to uncontinued logging, mining and hunting on wilderness lands by expanding as jurisdiction over the environment. Especially under the presidency of Theodore Roosevelt, it created national forests parks and wildlife sanctuaries set limits and rules for the use of public lands and restricted the hunting of endangered species. It did so, however, as much out of a desire to increase industrial efficiency, regulate competition and ensure a steady supply of resources as it did from any sense of normal outrage. Similarly, the sudden emergence of toxic waste as a premier media issue in the early 1980s led to Congressional efforts in the United States to pass a new 'Superfund' law which would give the government statutory authority and the fiscal mechanisms to undertake clean-up operations without first having to legally identify the responsible parties. This was, Szasz notes, not simply a matter of Lanwtakers addressing a newly recognized social need but instead, 'one of those Quiescential "time to make anew law" moments to characteristic of the American legislative process."

Nevertheless most governments remain wary of running the risk of slowing down the drive towards economic expansion or decelerating the treadmill of production. Caught in a contradictory position as both promoter of economic development and as environmental regulator, governments often engage in a process of 'environmental managerialism', in which they attempt to legislate a limited degree of protection sufficient to deflect criticism but not significant enough to derail the engine of growth. By enacting environmental policies and procedures which are complex, ambiguous and open to exploitation by the forces of capital production and accumulation, the state reforms its commitment to strategies for prompting economic development.

Other more stridently left-wing critiques have been even more unsparing in linking the dynamics of capitalist development to the rise in environmental destruction. David Harvey, the Marxist geographer, accuses capitalist supremos of deliberately creating resource scarcities in order that prices may be kept high. Faber and O' Connor charge that goal of capital restructuring in the 1980s and 1990s, which includes geographical relocation, plant closures and down-sizing, is to increase the exploitation of both the workers and nature; for example, by reducing spending on pollution control equipment. Cable and Cable refuse to rule out the possibility of insurrection in the Unites States if the grievances of grassroots environmental groups are ignored by capitalist economic institutions.

In his most recent writing with collaborator Kenneth Gould, Schnaiberg addressed the application of the treadmill of production to a Third world contest. Ignoring the negative environmental impacts that the treadmill has produced in less developed regions, the leaders of southern nation, in concert with the governments and corporations of the North, have sought to reproduce industrialization as experienced by the First World. The primary mechanism for achieving this is the transfer to modern Western industrial techniques from North to South. However, a Redclift and others have noted, this transplant has become largely unsuccessful both in economic and environmental terms. Dependency on global markets has made economic development a risky venture for many, especially in third world nations where these markets can easily be decimated by the appearance of new, low-cost alternatives elsewhere in the world. Furthermore, development schemes require an expensive infrastructure of roads, hydroelectric power dams, airports etc., which must be paid for by borrowing heavily from Northern financial institution. Such projects often fail to produce the expected level of economic growth while at the same time causing massive ecological damage in the form of flooding, rainforest destruction, soil erosion and pollution.

The political economy explanation has the advantage of locating present environmental problems in the inequities of humanly constructed political and economic systems rather than the abstract conflict of functions favoured by human ecologists. This brings in closure to the orbit of mainstream sociology than the more idiosyncratic approach advocated by Catton and Dunlap. Yet models such as Schnaiberg's are not without their own set of problems.

As the revelations of widespread environmental destruction throughout the former Soviet bloc and more recently in China have indicated, it does not make sense to blame the ills of the planet exclusively on the logic of capitalism. A commitment to economic growth and development and the large-scale social structures which they sustain characterizes most major post-Enlightenment ideologies including Marxism, liberalism and social democracy. Neo-Marxis writers have performed some remarkable contortions in trying to rationalize this contradiction. It is claimed, for example, that orthodox Communism had metamorphinto a brand of state socialism which was finally flawed by a combination of widespread bureaucratic inflexibility and corruption and an ill-conceived attempt to emulate capitalist economies. It is probably more accurate to say that both systems share a commitment to an unbridled industrialism for which the development ethic is vital.

Furthermore, unidimensional models such as Schnaiberg's seem better suited to addressing the classic cases of resource exploitation by primary producers or toxic dumping by petrochemical firms and other corporate polluters than they are in explaining the more recent transnalation problems such as global warming or biodiversity loss. The latter are more multi-dimensional and complex, encompassing a wide range of different economic, social and political interests, ideologies and conflicts. While a central cast of capitalist actors (multinational corporations, the World Bank, the International Monetary Fund) is deeply implicated in the fate of the global environment, so too are a variety of supporting players-Faustain scientists in the biotechnology labs of California, maverick gold-miners in the Amazon rainforest, walrus poachers on the Bering Sea. There is a richly variegated political economy here but charting it requires a more flexible, historically sensitive approach than is possible with the more rigid, structurally centered models which have predominated thus far.

Political economy approaches can also the criticized for having adopting a monolithic view of the state as an environmental transgressor. It is more accurate to view politicians and civil servants as representing a variety of policy positions which are not always compatible. For example, Litfin cites the prominent role of some national environmental agencies is constructing and promoting international agreements on pollution control as evidence of the positive entrepreneurial leadership role which some public servants can play in environmental politics. The campaign to save the North American whooping crane from extinction began in the early twentieth century with a few individual wildlife managers within the public service, notably fred Bradshaw, Chief Game Guardian of Saskatchewan and head of the Provincial Museum of Natural History. On occasion, differences may even emerge in full public view, the contrasting positions of President George Bush and his Secretary of the Environment at the June 1992 Earth Summit in Rio de Janeiro is one notable example.

2.8 Solutions to Environmental Problems

As was true for the causes of environmental problems, early work by environmental sociologists interested in solutions to these problems often involved explications and critiques of predominant approaches. Early on Heberlein (1974) noted the predilection of the United States for solving environmental problems via a "technological fix," or developing and applying new technologies to solve problems such as air and water pollution. Understandably popular in a nation with a history of technological progress, such a solution is appealing because it avoids mandating behavioral and institutional change. Unfortunately, solving problems with new technologies sometimes creates even more problems, as illustrated by attempts to solve energy shortages with nuclear power. Consequently, as the seriousness and pervasiveness of environmental problems became more obvious, attention was given to a variety of "social fixes," or efforts to change individual and institutional behaviors.

Expanding on Heberlein's analysis, other sociologists (e.g, Dunlap et al. 1994) have identified three broad types of social fixes, or implicit policy types:

(1) the cognitive (or knowledge) fix, which assumes that information and persuasion will suffice to produce the necessary changes in behavior, illustrated by campaigns encouraging energy conservation and recycling;

(2) the structural fix, which relies on laws and regulations that mandate behavioral change, reflected in highway speed limits or enforced water conservation; and

(3) the intermediary behavioral fix, which employs incentives and disincentives to encourage changes in behavior, as illustrated by pollution taxes (penalties) and tax credits (rewards) for installing pollution-abatement technology (see Gardner and Stern 1996 for a more refined typology of policy approaches and detailed examples of each).

Environmental sociologists, in conjunction with other behavioral scientists, have conducted a range of studies that bear on the efficacy of these differing strategies for solving environmental problems, ranging from field experiments to test the effectiveness of information campaigns in inducing energy and water conservation to evaluations of alternative strategies for generating participation in recycling programs (see Gardner and Stern 1996 for a good summary). A noteworthy sociological study was Derksen and Gartrell's (1993) investigation of recycling in Edmonton, Alberta, which found that individuals' level of environmental concern (and, by implication, knowledge about the importance of recycling) was not as important in predicting recycling behavior as was ready access to a curbside recycling program. While sociologists have conducted numerous field experiments and evaluations of community environmental programs, typically investigating the efficacy of one or more of the above-noted "fixes," they have generally left examinations of national and international environmental policy making to political scientists and economists. However, sociologists have begun to pay attention to efforts to negotiate international agreements to achieve reduction of greenhouse gases (Redclift and Sage, 1998), and we expect more sociological work along these lines.

2.9 Rise of Environmental Consciousness and Movements

A second problem which is centrally addressed in the environmental sociology literature is that of why environmental consciousness and movements grew so dramatically from the early 1970s onwards in both Europe and America. Four main explanations have been put forward here : the reflection hypothesis; the post-materialism thesis; the new middle-class thesis; and the regulationist/political closure approach.

Reflection Hypothesis

The reflection hypothesis starts with the observation that environmental deterioration in Western industrial nations first began to climb after the Second World War, reaching its zenith by the late 1960s. The dramatic upswing after 1970 in environmental consciousness and concern is interpreted as a direction reaction to this worsening situation.

Circumstantial evidence for this position is provided by Dunlap and Scarce (1990), whose analysis of twenty years of polling data indicates that a majority of the American public has increasingly come to view a wide range of environmental problems as threatening both their personal health and the over all quality of the environment, and that this threat has increased markedly. Furthermore, this majority perceives environmental quality as deteriorating and likely to continue to do so.

More explicitly, Jhlicka (1992; cited in Martell 1994) argues that green concern in Western Europe varies directly according to the seriousness of ecological conditions. Thus, in Southern Germany, Belgium, Luxembourg, the Netherlands, Northern France and Switzerland, where the pollution of rivers, forests and work is most acute, environmental concern is highly developed. By contrast in Britain and Scandinavia where environmental deterioration is low obvious, environmentalism is more moderate and absorbed into mainstream politics.

Other data, however, have not supported this reflection hypothesis. While environmental quality has been steadily deteriorating for much of this century, the public has ignored these developments for most of this period. When the lzaak Walton League, an established American conservation organization, sponsored a national Clean Air Week in 1960 to try to acquaint the public with the existence of a national crisis, it encountered little popular interest or support. Instead, perception of environmental problems may even be independent of the magnitude of the problems themselves. For example, concern about air pollution arose in the United States in the late 1960s at the same time as the levels of a number of common air pollutants were found to have declined in a broad sample of urban areas. This suggests that public concern is at least partially independent of actual environmental deteriorate and is shaped by other considerations; for example, the extent of mass media coverage.

Furthermore, most of the modern environmental problems, particularly second generation problems such as acid rain, global warming, ozone depletion and toxic contamination, are likely to be invisible to the naked eye except in the most extreme cases. As a result, the public perception that environmental problems have reached 'crisis' proportions does not necessarily reflect the reality of actual problems but rather the particular view of scientific experts, environmentalists and the media.

Post - materialism Thesis

A second explanation locates environmental concern as part of a more extensive shift in values among certain segments of Western societies. This approach has as its touchstone Inglehart's (1971, 1977 and 1990) post materialism theses.

Inglehart's interpretation is derived from the 'hierarchy of needs' proposed by the humanistic social psychologists, Abraham Maslow (1954) Loglehart proposed that the economic worries experienced by an older generation during the Great Depression and the two World Wars had little meaning for the post-Second World War 'baby boom' generation which had the financial security to allow them instead to address their non-material needs to belonging and individual fulfillment. This cohort was less interested in promoting economic growth and progress than in furthering post-materialist values such as concern for ideas, the pursuit of personal growth, autonomy in decision-making and improving the quality of the physical environment. Significantly, post materialist-was not simply a life cycle phenomenon, finding out to existence when the post-war generations settled down and start families of their own, but a lasting value change.

Thus, in contrast to the reflection hypothesis, the growth of environmental consciousness and concern is not seen as being directly related to the actual extent to which the environment has deteriorated. As Cotgrove notes, the 'objective facts' about pollution and environmental damage and shortage do not and cannot exist in some kind of cognitive and moral vacuum, but rather arise from a moral debate over the nature of the good society which cannot 'easily be settled by {an} appeal to facts and rational argument'.

The post-materialist thesis recently been challenged by Brechin and Kernpton (1994), who demonstrate that public environmental concern is not just restricted to advanced industrial countries but exists on a global scale. They present two types of evidence to support this: widespread grassroots environmental activism and a pair of cross-national opinion surveys. Brechim and Kempton's survey data analysis reveals higher percentages of respondents in some Third World nations (India, Mexico, Uruguay) willing to buy higher prices and taxes in order to protect the environment than is the case in some more industrialized nations such as Finland and Japan. Environmentalism, they conclude, should not be viewed as a product of post-materialist shift in values but rather appear to be more complicated phenomenon, emerging from multiple sources in richer and poorer nations alike.

The problem is that it is never made clear where these post-materialist values originate. It may be surmised that they are a function of interests; for example, industrialists can be expected to oppose an ideal society which, among other things, aspects a no-growth philosophy or one which is predominantly socialist. It is not an easy to figure out where post-materialists, including environmentalists, get their values. Cotgrove promises to answer this question in the conclusion to his second chapter but then only tells us that a commitment to non-material values is forged in adolescence, is part of a long-term drift away from any strong allegiance to the culture of business and is more likely to occur in homes where the parents have already embraced post-material values. He does, however, observe that environmentalism is an expression of the interests of a new middle-class fraction who dissent from traditional paradigms which emphasis pro-business values. This is the basis for the third sociological explanation for the growth of environmental consciousness and concern, the new middle-class thesis.

New Middle-class Thesis

The new middle-class thesis is companion to the post-materialism thesis but it puts a greater emphasis on the social location of those who adopt an environmentalist's ethic. According to this view, environmentalists are drawn disproportionately from that segment of society which has been termed social and cultural specialists' - teachers, social workers, journalists, artists, and professions who work in creative and/or public service-oriented jobs.

It is not entirely clear why this occupational segment should be more inclined to produce environmentalists with post-material values as against other sections of the middle classes. One possible explanation lies in the nature of their involvement and interaction with their clients. By virtue of their positions, they are socially situated so as to witness first hand the victimization of the powerless by the heralds of industrial progress. For example, doctors staffing a community health clinic are strategically located to witness the adverse effects on school children of elevated lead levels in the soil of neighborhood built around polluting, inner city factories. As a result, they tend to become personally involved in environmental problems even to the point of becoming advocates for their patients' interests. Alternatively, it may simply be that those who enter professions which have a significant creative or social welfare component may choose these deliberately, guided by an already existing post-materialist value orientation. By contrast, those who are more interested in technical or financial goals choose to work in banks, engineering firms, public works departments etc. In reality, it is probably some combination of these who explanations which is operative here.

A useful comparison may be made to the extensive involvement of Catholic religious orders in movements for social change in Latin America, the Philippines and other Third World nations, Initially guided by certain altruist values, it is only when missionaries from Ireland and other European nations directly encounter the often violent realities of life among the ;shirtless ones' in despotic regimes that they adopt an explicitly activist and often radical perspective. Similarly, members of the new middle class may enter their jobs possessing certain inclinations but it is the fact of being in the firing line of environmental injustice that pushes them towards a more explicit ecological consciousness.

An alternative explanation which has been associated with Peter Berger (1986) suggests that this new knowledge class is not so much altruistic as intensely cognizant of its own interests. Since they are one ones most likely to enjoy the positive organizational fruits of NSM activism-jobs in universities, government departments, regulatory agencies and pressure groups, research grants, conference travel, etc. It is not surprising that members of the new middle class make up the bulk of the constituency of support for environmentalism, feminism, anti-nuclearism, etc. Steinnetz has identified two major difficulties in attempting to explain NSMS such as environmentalism, in terms of the rise of new middle class.

First, he notes that recent research has indicated that the social composition of NSMs is more diverse than the class explanation has acknowledged. For example, he cites evidence from public opinion poils and voting patterns in Germany in the late 1980s which indicates that the distribution of support for Dir Grunen (Greens) was, in fact, flattering out. This is consistent with recent research in the United States on the environmental justice movement which reports a rising presence in environmental protests by members of disadvantaged groups. Steinmetz cites Beck's observation that 'need is hierarchical, smog is democrat' to illustrate that in the contemporary 'risk society' we are all centrally affected by environmental problems, a fact which sooner or later will lead to increased environmental consciousness across class lines.

Second he observes that even if the thesis that the new middle class is over represented could be supported empirically, this may indicate that this group is simply better able to perceive and mobilize against problems such as environmental deterioration than are the equally concerned but less positively resourced lower class. As it happens, segments of the middle class were similarly over-represented in many 'old' social movements-a further indication that they possess resources (flexible time, leadership skills, etc.) which allow them to participate more intensely.

Regulationist/ Political Closure Approach

Finally, there have been attempts to account for the rise of environmental consciousness and action by identifying tensions in the political system of some Western European nations.

From this perspective, the New Social Movements are said to have arisen as a defensive reaction against the intrusion of the state into the every day life of ordinary citizens-what Habermas (1987) terms the 'colonisation of the life world' While this generally fits better as an explanation for the growth of social movements organized around alternative sexual identities and lifestyles, it can also be seen as having some relevance to the environmental sphere. It can be argued for example, as does Beck (1992), that the proliferation of new chemical and nuclear, and, most recently, biogenetic technologies has brought a host of new risks into the daily lives of modern, citizens, Governments have sometimes been the architects of these risks ; at other times the henchmen of those who are the risk creators. Halfmann and Japp (1993 ; 438) argue that modern social movements such as the environmental movement choose as their targets risks which appear to represent the ultimate threat to our 'life chances' because they seem to be uncontrollable and ineversible : nuclear power plants, deranged ecosystems, the arms race and biotechnology.

Another plane of this structural explanation casts the rise of environmentalism in the context of 'neo-corporatism'. Corporatist-type political arrangements exist when the state joins in partnership with private industry and sometimes big labour unions to circumvent formal democratic procedures and make key political and economic decisions behind closed doors. Frequently, this form of circumscribed decision-making can result in damage to the environment, especially since corporatism is premised on sustained economic growth and high levels of employment. For example, the 1992 Summer Olympic Games in Barcelons, which were organized under the aegis of a public limited company which conjoined private capital with regional and state governments, resulted in environmental damage at a number of locations including the natural park of Collserola, the last remaining habitat for a number of plant and animal species.

It is argued that the political closure imposed by corporatist arrangements has precipitated new forms of ecological protest. NSMs are said to have arisen outside mainstream politics in civil society in order to address grievance and themes (including ecological destruction) which have been systematically marginalized by the corporatist state. Such issues have been officially excluded because they are of no significance or challenge to the interests of the major parties in the corporatist partnership. Scott (1990) observes that it is in nations in which political debate has been stifled under a real or apparent consensus and decision-making dominated by a small group of 'social partners' (i,e. Austria, Germany, Sweden) that ecological movements, notably the Greens, have been most active in the political sphere.

In West Germany, for example, bureaucratic policy-makers had, by the 1970s, increasingly begun to avoid parliamentary institutions, preferring to make key decisions in concert with industry representatives behind closed doors. The rise of Die Grunns can thus be interpreted as an attempt to re-establish the democratic political link between the state and citizenry, first through the formation of extra-parliamentary citizen initiative groups, and later by re-entering parliaments in the form of alternative parties with the goal of helping to restore parliamentary legitimacy.

While these regulationist / political closure explanations have the advantage of placing the rise of environmentalism in a wider historical and cultural context, they tell us more about the structural source and challenging of grievance which are held by environmental activists than they do about any individual motivations to embrace a 'green' view of the world (Steinmetz 1994 : 195-6). Furthermore, while it is possible to understand why in some European nations the centre of gravity of environmental discourse was to be found inecological movements rather than in politics, it is less evident how environmentally related grievance came to be constructed into full-blown claims within these newly emergent green networks. This is especially relevant since these decentralized NSM groups tends to work out their new collective meanings and identities in a pre-political or private context rather than in the full glare of politics and public policy-making.

2.10 Sum up

Sociology has traditionally made a distinction between humans and nature. As we will see, this is precisely the problem that humans coincidentally suffer from when interacting with their surroundings. Automatically, it seems we are put at a disadvantage by forming human social structures and ignoring the larger all-embracing society of the animal and vegetal realms. If one were to think in terms of humans as an integral part of nature, and therefore inherently natural, many problems associated with the abuse of the environment should be positively affected. Classical sociology was concerned primarily with humans as a part of systems. These systems were limited primarily to the social and economic sectors of human society. Environmental sociology has gone through several phases. Originally in response to public attention to environmental problems, the field of environmental sociology for several years was essentially a repackaging of several pre-existing literatures. Within a decade, however, environmental sociology came to be unified to a significant degree around the contributions of Dunlap and Catton, Schnaiberg, and a handful of others.

The environmental sociology approaches were not able to adequately account for the manner in which environmental problems are defined, articulated and acted upon by social actors. For example, why did environmentalism remain in a relative of abeyance for a half century from 1920 to 1970? Why have global environmental problems such as ozone depletion, global warming and biodiversity loss displaced more local problems such as groundwater pollution and urban sewage disposal as priorities for governments, the media and the mainstream environmental movement? A social constructionist perspective on the environment has several advantages over other theoretical approaches.

In contrast to much of the existing sociological literature on the environment, social constructionism does not uncritically accept the existence of an environmental crisis brought on by unchecked population growth, over-production, dangerous new technologies, etc. Instead, it focuses on the social, political and cultural processes by which environmental conditions are defined as being unacceptably risky and therefore actionable. As Thompson (1991) has noted, environmental debates reflect the existence not just of an absence of certainty (e.g. about energy futures, the extent of the hazardous waste problem, the health affects of low level radiation) but rather the existence of contradictory certainties : severely divergent and mutually irreconcilable sets of convictions both about the environmental problems we face and the solutions that are available to us.

It is important to note, however, that environmental risks and problems as socially constructed entitled need not undercut legitimate claims about the condition of the environment, thereby denying them an objective reality. As Yearly (1992 : 186) observes, demonstrating that a problem has been socially constructed is not to underminer or debunk it, since both valid and invalid social problem claims have to be constructed'. Similarly, social constructionism as it is conceptualized here does not deny the independent casual powers of nature but rather asserts that the rank ordering of these problems by social actors does not always directly correspond to actual need. To a considerable extent, this reflects the political nature of agenda-setting. As Bird (1987) has argued that understanding environmental problems have been socially and politically negotiated gives them 'enormous normative weight. Second, much of the manufacturing of environmental problems is carried out in arenas that are populated by communities of specialists: scientists, engineers, lawyers, medical doctors, government officials, corporate managers, political operatives, etc., rather than in full view of the general public. As a result research representatives which focus exclusively on public discourse fail to fully capture the details of environmental agenda-setting and policy-making. A social constructionist approach, by contrast, recognizes the extent to which environmental problems and solutions are end-produces of any dynamic social process of definition, negotiation and legitimatize both in public and private settings.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

3.1 Objectives

After reading this lesson you would be able to know:

- What global warming is?
- What are the green house gases responsible for global warming
- The impacts of global warming on human and human health, agriculture, climate
- Management of global warming

3.2 Introduction

At the heart of the climate change issue is the phenomena of global warming and the greenhouse effect. Earth supports life, thanks to its gaseous atmosphere, which perform an important function of trapping the heat that leaves the Earth's surface. Energy from the Sun drives the Earth's weather and climate. The Earth absorbs energy from the Sun, and also radiates energy back into space. However, much of this energy going back to space is absorbed by "greenhouse" gases in the atmosphere. Because the atmosphere then radiates most of this energy back to the Earth's surface, our planet is warmer than it would be if the atmosphere did not contain these gases. The average global temperature is 15?c. In the absence of green house gases this temperature would have been -18? c. This effect is called Green House Effect and it contributes a temperature rise to the tune of 33?c. This regulates the planet's average temperature and makes it suitable for life. The amount of heat trapped in the atmosphere depends mostly upon the concentration of heat trapping or green house gases and length of time they stay in the atmosphere.

3.3 Causes of Global Warming

Green house gases

Greenhouse gas concentrations in the atmosphere have historically varied as a result of many natural processes (e.g. volcanic activity, changes in temperature, etc). However, since the Industrial Revolution humans have added a significant amount of greenhouse gases. During the past century humans have substantially added to the amount of greenhouse gases in the atmosphere by burning fossil fuels such as coal, natural gas, oil and gasoline to power our cars, factories, utilities and appliances coupled with cutting down forests and other activities.

Changes in the atmospheric concentration of the major greenhouse gases are described below:

Carbon dioxide (CO_2)

Carbon dioxide, the predominant green house gas, is controlled mostly by the global carbon cycle and has increased over time. Carbon dioxide is released by the burning of fossil fuels like coal, oil and biomass. Deforestation is resulting in lesser absorption of carbon dioxide. Since the mid 1800s, which is when the industrial revolution started, there has been a steady increase in CO_2 levels in the atmosphere and this is a matter of worry. Deforestation has further resulted in elevated levels of carbon dioxide due to non removal of carbon dioxide by plants through photosynthesis.

The concentrations of carbon dioxide in the atmosphere increased from approximately 280 parts per million (ppm) in pre-industrial times to 382 ppm in 2006 a 36 percent increase (according to the National Oceanic and Atmospheric Administration's (NOAA) Earth Systems Research Laboratory). Almost all of the increase is due to human activities (IPCC, 2007). The current rate of increase in CO_2 concentrations is about 1.9 ppmv/ year. Present CO_2 concentrations are higher than any time in at least the last 650,000 years (IPCC, 2007).

Methane (CH_4)

Other gases whose levels have increased due to human activities are methane, nitrous oxide. Methane is released from inundated rice fields and when waste matter rots in an oxygen-free environment in garbage dumps. Cattle rearing is also contributing to increased methane emissions. Methane is more abundant in the Earth's atmosphere now than at any time in at least the past 650,000 years (IPCC, 2007). Methane concentrations increased sharply during most of the 20th century and are now 148% above pre-industrial levels. In recent decades, the rate of increase has slowed considerably.

Nitrous Oxide (N_2O)

Nitrous oxide is produced during biomass burning and when nitrogen based fertilizers are used. Nitrous oxide (N_2O) has increased approximately 18 percent in the past 200 years and continues to increase. For about 11,500 years before the industrial period, the concentration of N_2O varied only slightly. It increased relatively rapidly toward the end of the 20th century (IPCC, 2007).

Tropospheric ozone (O_3)

Ozone is created by chemical reactions from automobile, power plant and other industrial and commercial source emissions in the presence of sunlight. It is estimated that O3 has increased by about 36% since the pre-industrial era, although substantial variations exist for regions and overall trends (IPCC, 2007). Besides being a greenhouse gas, ozone can also be a harmful air pollutant at ground level, especially for people with respiratory diseases and children and adults who are active outdoors. Measures are being taken to reduce ozone emissions in the U.S. (through the Clean Air Act) and also in other countries.

Chlorofluorocarbons (CFCs) and hydro-chlorofluorocarbons (HCFCs)

The gases are used in coolants, foaming agents, fire extinguishers, solvents, pesticides and aerosol propellants. These compounds have steadily increased in the atmosphere since their introduction in 1928. Concentrations are slowly declining as a result of their phase out via the Montreal Protocol on Substances that Deplete the Ozone Layer.

Fluorinated gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6) are frequently used as substitutes for CFCs and HCFCs and are increasing in the atmosphere. These various fluorinated gases are sometimes called "high global warming potential greenhouse gases" because, molecule for molecule, they trap more heat than CO_2.

One of the chief GHGs is carbon dioxide. In addition to carbon dioxide, other naturally occurring GHGs are methane, nitrous oxide, and water vapour. The concentration of these greenhouse gases in the atmosphere is important to maintain the balance in Earth systems. Heat trapped by green house gases in the atmosphere keeps the planet warm enough to allow us and other species to exist.

3.4 Effects of Global warming

Man made green house gases have significant Global Warming Potential (GWP) when compared with CO_2 and they remain in the atmosphere for a very long time. The added gases - primarily carbon dioxide and methane - are enhancing the natural greenhouse effect, and likely contributing to an increase in global average temperature and related climate changes. The increase in the concentration of gases that trap heat within the Earth's atmosphere is resulting in global warming.

Warming or cooling by more than 2° c over the past few decades may prove to be disastrous for various ecosystems on the earth including humans as it would alter the conditions faster than some species could adapt or migrate. Some areas will become inhabitable because of droughts or floods following rise in average sea level.

The sharp increase in the concentration of natural greenhouse gases is noticeable since the Industrial Revolution (around 1750), human activities have substantially added to the amount of heat-trapping greenhouse gases in the atmosphere. The burning of fossil fuels and biomass (living matter such as vegetation) has also resulted in emissions and this only reinforces the fact that human activities are responsible for this rise.

The enhanced greenhouse effect will not only cause global warming but will also affect various other climatic and natural processes.

3.4.1 Climate change

Climate models calculate that the global mean surface temperature could rise by about 1 to 4.5 degrees centigrade by 2100. Global warming is creating an imbalance in climate regulating systems and this has widespread impacts. The 10 warmest years on record between 1880- 2008 (in descending order) are: 1 - 2005; 2 - 1998; 3 - 2002; 4 - 2003; 5 - 2006; 6 - 2007; 7 - 2004; 8 - 2001; 9 - 2008 and 10 - 1997

Over the past few years we have been noticing changes in the climatic conditions in many places across the world - severe heat waves, unusually high rainfall over short periods of time, snowfalls in places that do not usually have them and an increase in the number and intensity of hurricanes, typhoons and floods. Evidence of glacier retreat has been found across the world - in the Himalayas in Asia, the Alps in Europe, Rockies and Alaskan glaciers in North America, the Andean glaciers in South America, tropical and sub tropical glaciers in Oceania and New Zealand, Greenland, Iceland etc.

3.4.2 Global temperature increase:

It is estimated that the earth's mean temperature will rise between 1.5 to 5.5° c by 2050 if input of greenhouse gases continues to rise at the present rate. Even at the lower value, earth would be warmer that it has been for 10000 years.

3.4.3 Rise in Sea Level:

With the increase in global temperature sea water will expand. Heating will melt the polar ice sheets and glaciers resulting in further rise in sea level. Current models indicate that an increase in the average atmospheric temperature of 3° c would raise the average global sea level by 0.2-1.5 meters over the next 50-100 years. Eventually, the rising waters could take away land inhabited by people, forcing them to move. One meter rise in sea level will inundate low lying areas of cities like Shanghai, Cairo, Bangkok, Sydney, Hamburg and Venice as well as agricultural lowlands and deltas in Egypt, Bangladesh, India, China and will affect rice productivity. This will also disturb many commercially important spawning grounds, and would probably increase the frequency of storm damage to lagoons, estuaries and coral reefs. Bangladesh being massively populated and poor, will loose something like a sixth of the country due to sea level rise. Bangladesh cannot afford to build barriers to hold back the sea, so people would have to move inland, increasing the populations density and leading to an increase in hunger and disease. The Maldive Islands in the Indian Ocean have the same problem. They are a nation of 1190 islands with an average height of about 1.5 meters above sea level. If the sea level rises, more than 200,000 people will have to abandon their homes. Life of millions of people will be affected by the sea level rise especially those who have build homes in the deltas of Ganges, the Nile, the Mekong, the Yangtze and the Mississippi rivers.

Moreover there will be flooding of coastal estuaries, wetlands and coral reefs; beach erosion, salinisation of coastal aquifers due to salt water and disruption of coastal fisheries. Warming of the oceans could also promote toxic algae which can lead to cholera. Some of the most beautiful cities like Mumbai may be saved by heavy investment on embankment to prevent inundation.

3.4.4 Precipitation Changes

Increasing temperatures tend to increase evaporation which leads to more precipitation

(IPCC, 2007). As average global temperatures have risen, average global precipitation has also increased. According to the IPCC, the precipitation has generally increased over land north of 30°N from 1900-2005, but has mostly declined over the tropics since the 1970s. It has become significantly wetter in eastern parts of North and South America, northern Europe, and northern and central Asia, but drier in the Sahel, the Mediterranean, southern Africa and parts of southern Asia. Although there has been an increase in the number of heavy precipitation events over many areas during the past century, there has been an increase in the prevalence of droughts since the 1970s -especially in the tropics and subtropics.

3.4.5 Effects on human and human health:

It is widely believed that the global mean temperature could increase from 1.4 degrees to 5.8 degrees centigrade by the year 2100 and this could translate into heat and health related issues for the populace unaccustomed or ill-prepared for this change. The effects of such a change in temperature of environment could bring about more frequent extreme high maximum temperatures and less frequent low minimum temperatures.

A statement released from the Intergovernmental Panel on Climate Change (IPCC) said, "Climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life." As temperatures increase towards the poles, similar to farmland, insects and other pests migrate towards Earth's poles. These insects and pests could be allowed to migrate up to 550 Km or 550 miles. Some insects carry diseases such as malaria and dengue fever. Thus, an increase in these particular insects and pests closer to the poles results in an increase in these diseases. This could lead to 50 to 80 million additional cases of Malaria annually, a 10-15% increase.

The most obvious impact of global warming will be the heat and cold waves. These will lead to an increase in the number of deaths of both human and animals. With an increase in heat waves, there will be more people who will suffer from heatstroke, heart attacks and other ailments aggravated by the heat. According to the EPA, "In July 1995, a heat wave killed more than 700 people in the Chicago area alone." Hot conditions could also cause smoke particles and noxious gases to linger in the air and accelerate chemical reactions that generate other pollutants. This leads to an increase in risk of respiratory diseases like bronchitis and asthma.

The other health effects are of weather-related disasters, and that is addition to immediate death and injury to people, are the increase in the occurrences of depression and psychological effects.

3.4.6 Impact of Global warming on Agriculture

In the perspective of Agriculture, it is believed that, global warming is good for the human race, because it helps increase food production. Climate change affects agriculture through direct and indirect effects i.e. temperature, precipitation, changes in the biological and physical environment.

"The most determinant factor in agriculture production is climate. History reveals that for food production, warming is better than cooling. Moreover carbon dioxide is an essential nutrient for the production of food, and food is one of the most important things in our lives. As the temperature rises, more farmland will be open towards the poles and the length of the growing season will also lengthen. With all the people who go hungry each day food production should be one of our main concerns.

Less availability of irrigation water due to warmer temperatures will also be a big negative for dry areas. Many of our most productive farming areas depend heavily on irrigation. Further, there is a local cooling effect in irrigated areas (from evaporating water) that moderates temperatures, helping crops survive withering summer temps. Thus, less irrigation will exacerbate global-warming-driven temperature increases in water-short areas. It is worth noting that 40% of the world's food supply comes from the 2% of land that is dependent on irrigation.

With the impact of global warming effects, agriculture will becomes increasingly difficult. Farmers will find it hard to grow crops in the face of droughts and other natural disasters. We have some questions to ponder on i.e Will you be able to eat the same foods you're used to eating? What will happen to the world's food supply? The impacts of global warming on agriculture envisaged are:

- Attack of Diseases and fungi on crops:

The attack of diseases and other pathogens will lower the quality and production. Without the normal cold spells, diseases and invasive species will spread more easily, affecting more of our world's food supply. Farmers will either have to sell the food as is, or spray it with harmful chemicals that may hurt our health.

- Destruction of existing crops due to Natural disasters

Flooding, drought, and hailstorms are just some of the problems farmers will have to deal with more often as global warming worsens.

- Disapperance of once abundant foods:

The crops which are abundant may disappear or become more expensive. The destructive, frequent natural disasters, combined with a swelling world population, will lead to an increased demand for staples like rice, maize, and wheat. This will cause food shortages and dramatic price increases around the world.

Water availability is one of the most dramatic consequences of climate change for the agricultural sector. Although it is expected to be even more limited in the future. Water scarcity of is due to potential evapo-transpiration increase. It is related to an increase in air and earth surface temperatures. This phenomenon is important in low-precipitation seasons, and is even greater in dry areas. The number of regions with a loss of soil moisture is expected to increase, resulting in direct economic consequences on the production capacity (IPCC 1994). Soil moisture drop implies a significant reduction in dry land crops potential productivity; it may be a threat to economic viability. An increase of heavy rain has an impact on erosion and soil desertification indexes. High evapo-transpiration rates produce a higher frequency of times at which the soil's surface is dry and, therefore, more vulnerable to wind erosion.

3.4.7 Loss of ecosystems and biodiversity

Rapid climate change would have severe impact on natural ecosystems. Plant and animal species would be forced to migrate to keep up with climate shifts. Species that have adapted to cool climates could become extict as their habitats will disappear. There may be heavy damage to sensitive ecological systems. Large areas of forests may disappear due to extreme heat waves and more forest fires. The wildfires may also further increase the CO2 load in the atmosphere.

3. 4. 8 Conflicts

The impact of climate change will influence the social and economic structure of nations around the world. Terrorism, civil wars and economic crises may be some of the consequences. The environmental imbalance created due to global warming may give rise to conflicts between nations such as war for resources like water. The sea level rise and changing weather pattern could trigger large scale migration from more seriously affected areas. All these consequences of global warming will translate into huge financial loss.

3. 5 Management

In light of the uncertainties in the global warming models and lack of unanimity among scientists with regard to consequences of increased levels of green house gases the chances of suggesting management solutions are seriously reduced. There are three schools of thought on the political level ranging from drastic measures to reduce Green House Gases to suggestions that nothing should be done. The first approach is to wait and see approach. The believers of this approach think that global warming would not necessarily be harmful and that the counter measures are inappropriate unless huge adverse climatic change is established. The second approach is the "adaptation to incurable change". According to this approach the prevention of global warming is useless and instead humanity should rely on its innate ability to evolve to changes in the environment. The third approach to global warming is to "act now" approach which demands an immediate legislative response.

The various management approaches can be categorized as

1. Reduction of the amount of green house gases emitted in the environment by burning of fossil fuels. Efficiently remove carbon dioxide from smoke stacks;

2. The toal elimination of fossil fuels as energy sources and shifting to renewable energy resources that do not emit GHGs;

3. Increasing the use of energy efficient and cleaner production technologies processes;

4. Reduction of the effects of green house gas emissions by reforestation for CO_2 sequestration or alternate methods of reduction of carbon dioxide disposal;

5. Adopting practices and technologies to make agriculture sustainable;

6. Creating wide-spread awareness about the need to undertake appropriate steps safe and sustainable environment.

3. 6 Global effort

In 1990, the UN General Assembly established the Inter-governmental Negotiation Committee (INC) for a Framework Convention on Climate Change (UNFCC). The convention was signed in June, 1992, UN Conference on Environment and Development (Earth Summit), in Rio de Janeiro by 154 nations and the European Union (EU). By November, 1999, 181 states and EU had ratified the convention, which committed the signatories to make voluntary efforts to curtail Green House Gases emission.

At a meeting of member countries held at Kyoto in December 1997, delegates approved the Kyoto Protocol and called for GHG emission reduction jointly by industralised countries to 5 percent below their 1990 levels. These targets were set to be achieved in the period 2008-12, termed the first commitment period.

3. 7 Sum up

The reduction of carbon dioxide emissions should be reduced either by global efficiency, removal of harmful gases from the flue gases of the thermal plants and industries or using new energy sources. Reforestation is more vital because the slash and burn agriculture common in tropics is devastating for the environment. There is a need to shift from coal and gasoline to natural gas plants and adopting solar, wind, geothermal, and nuclear energy efforts. Plant more trees.. Remove atmospheric carbon dioxide by utilizing photosynthetic algae.

-000-

Structure

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

4.1 Objectives:

The main objective of the lesson is to acquaint you to

- Concept of acid rain

- Formation of acid rain
- Impacts and effects of acid rain
- Mitigation of acid rain
- Role of society in combating acid rain

4.2 Introduction

An analysis of the ice core from Greenland indicated that anthropogenic sulphate has dominated sulphur deposition since the early twentieth century and anthropogenic nitrate has dominated nitrogen deposition since about 1960.

Acid rain is an invisible environmental threat to the society. The word acid rain was first coined by Robert Angus Smith, a British chemist, in 1852 to describe the high acidity of the rain due to presence of sulphuric acid attributed to release of smoke from burning of coal in Liverpool, Glasgow and other British industrial centres. Smith speculated various effects of acid rain on trees and crops and corrosion of metals. In 1950s, Eville Gorham, a Canadian ecologist at Dalhousi University who had come across Smith's work and documented the effects of acid precipitation in the English Lake and in vicinity to Inco Nickel mining smelter located at Sudbury, Canada. The acid rain debate spread to United States in 1974 when work of Likens and Bormann was published in a journal Science. The environmental problem of acid rain has become a very important pollution issue of the present times.

The Acid rain is characterized as a global and a trans-boundary environmental problem. The regions which are down wind from coal-burning power plants, smelters or factories or major urban areas with large number of motor vehicles are most affected e.g. acidic emissions from industrialized areas of Western Europe (especially United Kingdom and Germany) and eastern Europe blow into Norway, Switzerland, Austria, Sweden, the Netherlands, and Finland.

The worst acid deposition is in Asia, especially in China, which gets about 59 percent of its energy from burning coal. According to the estimates by scientists by 2025 China will emit more sulphur dioxide and carbon dioxide than United States, Canada, and Japan combined.

Acid rain is term for atmospheric deposition of acidic substances. Acidic substances are deposited not only by rain and other forms of moist air but as dry particles also.

The precipitation is normally mildly acidic with average pH of 5.0. The pH is the measurement for acidity, the lower the number, the more acidic the substance, with 7.0 being the divide between acidity and alkalinity.

4.3 Formation of Acid rain

The precursors of acid rain formation result from both natural sources, such as volcanoes and decaying vegetation, and man-made sources, primarily emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) resulting from fossil fuel combustion. Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. The result is a mild solution of sulfuric acid and nitric acid. When sulfur dioxide and nitrogen oxides are released from power plants and other sources, prevailing winds blow these compounds across state and national borders, sometimes over hundreds of miles.

4.4 Types of Acid depositions

4.4.1 Wet Deposition

Wet deposition refers to acidic rain, fog, and snow. When the acid chemicals in the air are blown into areas where the weather is wet, the acids can fall to the ground in the form of rain, snow, fog, or mist. As this acidic water flows over and through the ground, it affects a variety of plants and animals. The strength of the effects depends on several factors, including how acidic the water is; the chemistry and buffering capacity of the soils involved; and the types of fish, trees, and other living things that rely on the water.

4.4.2 Dry Deposition

In areas where the weather is dry, the acid chemicals may become incorporated into dust or smoke and fall to the ground through dry deposition, sticking to the ground, buildings, homes, cars, and trees. Dry deposited gases and particles can be washed from these surfaces by rainstorms, leading to increased runoff. This runoff water makes the resulting mixture more acidic. About half of the acidity in the atmosphere falls back to earth through dry deposition.

4.5. Effects of acid rain

4.5.1 Impact on human Health

The pollutants that cause acid rain-sulfur dioxide (SO_2) and nitrogen oxides (NO_x)-do damage human health. These gases interact in the atmosphere to form fine sulfate and nitrate particles that can be transported long distances by winds and inhaled deep into people's lungs. Fine particles can also penetrate indoors. Many scientific studies have identified a relationship between elevated levels of fine particles and increased illness which contributes to human respiratory disease such as bronchitis and asthma. It can leach toxic metals, such as lead and copper, from water pipes into drinking water causing many diseases.

4.5.2 Impact on property and materials

Acid rain and the dry deposition of acidic particles contribute to the corrosion of metals (such as bronze) and the deterioration of paint and stone (such as marble and limestone). These effects significantly reduce the societal value of buildings, bridges, cultural objects (such as statues, monuments, and tombstones). For instance the Parthenon in Greece and the Taj Mahal in India have been affected by acid rain.

4.5.3 Impact on aquatic ecosystem

The ecological effects of acid rain are most clearly seen in the aquatic, or water, environments, such as streams, lakes, and marshes. Acid rain flows into streams, lakes, and marshes after falling on forests, fields, buildings, and roads. Acid rain also falls directly on aquatic habitats. Most lakes and streams have a pH between 6 and 8, although some lakes are naturally acidic even without the effects of acid rain. Acid rain primarily affects sensitive bodies of water, which are located in watersheds whose soils have a limited ability to neutralize acidic compounds (called "buffering capacity"). Lakes and streams become acidic (i.e., the pH value goes down) when the water itself and its surrounding soil cannot buffer the acid rain enough to neutralize it. In areas where buffering capacity is low, acid rain releases aluminum from soils into lakes and streams; aluminum is highly toxic to many species of aquatic organisms. Acid rain causes a cascade of effects that harm or kill individual fish, reduce fish population numbers, completely eliminate fish species from a waterbody, and decrease biodiversity. Some types of plants and animals are able to tolerate acidic waters. Others, however, are acid-sensitive and will be lost as the pH declines. Generally, the young of most species are more sensitive to environmental conditions than adults. At pH 5, most fish eggs cannot hatch. At lower pH levels, some adult fish die. Some acid lakes have no fish.

4.5.4 Impact on soil and plants

The shower in the forest washes leaves and falls through the trees to the forest floor below. Some trickles over the ground and runs into streams, rivers, or lakes, and some of the water soaks into the soil. The soil may neutralize some or all of the acidity of the acid rainwater. This ability is called buffering capacity, and without it, soils become more acidic. Differences in soil buffering capacity are an important reason why some areas that receive acid rain show a lot of damage, while other areas that receive about the same amount of acid rain do not appear to be harmed at all. The ability of forest soils to resist, or buffer, acidity depends on the thickness and composition of the soil, as well as the type of bedrock beneath the forest floor. Acid rain does not usually kill trees directly. Instead, it is more likely to weaken trees by damaging their leaves, limiting the nutrients available to them, or exposing them to toxic substances slowly released from the soil. Quite often, injury or death of trees is a result of these effects of acid rain in combination with one or more additional threats.

The research shows that acidic water dissolves the nutrients and helpful minerals in the soil and then washes them away before trees and other plants can use them to grow. At the same time, acid rain causes the release of substances that are toxic to trees and plants, such as aluminum, into the soil. Scientists believe that this combination of loss of soil nutrients and increase of toxic aluminum may be one way that acid rain harms trees. Such substances also wash away in the runoff and are carried into streams, rivers, and lakes. More of these substances are released from the soil when the rainfall is more acidic.

However, trees can be damaged by acid rain even if the soil is well buffered. Forests in high mountain regions often are exposed to greater amounts of acid than other forests because they tend to be surrounded by acidic clouds and fog that are more acidic than rainfall. It is believed that when leaves are frequently bathed in this acid fog, essential nutrients in their leaves and needles are stripped away. This loss of nutrients in their foliage makes trees more susceptible to damage by other environmental factors, particularly cold winter weather.

Acid rain can harm other plants in the same way it harms trees. Although damaged by other air pollutants such as ground level ozone, food crops are not usually seriously affected because farmers frequently add fertilizers to the soil to replace nutrients that have washed away. They may also add crushed limestone to the soil. Limestone is an alkaline material and increases the ability of the soil to act as a buffer against acidity.

4.6 Solutions for acid rain control

Control of acid deposition is a regional problem and is a tricky political problem for three basic reasons:

Firstly, the population and the ecosystems affected by acid rain are at distance from the areas which are actually causing the problem.

Secondly, the countries with large reserves of coal (such as China, India, Russia, and United States, etc) are more inclined to use coal as main energy resource.

Thirdly, The owners of the thermal power plants and industries are of the opinion that the cost of adding equipment to reduce air pollution, using low sulphur coal, or removing sulphur from coal are too high which in turn will add to the cost of electricity to consumers.

The best solutions are the preventive approaches to reduce or eliminate emissions of SO_2, NOx and particulates are

1. Reduce the use of coal and other fossil fuels : The reduction in use of coal and other fossil fuels is the most effective solution for reducing the sulphur and nitrogen dioxides release in the air.

2. Reduce air pollution by improving the energy efficiency: With the use of energy efficient sources of energy the air pollutants in the air can be reduced in turn reducing the acid rain producing gases.

3. The use of natural gas has to be increased: The use of natural gas for production of electricity has to be increased as a substitute for use of coal in thermal power plants, the main consumer of coal.

4. The renewable energy sources have to be preferred: The use renewable energy

resources such as solar energy, wind energy, etc. can reduce the pollution load in the atmosphere.

5. Burn low sulphur coal: Most of the sulphur dioxide produced , that leads to acid rain, is due to the burning of sulphur containing coal. Before burning of coal it can be washed. On the other hand low sulphur coal can be substituted for high sulphur coal.

6. Remove SO_2, NOx and particulates from gases released from the stacks: There are devices such as scrubbers which can be installed in tall stacks or chimneys of furnaces to prevent SO_2, NOx entering the air.

7. Remove NOX from exhaust gases of vehicles, etc.

8. The effect of acid rain can be reduced by using large quantities of limestone and lime to neutralise the acidified lakes or soil.

4.6 Sum up

Acid rain is outcome of the natural processes which occur due to chemical reactions taking place in the atmosphere. The anthropogenic activities have altered the concentration of NOx and SO_2 in the atmosphere which in turn has enhanced the global environmental problems.

Acid rain damage is extensive and is known to cause widespread environmental damage on the aquatic environment, flora and fauna, human health, and increasingly on buildings, structures made of stone and metal.

The best solution to reduce the formation of acid rain is to reduce the emissions of SO_2 and NO and this can only be done by reduced burning of fossil fuels and adopting clean energy alternatives.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

5.1 Objectives

After studying this lesson you should be able to know

- What is meant by biodiversity
- What are the levels of biodiversity

- The impacts on biodiversity
- Conservation of biodiversity and
- Global initiative for biodiversity conservation

5.2 Introduction

The very existence, survival and progress of humanity depend upon the quality of the environment. Today, the delicate environment is facing a danger of destruction on a scale as never before in the history of mankind. Advancement in the field of science and technology created a competitive world, making man become one of the selfish masters as a result of his wisdom. According to Maloney and Ward (1973) the environmental crisis is the result of mal-adaptive behavior of man, which is the root of environmental problems. Humanity's struggle toward a better life and higher standard of living through ruthless tapping of natural resources thus has resulted in serious environmental problems. The population explosion along with hasty industrialization, urbanization, indiscriminate use of chemical fertilizers, pesticides and fossil fuels and construction of barrages and dams has led to the depletion of forest covers, pollution, waste accumulation, soil erosion, floods and above all global warming. The effect of all these problems has led to a global catastrophe. There is an urgent need to preserve the environment and improve it qualitatively not only for the present but also for the future generations. One would be surprised to know that 99 percent of all the species of plants and animals that existed on the planet at some point of time have become extinct today. This large-scale species extinction can be attributed to the five mass extinctions that the planet was subjected to, since it came into existence. The last of these mass extinctions - the Cretaceous-Tertiary extinction, occurred 65 million years ago, and led to extinction of one of the most amazing species of fauna on the planet - the dinosaurs. Lately, the extinction of species has become much more prominent occurrence, and this phenomenon is directly related to the increase in human activities. While a significant number of animals and plants species have already been wiped off the planet, several species are fighting for their very existence. Going by estimates, a quarter of plants and animal species on the planet have already been brought to the verge of extinction as a result of human exploitation.

Even though we have come a long way from the crude caves in deep forests to sky scrapers in concrete jungles, we can't really boast of being a step ahead in competing with nature. We have made some serious alterations in our natural surroundings so as to suit our basic requirements, and some of these alterations have backfired on us in a drastic manner. From flash floods to landslides, we have had quite a few lessons to learn. But we seem to be more comfortable turning a blind eye towards them. Those who ask what difference would the extinction of a species or two make, don't quite understand the importance of biodiversity in an ecosystem. The fact is that all the species of flora and fauna, including humans, are dependent on each other, and the extinction of any one of these species can trigger a domino effect on the other species, which are directly or indirectly dependent on it. For instance, the extinction of the apex predator of a particular biome is bound to result in severe depletion of the vegetation cover here as the number of herbivores will increase due to lack of predators to curb their growth. When we talk about biodiversity importance, even those miniscule organisms which we can't see with our naked eye play a crucial role in smooth functioning of the ecosystem. For instance, a basic requirement for plant growth, nitrogen, is produced by the nitrogen fixing bacteria in the soil. If these bacteria species became extinct, the plants will have no nitrogen to grow, and this will result in the devastation of the agricultural sector. Wild animals encroach upon human habitation owing to loss of habitat and scarcity of food, both of which are caused as a result of human encroachment in their natural habitat.

At the end of the day, biological diversity is undoubtedly one of the most important components of the ecosystem. That being said, the onus is on us to understand the importance of biodiversity conservation, and implement wildlife conservation measures to save our ecosystem.

Biodiversity is a combination of two words 'biological' and diversity. In literal sense it is number of, variety and variability of all living forms on earth. These include millions of plants, animals, and micro-organisms, the genes they contain and intricate ecosystems of which they are the part. From the driest deserts to the dense tropical rainforests and from the high snow-clad mountain peaks to the deepest of ocean trenches, life occurs in a marvelous spectrum of forms, size, colour and shape, each with unique ecological inter-relationships.

Convention of Biological diversity (1992) defines biodiversity as the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part.

5.3 Levels of Biodiversity

5.3.1 Genetic diversity

It is the basic source of biodiversity. The diversity of genes within a species passed down the generations is known as genetic biodiversity. The genes found in organisms can form enormous number of combinations each of which gives rise to some variability e.g. Oryza sativa (rice), has thousands of wild and cultivated varieties which show variations at the genetic level and differ in their color, size, shape, aroma and nutrient content of the grain.

5.3.2 Species diversity

Species is the unit used to classify the millions of life forms on earth. Each species is different from every other species. The species diversity can be defined as the variability found within the population of a species or between different species of a community.

Horses and donkeys are distinct species so as lions and tigers. What unites a member of a species is that genetically they are similar and can produce fertile offspring. Species diversity is generally measured in terms of total number of species within a specific area.

It represents broadly the species richness and their abundance in a community. The current estimates put the total number of living species in a range of 10 million to 50 million (Wilson, 1992). Till now only about 1.5 million living and 300,000 fossil species have actually been described.

5.3.3 Ecosystem diversity

Ecosystem is a complex of life forms (which include plants, animals, and micro-organisms) interacting with one another and with non living elements like soil, water, air, minerals etc. This diversity of ecological complexity showing variations in ecological niches, trophic structure, food-webs, nutrient cycling, etc. is ecosystem diversity. The ecosystems also show variations with respect to physical parameters like moisture, temperature, altitude, precipitation etc.

Distribution of species in major groups of flora and fauna in India

Plants		**Animals**	
Bacteria	850	Lower groups	9979
Fungi	23,000	Mollusca	5042
Algae	2500	Arthropods	57,525
Bryophytes	2564	Pisces (Fishes)	2546
Pteridophytes	1022	Reptiles	428
Gymnosperms	64	Birds	1228
Angiosperms	15,000	Amphibians	204
		Mammals	372

Why is ecosystem diversity important?

Ecosystem diversity is of great value and has to be kept intact. The diversity which we observe today has developed over millions of years of evolution. Biodiversity is important and necessary to keep an ecological balance. If we destroy this diversity, it would disrupt this balance. If the diversity in one ecosystem is lost we cannot even replace the diversity of the ecosystem by that of another i.e. Coniferous trees of boreal forests do not take up the function of the trees of tropical deciduous forests and vice versa. This is because ecosystem diversity has evolved with respect to the prevailing environmental conditions with well-regulated ecological balance.

5.4 Endemism

Species which are restricted only to a particular area are known as endemic. India shows a good number of endemic species. About 62% of amphibians and 50% of lizards are endemic to India. Western ghats are the site of maximum endemism.

India has two biodiversity hot spots and thus possesses a large number of endemic species. Out of about 47,000 species of plants in our country 7000 are endemic. Indian subcontinent has about 62% endemic flora, restricted mainly to Himalayas, Khasi Hills and Western Ghats. The Western Ghats are particularly rich in amphibians (frogs, toads etc.) and reptiles (lizards, crocodiles etc.). About 62% amphibians and 50% lizards are endemic to Western Ghats. Different species of monitor lizards (Varanus), Reticulated python and Indian Salamander and Viviparous toad Nectophhryne are some important endemic species of our country.

5.5 Hot Spots of Biodiversity

Areas which exhibit high species richness as well as high species endemism are termed as hot spots of biodiversity (Myers, 1977). There were 25 such hot spots of biodiversity on a global level (now increased to 34) out of which two are present in India, namely the Eastern Himalayas and Western Ghats. These hotspots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity. Each hotspot contains at least 0.5% of the plant species as endemics. About 40% of terrestrial plants and 25% of vertebrate species are endemic and found in these hotspots.

5.6 Marine diversity

Along 7500 km long coastline of our country in the mangroves, estuaries, coral reefs, back waters etc. there exists a rich biodiversity. More than 340 species of corals of the world are found here. The marine diversity is rich in mollusks, crustaceans (crabs etc.), polychaetes and corals. Several species of Mangrove plants and sea grasses (Marine algae) are also found in our country.

5.7 Value of biodiversity

The multiple uses of biodiversity or biodiversity value have been classified by McNeely et al. (1990) as follows:

a) Consumptive use value

b) Productive use values

c) Social Value

d) Ethical value

e) Aesthetic value

f) Option values

g) Monetary value

h) Ecosystem service value

a) Consumptive use value

These are direct use values where the biodiversity product can be harvested and consumed directly e.g. fuel, food, drugs, fibre, etc. Biodiversity is critical for agriculture. About 80,000 edible plant species have been reported from wild. About 90 percent of present day food crops have been domesticated from wild tropical plants. The fossil fuels coal, petroleum and natural gas are also products of fossilized biodiversity. About 80% of the world's population in the developing countries depends on traditional medicines derived from plants or plant extracts and some animal and mineral resources for primary health care. The wonder drug Penicillin used as an antibiotic is derived from a fungus called Penicillium. We get Tetracycline from a bacterium. Quinine, the cure for malaria is obtained from the bark of Cinchona tree, Digitalin is obtained from foxglove (Digitalis) which is an effective cure for heart ailments asprin from plant Filipendula ulmaria.

b) Productive use values

These are the commercially usable values where the product is marketed and sold. It may include lumber, wild gene resources that can be traded for use by scientists for introducing desirable traits in the crops and domesticated animals. These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, fir of many animals, lac from lac insects etc, all of which are traded in the market. Many industries are dependent upon the productive use values of biodiversity e.g. the paper and pulp industry, Plywood industry, Railway sleeper industry, Silk industry, textile industry, ivory-works, leather industry, pearl industry etc.

c) Social Value

These are the values associated with the social life, customs, religion and psycho-spiritual aspects of the people. Many of the plants are considered holy and sacred in our country like Tulsi (holy basil), Peepal, Mango, Lotus, Bael, etc. The tribal people are very closely linked with the wild life in the forests. Their social life, songs, dances and customs are closely woven around the wildlife. Many animals like Cow, Snake, Bull, Peacock, Owl etc. also have significant place in our psycho-spiritual arena and thus hold special social importance. Thus biodiversity has distinct social value, attached with different societies.

d) Ethical value (Existence value)

Each species is important and has right to exist. Human have no right to eliminate any of the species. It involves ethical issues like "all life must be preserved". It is based on the concept of "Live and Let Live". If we want our human race to survive, then we must protect all biodiversity, because biodiversity is valuable. The ethical value means that we may or may not use a species, but knowing the very fact that this species exists in nature gives us pleasure.

e) Aesthetic value

Great aesthetic value is attached to biodiversity. No one of us would like to visit vast stretches of barren lands with no signs of visible life. People from far and wide spend a lot of time and money to visit wilderness areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is now known as eco-tourism. The "Willingness to pay" concept on such eco-tourism gives us even a monetary for aesthetic value of biodiversity. Ecotourism is estimated to generate about 12 billion dollars of revenue annually that roughly gives the aesthetic value of biodiversity.

f) Option values

These values include the potentials of biodiversity that are presently unknown and need to be explored. There is a possibility that we may have some potential cure for AIDS or cancer existing within the depths of a marine ecosystem, or a tropical rainforest.

g) Monetary value of Biodiversity

Each species on this earth has some value in terms of aesthetics or other ecosystem services provided by them, when converted to monetary terms. The examples of these are given as under:

- A male lion living up to an age of 7 years can generate upto $ 515,000 due to its aesthetic value as paid by tourists, whereas if killed for the lion skin a market price upto $ 1,000 can be fetched.

- In its lifetime a Kenyan elephant can earn worth $ 1 million as tourist revenue.
- The mountain gorillas in Rwanda are fetching $ 4 million annually through eco-tourism.
- Whale watching on Harvey Bay on Queensland's coast earns $12 million annually.
- Tourism to Great Barrier Reef in Australia earns $ 2 billion each year.
- A typical tree provides $ 196, 2150 worth of ecological services as oxygen, clean air, fertile soil, erosion control, water recycling, wildlife habitat, toxic gas moderation etc. Whereas its worth is only about $ 590 if sold in the market as timber.

h) Ecosystem service value

Recently, a non-consumptive use value related to self maintenance of the ecosystem and various important ecosystem services has been recognized which refers to ecosystem services like:

- prevention of soil erosion
- prevention of floods
- maintenance of soil fertility
- cycling of nutrients
- fixation of nitrogen
- cycling of water
- their role as carbon sink
- pollutant absorption, and
- Reduction of the threat of global warming etc.

Some Endangered Animals of India	
Reptiles	Gharial, Green sea turtle, Tortoise, Python
Birds	Great Indian bustard, Peacock, Pelican, Great Indian Hornbill, Siberian White crane
Carnivores	Indian wolf, Red fox, Sloth bear, Red panda, Tiger, Striped, hyena, Indian lion
Mammals	Golden cat, Desert cat, Dugong
Primates	Hoolock gibbon, Lion-tailed macaque, Nilgiri langur, Capped monkey, Golden monkey

5.8 Impacts on Biodiversity

5.8.1 Population:

Growth of the human population is a major factor affecting the environment. Overpopulation means that there are more people than there are resources to meet their needs. Almost all the environmental problems we face today can be traced back to the increase in population in the world. The human population is at 7 billion; with an annual global growth rate of around 1.14%, three more people are added to the earth every second.

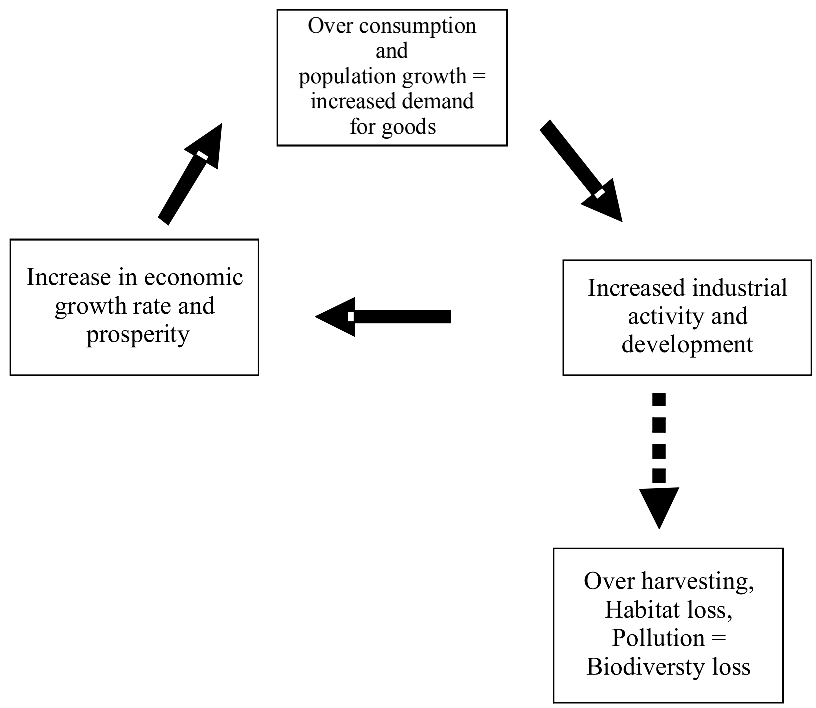
5.8.2 Affluence:

The world is experiencing an increase in annual economic growth rate. Affluence is a problem because with increasing affluence comes an increase in the per capita resource utilization. Less than 20% of the world's population controls 80% of the world's wealth and resources. The high standard of living that accompanies the increased production and consumption of goods is the major cause of pollution and environmental degradation (E.O. Wilson, 1994)

There is no single cause for deterioration of natural ecosystems. The effects of overpopulation and over consumption are not only felt locally or nationally but globally.

Pollution generated in one region can affect the air, water, vegetation or animals in another. The effect of global CO2 changes, loss of biodiversity and marine pollution do not respect political boundaries and ultimately affect everyone in the world.

5.2 The relationship between human activity and biodiversity impacts:



The problem with biological resource extraction is when the rate of increase in demand for the resource far outstrips the reproductive rate of the population. The demand for the resource outstrips supply and increase the value of that resource, increasing the incentive to extract them and causing the population to eventually deplete. Just to name a few like whales, elephants, spotted cats, cod, old-growth forests, ginseng, parrots, tuna and passenger pigeons have undergone the ill fate.

The unsustainable biological resource extraction has main problem of increased demand for the resource and short-term profit goals of extractors.

5. 8. 3 Habitat destruction

Habitat loss or fragmentation refers to disturbance of the physical environment in which a species lives which can range from minor to drastic. In other words habitat fragmentation is the loss and subdivision of a habitat and the corresponding increase in other habitats in the landscape. The minor changes such as mild chemical changes from air pollution, affects only most susceptible species. However the extreme physical changes can eliminate many species from the area.

Biologically diverse natural systems and the services they provide are most often undervalued in monetary terms and as a result, are used for development activities that seemingly have more direct economic effect. Large scale industrial and developmental projects have contributed to the habitat fragmentation and in turn loss of substantial biodiversity rich areas. Conversion of habitat represents the greatest threat to biodiversity, since almost all human activities cause alterations to the natural environment to a greater or lesser degree. Habitat fragmentation not only affects species, but also affects the processes that drive biodiversity. Habitat fragmentation causes large populations to be broken into smaller populations which may be isolated from one another. These sub-populations may be too small to be viable or, if local extinction of species occurs, fragmentation cuts off the potential for repopulation since there are no intact populations nearby.

Poor agricultural practices also degrade soil quality and promote the loss of topsoil. Furthermore, agriculture has resulted in local reductions and extirpations of fauna associated with agricultural lands (e.g. grassland and scrubland birds, wild pollinating insects).

5.8.4 Overharvesting/Overexploitation

After habitat loss, over harvesting has had the greatest effect on biodiversity. In fact, over harvesting and habitat loss often occur simultaneously, as removal of an organism from its environment can have irreversible impacts on the environment itself.

Humans have historically exploited plant and animal species in order to maximize short-term profit at the expense of sustainability of the species or population. Many species such as tigers and elephants are killed or poached for their skin, tusks, claws, etc. which have high commercial value. This exploitation follows a predictable pattern initially, a species harvested from the wild can turn a substantial profit, encouraging more people to get involved in its extraction. This increased competition encourages the development of more large-scale and efficient methods of extraction, which inevitably deplete the resource. Eventually, quota systems are applied, leading to more competition, decreased earnings and the need for government subsidies to support the extraction industry. This sequence of events has been observed in the fishing industry, the logging industry, and the grazing of cattle on public lands. The rapidly expanding pharmaceutical industry has affected the population of medicinal plants. The results for the resource are always the same: extreme population crashes, sometimes ending in global extinction.

5.8.5 Secondary Extinction

Secondary extinctions occur when the extinction of one group causes the extinction of another. It often involves loss of food species. Familiar Panda bear of China subsist largely on Bamboo. As the bamboo is destroyed, panda may become extinct from that cause alone.

5.8.6 Introduction of exotic species

The threat of exotic species (also known as non native, alien species) to natural habitats deliberately or accidentally has been a major threat to biodiversity through out the world. Sometimes the introduced species have high growth rate, high competitiveness and high reproductive rate as a result it can cause the eradication of indigenous species

5.8.7 Predation

The introduction of a predator, that organisms have not previously been exposed to can profoundly affect the food chains of the area.

5.8.8 Competition

Exotic species can often out-compete native species for food and habitat acquisition, mainly because they have no local controls (disease and predators) to keep their population in check.

5.8.9 Hybridization

Geographic barriers help to maintain genetically diverse populations of organisms. Introduction of non-native species, whether intentional or not, results in the interbreeding of native and non-native species, with the consequent decline of native species.

5.8.10 Diseases and parasites

Pest species accidentally introduced to an area provide the most dramatic example of the damage that exotics can pose to native species. For instance, an exotic beetle was the vector for Dutch Elm Disease, which has devastated elm trees in North America.

5.8.11 Homogenization of ecosystems

All the above impacts combine to decrease the number of native species in a habitat and replace them with weeds and thus cause regional homogenization of ecosystems.

Species introductions can occur accidentally, when organisms "hitchhike" into new systems on other animals or objects. Unintentional species introductions can also result from lack of education of the general public. For instance, releasing aquarium fishes or using exotic ornamental garden plants whose seeds escape into natural systems can increase the probability of an exotic species becoming established in our native ecosystems.

5.8.12 Pollution

Pollution involves the addition of materials that are usually not present or present in very different amounts. Soil, water and air pollution affects the functioning of the ecosystem and may remove or eliminate important sensitive species.

Toxic discharges which include metals, organic chemicals, and suspended sediments usually found in industrial and municipal effluents that are discharged directly into water bodies. Toxic discharges can inversely impact the biota (living organisms) in an ecosystem by killing them, weakening them, or affecting their ability to carry out essential biological functions (feeding, reproducing, etc.). Several studies conducted have shown that there is great impact of pesticides pollution on the populations of the specific plant and animal species.

Nutrient buildup in form of phosphorus and nitrogen is of great concern, which often originate as run-off from fertilizers applied on agricultural fields. These nutrients, naturally present in very low concentrations, stimulate rapid growth of algae and aquatic plants, ultimately limiting the amount of oxygen and light available to other organisms in the ecosystem.

5.8.13 Change in global climate

A number of investigations predict a global climate change in time to come. Human caused increase in green house gases in the atmosphere are likely to bring about a global temperature rise of 1 degree to 3 degrees during the next century. It is believed that an increase of 1 degree increase in global temperature will displace the limit of tolerance of land species some 125 km towards the poles, or 150 m vertically on the mountains.These abrupt changes may be beyond the tolerance range of many species and it is likely that we may loose them for ever. Moreover the sea level rise associated with global warming would submerge the low lying coastal areas endangering coastal flora and fauna.

5.8.14 Globalization

The proliferation of international trade treaties in the last few decades has led to an increase in global movement of goods. While globalization itself is not directly detrimental to the environment, certain aspects of increased transportation, particularly oceanic shipping traffic, have placed a strain on natural systems by facilitating the immigration of species to new habitats, introducing pollutants into aquatic ecosystems, and altering and destroying coastal habitats.

The greatest impact of globalization has been the introduction of exotic species to native habitats. This has occurred most often through the release of ballast waters from ships. Ships take up water in their ballast from their point of origin for stabilization as they cross the oceans and release it when they arrive at their port of destination. This ballast water may contain many plants and animals native to other regions of the world. Increased shipping traffic also means increased probabilities of accidental spills of substances that pose a risk to aquatic wildlife, such as crude oil and the increased release of fuels to aquatic ecosystems.

5. 9 Biodiversity conservation

Biodiversity can be preserved in two ways-

1. In-situ
2. Ex-situ

1.) In situ conservation (within habitat)

This method of conservation is by protection of wild flora and fauna in nature itself like Biosphere Reserves, National Parks, Sanctuaries, Reserve Forests, etc. Approximately, 4.83 per cent of the total geographical area of the country has been earmarked for extensive in-situ conservation of habitats and ecosystems through a protected area network of 99 National Parks and 523 Wildlife Sanctuaries. The results of this network have been significant in restoring viable populations of large mammals such as tigers, lions, rhinoceros, crocodiles and elephants. To conserve the representative ecosystems, the Biosphere Reserve Programme is being implemented. In all, 15 biodiversity rich areas of the country have been designated as Biosphere Reserves. Programmes have also been launched for scientific management and wise use of fragile ecosystems. Specific programmes for management and conservation of wetlands, mangroves and coral reefs systems are being implemented.

2) Ex situ conservation (outside habitats)

This method of conservation involves establishment of gene banks, seed banks, zoos, botanical gardens, culture collections etc. Attention has been paid to ex-situ conservation measures also as they complement in-situ conservation measures and are even otherwise important. There are about 70 botanical gardens, including 33 University botanical gardens. Also, there are 275 centres of ex-situ wildlife preservation in the form of zoos, deer parks, safari parks, aquaria etc. A Central Zoo Authority supports, oversees, monitors and coordinates the development and management of zoos in the country.

5.10 Global initiative:

Five international conventions focus on biodiversity issues like conservation :

- Convention on Biological Diversity,
- Convention on Conservation of Migratory Species,
- Convention on International Trade in Endangered Species of Wild Fauna and Flora,
- Ramsar Convention on Wetlands and
- World Heritage Convention.

The Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) was signed by the Community and all the Member States at the United Nations Conference on Environment and Development in Rio de Janeiro from 3 to 14 June 1992. For many decades there has been a substantial loss of biological diversity worldwide and in Europe due to human activities (pollution, deforestation, etc.). The convention focuses not only on conserving biodiversity but also on the sustainable use of biological resources and equitable sharing of benefits arising from its use.

The Convention makes provision for the following:

- establishment and maintenance of programmes for scientific and technical education and training for the identification, conservation and sustainable use of biological diversity and its components and providing support for such education and training for the specific needs of developing countries;
- encouragement of research which contributes to the conservation and sustainable use of biological diversity, particularly in developing countries;
- promoting the use of scientific advances in biological diversity research in developing methods for conservation and sustainable use of biological resources.

Public education should be promoted and awareness enhanced to highlight the importance of biological diversity through the media and the inclusion of these topics in educational programmes.

The Convention emphasises the role of indigenous and local communities in conserving biodiversity. These populations heavily and traditionally depend on the biological resources on which their traditions are based.

The Convention on the Conservation of Migratory Species of Wild Animals

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include over 100 Parties from Africa, Central and South America, Asia, Europe and Oceania. The Convention was signed in 1979 in Bonn (hence the name) and entered into force in 1983.

Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES):

This convention is an international treaty which is designed to protect wild plants and animals affected by international trade. The treaty is in force since 1975 and controls the export, import and re-export of endangered and threatened wildlife. At present this convention provides varying degree of protection to more than 30,000species of animals and plants that are being traded as live specimen, for fur coats, or even as dried herbs.

The Ramsar Convention on Wetlands:

This convention was signed in Ramsar (Iran) in 1971, and came into force in December 1975. It provides a framework for international cooperation for the conservation of wetland habitats which have been designated to the list of wetlands of international importance. The main focus of this convention originally being conserving habitats for wetlands now covers all aspects of wetlands conservation and wise use. India became signatory to this convention in 1982. There are ---- sites which have been designated as Ramsar sites.

The World Heritage Convention:

The convention is also devoted to the protection of the World Culture and Heritage aimed at protecting sites of such outstanding value that their conservation is of concern to all people. The treaty was adopted in Paris in 1972 and came in force in 1075. India has a total of 23 designated World Heritage Sites of which five are natural sites. These are Keoladeo National Park (Rajasthan), Manas National Park (Assam), Kaziranga National Park (Assam), The Sundarbans (West Bengal) and Nanda Devi National Park (Uttarakhand).

5.11 Sum up

Increased human and livestock population has resulted in enhanced demand for fuel, fodder, timber and non timber forest produce, increasing the pressure on existing natural forests. On the other hand forest lands are being diverted for such developmental activities as agriculture, industry, power and irrigation projects, housing and urban development. These developmental activities along with non sustainable human activities as shifting cultivation and overexploitation of natural resources has led to deforestation, loss in forest cover, and loss of replaceable biological resources. Thus an international approach and environmental audit of all developmental activities are essential to ensure balance between sustainable development and conserving biodiversity for the benefit of mankind.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

6.1 Objectives:

The main objective of the lesson is to make you understand about

- The ozone layer and its depletion
- Chemistry involved in production and depletion of ozone
- The main effects of ozone depletion
- Mitigation measures to reduce ozone depletion.

6.2 Introduction

Another environmental problem causing grave concern is the depletion of ozone in the stratosphere. Ozone is a naturally occurring gas found in very small traces in the earth's atmosphere. Ozone is a particular gas present both in the Earth's upper atmosphere and at ground level. There are two distinct types of ozone; the Ground-level Ozone present in troposphere and the Stratospheric Ozone.

Ground-level Ozone (GOL) is located in the troposphere, close to the Earth's surface. The troposphere is the lowest layer of the atmosphere, extending from the ground to roughly 10 - 17 km altitude. The temperature in the troposphere decreases with height. That is, as you go higher in altitude, the temperature decreases. The troposphere is a zone of rapid vertical mixing in addition to horizontal winds. Ozone is the main ingredient of urban smog that originates in emissions from industrial activities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents. Ground level ozone is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Ground-level ozone is a harmful pollutant for humans. Breathing ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion or it can worsen bronchitis, emphysema, and asthma. Another aspect of the GLO is its detrimental effect on the ecosystem as it can damage crops, trees and other vegetation.

Stratospheric Ozone

Ozone is primarily present in the stratosphere. The stratosphere is the layer above the troposphere. It extends from troposphere to approximately 45 - 55 km altitude. Unlike the troposphere, temperature increases with height in the stratosphere. The stratosphere is thus a region of high horizontal winds but no vertical mixing, so it is horizontally "stratified" or layered.

Ozone also plays a very important role in protecting organisms at the Earth's surface by keeping 95% of harmful ultraviolet (UV-B) radiation from reaching the earth's surface. Changes in stratospheric ozone levels can thus affect human and ecosystem health as well as the chemistry of the troposphere. From the above discussion, we can see that ozone protects us from UV light and it is a greenhouse gas in its own right.

Stratospheric Ozone Abundance

Ozone occurs in a layer, centered at around 30 km altitude, reaching a peak abundance of approximately 10 parts per million. Even at the peak of the ozone layer, however, it is still very much a trace constituent.

6.3 Ozone Production

Ozone is a deep blue, explosive, and poisonous gas. It is made in the atmosphere by the action of sunlight on molecular oxygen. In the stratosphere, UV light is available that can split up ordinary molecular oxygen into two atomic oxygen atoms.

$$\mathbf{O2 + UV\ photon \dashrightarrow\ O + O}$$

Now, atomic oxygen is a very reactive species. It immediately combines with something else. In the stratosphere, atomic oxygen can quickly combine with molecular oxygen (in the presence of a third body) to yield ozone or O3.

$$\mathbf{O + O2 + third\ body \dashrightarrow O3 + third\ body}$$

The combination of above two reactions, in presence of sunlight, converts molecular oxygen to ozone. Thus ozone is continually being created in the stratosphere.

6.4 Ozone Depletion

The role of ozone to protect the mankind from harmful impacts of the Ultra violet radiations is well understood. The measurements made by the scientists reveal that there is seasonal depletion or thinning of ozone concentrations in the stratosphere above Antarctica and Arctic. It is a matter of serious concern that the depletion of ozone in the stratosphere is a long term threat to humans, animals, and sunlight driven primary producers (mostly plants) that support the earth's food chains and food webs.

Ozone is lost through the following pair of reactions:

$$\mathbf{O_3 + UV\ photon \rightarrow O_2 + O}$$

$$\mathbf{O + O_3 \rightarrow 2O_2}$$

The first of these two reactions serves to regenerate atomic oxygen for the second reaction which converts the ozone back to molecular oxygen. This second reaction is very slow. It can be enormously accelerated, however, by catalytic reactions (see below). In the absence of such catalytic reactions, ozone can survive for 1-10 years in the stratosphere.

The chlroflourocarbon (CFC) / Ozone depletion theory

- CFCs are building up in the troposphere and slowly migrate to the stratosphere
- Break-up of CFCs by sunlight in the stratosphere releases chlorine
- Chlorine converts ozone to molecular oxygen
- Reduced ozone amounts would lead to increased ultraviolet radiation ("UV-B")
- Increased UV-B could lead to:
    - An increase in skin cancer
    - Cataracts
    - Immune system damage
    - Possible crop and marine life damage

Catalytic Destruction of Ozone by Chorine from CFC's

Catalysis refers to the acceleration of a particular chemical reaction by a catalyst, a substance that is not destroyed in the reaction, enabling it to continue having the same accelerating effect time and time again.

Rapid catalytic destruction of ozone is best explained by reference to the famous example of CFC's (also known as freons) in the stratosphere. Chlorofluorocarbons (CFC's) were developed to be colorless, odorless, non-staining, chemically inert, non-toxic, non-flammable, and to have certain other properties that make them excellent refridgerants, solvents, propellants for aerosol cans, and foam-blowing agents. These same properties make them essentially inert in the troposphere.

In the stratosphere, however, the CFC's can be broken apart into more reactive fragments under the action of UV light. When this splitting occurs, free chlorine is liberated which can catalytically destroy ozone. The process occurs in two steps:

Step 1. "Photolysis" (splitting by sunlight) of CFC's in the stratosphere

$$Cl_2CF_2 + \text{UV light} \rightarrow ClCF_2 + Cl$$

Step 2. Catalytic destruction of ozone

$$Cl + O_3 \rightarrow ClO + O_2$$

$$ClO + O_3 \rightarrow Cl + 2O_2$$

Notice that the net effect of this pair of fast reactions is to turn two ozone molecules into three normal molecules of oxygen. The (catalyst) atomic chlorine is recovered in the second reaction, making it available to start over. In fact, each chlorine atom can destroy hundreds of thousands of ozone molecules.

These two steps turn a very unreactive chemical into a devastatingly effective destroyer of ozone. Whenever free chlorine atoms exist in the stratosphere, ozone is quickly depleted. Other species (such as bromine and fluorine) can also act as ozone-destroying catalysts.

Given this chemistry, it is useful to consider a typical life history of CFC's in the atmosphere:

1. Spray starch aerosol can is emptied

2. The CFC is rapidly dispersed until it is uniformly distributed throughout the troposphere. It takes about a year to mix across into the southern hemisphere as well, carried by weather patterns .

3. After a few years, some of the CFC leaks into the stratosphere. At a sufficiently high altitude (~30 km), the available UV light can photolyze the CFC, liberating chlorine.

4. Each atom of chlorine participates in the catalytic destruction of thousands of

molecules of ozone.

5. Eventually the chlorine atom reacts with methane to produce HCl, a molecule of hydrochloric acid.

6. Some of the HCl reacts with OH to liberate Cl again, but a small fraction of it mixes down into the troposphere where it can dissolve in rainwater and be lost to the atmosphere through precipitation.

7. The time scale for this process is ~100 years!

6.5 The Antarctic Ozone Hole

The famous Antarctic Ozone Hole was discovered by British scientists who made systematic observations of ozone using a simple ground instrument - the Dobson Meter. They published this famous figure that illustrated the downward trend of total ozone over Halley Bay, Antarctica in the month of October (austral Spring). These measurements of Farman *et al*., provided a wake-up call to the atmospheric science community. They were quickly verified by satellite observations and several campaigns were organized to find out what was happening in this region and during this particular time of the year.

The Farman *et al*. paper, published in 1985 showed a dramatic decrease in ozone. The decline from year to year has continued, more-or-less to this day.

The Antarctic Ozone Hole is now well understood and can be summarized as follows:

The Antarctic Ozone hole is limited in space and time, occurring at the time of year when the Sun first appears above the horizon after the long polar night. During Polar Winter, a polar vortex forms and the polar air mass in the stratosphere becomes separated from other air masses. The temperature drops and drops, ultimately leading to the stratospheric air trapped in the vortex becoming very cold - in fact the coldest air to be found in any part of the Earth's stratosphere. In this cold vortex, polar stratospheric ice crystal clouds form. Gas phase HCl dissolves in the surfaces or clings to the surfaces of the clouds. The CFC's react with the HCl ice, converting relatively unreactive chlorine to the more active species, Cl_2, $ClONO_2$, and HOCl. At sunrise, in October, the chlorine-bearing compounds are photolyzed, releasing the highly reactive Cl atoms that attack ozone. Ozone densities drop rapidly, only to recover when the polar vortex breaks up, mixing warmer air in and releasing the ozone-depleted air to move away from the polar region. The ozone loss is felt globally.

6.6 Northern Hemisphere Ozone

The Northern hemisphere is not immune from Ozone Holes. In the north, the stratospheric polar vortex is not as well formed as in the south. This is because of the larger contrast between land and water in the northern hemisphere. The existence of land masses tends to break up the symmetry of the polar vortex in the north. However, the same processes operate as in the south and satellite data show the effect occurring in March (Spring time in the northern hemisphere).

Sooner or later, we will see colder than usual northern polar stratospheric temperatures in the early Spring and heavily populated areas will be warned of unusually low ozone levels. Since ozone depleting compounds will be in the atmosphere for many tens of years, we have to live with these effects. Ultimately, chlorine compounds will cleanse themselves from the stratosphere and the Earth's ozone shield will return to normal - for our grandchildren's children.

6.7 Potential Effects of Depleted Ozone

The primary concern is the enhanced levels of UV radiation that reach the Earth's surface due to depletion in stratospheric ozone. The UV spectrum can be broken into two parts:

UV-A: 400 - 320 nm

UV-B: 320 - 290 nm

The more energetic UV-B portion of the spectrum is responsible for sunburn, cataracts, potential ecological damage, and skin cancer. It can be absorbed by glass as well as by sunscreens and hats.

Relatively little is known or understood about the consequences of enhanced UV-B levels. We do know, however, that a 1% decrease in ozone abundance causes an approximately 2% increase in UV-B. Increased UV-B exposure at the Earth's surface can impact human, agriculture and forest growth, marine ecosystems, biogeochemical cycles, and materials. Table 1 summarises some of the potential effects of UV-B increases.

Table 1. Potential Effects of UV-B Increases.

Effects	State of Knowledge	Potential Global Impact
Plant Life	Low	High
Aquatic Life	Low	High
Skin Cancer	Moderate to High	Moderate
Immune System	Low	High
Cataracts	Moderate	Low
Climate Impacts*	Moderate	Moderate
Tropospheric Ozone	Moderate	Low

6.8 Effects on Human Health

Our best understanding of potential effects is in the area of skin cancers, for which detailed epidemiological records and studies exist. It is known, for example, that more than 90% of non-melanoma skin cancers are related to UV-B exposure. A 2% increase in UV-B is linked with a 2-5% increase in basal-cell cancer cases and a 4-10% increase in squamous-cell cancer cases.

In 1990, there were ~500,000 cases of basal-cell cancer in the U.S. and ~100,000 cases of squamous-cell cancer. A 1% depletion of ozone would cause an increase in skin cancer cases of ~20,000 per year. To put this rather alarming figure in context, it is necessary to discuss briefly the geographical prevalence of skin cancer.

6.8.1 Effects on Plants

UV-B radiation affects plant physiological and developmental processes and can affect plant growth. Indirect changes, such as in the manner in which nutrients are distributed within the plan, the timing of developmental phases and secondary metabolism and plant form, may be as or more important than the directly damaging effects of UVB.

6.8.2 Effects on Marine Ecosystems

Phytoplankton are the foundation of aquatic food webs, and their productivity is limited to the upper layer of the water column in which there is sufficient sunlight to support net productivity. Exposure to solar UVB radiation affects phytoplankton orientation mechanisms and motility and lowers survival rates for these organisms. UVB radiation has also been found to damage early developmental stages of fish, shrimp, crab, amphibians and other animals.

6.8.3 Effects on Biogeochemical Cycles

Increases in solar UV radiation might affect terrestrial and aquatic biogeochemical cycles, which could affect sources and sinks of greenhouse and a number of other trace gases e.g., carbon dioxide (CO2), carbon monoxide (CO), carbonyl sulfide (COS) and possibly ozone. Such changes would contribute to interactions between the atmosphere and biosphere that attenuate or reinforce the atmospheric buildup of these gases.

6.8.4 Effects on Materials

Although a number of materials are now somewhat protected from UVB by special additives, synthetic polymers, naturally occurring biopolymers, and other materials of commercial interest are adversely affected by solar UV radiation. Increases in solar UVB levels will therefore accelerate their breakdown and limit their useful life outdoors.

6.9 Mitigation Strategies

In the light of the publication of the Farman et al. findings in 1985, a series of ground-based and airborne measurements campaigns were conducted to develop an understanding of the chemistry and dynamics associated with the Antarctic Ozone Hole. This understanding leads to the Montreal Protocol on Substances that Deplete the Ozone Layer in October 1987. It required a freeze on the annual use of CFCs as early as 1990 with decreases leading to a 50% reduction by the year 2000. In 1990, the Montreal Protocol was amended to take into account the severe losses during the ozone hole events and the downward trends in global ozone. The participating countries substantially strengthened the protocol, calling for accelerated reductions in emissions, and requiring complete phase out of CFCs and other major ozone-depleting substances by 2000. The Montreal Protocol was further amended in 1992, calling for the complete phase out of CFCs, etc, by 1996.

India is concerned about the ozone problem and signed the Montreal Protocol in 1992. Strict measures have been initiated in the country to phase out ozone depleting substances. These measures include a ban on trade in Ozone Depleting Substances (ODS), licensing the import and export of ODS and a ban on new ODS production facilities. The Ozone Cell at the Ministry of Environment and Forests, Government of India, is the Indian National Lead Agency coordinating all matters related to Montreal Protocol.

6.10 Sum up

Naturally produced in the stratosphere (extending upward from about 6 to 30 miles from the earth surface), the stratospheric ozone is a layer in the Earth atmosphere comparable to a natural shield protecting life on earth. This ozone absorbs between 97 to 99% of the sun's harmful ultra-violet (UV) rays thus protecting life on earth. However, this "good" ozone is gradually being depleted by chemicals referred to as ozone-depleting substances (ODS), including chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl bromide, carbon tetrachloride, and methyl chloroform. These man-made chemicals are ultimately responsible for more cases of skin cancer, cataracts, and other health problems.

-000-

Structure

7.1 Objectives

The aim of the chapter is to :

- understand the social problem
- construction of social problem
- claim making process
- assembling and presenting environmental claims

7.2 Introduction

Nearly a quarter of a century ago, the sociology of social problems first began to experience a major conflict with the appearance of a seminal article by Malcolm Spector and John Kitsuse (1973) entitled 'Social problems: a reformulation'. Here, and in a subsequent book (1977), Spector and Kitsuse challenged the 'structural functional' approach to social problems that had theretofore dominated the field. Functionalism, as exemplified by the work of Merton and Nisbet (1971), assumed the existence of social problems (crime, divorce, mental illness) which were the direct products of readily identifiable, distinctive and visible objective conditions. Sociologists were regarded as experts who employ scientific methods to locate and analyse these moral violations and advise policy-makers on how best to cope. In addition, the sociologist's role was to bring to lay audiences an awareness and understanding of worrisome conditions, especially where these were not readily evident (Gusfleld 1984-: 39).

7.3 Construction of Social Problem

Spector and Kitsuse argued that social problems are not static conditions but rather 'sequences of events' that develop on the basis of collective definitions. Accordingly, they defined social problems as 'the activitias of groups making assertions of grievances and claims to organizations, agencies and institutions about some putative conditions' (1973: 146). From this point of view, the process of claims-making is treated as more important than the task of assessing whether these claims are truly valid or not. For example, rather than document a rising crime rate, the social problems analyst is urged to focus on how this problem is 'generated and sustained by the activities of complaining groups and institutional responses to them' (1973: 158). Since 1973, social constructionism has increasingly moved towards the core of social theorising, generating a critical mass of theoretical and empirical contributions both within the social problems area and across sociology as a whole.

7.4 Construction as an analytic tool

Best (1989: 250) has noted that constructionism is not only helpful as a theoretical stance but also that it can be useful as an analytic too!' In this regard, he suggests three primary foci for studying social problems from a social constructionist perspective: the claims themselves; the claims-makers; and the claims-making process.

Nature of claims

As initially conceptualised by Spector and Kitsuse, claims were complaints about social conditions which members of a group perceived to be offensive and undesirable. According to Best (1989: 250), there are several key questions to be considered when analysing the content of a claim: What is being said about the problem? How is the problem being typified? What is the rhetoric of claims-making? How are claims presented so as to persuade their audiences? Of these, it is the third question that has generated the most interest among contemporary social problems analysts. Using the example of the 'missing children', e.g. runaways, child-snatched abductions by strangers, Best (1987) analyses the content of social problems claims by focusing on the 'rhetoric' of claims-making. Rhetoric involves the deliberate use of language in order to persuade. Rhetorical statements contain three principal components or categories of statements: grounds, warrants and conclusions.

Grounds or data furnish the basic facts that shape the ensuing policy-making discourse. There are three main types of grounds statements: definitions, examples and numeric estimates. Definitions set the boundaries or domain of the problem and give it an orientation, that is, a guide to how we interpret it. Examples make it easier for public bodies to identify with the people affected by the problem, especially where they are seen as helpless victims. Atrocity tales are one especially effective type of example. By estimating the magnitude of the problem, claims-makers establish its importance, its potential for growth and its range (often of epidemic proportions).

Warrants are justifications for demanding that action be taken. These can include presenting the victim as blameless or innocent, emphasising links with the historical past or linking the claims to basic rights and freedoms. For example, in analysing the professional literature on 'elder abuse', Baumann (1989) identified six primary warrants: (1) the elderly are dependent; (2) the elderly are vulnerable; (3) abuse is life-threatening; (4) the elderly are incompetent; (5) ageing stresses families; (6) elder abuse often indicates other family problems.

Conclusions, spell out the action that is needed to alleviate or eradicate a social problem. This frequently entails the formulation of new social control policies by existing bureaucratic institutions or the creation of new agencies to carry out these policies.

Best further proposes two rhetorical themes or tactics which vary according to the nature of the target audience. The rhetoric <if rectitude (values or morality require that a problem receive attention) is most effective early on in a claims-making campaign when audiences are more polarised, activists are less experienced and the primary demand is for a problem to be viewed in a new way. By contrast, the rhetoric <if rationality (ratifying a claim will earn the audience some type of concrete benefits) works best at the later stages of social problems construction when claims-makers are more sophisticated, the primary demand is for detailed policy agendas and audiences are more persuadable. Rafter (1992: 27) has added another rhetorical tactic to Best's list: that of archetype formation. Archetypes are the templates from which stereotypes are minted and therefore possess considerable persuasive power as part of a claims-making campaign.

A further set of rhetorical strategies in claims-making has been proposed by Ibarra and Kitsuse (1993) who outline a variety of rhetorical idioms, motifs and claims-making styles.[1]

Rhetorical idioms are image clusters that endow claims with moral significance. They include a 'rhetoric of loss ' (of innocence, nature, culture, etc.); a 'rhetoric of unreason' that invokes images of manipulation and conspiracy; a 'rhetoric of calamity' (in a world full of deteriorating conditions, epidemic proportions are claimed for a few; for example, AIDS or the greenhouse effect); a 'rhetoric of entitlement' (justice and fair play demand that the condition, or as Ibarra and Kitsuse term it, the 'condition-category', be redressed), and the 'rhetoric of endangerment' (condition-categories pose intolerable risks to one's health or safety).

Rhetorical motifs are recurrent metaphors and other figures of speech (AIDS as a 'plague', the depletion of the ozone layer as a 'ticking time bomb') that highlight some aspect of a social problem and imbue it with a moral significance. Some motifs refer to moral agents, others to practices and still others to magnitudes (Ibarra and Kitsuse 1993: 47).

Claims-making styles refer to the fashioning of a claim so that it is synchronous with the intended audience (public bodies, bureaucrats, etc.). Examples of claims-making styles include a scientific style, a comic style, a theatrical style, a civic style, a legalistic style and a subcultural style. Claims-makers must match the right style to the situation and audience.

In looking at the identity of claims-makers, Best (1989b: 250) advises that we pose a number of questions. Are claims-makers affiliated to specific organisations, social movements, professions or interest groups? Do they represent their own interests or those of third parties? Are they experienced or novices? (As we have seen, this can influence the choice of rhetorical tactics.)

Many studies that have been undertaken in the social constructionist mode have pointed to the important role played by medical professionals and scientists in constructing social problems claims. Others have noted the importance of policy or issue entrepreneurs politicians, public interest law firms, civil servants - whose careers are dependent upon creating new opportunities, programmes and sources of funding. Claims-makers may also reside in the mass media, especially since the manufacture of news depends upon journalists, editors and producers constantly finding new trends, fashions and issues.

The cast of claims-makers who combine to promote a social problem can be quite diverse. For example, Kitsuse et aJ. (1984) identify three main categories of claims-makers in the identification of the kikokushijo problem in Japan, that is, the educational disadvantage of Japanese schoolchildren whose parents have taken them abroad as part of a corporate or diplomatic posting: officials in prestigious and influential government agencies; informally organised groups of diplomatic and corporate wives; and the 'mew' - a support group of young adults who have been victims of the kikokushijo experience.

It is also important to keep in mind that not all claims-makers are to be found among the grass roots or civil society. For example, it has been suggested that the contemporary 'obesity crisis' has been captained by 'a relatively small group of scientists and doctors, many directly funded by the weight-loss industry, [who] have created an arbitrary and unscientific definition of overweight and obesity' (Oliver 2005, cited in Gibbs 2005: 72).

7.5 Claims making process

Wiener (1981) has depicted the collective definition of social problems as a continually ricocheting interaction among three sub-processes: animating the problem (establishing turf rights, developing constituencies, funnelling advice and imparting skills and information); legimating the problem (borrowing expertise and prestige, redefining its scope, e.g. from a moral to a legal question, building respectability, maintaining a separate identity); and demonstrating the problem (competing for attention, combining for strength, i.e. forging alliances with other claims-makers, selecting supportive data, convincing opposing ideologists, enlarging the bounds of responsibility). These are overlapping rather than sequential processes which together result in a public arena being built around a social problem.

Hilgartner and Bosk (1988) have identified these arenas of public discourse as the prime location for the evaluation of social problem definitions. However, rather than examining the stages of problem development, they propose a model which stresses the competition among potential social problems for attention, legitimacy and societal" resources. Claimsmakers or 'operatives' are said to deliberately adapt their social problem claims to fit their target environments; for instance, by packaging their claims in a novel, dramatic and succinct form or by framing claims in politically acceptable rhetoric.

Best (1989b: 251) poses a number of useful questions about the claims-making process. Whom did the claims-makers address? Were other claims-makers presenting rival claims? What concerns and interests did the claims-makers' audience bring to the issue, and how did these come to shape the audience's responses to the claims? How did the nature of the claims or the identity of the claims-makers affect the audience's response?

7.6 Key tasks

In defining environmental problems, bringing them to society's attention and provoking action, claims-makers must engage in a variety of activities. Some of these are centrally concerned with the collective definition of potential problems, others with the collective action necessary to ameliorate them (Cracknell 1993: 4-). This is not to say that elements of definition and action do not interweave constantly. Neyertheless, environmental problems do follow a certain temporal order of development as they progress from initial discovery to policy implementation.

In this section of the chapter, I identify three central tasks that characterise the construction of environmental problems. In doing so, I draw upon two prior models: Carolyn Wiener's (1981) three processes through which a public arena is built around a social problem, and William Solesbury's (1976) three tasks which are necessary for an environmental issue to originate, develop and grow powerful within the political system.

As already noted earlier in this chapter, in her book The Politics,?! Alcoholism, Wiener depicted the collective definition of social problems as a continuing ricocheting interaction among three processes: animating, legitimising and demonstrating the problem. These are presented as overlapping rather than sequential processes; that is, they interact with one another rather than operate independently.

Solesbury's scheme is more concerned with the political fate of environmental concerns. He notes the 'continuing change in the agenda of environmental issues' that may be partly accounted for by changes in the state of the environment itself (see Ungar 1992) and partly through changing public views as to which issues are important and which are not. All environmental issues, he states, must pass three separate tests: commanding attention, claiming legitimacy and invoking action. Like Wiener, Solesbury points out that these tasks may be pursued simultaneously in no particular order (Cracknell 1993: 5), although it would presumably be difficult to invoke policy changes before the problem is recognised and legitimised.

In considering the social construction of environmental problems, it is possible to identify three key tasks: assembling, presenting and contesting claims.

7.7 Assembling environment claims

The task of assembling environmental claims concerns the initial discovery and elaboration of an incipient problem. At this stage, it is necessary to engage in a variety of specific activities: naming the problem, distinguishing it from other similar or more encompassing problems, determining the scientific, technical, moral or legal basis of the claim, and gauging who is responsible for taking ameliorative action.

Environmental problems frequently originate in the realm of science. One reason for this is that ordinary people have neither the expertise nor the resources to find new problems. For example, knowledge about the ozone layer is not tied to our everyday experience; it is available only through the use of high technology probes into the atmosphere above the polar regions (Yearly 1992: 116)

Some problems, however, do relate more closely to our life experiences. Concern over toxic wastes frequently begins with local citizens who come to draw a causal link between seeping dump sites and a perceived increase in the neighbourhood incidence of leukaemia, miscarriages, birth defects and other health problems. This is what occurred in Niagara Falls, New York State, where Lois Gibbs and her neighbours were the first to associate their health-related problems with the chemical wastes buried thirty years before in the reside in the

Table 2 Key tasks in constructing environmental problems

	Task		
	Assembling	Presenting	Contesting
Primary aaivities	discovering the problem naming the problem determining the basis of the claim establishing parameters	commanding attention legitimating the claim	invoking action mobilising support defending ownership
Central forum	science	mass media	politics
Predominant layer	scientific	moral	legal
Predominant scientific role(s)	trend spotter	communicator	applied policy analyst
Potential piifalls	lack of clarity ambiguity conflicting scientific evidence	low visibility declining novelty countervailing claims	co-optation issue fatigue
Strategies for success	creating an experiential focus streamlining knowledge claims scientific division of labour	linkage to popular issues and causes use of dramatic verbal and visual imagery rhetorical tactics and strategies	networking developing technical expertise opening policy windows

abandoned Love Canal. Those whose jobs or recreational pursuits bring them into close contact with nature on a daily basis (farmers, anglers, wildlife officers) may also be the initial source of claims because they pick up early environmental warning signals such as reproductive problems in livestock or mutations in fish. Acid rain was first launched as a contemporary environmental problem when a fisheries inspector in a remote area of Sweden telephoned researcher Svante Oden with the observation that there appeared to be a link between a rising incidence of fish deaths and an elevation in the acidity of lakes and rivers in the area.

Practical knowledge about the environment often originates from the everyday experience of villagers, small farmers and others in Southern societies. Sir Albert Howard, often regarded as the originator of organic agriculture, derived many of his ideas from consulting with peasant cultivators in India whom he called his 'professors' (Howard 1953: 222) a strategy which was considered revolutionary in the context of British colonial administration. More recently, grassroots activists in Third World countries have emphasised the importance of 'ordinary knowledge' (Lindblom and Cohen 1979) that depends more on keen observation and common sense than on professional techniques. This ordinary knowledge is accumulated within local grassroots networks by breathing air, drinking water, tilling soil, harvesting forest produce and fishing rivers, lakes and oceans (Breyrnan 1993: 131). In a similar fashion, native (aboriginal) people in Northern societies accumulate firsthand knowledge of the environment that may not be available to non-indigenous observers. For example; it has been suggested2 that biologists estimating the effect of mega projects on the ecology of rivers in the Canadian north may overlook the existence of a number of fish species simply because they never bother to ask native residents who know the land intimately (Richardson et al. 1993: 87).

In researching the origins of environmental claims, it is important for the researcher to ask where a claim comes from, who owns or manages it, what economic and political interests claims-makers represent and what type of resources they bring to the claims making process.

In the early US conservation movement, environmental claims were largely traceable to an East Coast elite who utilised a network of 'old boy' ties to secure funding and political action. Enthusiastic amateurs, they dominated the boards of zoos, natural history museums and other public institutions from where they were able to direct campaigns to save redwood trees, migratory birds, the American bison and other endangered species and habitats (Fox 1981). In a similar fashion, the threat to British birds, wildlife sites and other elements of nature was proclaimed in the late nineteenth and early twentieth centuries by a number of conservation groups with elite membership (Evans 1992; Sheail 1976).

By contrast, present day environmental claims-makers are more likely to take the form of professional social movements with paid administrative and research staffs, sophisticated fund-raising programmes and strong, institutionalised Jinks both to legislators and the mass media. Some groups even use door-to-door canvassers who are paid an hourly wage or get to keep a percentage of their solicitations. Campaigns are planned in advance, often in pseudo-military fashion. Grassroots participation is not encouraged beyond 'paper memberships' with control centralised in the hands of a core group of full-time activists.

The process of assembling an environmental claim often involves a rough division of labour. While there are notable exceptions, research scientists are normally handicapped by a combination of scholarly caution, excessive use of technical jargon and inexperience in handling the media. As a result, an important finding may lie fallow for decades until proactively transformed into a claim by entrepreneurial organisations (Greenpeace, Friends of the Earth, Sierra Club) or individuals (Paul Ehrlich, Jeremy Rifkin). Greenpeace's claimsmaking activity, for example, does not so much flow out of its ability to construct entirely new environmental problems but rather from its genius in selecting, framing and elaborating scientific interpretations which might otherwise have gone unnoticed or been deliberately glossed over (Hansen 1993b: 171). Indeed, the nature of the relationship between the news media and environmental pressure groups such as Greenpeace has become sufficiently institutionalised (Anderson 1993a: 55) that it would be difficult for an emergent problem to penetrate the mass media arena without at least token validation from the latter.

In assembling an environmental problem, not all explanations are created equally. Claims that hinge on difficult to understand concepts such as 'entropy' are far less likely to stick than those that have at their nucleus more readily comprehensible constructs, for example, 'extinction' or 'overpopulation'. Sometimes, the basic outline of a claim only becomes clear in the context of a political, economic or geographic 'crisis'. This was the case in 1973 when concerted action by OPEC (Organisation of Petroleum Exporting Countries), the oil producers' cartel, triggered an energy crisis in industrial nations in the West. Similarly, the abnormally hot US summer of 1988 gave the problem of global warming a visible, experiential focus.

7.8 Presenting environmental claims

In presenting an environmental claim, issue entrepreneurs have a dual mandate: they need both to command attention and to legitimate their claim (Solesbury 1976). While not unrelated, these constitute two quite separate tasks.

As Hilgartner and Bosk's (1988) model emphasises, the arenas through which social problems become defined and conveyed to the public are highly competitive. To command attention, a potential environmental problem must be seen to be novel, important and understandable- the same values which characterise news selection in general (Gans 1979).

One effective way of commanding attention is through the claimants' use of evocative verbal and visual imagery. Thus the extreme thinning of the ozone layer became much more saleable as an environmental problem when depicted as an expanding 'hole'; American children's entertainer Bill Shontz has even recorded a hit song entitled Hole in the Ozone. Similarly, the effects of acid rain were successfully dramatised when German environmentalists began to use the term Waldsterben (forest die-back). More recently, Larson et al. (2005) have demonstrated the prevalence of militaristic metaphors (attack, destroy, wipe out, contain, counteroffensive, full-scale war) in the media reporting of three contested areas of science society discourse (invasive species, foot-and-mouth disease and SARS (Severe Acute Respiratory Syndrome). Visual language can be especially powerful in carrying out this task. For example, technical data on the size of seal herds and codfish stocks instantly lost relevance when Brian Davies and other activists released photos to the media of baby seal pups being clubbed to death on the ice floes of Labrador.

It is not unusual, however, for these visual images to be streamlined so as to underline a central image. Mazur and Lee (1993: 711) give several striking examples of this. The NASA satellite pictures of the ozone hole over the Antarctic, which became a 'logo' of the problem, transformed continuous gradations in real ozone concentration into an ordinal scale that is colour-coded, conveying the erroneous impression that a discrete, identifiable hole could actually be located in the atmosphere over the South Pole. In August 1988, a New York Times article on rainforest destruction was accompanied by a stunning satellite photograph of the burning Amazon that was created by Alberto Setzer of the Brazilian Institute of Space Research. The photograph showed what appeared to be nearly 100,000 fires; however, it was really a composite of many separate pictures and included fires in areas of secondary forest growth as well as virgin rainforest.

Environmental issues may be forced into prominence when exemplified by particular incidents or events, for example, the nuclear accidents at Chernobyl and Three Mile Island, the Bhopal chemical disaster, the wreck of the oil tankers Torre)' Canyon and Exxon Valdez. Dramatic events like these are important because they assist political identification of the nature of an issue, the situations out of which it arises, the causes and effects, the identity of the activities and the groups in the community which are involved with the issue (Solesbury 1976: 384--5).

Staggenborg (1993) has identified six major types of 'critical events' that affect social movements such as the environmental movement. Large-scale socio-economic and political events such as wars, depressions and national elections influence the opportunities for collective action by altering perceptions of grievances and threats; for example, the 1980 election of US President Ronald Reagan led to increased memberships in environmental groups since it raised the spectre of a free enterprise run rampant in national parks and other wilderness settings. National disasters and epidemics can represent a turning point in the movement, highlighting grievances and bringing about movement growth. Similarly, industrial and nuclear accidents can be potentially useful to the movement by laying bare policies and features of the power structure that are normally hidden; for example, the power of the oil companies in the Santa Barbara oil spill (Molotch 1970). Critical encounters involve face-to-face interaction between authorities and other movement actors focusing attention on movement issues. Strategic initiatives are events created by deliberate actions taken by supporters or opponents to advance movement or counter-movement goals. The staged events that are characteristic of Greenpeace campaigns are examples of this, as is the publication of polemical books such as Paul Ehrlich's The Population Bomb and Jeremy Rifkin's Beyond Beif. Finally, policy outcomes are official responses to collective action by a movement or counter-movement - critical junctures at which movements are forced to renegotiate their strategies, tactics and goals as a result of changes in the political environment. The decision by the Roosevelt administration in 1914- to begin construction of the Hetch Hetchy Dam in Yosemite National Park in order to provide water for a pipeline to San Francisco was such a decision, in that it destroyed any possibility of a further alliance between the resource conservationists as represented by Gifford Pinchot and the preservationists led by John Muir.

Staggenborg's discussion is directed primarily towards the issues of social movement mobilisation and strategies, but her typology of events is relevant to the presentation of environmental claims insofar as environmental organisations often represent the primary claims-makers at this stage of the construction of environmental problems.

Of course, not all critical events are guaranteed to generate a high profile problem. According to Enloe (1975: 21), an event provokes an environmental issue when it (1) stimulates media attention; (2) involves some arm of the government; (3) demands governmental decision; (4-) is not written off by the public as a freak, one-time occurrence; and (5) relates to the personal interests of a Significant number of citizens. These criteria are partly a function of the incident itself but also depend on the successful exploitation of the event by environmental promoters.

In presenting environmental claims, movement leaders engage in what Snow et al. (1986) call the process of 'frame alignment'; i.e. environmental groups tap into and manipulate existing public concerns and perceptions in order to broaden their appeal. For example, Greenpeace primarily chooses topics and organises campaigns in areas that can lend themselves to the widest public resonance (Eyerman and Jamison 1989: 112) while avoiding those which are more divisive. In a similar fashion, environmental movement opponents attempt to appeal to a wider public by linking new technologies or programmes to popular issues and causes. Thus the biotechnology industry has tried to foster a public image of an incremental and benign technology that is useful in promoting economic development (Plein 1991). Commanding attention is not, however, sufficient to get a new issue on the agenda for public debate (Solebury 1976: 387). Rather, emergent environmental problems must be legitimated in multiple arenas - the media, government, science and the public.

One way to achieve this legitimacy is through the use of the rhetorical tactics and strategies cited by Best (1987) and Ibarra and Kitsuse (1993). Rather than follow a chronological order, as Best suggests, environmental rhetoric has become increasingly polarised. Ecofeminists, deep ecologists and other purveyors of what Dryzek (2005) calls 'green radicalism' have tended to adopt a 'rhetoric of rectitude' which justifies consideration of environmental problems on strictly moral grounds. By contrast, environmental pragmatists, who advocate sundry versions of the 'sustainable development' paradigm, tend towards a rhetoric of rationality. Green business, for example, is based on the premise that environmentalism can be both socially useful and profitable.

This cleavage can be illustrated with reference to the loss of tropical rainforests in Brazil, Malaysia and Indonesia. Pragmatists argue that the loss of these rainforests is a serious problem because it leads to the extinction of rare indigenous insects, plants and animals that are invaluable to pharmaceutical companies as sources of new wonder drugs. Environmental purists, on the other hand, base their claims on a rhetoric that stresses the inherent spiritual value of these endangered habitats.[4]

Environmental claims can also be legitimated when their sponsors become legitimate and authoritative sources of information. Hansen (1993b) has demonstrated that Greenpeace has achieved this kind of sustained success as a claims-maker in a number of ways: by acting as a conduit for the dissemination of new scientific developments between the research community and the media; by becoming a 'shorthand signifier' for everything environmental-environmental caring, green lifestyles, environmentally conscious attitudes - and by producing knowledge and information which can be used strategically in public arena debates (see Eyerman and Jamison 1989).

It is sometimes possible to pinpoint an event which constitutes the turning point for an environmental problem and when it breaks through into the zone of legitimacy . With regard to global warming, this occurred at US Senate hearings in 1988 when Dr James Hansen made the claim that he was 99 per cent sure that the warming of the 1980s was not due to chance but rather to global warming. In the case of ozone depletion, the key event was a 1988 NASA/NOAA report providing hard evidence for the first time implicating CFCs (chlorofluorocarbons) in ozone layer depletion. With pulp mill dioxins, it was the 1987 release of the '5 Mill Study' showing that traces of this toxic chemical had been detected in various household paper products and the subsequent front-page story in the New York Times that launched this problem in the United States, and, later, in Canada (Harrison and Hoberg 1991).

Yet scientific findings and testimony by themselves are not always sufficient to push an environmental problem past the break point of legitimacy. In the case of global warming, Dr Hansen's earlier Senate testimony in 1986, where he predicted that significant global warming might be felt within five to fifteen years, did not attract comparable coverage or concern. This only occurred two years later when there had been a Significant shift in media practices and public attention (Ungar 1992: 4-92). Similarly, Molina and Rowland's

1974publication in the journal Nature of their theory that CFCs were destroying the ozone layer at first only brought limited coverage in the California press. It was only later on when the issue became linked to claims that other gases from aerosol cans, notably vinyl chloride, were linked to skin cancer, that their data were given wide attention and media legitimacy (Mazur and Lee 1993: 686).

7.9 Contesting environmental claims

Even if an emergent environmental claim manages to transcend the threshold of legitimacy, this does not automatically ensure that an ameliorative action will be taken. As Gould et al. (1993: 229) have noted, one can interpret environmental protection history from the position that environmental movements have been far more successful in getting listed on the broad political agenda than in getting their policies within this agenda, especially where these policies might require the reallocation of resources away from largescale capital interests and state bureaucratic actors.

Solesbury (1976: 392-5) has noted a number of factors that can contribute to an issue being lost at the point of decision or action. Major external constraints such as the onset of a national economic crisis may lead to a problem being postponed, then altogether abandoned. A problem may be transformed into a less threatening political issue. Opponents within government bureaucracies may use a number of tactics - postponing discussion, referring an item back for further research or amendment - which ensure that a problem will not immediately be acted upon.

"As a consequence, invoking action on an environmental claim requires an ongoing contestation by claims-makers seeking to effect legal and political change. While scientific support and media attention continue to constitute an important part of the claim package, the problem is principally contested within the arena of politics. Contesting an environmental problem within the political policy stream is a fine art, given the cross pressures which legislators face.

Environmental entrepreneurs must skilfully guide their proposals through a log jam of vested and often conflicting political interest groups, each of which is capable of stalling or sinking the proposals. As Walker has noted:

Public [environmental] policies seldom result from a rational process in which problems are precisely identified and then carefully matched with optimal solutions. Most policies emerge haltingly and piecemeal from a complicated series of bargains and compromises that reflect the biases, goals and enhancement needs of established agencies, professional communities and ambitious political entrepreneurs.

Kingdon (1984) observes that policy proposals that survive in this political jungle usually satisfy several basic criteria.

First, legislators must be convinced that a proposal is technically feasible; that is, if enacted, the idea will work. This may not prove to be the case in hindsight; for example, the Endangered Species Act in the United States has worked out much less perfectly in its implementation than on paper. Nevertheless, a proposal must at least initially appear to be scientifically sound and politically administrable.

Second, a proposal that survives in the political community must be compatible with the values of policy-makers. Since most bureaucrats and politicians do not hold ecocentric views, this means that solutions which reflect the New Ecological Paradigm are not likely to get very far unless there is a generally perceived crisis. Instead, environmental solutions that appear, on the surface, to be neutral stand a better chance of being accepted than those that seem ideologically tinged. Furthermore, problems that are framed in utilitarian terms often go further than those that are not. This means that arguments made with financial expediency in mind - figures and statistics translated into 'bottom-line' dollars (pounds/ euros) - are more likely to resonate than those that are presented solely on the basis of moral justifications (Hunt et a1. 1994: 200-1). .

Environmental policy is by no means a perfectly predictable and consistent enterprise. For example, Milton (1991) has suggested that the British government routinely adopts a contradictory approach to the environment. On domestic pollution issues it adopts a rigid, hierarchical position that tends to retard change. This has been guite evident in, for example, the British response to the acid rain problem. By contrast, on international environmental problems such as global warming, the UK has adopted a more 'entrepreneurial' approach. On wildlife and conservation issues an approach that constitutes a mixture of the hierarchical and the entrepreneurial is favoured. Sometimes, an issue will rise in the policy agenda for totally unexpected reasons. This occurred with the greenhouse effect which initially achieved the stamp of seriousness not in terms of a long-range threat to the world climate but in relation to what was basically a side issue: the environmental implications of the large-scale deployment of the supersonic transport airplane (SST) in the early 1970s (Hart and Victor 1993: 663-4).

Thus successfully contesting an environmental claim in the political arena requires a unique blend of knowledge, timing and luck. This process is often event-driven with a disaster such as the Three Mile Island nuclear accident opening up 'political windows' (Kingdon 1984: 213) that would otherwise remain closed. This is not to say that agendasetting and legislative action are totally random but that the process is highly contingent upon a number of internal and external factors, many of which are not linked to the obvious merits of the case.

At the same time, there may also be a contest for 'ownership' of an environmental problem. This can be particularly rancorous where one of the contesting parties is drawn from the ranks of those directly victimised by a problem. There are many examples of this in the social problems field ranging from 'deviance liberation movements' such as the American prostitutes' rights campaign Uenness 1993; Weitzer 1991) to victims' rights groups; for example, those formed by breast cancer patients. This is less common with environmental problems, which generally have a more diffused impact. One significant example, however, is the dispute over the issue of who owns 'biodiversity' both as a resource and as an environmental problem (see Chapter 9). This struggle pits a coalition of small farmers, ecological activists and others in Third World countries against the conservation establishment: biologists, bureaucrats from non-governmental organisations and government ministries dealing with trade and environmental issues.

7.10 Sum up

Hawkins (1993) has identified three ideal-type paradigms that occupy the increasingly contested discourse over global environmental futures. The prevailing 'global managerialist paradigm' advocates the detection and solution of problems in the globalised commons by an existing configuration of nation states and international organisations buttressed by scientific experts and professional environmentalists within international NGOs (nongovernmental organisations). This approach downplays local perceptjons and definitions of problems, and on occasion may even blame poor people in Third World nations for causing environmental degradation. The 'redistributive development paradigm' recognises the need for greater equity in matters pertaining to development and the environment in Southern countries. It proposes that such inequities can be redressed through a number of innovative measures such as the Green Fund within the World Bank or debt-for-nature swaps. The 'new international sustainability order paradigm' calls for a fundamental restructuring of the world order such that Third World nations claim a more direct voice in establishing a balance between economic and social sustainability.

Hawkins depicts the construction of international environmentalism as reflecting an ongoing struggle among supporters of these three paradigms. The dispute over the ownership of biodiversity is one manifestation of this; the conflict over global climate change is another. Even the language used in defining this contested ground is itself socially constructed. For example, countries of the North have adopted a globalised language to describe the situation in Southern nations in which 'our' environmental problems (climate change, ozone depletion) are caused by 'their' development problems (forest loss, overpopulation), a situation which is solvable only by embracing 'sustainable development' strategies (Redclift and Woodgate 1994: 64-5). At present, the first two paradigms still predominate but the new international sustainability order paradigm appears to be making some significant inroads.'

-000-

Structure

8.1 Objectives

The main objective of this chapter is to equip you with:

- Classical sociological theroriels.
- Sociological pioneers view on nature and society

8.2 Introduction

One possible source of inspiration for contemporary sociologists seeking to engage with environmental topics is the canon of classical social theory, notably that bequeathed to us by Durkheim, Weber and Marx. To a certain extent each of these sociological pioneers had something significant to say about nature and society, although this was often more implied than direct, and was embedded in the philosophical controversies and scholarly debates of the time in which they were writing.

Some commentators have been decidedly downbeat about the potential usefulness of this canon. Goldblatt (1996: 1-6), for example, advises that we be wary of the legacy left to us by classical sociological theory insofar as it lacks an adequate conceptual framework with which to understand the complex interactions between societies and environments. Rewarding though it may be, Jarvikowski (1996: 82-3) says, the reading of classic works by this triumvirate is simply not sufficient for adequate theorizing of contemporary environmental problems. Finally, Butte! (2000: 19) concludes that the legacy bequeathed by classical sociology is very much mixed: some of the tools initially developed by the classical theorists are needed, but 'the overall thrust of the classical tradition was to down play ecological questions and biophysical forces' .

On the other hand, there is a rich and expanding corpus of work in which environmental scholars seek to reveal this conventional wisdom to be premature. As we will see, some commentators (William Catton, John Bellamy Foster) deliberately adopt the strategy of extracting 'ecological' insights from the work of the classic thinkers that have been overlooked or misunderstood in the past. Others (Raymond Murphy, Peter Dickens) are more inclined to smoke out concepts and ideas from the collected works of the sociological pioneers, even if these were not originally used in an environmental context, and apply them to the current environmental 'crisis' with some intriguing results. Some analysts have chosen to adopt a typological approach, organising the field on the basis of classical theory. For example, Sunderlin (2003) defines and conceptualises three key paradigms (individualist, managerial, class), each of which is derived from the classical sociological literature (Durkheim, Weber, Marx).

8.3 Emile Durkheim

Of the three founding figures in sociology, Durkheim is probably the least likely to be recognised as an environmental commentator.[2] In large part, this reflects his deliberate decision to elevate social facts over 'facts of a lower order' (that is, psychological, biological).

For Durkheim, a social fact is 'any way of acting, whether fixed or not, capable of exerting over the individual an external constraint' (2002 [1895]: 117). This constraint is normally manifested in the form of law, morality, beliefs, customs and even fashions. We can verify the existence of a social fact, Durkheim ventured, by examining an experience that is characteristic. For example, children are compelled to adopt ways of seeing, thinking and acting that they otherwise would not have arrived at spontaneously.

Durkheim is quite firm in asserting that social phenomena cannot be explained through the lens of individual psychology. It is a central rule of the sociological method that 'the determining cause of a social fact must be sought among antecedent social facts and not among the states of individual consciousness' (p.125). This rule may infuriate strong advocates of individualism, but no matter. Social facts, Durkheim insists 'are consequently the proper field of sociology' (p.112).

While this vigorous defence of social facts and collective consciousness most certainly buttressed the theoretical independence of sociology, it also had the effect of warning off members of the new discipline from non-sociological approaches that were reductionist in nature (that is, they reduced explanation to biological or psychological factors).

Nevertheless, Durkheim himself frequently utilized biological concepts and metaphors in presenting his theory of societal transformation. Furthermore, this theory was most certainly inspired by the Darwinian evolutionary model that was popular among intellectuals in the late nineteenth century. In The Division if Labour in Society (1893), he describes the evolution of modern societies from a state of mechanical solidarity, wherein social solidarity is a product of shared cultural values, to one of orsanic solidarity, where the social bond is a function of interdependence, most notably that arising out of an increasingly complex division of labour.

Catton (2002: 92) proposes that Durkheim's theory was very much an attempt to devise a solution to what is essentially an ecological crisis of rising population paired with scarce resources. As societies became larger and denser, it would have been disastrous if everyone had continued to engage in agriculture. Increasingly, occupational specialisation meant that the competition over arable land was lessened, even as that land became more productive thanks to technological innovation.

Alas, Durkheim was doubly hobbled, Catton says, both by his narrowly selective reading of Darwin and by the unavailability in the 1880s of our knowledge today of ecology and evolution (2002: 93). In the first instance, he erroneously supposed that Darwin believed increasing diversity to be a way of minimising competition for scarce resources. Rather, Darwin cautioned that co-evolution (two species evolving at the same time) could, in some cases, increase their resemblance to one another or result in one species bringing the other to extinction. In short, Darwin viewed specialisation as a way in which one species could gain competitive advantage over another, not, as Durkheim believed, as a way of lessening rivalries and increasing mutual interdependence. Furthermore, Durkheim could not have been privy to the insights of modern ecology, which did not emerge as a sub-field of biology until the next century. Most crucially, no one in Durkheim' s time recognised that mutual dependence was symbiotic but not necessarily balanced. That is, some interactions in nature benefit both member populations (mutualism) but others benefit one without either harming or benefiting the other (commensalism); and yet others are beneficial to one and detrimental to the other, as with predators and parasites (Catton 2002: 93). The latter gives rise to power differences, something especially significant when you are dealing with human ecological communities.

What we are left with then is chiefly speculation on what might have been. Citing Talcott Parsons (1978: 217), Jarvikowski (1996: 82) ventures that Durkheim would likely have written in a different way today about the relations between the social and physical environments because biological theory has undergone a profound process of change.

8.4 Max Weber

A second sociological pioneer whose work is said to possess an ecologically releyant component is Max Weber. As Buttel (2002) has pointed out, this environmental connection has been located in two entirely different corners of Weber's work by Patrick West and Raymond Murphy.

West (1984) draws mostly on Weber's historical sociology of religion and his comparative research on ancient societies. He emphasises that Weber ana lysed concrete examples of struggles over natural resources, for example, the control of irrigation systems.

By contrast, Murphy's more extensively drawn discussion of neo- Weberian environmental sociology is based primarily on Weber's book Economy and Society (1978 [1922]). For Murphy, the key concept to be extracted here is formal rationalisation. Rationalisation is composed of several dynamic institutional components. Increased scientific and technical knowledge brings with it a fresh orientation in which nature exists only to be mastered and manipulated by humans. An expanding capitalist market economy lea yes little room for anything beyond the calculating, self-interested pursuit of market domination. Industry and government are controlled by a bureaucratic apparatus, the purpose of which is to attain a high level of efficiency. The legal system operates like a technically rational machine. Together, these components promote a pervasive logic whereby efficiency reigns supreme, on occasion even superseding a sensible choice of goals or alternatives, what Weber called substantive rationality. Formal rationality thus dictates that the most efficient action is to clear-cut an old growth forest, even if this is in no way substantively rational from an ecological point of view (Murphy 1994: 29 30).

Murphy (1994: 34) identifies two interrelated processes first highlighted by Weber at the beginning of the twentieth century that have become distinctive features of our time: the intensification of rationality and the intensification of rationality and the magnification of rationality. The more we try to run things according to the principle of dispassionate calculation the more we open the door to a swarm of unwanted and negative effects. When applied to the case of nature, this is called ecological irrationality. It is manifested in a wide range of destructive consequences from sensational technological disasters such as nuclear accidents to routine pollution events such as industrial dumping into urban storm sewers.

Drawing on another of Weber's (1946 [1918)) concepts - Intellectual rationality Freudenburg (2001) ,.makes an important point about science, technology and risk. In contrast to tribal societies, the average individual in an industrial society cannot know more than a minimum about how technology works - unless he or she is a physicist, one who rides on the streetcar has no idea how the car happened to get into motion (Weber 1946 [1918]: 138-9). Consequently, while one may in principle master all things by intellectual calculation, in reality we depend on an army of experts to do so. Yet, as Freudenburg notes, this expectation is inherently problematic because a minority of the time these experts fumble the ball, leading to potential, and sometimes actual, environmental emergencies.

8.5 Karl Marx

Of the three main sociological traditions, it is that associated with Karl Marx that has provoked the most extensive response from present-day environmental interpreters. Marx and his early collaborator Friedrich Engels were only marginally concerned with environmental degradation per se but their analysis of social structure and social change has become the starting point for several formidable contemporary theories of the environment.

Marx and Engels believed that social conflict between the two principal classes in society, that is capitalists and the proletariat (workers), not only alienates ordinary people from their jobs but also leads to their estrangement from nature itself. Nowhere is this more evident than in 'capitalist agriculture' which puts a quick profit from the land ahead of the welfare of both humans and the soil. As the industrial revolution proceeded through the eighteenth and nineteenth centuries, rural workers were removed from the land and driven into crowded, polluted cities while the soil itself was drained of its vitality (Parsons 1977: 19). In short, a Single factor, capitalism, was held responsible for a wide range of social ills from Overpopulation and resource depletion to the alienation of people from the natural world with which they were once united. Marx and Engels saw the solution as the overthrow of the dominant system of production, capitalism, and the establishment in its place of a 'rational, humane, environmentally unalienated social order' (Lee 1980: 11).

Marx and Engels argue for the establishment of a new relationship between people and nature. However, it is not entirely clear what form such a relationship should take. In the work of the more mature Marx, this seems to follow a distinctly anthropocentric direction depicting humans as achieving mastery over nature, in no small part because of technological innovation and automation. This has been ailed a Promethean (pro-technological, antiecological) attitude toward nature (Foster 1999: 372; Giddens 1981: 60).

By contrast, in Marx's early work the concept of the 'humanisation of nature' is proposed. This suggests that humans will develop a new understanding of and empathy with nature. A key question here is whether this new understanding would be used solely for human emancipation or whether it would take a more 'ecocentric' form in which the powers and capacities of non-human species would be enhanced. In the former case, the humanisation of nature might, in fact, be deployed to eliminate species and organisms that threaten human health (Dickens 1992: 86). As Martell (1994: 152) observes, the texts of the early Marx are too complicated and contradictory on ecological concerns to be the basis for a fully fledged theory of environmental protection; it may be more useful to pursue this project through other sources or frameworks.

Contemporary Marxist theory emphasises not only the role of capitalists but also that of the state in fostering ecological destruction. Both elected politicians and bureaucratic administrators are depicted as being centrally committed to propping up the interests of capitalist investors and employers. While the incentive here is partly material (e.g. corporate campaign contributions, future job offers), public servants, politicians and capitalist producers are said to share an 'ethic' which accentuates capitalist accumulation and economic growth as the dual engines which drive progress. This, they argue, applies at all political levels from the global system to the local community.

One widely noted reading of Marx's environmental views is John Bellamy Foster's seminal article on Marx's theory of metabolic rift. According to Foster, Marx has been wrongly accused of providing little insight into the 'ecological crisis' of our times. Indeed, due to the Promethean attitude that suffuses his later writing he may even have impeded the understanding of environmental problems. To the contrary, Foster argues:

Marx provided a powerful analysis of the main ecological crisis of his day - the problem of soil fertility within capitalist agriculture - as well as commenting on the other major ecological crises of his time (the loss of forests, the pollution of the cities, and the Malthusian specter of overpopulation). In doing so, he raised fundamental issues about the antagonism of town and country, the necessity of ecological sustainability, and what he called the 'metabolic' relation between human beings and nature.

8.6 Sum up

It is this latter issue that Foster addresses most substantively in his article. Borrowing from the vocabulary of mid-nineteenth-century chemistry, Marx employed the concept of metabolism to describe the complex interaction between society and nature. Metabolism, he observed 'constitutes the fundamental basis on which life is sustained and growth and reproduction become possible' (Foster 1999: 383). By the 1860s, this organic relationship was being seriously undercut by the practices of capitalist agriculture. Most notably, landowners were accused of callously robbing the soil of its key nutrients by declining to recycle them. This, of course, is exactly what is still occurring, especially where monocultures (a single variety of a single crop grown for commercial profit) prevail. Marx describes this as a 'metabolic rift'- the estrangement of human beings from the natural world of the soil. This paralleled the estrangement of workers from their labour and was attributable to the same source - capitalism.

Rather than a huckster for chemical agriculture, Marx (and Engels) appears to have been an early advocate of organic farming methods. For example, he writes at length about the benefits of spreading manure on crop lands, even suggesting that human waste from the city be recycled as fertiliser rather than polluting the rivers and oceans. Strangely enough, his inspiration for this view seems to have been the German agricultural chemist Justus von Liebig, who achieved renown as the inventor of synthetic fertilisers. By the late 1850s, Liebig had evidently come to the conclusion that soil depletion was becoming a major problem, especially in America where vast tracts of arable land were cultivated for the sole purpose of exporting grain to the big cities. Liebig even went so far as to recommend that the city of London organically recycle its sewage rather than dump it in the river Thames.

For Foster, the importance of Marx's theory of metabolic rift lies not just in his repatriation of Karl Marx as an advocate of organic agriculture but also in his successful application of sociological thinking to the ecological realm. Foster (1999: 400) calls this 'one of the great triumphs of classic sociological analysis' and proof that 'ecological analysis, devoid of sociological insight is incapable of dealing with the contemporary crisis of the earth'. Furthermore, it provides a portal through which contemporary environmental analysts might better understand the metabolic relation between humans and nature.

One recent effort along these lines is York al's (2003: 36-8) discussion of how the metabolic rift can lead to increases in GHG (greenhouse gas) emissions. Three ways this occurs are specified here: the increased transportation of natural resources necessitated by urbanisation; the replacement of organic matter by chemical fertilisers; and the diversion of methane-generating organic waste to landfill rather than back into the Soil.

-000-

Structure

9.1 Objectives

The aim of the chapter is to equip you with :

- understanding of New Ecological Paradigm
- functions of Environment
- contribution of Cotton and Dunlop

9.2 Introduction

In accounting for the causes of widespread environmental destruction, two primary approaches stand out: the ecological explanation as embodied in Catton and Dunlap's model of 'competing environmental functions', and the political economy explanation as found in Alan Schnaiberg's concepts of the 'societal-environmental dialectic' and the 'treadmill of production'. As Buttel (1987: 471) has noted, both approaches view social structure and social change as being reciprocally related to the biophysical environment but the nature of this relationship is depicted very differently.

9.3 Ecological explanation

The ecological explanation for environmental destruction has its roots in the field of 'human ecology' that remained dominant within urban sociology from the 1920s to the 1960s.

This urban ecology model was introduced during the 1920s and 1930s by sociologist Robert Park and colleagues at the University of Chicago. Park was well acquainted with the work of Darwin and his fellow naturalists, drawing on their insights into the interrelation and interdependence of plant and animal species. In his discussion of human ecology, Park (1936 [1952]) begins with an explanation of the 'web of life', citing the familiar nursery rhyme, The House that Jack Built, as the logical prototype of long food chains, each link of which is dependent upon the other. Within the web of life, the active principle is the 'struggle for existence' in which the survivors find their 'niches' in the physical environment and in the division of labour among the different species.

If Park had been primarily interested in the natural environment for its own sake, he might have realised that human intervention in the form of urban development and industrial pollution artificially broke this chain, thereby upsetting the 'biotic balance'. In fact, he did acknowledge that commerce, in 'progressively destroying the isolation upon which the ancient order of nature rested', has intensified the struggle for existence over an everwidening area of the habitable world. But he believed that such changes had the capacity to give a new and often superior direction to the future course of events forcing adaptation, change and a new equilibrium.

Biological ecology was the primary source from which Park borrowed a series of principles, which he applied to human populations and communities. In doing so, however, he notes that human ecology differs in several important respects from plant and animal ecology. First, humans are not so immediately dependent upon the physical environment, having been emancipated by the division of labour. Second, technology has allowed humans to remake their habitat and their world rather than to be constrained by it. Third, the structure of human communities is more than just the product of biologically determined factors; it is governed by cultural factors, notably an institutional structure rooted in custom and tradition. Human society, then, in contrast to the rest of nature, is organised on two levels: the biotic and the cultural.

9.4 New Ecological Paradigm

This portrait of the nature-society relationship clearly contravenes many of the tenets of Catton and Dunlap's New Ecological Paradigm. It emphasises humans' exceptional characteristics (inventiveness, technical capability) rather than their commonality with other species. It gives priority to the influence of social and cultural factors (communication, division of labour) rather than biophysical, environmental determinants. Finally, it down plays the constraints imposed by nature by celebrating the human capacity to master it.

Park, his colleagues and students (notably McKenzie and Burgess) applied their principles of human ecology to the processes that create and reinforce urban spatial arrangements. They visualised the city as the product of three such processes: (1) concentration and deconccntration; (2) ecological specialisation; and (3) invasion and succession. The building blocks of the city wen' said to be 'natural areas' (slums, ghettoes, bohemias), the habitats of natural group" that were in accordance with these ecological processes. The city was depicted as a territorially based ecological system in which a constant Darwinian struggle over land use produced a continuous flux and redistribution of the urban population. Nowhere was this more evident than in the 'zone in transition', an area adjacent to the central business district which went from a coveted residential district to a blighted area characterized by low rent tenants, deviant activities and marginal businesses.

Much of the early criticism of human ecology rested not on its failure to explore the interdependence between the human environment and the natural environment but rather in what was perceived as its failure adequately to account for the role of human values in residential choice and movement. In the late 1940s, a sociocultural critique of mainstream human ecology briefly lit up the landscape of American sociology. Firey (1947) used the example of land use in central Boston to demonstrate that symbolism and sentiment were equally, if not more, important than standard ecological principles in accounting for the shape of the city. Similarly, Jonassen (1949) presented the history of settlement and relocation of Norwegian immigrants to the New York City area as evidence that ethnic groups consciously choose a specific type of residential environment on the basis of values which they bring with them as a type of cultural baggage (in this case, the ideal included the sea, a harbour and mountains). Jonassen's research might have been the launching pad for a body of research on the origins of environmental perceptions (see for example Lynch's (1993) article on constructions of nature in Latin America) but the main thrust of his argument was rather to discredit the economic determinism that characterized the orthodox ecology of the day.

While cultural ecology, per se, never became dominant, it did force more traditional human ecologists to take greater account of social organisational and cultural variables. This was evident in O. D. Duncan's 1961 POET model (Population-Organisation-Environment Technology) which was depicted as an 'ecological complex' in which: (1) each element is interrelated with the other three, and (2) a change in one can therefore affect each of the others. The POET model was a trailblazer in providing insight into the complex nature of ecological disruptions even if it failed to give sufficient weight to environmental constraints. For example, in a causal sequence suggested by Dunlap (1993: 722-3), an increase in population (P) can create a pressure for technological change (T) as well as increased urbanisation (0), leading to the creation of more pollution (E). While it was still rooted in orthodox human ecology, nevertheless, Duncan's POET model with its use of the human ecological complex at times 'came close to an embryonic form of environmental sociology' (Buttel and Humphrey 2002).

In all of this, an important issue is whether the notion of an 'ecosystem' should be accepted at face value or merely treated as an analogy. It seems likely that Park and the Chicago School had the latter in mind, adopting the conceptual language of biological ecology because it was the scientific flavour of the day (see Chapter 3). Other social scientists, however, took the ecological metaphor more literally. For example, the noted economist Kenneth Boulding (1950: 6) claimed that he was using the ecosystem concept in its proper sense, and not merely [as] an analogy. Society was, he wrote, 'something like a great pond' filled with 'innumerable "species" of social life, organisations, households, businesses and commodities of all kinds' (1950: 6).[1]

9.5 Competing functions of the environment

The ecological basis of environmental destruction is probably best described in Catton and Dunlap's own 'three competing functions of the environment' (see Figure1). This scheme has been much less widely disseminated than their theory of the 'dominant social paradigm', even though it is, to my mind, more conceptually interesting.

Catton and Dunlap' model specifies three general functions that the environment serves for human beings: supply depot, living space and waste repository. Used as a supply depot, the environment is a source of renewable and non-renewable natural resources (air, water, forests, fossil fuels) that are essential for living. Overuse of these resources results in

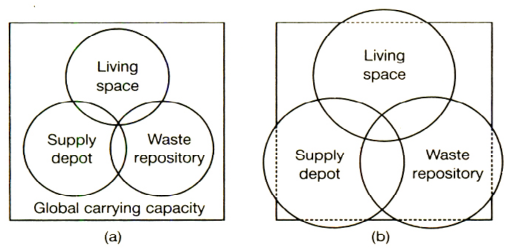


Figure 1 Competing functions of the environment: (a) circa 1900; (b) current situation. Source: Dunlap 1993

shortages or scarcities. Living space or habitat provides housing, transportation systems and other essentials of daily life. Overuse of this function results in overcrowding, congestion and the destruction of habitats for other species. With the waste repository function, the environment serves as a 'sink' for garbage (rubbish), sewage, industrial pollution and other by products. Exceeding the ability of ecosystems to absorb wastes results in health problems from toxic wastes and in ecosystem disruption.

Furthermore, each of these functions competes for space, often impinging upon the others for example, placing a garbage landfill in a rural location near to a city both makes that site unsuitable as a living space and destroys the ability of the land to function as a supply depot for food. Similarly, urban sprawl reduces the amount of arable land that can be put into production while intensive logging threatens the living space of native (aboriginal) peoples.

In recent years, the overlap, and therefore conflict, among these three competing functions of the environment has grown considerably. Newer problems such as global warming are said to stem from competition among all three functions simultaneously. Furthermore, conflicts between functions at the level of regional ecosystems now have implications for the global environment.

There are several very attractive features to Catton and Dunlap's competing functions of the environment model. First and foremost, it extends human ecology beyond an exclusive concern with living space - the central focus of urban ecology - to the environmentally relevant functions of supply and waste disposal. In addition, it incorporates a time dimension: both the absolute size and the area of overlap of these functions are said to have increased since the year 1900.

At the same time, there are problems with the model. As is the case with the urban ecology of Park and the Chicago School, there is no evidence of a human hand here. It says nothing about the social actions involved in these functions and how they are implicated in the overuse and abuse of environmental resources. Above all, there is no provision for changing either values or power relationships. The former is especially puzzling, since one would have thought that Catton and Dunlap would have attempted to link their ecological model to the new human ecology as emphasised in the HEP/NEP contrast. Finally, one cannot help comparing the longitudinal features of the Catton-Dunlap model to Beck's (1992) depiction of the transformation from an industrial to an industrial risk society. Both models recognize some of the same features: the increasing globalization of environmental dangers, the rising prominence of output or waste-related elements as opposed to input or production-related ones. However, Beck's model is ultimately more exciting because it centrally incorporates the process of social definition. Beck's (1992: 24-) criticism of environmental risk assessment, i.e_ that 'it runs the risk of atrophying into a discussion of nature without people, without asking about matters of social and cultural significance', is equally applicable to Catton and Dunlap's competing functions of the environment.

9.6 'Societal-environmental dialectic' and the ''treadmil of production’

Within environmental sociology, probably the most innuential explanation of the relationship between capitalism, the state and the environment can be found in Alan Schnaiberg's book, The Environment: From Surplus to Scarcity (1980). Drawing on strands of both Marxist political economy and neo- Weberian sociology, Schnaiberg outlines the nature and genesis of the contradictory relations between economic expansion and environmental disruption.

Schnaiberg has depicted the political economy of environmental problems and policies as being organised within the structure of modern industrial society, which he labels the treadmill of production. This refers to the inherent need of an economic system to continually yield a profit by creating consumer demand for new products, even where this means expanding the ecosystem to the point „-here it exceeds its physical limits to growth or its 'carrying capacity'. One particularly important tool in fuelling this demand is advertising, which convinces people to buy new products as much for reasons of lifestyle enhancement as for practical considerations.

Sehnaiberg portrays the treadmill of production as a complex self-reinforcing mechanism whereby politicians respond to the environmental fall-out created by capital intensive economic growth by mandating policies that encourage yet further expansion. For example, resource shortages are handled not by reducing consumption or adopting a more modest lifestyle but by opening up new areas to exploitation.

Schnaiberg detects a dialectic tension that arises in advanced industrial societies as a consequence of the connict between the treadmill of production and demands for environmental protection. He describes this as a clash between 'use values'; for example, the' value of preserving existing unique species of plants and animals, and 'exchange values' which characterise the industrial use of natural resources. As environmental protection has emerged as a significant item on the policy agendas of governments, the state must increasingly balance its clual role as a facilitator of capital accumulation and economic growth and its role as environmental regulator and champion.

From time to time, the state finds it necessary to engage in a limited degree of environmental intervention in order to stop natural resources from being exploited with abandon and to enhance its legitimacy with the public. For example, in the progressive era of American politics in the late nineteenth and early twentieth centuries, the US government responded to uncontrolled logging, mining and hunting on wilderness lands by expanding its jurisdiction over the environment. Especially under the presidency of Theodore ('Teddy') Rooseyelt, it created national forests, parks and wildlife sanctuaries, set limits and rules for the use of public lands and restricted the hunting of endangered species. It did so, however, as much out of a desire to increase industrial efficiency (Hays 1959), regulate competition and ensure a steady supply of resources (ModaYi 1991) as it did· from any sense of moral outrage. Similarly, the sudden emergence of toxic waste as a premier media issue in the early 1980s led to Congressional efforts in the United States to pass a new 'Superfund' law that would give the government statutory authority and the fiscal mechanisms to undertake clean-up operations whom first having legally to identify the responsible parties. This was, Szasz (1994: 65) notes, not simply a matter of lawmakers addressing a newly recognised social need, but instead 'one of those quintessential "time to make a new law" moments so characteristic of the American legislati ve process'. Nevertheless, most governments remain wary of running the risk of slowing down the drive towards economic expansion or decelerating the treadmill of production (Novek and Kampen 1992). Caught in a contradictory position as both promoter of economic development and as environmental regulator, governments often engage in a process of 'environmental managerialism' (Redclift 1986), in which they attempt to legislate a limited degree of protection sufficient to deflect criticism but not significant enough to derail the engine of growth. By enacting environmental policies and procedures that are complex, ambiguous and open to exploitation by the forces of capital production and accumulation (Modavi 1991: 270) the state reaffirms its commitment to strategies for promoting economic development.

Other more stridently left-wing critiques have been even more unsparing in linking the dynamics of capitalist development to the rise in environmental destruction. David Harvey (1974), the Marxist geographer, accuses capitalist supremos of deliberately creating resource scarcities in order that prices may be kept high. Faber and 0 'Connor (1993) charge that the goal of capital restructuring in the 1980s and 1 990s, which included geographical relocation, plant closures and downsizing, is to increase the exploitation of both the workers and nature; for example, by reducing spending on pollution control equipment. Cable and Cable refuse to rule out the possibility of insurrection in the United States if the grievances of grass roots environmental groups continue to be ignored by capitalist economic institutions (1995: 121). Schnaiberg himself (2002: 33) has complained that the central tenets of the treadmill have not found their way into the environmental sociological literature in any significant way because they are too 'radical'. That is, if the treadmill was indeed operating as he describes, then it can only be altered by a major and sustained political mobilisation, something that would be sharply resisted by politicians, government agencies and corporate America.

Subsequently, the 'treadmill of production group'2 has addressed the application of the treadmill of production to a Third World context. Ignoring the negative environmental impacts that the treadmill has produced in less developed regions, the leaders of Southern nations, in concert with the governments and corporations of the North, have sought to reproduce industrialisation as experienced by the First World. The primary mechanism for achieving this is the transfer of modern Western industrial techniques from North to South (Schnaiberg and Gould 1994: 167). However, as Redclift (1984) and others have noted, this transplant has become largely unsuccessful both in economic and environmental terms. Dependency on global markets has made economic development a risky venture for many Third World nations, especially where these markets can easily be decimated by the appearance of new, low-cost alternatives elsewhere in the world. Furthermore, development schemes require an expensive infrastructure of roads, hydroelectric power dams, airports, and so on, which must be paid for by borrowing heavily from Northern financial institutions. Such projects often fail to produce the expected level of economic growth while at the same time causing massive ecological damage in the form of flooding, rainforest destruction, soil erosion and pollution.

The treadmill of production explanation has the advantage of locating present environmental problems in the inequities of humanly constructed political and economic systems rather than the abstract conflict of functions preferred by human ecologists. This brings it closer to the orbit of mainstream sociological theory than the more idiosyncratic approach advocated by Catton and Dunlap. At the same time, as Buttel (2004: 323) has observed, the concept of the treadmill is unique insofar as it is based in sociological reasoning but, at the same time, features a key or penultimate dependent variable - environmental destruction that is biophysical. [n Buttel's judgement, this makt's it 'the single most important sociological concept and theory to have emerged within orth American environmental sociology' .

9.7 Sum up

As Schnaiberg himself has recognised, the treadmill of production has not achieved the paradigmatic status within environmental sociology that he would have liked. Buttel offers several possible reasons for this. First, political economy, especially that with a neo-Marxist hue, has been somewhat o"ershadowed in recent decades by other theoretical flavours, notably postmodernism and cultural sociology. Second, treadmill theory has remained somewhat static, wedded to a manufacturing economy in a neo-liberal era in which Western economics seem to have shifted towards new information technologies, financial services and entertainment. Another reason may be simply that the notion of the treadmill is no longer very new or, in spite of what Schnaiberg believes, very controversial. To actually shut down the treadmill, of course, would be quite radical, but as an analysis of industrial and consumer society the model seems rather obvious, something that might not have been the case thirty years ago.

-000-

Structure

10.1 Objectives

The aim of this chapter is to equip the learner with:

- Beck's risk theory
- sociological perspective regarding reeks
- social construction of Environmental Risk

10.2 Introduction

In considering mechanisms of environmental improvement, Buttel (2003) proposes four potential channels: environmental activism/movements (he judges this to be the most fundamental and promising), state environmental regulation, ecological modernisation, and international environmental governance.

Theoretically speaking, two recent models stand out here, both normatively charged, late modernist prescriptions emanating from Germany and Holland. These are Beck's 'risk society thesis' and Mol and Spaargaren's 'ecological modernisation' (EM) theory. The two approaches have often been pitted against one another, insofar as the latter is intended to transform economy-ecology contradictions into win-win situations, while the former claims that our efforts to reform industrial society in the face of an apocalyptic eco-societal crisis are Herculean, if not futile (Blowers 1997; Desfor and Keil 2004: 62). At the same time, the two approaches share an important commonality: the expectation that an 'environmental state' will eventually emerge, where environmental protection is a basic responsibility (Fisher 2003: 9-10).

As we begin the new millennium, probably the most influential attempt to update modernism has been Ulrich Beck's 'risk society thesis'. In comparison to EM theory, Beck is openly critical of modernity and its attendant risks. Nevertheless, he concludes that modernity ultimately has the capacity to solve the problems it produces (Barry 1999: 152).

Beck's thesis starts with the premise that Western nations have moved from an 'industrial' or 'class' society in which the central issue is how socially produced wealth can be distributed in a socially unequal way while at the same time minimising negative side effects (poverty, hunger) to the paradigm of a 'risk society' in which the risks and hazards produced as part of modernisation, notably pollution, must be prevented, minimised, dramatised or channelled. In the case of the latter, risk is said to be much more evenly distributed than was formerly the case. As Beck phrases it, 'hunger is hierarchical, smog is democratic'. Nevertheless, both the former 'wealth distributing society' and the emergent 'risk distributing society' contain inequalities and these overlap in areas such as the industrial centres of the Third World.

Contemporary risks are set apart from those of the past through their origins, scope and effect and the difficulties of identification (see Higgins and Natalier 2004: 78-9). Risk attached to events such as chemical spills and radiation poisoning are more than the unfortunate by products of industrialism and capitalism. Rather, they are a testament to the failure of social institutions, most notably science, to control new technologies. Such risks transcend both space and time, extending well beyond the geographic source, and temporally, beyond the present generation. The 1986 Chernobyl nuclear accident in the Ukraine is a dramatic illustration of this. Due to the 'boomerang effect', risks that are exported abroad, notably to the nations of the South, inevitably come back to haunt us. Finally, risk~ today are said by Beck to be largely invisible to lay people, identifiable only through sophisticated scientific instrumentation.

One important feature of the risk society is the way in which the past monopoly of the sciences on rationality has been broken. Paradoxically, science becomes 'more and more necessary)', but at the same time, less and less sufficient for the socially binding definition of truth' (Beck 1992: 156). Beck contrasts the rigid 'scientific rationality' that prevailed for most of the twentieth century with a new 'social rationality' that is rooted in a critique of progress. Under pressure from an increasingly edgy public, new forms of 'alternative' and 'advocacy' science come into being and force an internal critique. This 'scientisation of protest against science' produces a fresh variety of new public-oriented scientific experts who pioneer new fields of activity and application (e.g. conservation biology). In a similar fashion, monopolies on political action are said to be coming apart, thus opening up political decision-making to the process of collective action. One example of this is the entry of the 'greens' into parliamentary politics in Germany in the 1980s.

Finally, the dynamic of reflexive modernisation leads to a greater individualization. Unbound from the strictures of traditional, pre-modern societies, the new urban citizens of the industrial revolution were supposed to reach new levels of creativity and selfactualisation. However, this did not happen, largely because a new constraint - the 'culture of scientism' - invaded every part of our lives from risk construction to sexual behaviour. Now there is a chance for individuals once again to break free and choose their own lifestyles, subcultures, social ties and identities (p. 131). Each of us, Beck believes, is obliged to reflect upon our personal experiences and make our own decisions about how we wish to live (Irwin 2001: 56). Yet, ironically, just as the individualised private existence finally becomes possible we are confronted with risk conflicts, which by their origin and design, resist any individual treatment. 'Global environmental problems' such as the greenhouse effect and the thinning of the ozone layer are key illustrations of this. Thus the 'reflexive scientisation' in which scientific decision-making, especially that related to risk, is opened up to social rationality is vital to the reclamation of individual autonomy. Democracy should not, he insists, 'end at the laboratory door'.

While Beck's analysis is fresh and powerfully presented, it is not without its problems. As Lidskog (1993) has pointed out in his review of Risk Society Beck contradicts himself by arguing that the planet is in increasing peril due to an escalation of objectively certifiable global risks and, at the same time, insisting that risks are entirely socially constructed and therefore do not exist beyond our perception of them. Bluhdorn (2000: 86) too hones in on this inconsistency, pointing out that Beck 'seems to be undecided whether ecological risks have to be conceptualised as objective empirical realities or as subjective perceptions and social constructions'. Indeed, if you were to question Beck's assertion that the scope and effect of 'real' risk has sharply increased in late modernity, then this would have serious implications for the efficacy of his entire 'risk society' thesis"

More generally, Beck's inconsistency on this point reflects a long-standing tension in environmental sociology between the role of the sociological analyst and that of the environmental activist. Catton and Dunlap's HEP /NEP dichotomy is the epitome of this but it runs through much of the rest of the literature as well, surfacing, for example, in the 'critical realist' approach of Benton, Dickens, Marttell and other British sociological thinkers who seek to put nature back into the nature-society relationship. In Beck's risk society thesis, descriptive and prescriptive dimensions continually interweave" Indeed, Beck appears to be actively promoting a distinctive vision of an 'ecologically rational' or 'ecologically enlightened' society (Barry 1999: 153).

Beck's response to this criticism is frustrating. He sees no essential contradiction between depicting a world in which risk is pervasive and possibly apocalyptic while observing that such risks are' particularly open to social definition and construction' (1992: 23).

Even more fundamentally, Beck conflates and confuses the meaning of risks and hazards.

On the one hand, he defines risk as 'a systematic way of dealing with hazards and insecurities introduced by modernization itself' (1992: 21). While citizens in a pre-industrial society were no strangers to hazards - famines, plagues, natural disasters no notion of risk was to be found, because hazards or dangers were experienced as pre-given, usually as punishments from the gods (Elliott 2002: 295). Yet, as we have seen, Beck's theory of social change rests on the assertion that risks in a globalised society are both more extensive and more democratically distributed than was true before. Furthermore, it implies that risks such as those related to nuclear power plants and runaway biotechnology are hazardous in and of lhemselves rather than constituting new ways of defining and coping with these hazards (Sutton 2004: 121).

Beck has also attracted considerable critical heat for his assertion that class-based rancour over the distribution of goods has fallen off in favour of new and shifting patterns of coalition and division. Increasingly, he ventures, it is not unusual to observe situations where workers in environmentally polluting industries join together with management in opposition to 'victims' from competing sectors of the economy such as fisheries and tourism. In some cases, alliances may even emerge between those once seriously in conflict with one another. For example, in New Mexico and Montana, ranchers and green organisations such as the Sierra Club haw' recently put aside their historic differences to jointly battle against the common threat of proliferating oil and gas wells (Carlton 2005). This interpretation is flawed, however, in that powerless economic actors are freguently compelled to support polluting technologies and policies in order to survive. Citing the case of Australian broad acre farmers who have come to accept chemical-dependent styles of agriculture as rational approaches to environmental management, Lockie (1997) notes that it is possible to be both a 'victim' and a 'perpetrator' at one and the same time. That is, the farmer as perpetrator contributes to global pollution through engaging in chemical-intensive farming practices even as the farmer as victim is exposed to toxic materials that may be the source of chemically-induced illness, ranging from headaches to cancer.

Critics of the risk society thesis have accused Beck of being unacceptably vague about the details of political and scientific decision-making in the reflexive phase of modernity that he sees as imminent. Seippel (2002: 215-6) implies that Beck's vision of politics in a 'civil society' is native and utopian. Why should we expect the political jockeying and dealing that are characteristic of traditional politics suddenly to disappear overnight? Indeed, in blurring the boundaries between conventional politics and civil society, we may even risk opening the latter up to undemocratic interests, values or modes of action. Furthermore, Beck overstates the potential for ecological rationality here, ignoring the 'cultural embeddedness' of social interaction. That is to say, there is little reason to expect that a society obsessed with celebrities and shopping will suddenly change direction and start making choices solely on the basis of new, post-materialist values. In short, as enlightening as it may seem, the risk society thesis ultimately constitutes a 'mythical discourse' (Alexander and Smith 1996, cited in Seippel 2002: 215).

10.3 Risk and culture

The first notable challenge to this position came from a British social anthropologist, Mary Douglas, and an American political scientist, Aaron Wildfowls, who published a provocative book in 1982 entitled Risk and Culture: An Essay an the Selection if Technological and Environmental Danaers.

Rilk and Culture asks two simple but fundamental questions. Why do people emphasise certain risks while ignoring others? And, more specifically, why have so many people in our society singled out pollution as a source of concern? The answers, Douglas and Wildavsky insist, are embedded in culture.

In their view, social relations are organised into three major patterns: the individualist, the hierarchical and the egalitarian. Individualist arrangements are based on the laws of the marketplace while hierarchical relations are epitomised by government bureaucracies. Egalitarian groups are aligned in a 'border zone' on the margins of power at the political economic centre of society where the other two modes of social organisation are normally located.

Egalitarian groups have a cosmology or world-view that is more or less equivalent to the , New Ecological Paradigm' discussed by Catton and Dunlap. Unbridled economic growth is frowned upon, the authority of science is questioned and our boundless faith in technology is declared unwise.

Douglas and Wildavsky's central thesis is that the perception of risk varies considerably across these three forms of social organisation. Market individualists are primarily concerned with the upswing/downturn of the stock market, hierchists with threats to domestic law and order or the international balance of power and egalitarians with the state of the environment. This leads them to conclude that the selection of risks for public attention is based leyss on the depth of scientific evidence or on the likelihood of danger but rather according to whose voice predominates in the evaluation and processing of information about hazardous issues.

In this view, the public perception of risk and its acceptable levels are 'collective constructs' (Douglas and Wildavsky 1982: 186). No one definition of risk is inherently correct; all are biased since competing claims, each arising from different cultures, 'confer different meanings on situations, events, objects, and especially relationships' (Dake 1992: 27). Here, they are making the important point that competing definitions of what is risky are ultimately moral judgments about the proper way to organise society (Kroll-Smith et a/. 1997:8).

Unfortunately, at this point, Douglas and Wildavsky's cultural theory of risk slips off the rails on to spongier ground. Environmental egalitarians, they suggest, are the secular eguivalents of religious sects such as the Anabaptists, the Hutterites and the Amish. Obsessed with doctrinal purity and the need for unguestioned internal loyalty , sectarians are seen as having to create an image of threatening evil on a cosmic scale. It is therefore necessary and 'functional' for environmental sectarians such as those found in Friends of the Earth constantly to identify new risks ranging from nuclear winter to global warming. Each new crisis is chosen, they maintain, 'out of the necessity of maintaining cohesion by validating both the sect's distrust of the center and its apocalyptic expectations' (Rubin 1994: 236). This explains why they turn their' hack on local causes in favour of global issues so vast in scale as to warrant a sense of general doom. Pollution and other risks are wielded by these sectarian challengers as a way of holding their membership together and for attacking the establishment groups of the centre, which they oppose (Covello and Johnson 1987: x).

Risk and Culture has provoked much interest and a torrent of criticism. Much of the latter focused on the authors' claim that environmentalists mobilise for solidary rather than for purposive reasons. That is, rather than view environmentalism as part of a moral response to a very real societal crisis, they have chosen to treat risks as merely bogeymen which serve the same purpose as certain food prohibitions among tribal peoples. Environmentalists, therefore, are not regarded as rational actors but rather as 'true believers' open to manipulation by ecological prophets such as David Brower and Edward Abbey.

Karl Dake, a member of the Douglas- Wildavsky research circle, has insisted that this criticism is overstated and that the cultural school of risk never meant to imply that perceived dangers are simply manufactured:

People do die; plant and animal species are lost forever. Rather, the point is that world views provide powerful cultural lenses, magnifying one danger, obscuring another threat, selecting others for minimal attention or even disregard.

(Dake 1992:33)

Douglas and Wildavsky are less accommodating, however, insisting that knowledge about risk and the environment is 'not so much like a building eventually to be finished but more like an airport always under construction' (1982: 192). It is fruitless, they claim, for the social analyst to try to assess whether the risk under discussion is real or not; what matters is that the debate keeps going 'with new definitions and solutions'. Rubin (1994: 238-9) totally rejects this relativism, arguing that public policy considerations require that we know definitively whether risks such as those arising from global warming or ozone depletion are merely foils for the apocalyptic needs of sectarian organisations or genuine threats which must be dealt with. While Rubin's point is well taken, the ambiguity of many contemporary risks makes it difficult to achieve the certainty that he would like to see. Even if we reject Douglas and Wildavsky's absolute relativism, nevertheless, 'the by now widely accepted argument that they make about the subjective and imprecise nature of scientific findings militates against the infallibility of expert opinion. As a society, we still have to make social judgements about the magnitude of risk, although scientific evidence can be one helpful source of information in making these decisions.

Wilkinson (2001) has highlighted the similarities and differences between Mary Douglas and Ulrich Beck, whose 'risk society' thesis we examined in Chapter 2. Between them, he observes, 'they have provided the most detailed theoretical explanations for the social development of a new culture and politics of risk' (p. I). Both theorists have chosen to address risk on a societal scale. Both point to the cultural relativity of risk perception and use the arguments of social constructionism either is tempted to investigate empirically the prevalence of risk or the nature of risk perception. However, they differ as to the 'reality' of the risks we face. As we have seen, Beck embraces an apocalyptic vision of the future that is assured unless we engage in a new process of collaboration and social learning. By contrast, Douglas 'would cast doubt on the credibility of such an alarmist scenario and prefers to entrust herself to the professional opinion of government experts' (ibid).

10.4 Sociological perspectives on risk

Sociologists of risk generally adopt a more moderate position than that of Douglas and Wildavsky, insisting that while risk is certainly a sociocultural construct, it cannot be confined to perceptions and social constructions alone. Rather, technical risk analyses are an integral part of the social processing of risk (Renn 1992).

Dietz et al. (2002) observed, in preparatory work, that the main currents in the sociology of risk have followed three separate but complementary directions which are bound together by an underlying emphasis on the social context in which individual and institutional decisions about risks are made.

First, sociologists have been concerned with the question of how perceptions of risk differ across populations facing different life chances and whether the framing of choices stems primarily from power differences among social actors. Thus, Heimer (1988) points out that the residents of Love Canal saw the risks from chemical dumps differently from executives of the Hooker Chemical Company and from bureaucrats in the state government and various state agencies which deal with public health and the environment. Similarly, workers and bosses see environmental health risks in the workplace in a different light. To a certain extent, this issue overlaps the social distribution of risk, although the emphasis here is on how social location affects the perception of risk rather than on how it alters the likelihood of being exposed to hazardous conditions.

Second, sociologists of risk have proposed a model that reconceptualises the problem of risk perception by taking into account the social context in which human perceptions are formed. That is, individual perception is powerfully affected by a panoply of primary influences (friends, family, co-workers) and secondary influences (public figures, mass media) which function as filters in the diffusion of information in the community. This is captured in the concept of 'personal influence' that was central in the mass communication research of the 1950s and 1960s (see Katz and Lazarsfeld 1955).

Third, risks, especially those of technological origin, have been conceptualised as components of complex organisational systems. This is exemplified in Perrow's (1984) analysis of 'normal accidents' in which an estimated probability of failure is built right into the design of technologies with high catastrophic potential. Once implemented, however, such systems severely limit any further human ability to manipulate risks since the source of the risk is now located in the organisation itself (Clarke and Short 1993).

Renn (1992) has further classified the sociological approaches along two dimensions: (I) individualistic versus structural, and (2) objective versus constructionist. The first dimension asks whether the approach in question maintains that the risk can be explained by individual intentions or by organisational arrangements. Objectivist concepts imply that risks and their manifestations are real, observable events while constructionist concepts claim that they are social artifacts fabricated by social groups or institutions. According to this taxonomy, the first two currents of risk research identified by Dietz and his colleagues tend to 'be individualist/constructionist while the third is structural objective. Notable by its absence is a 'social constructionist' perspective that Renn describes as an approach that 'treats risk as social constructs that are determined by structural forces on society' (1992: 71).

Social definition of risk

Hilgartner (1992) has argued that the constructionist perspective must begin by examining the conceptual structure of social definitions of risk. Such definitions, he maintains, include three major conceptual elements: an object deemed to pose the risk; a putative harm; and a linkage alleging some causal relationship between the object and the harm.

To assume that objects are Simply waiting in the world to be perceived or defined as risky is 'fundamentally unsociological' (Hilgartner 1992: 41). Rather, an initial phase of risk construction consists of isolating and targeting the object(s) that constitute(s) the primary source of a risk.

In the late 1980s, the lakeside Toronto neighborhood in which my family and I resided was designated by the municipal public works department to receive a pair of 'sewage detention tanks', one to be installed in Kew Gardens, a multi-use community park, the other on the beach adjacent to the boardwalk. The problem, we were told, was effluent from the City's storm sewer system that flowed into Lake Ontario and made it too polluted with faecal coliform bacteria to allow swimming. According to studies conducted by an engineering firm engaged by the City, there were two primary sources from which the faecal coliform pollution originated: human faeces contained in combined sewer overflowl and animal excrement which had been swept along with rainwater into the storm sewers.

Our residents' association, which first learned of the project when one member came across the publication of a statutory notice buried in the pages of a local daily newspaper, at first expressed concern on the grounds of the disruption which construction would bring to the park and the beach, both of which are heavily used. However, in the course of researching the proposal and meeting with other residents, we began to realise that, in fact, the source of the risk probably did not reside primarily in the storm-water but in effluent which was being dumped into the lake from the main sewage treatment plant located just to the west of our neighbourhood. We learned that, due to insufficient capacity, operators at this plant routinely opened the sea-wall gates just before it began to rain and released untreated or partially treated sewage into the lake at levels 10,000 times that at which the beaches were declared unsafe for swimming and closed. On one day out of three the lake currents reversed direction, sending this effluent towards our beaches. Immediately after a public meeting one night, a retired operator at the drinking-water filtration plant located at the eastern fringe of the neighbourhood told me that he used routinely to receive a telephone call from his equivalent at the sewage treatment plant advising that in advance of rain they were opening the gates and that he should raise the chlorine levels - a tip-off that the coliform pollution was migrating along the near shore area in a kind of bathtub ring pattern. We did not know it at the time but a somewhat similar situation occurs regularly in Sydney, Australia, where the ageing sewage system which pumps sewage out to sea is designed to overflow into storm sewers during periods of heavy rainfall so as not to clog up already overloaded treatment tanks (Perry 1994-: WS-4).

What happened here was that residents opposed to the sewage detention 'ranks developed an alternative definition of the 'risk object'. At public meetings, at City Hall and at a special hearing before an Environmental Assessment Advisory Committee 'appointed by the Provincial Minister of the Environment to consider whether to grant our request for a 'bump up' (i.e. from a routine class environmental assessment to a more formal and rigorous individual environmental assessment), \\ e actively contested the official designation of the object deemed to be risky and presented our claim (unsuccessfully) that the main sewage treatment plant was the villain instead.

The second element in the social definition of risk involves the process of defining harm. Once again, this is not as obvious as it may seem. For example, forest fires are commonly thought to wreak a path of destruction but ecologists contend that in nature they serve a useful function in woodland renewal. Offshore oil-drilling platforms are assumed to pollute the waters surrounding them but marine biologists have found that they also spawn a whole new micro-ecology at their base. Some environmentalists in the United States have campaigned to reduce allowable levels of the trace mineral selenium which can be added to animal rations on the basis that it leaves toxic residues, but representatives of the feed industry maintain that selenium additives are a boon to the environment because they reduce the amount of feed consumed thus saving on energy.

In each of these cases, the very definition of what harm ensues from a particular object or action is contested, sparking a variety of claims and counter-claims, despite the fact that there is mutual agreement as to the risk object (forest fires, offshore oil drilling, selenium as a feed additive). Risk claims may frequently conflict on ideational grounds. Thus, a river diversion project which provides irrigation water for local farmers (a human benefit) may result in the destruction of a fragile ecosystem of fish, birds, insects, etc. (a biological harm). Similarly, road salt, deemed so vital in order to cope with the harsh winter in parts of Canada and the Northern United States, has been labelled by scientists as harmful to the ecology of the lakes, rivers and streams where it is eventually deposited. Conversely, initiatives that are declared to be of ecological benefit may result in problems for human constituencies. For example, the protection of wolves is ~advocated by wildlife preservationists but it is keenly opposed by ranchers who fear the loss of livestock crucial to their economic survival. With consensus impossible, the central basis of contestation becomes the presence or absence of harm generated by a risk object.

A third component of the social construction of risk consists of the linkages alleging some form of causation between the risk object and the potential harm. Hilgartner (1992: 4-2) observes that constructing these linkages is always problematic because a risk can be attributed to multiple objects. Indeed, the 'laws' of ecology encourage this since all things are regarded as being interdependent. This is further complicated by the fact that the full extent of the risk may not be known until many years later. For example, a report in the mid-1990s by a Minnesota radio station suggested that a 1953 US Army test, in which clouds of zinc cadmium sulphide, a suspected carcinogen, were sprayed aerially over Minneapolis dozens of times have caused an unusual number of stillbirths and miscarriages; these" problems have shown up particularly often in former students of a public elementary school which was one of the spray sites forty years before (New York Times 1994-). The effects may sometimes be more immediate but it takes years for claims-makers to assemble them into a publicly acknowledged form. This has been the case with a raft of health problems among military veterans of the Gulf War. Even though symptoms began soon after their return, it took some time for public reports of a 'Gulf War syndrome' to penetrate the mainstream media and to be framed in terms of toxic environmental agents in the war zone.

Much of the discourse over the construction of risk takes place on this terrain. The situation is further complicated by the existence of multiple conflicting proofs: legal, scientific, moral.

The burden of legal proof is most onerous, since it cannot leave any room for 'reasonable doubt'. The caveats that are standard in scientific studies (e.g. 'the data are suggestive but require further research') do not stand up in court. Nor usually does anecdotal or clinical evidences As environmentalists have discovered, judges are often loath to break any new ground by acting to prevent a problem before it happens. As Freudenburg (1997: 34-5) pointed out, the capability of the courts to deal with technological risks and disasters is especially limited by 'the need to establish clear and unambiguous liability, even in the presence of evidence that will remain at best probabilistic'.

Scientific proof is easier to come by, but nevertheless is a slave to statistical levels of significance. It is also notoriously fickle, its authority intact only until the next disconfirming study appears. The scientific layer of proof can be subdivided into two: a standard drawn from pure science in which action is not recommended until correlations weigh in at the 95 per cent confidence level, and a standard utilised by the medical disciplines in which action may be taken before significance is reached if the evidence points towards a serious health problem.

Collingridge and Reeve (1986) have demonstrated the clash between these two versions of scientific evidence in the debate over the health effects on children of lead from vehicle exhausts. In the United States, it haunted the conflict between the EPA, which supported the removal of lead gasoline (petrol) on basis of broad differences in blood lead levels among urban and suburban populations, and the Ethyl Corporation, a major manufacturer of lead additives, which argued that the link between blood and air levels remained statistically unproven. In the UK, difficulties arose in early 1980s between the government-sponsored.'

'Lawther Report' which rejected all laboratory animal and biochemical studies as irrelevant to understanding the medical effects of lead on humans and the report entitled Lead or Health by the environmental group, the Conservation Society, which argued the contrary: 'Moral proofs are most easily manufactured but are heavily dependent upon the mobilisation of public opinion in order to make an impact.'

The use of moral proofs allows the formation of attitudes or opinions about a risk issue even if the scientific or legal layers of proof indicate a degree of uncertainty or ambiguity. For example, animal rightists have never been able to prove conclusively that animals 'suffer' so they have adopted the alternative strategy of trying to demonstrate ethically that this is the case, drawing in particular on the work of the philosopher Peter Singer. Similarly, the scientific case against the biological engineering of plants and animals is still inconclusive (no genetically altered fruits have thus far performed like the protagonist in the Roald Dahl story, James and the Giant Peach) but the moral case against interfering with nature is more impressive. Such moralization, however, tends to polarise positions on risk policies, making compromises more difficult (Renn 1992: 192).

Unlike the legal and the scientific, the most effective moral proofs are often those that follow a simple line of reasoning. Consider, for example, the nature of the argument presented by 'Kapox' -labelled by the South American press as the 'Tarzan of the Amazon'. Kapox, who engages in long-distance swims through the Amazon region to publicise the state of pollution of the river and the destruction of the surrounding rainforest, does not base his appeal on a sophisticated reasoning about the need to protect biodiversity. Rather, he preaches a simple, obvious, moral message; as the largest river in the world concentrating a fifth of the planet's fresh water, the Amazon deserves respect (Suzuki 1994a).

10.5 Arenas of risk construction

As powerful as Kapox's appeal may be, it is unlikely to influence collective risk decisions or policies directly. Instead, social definitions of environmental risk must be followed up by political actions designed to mitigate or control the risk that has been identified. Building on the work of Hilgartner and Bosk (1988), Renn (1992) argues that political debates about risk issues are invariably conducted within the framework of 'social arenas'.

The term social arenas is a metaphor to describe the political setting in which actors direct their claims to decision-makers in hopes of influencing the policy process. Renn conceives of several different (theatre) 'stages' sharing this arena; legislative, administrative, judicial, scientific and mass media. While both traditional and unorthodox action strategies are permitted, these arenas are nevertheless regulated by an established repertoire of norms. For example, illegal direct action such as that advocated by Earth First, the American renegade environmental group, violates this protocol. The code is, in fact, a combination of formal and informal rules usually monitored and coordinated by some type of enforcement or regulatory agency such as the EPA in the United States and the Department of the Environment (DoE) in Britain.

The concept of the social arena combines elements from the organisation-environment perspective in the field of complex organisations, Golfman's dramaturgical model of social relations and the symbolic models of politics as developed by Murray Edelman (1964; 1977) cemented together by a social constructionist compound. As formulated by Renn, it also stresses the mobilization of social resources as discussed by the McCarthy-Zald school within the resource mobilisation perspective on social movements. Renn seems unaware of the parallels but the social arena concepts that he uses also echo some basic research on international environmental diplomacy, notably Haas's (1990; 1992) seminal concept of 'epistemic communities'.

While some elements of risk construction may occur in the public domain beyond their parameters, the most important action takes place in arenas that are populated by communities of specialized professionals: scientists, engineers, lawyers, medical doctors, corporate managers, political operatives, etc. (Hilgartner 1992: 52). Such technical experts are the chief constructors of risk, setting an agenda that often includes direct public input only during the latter stages of consideration. Hilgartner and Bosk (1988) note that these 'communities of operatives' often function in a symbiotic fashion, the operatives in each arena feeding the activities of operatives in the others. Environmental operatives (environmental groups, industry lobbyists and public relations personnel, political champions, environmental lawyers, journalists and bureaucrats) are notable examples of this; by virtue of their activities they both generate work for one another and raise the prominence of the environment as a source of social problems.

Within the social arena of risk, the process of defining what is acceptable and what is not is often rooted in negotiations among several or multiple organisations seeking to structure relations among themselves. Clarke (1988) illustrates this in his analysis of an office building fire in Binghampton, New York, which left a legacy of toxic chemical contamination. In this case, three governmental agencies - the state health department, the county health department and the state maintenance organisation - collectively vied for suzerainty in determining how risky the situation was thought to be. In such cases, Clarke argues, the institutional assessment of risk is a claims-making activity in which corporations and agencies both compete and negotiate to set a definition of acceptable risk.

From a theatrical vantage point, social arenas of risk are populated by sundry groups of actors. Palmlund (1992) proposes the existence of six 'generic roles' in the societal evaluation of risk, each of which carries its own dramatic label: risk bearers, risk bearers' advocates, risk generators, risk researchers, risk arbiters and risk informers.

Risk bearers are victims who bear the direct costs of living and working in hazardous settings. In the past, those who are impacted most have rarely asserted themselves and have therefore remained on the margins of risk arenas. More recently, however, as can be seen in the rise of the environmental justice movement, risk bearers have become empowered and must increasingly be regarded as notable players. Risk bearers' advocates ascend the public stage to fight for the rights of victims. Examples include consumer organisations such as those headed by Ralph Nader and Jeremy Rifkin, health organisations, labour unions and congressional/parliamentary champions. They are depicted as protagonists or heroes. Risk Beneraror s - utilities, forestry companies, multinational chemical and pharmaceutical companies, etc. - are labelled as antagonists or villains since they are said by advocates to be the primary source of the risk. Risk researchers, notably scientists in universities, government laboratories and publicly funded agencies are portrayed as 'helpers' attempting to gather evidence on why, how and under what circumstances an object or activity is risk-laden, who is exposed to the risk and when the risk may be regarded as 'acceptable'. On occasion, however, risk researchers have become identified with risk generators, particularly if their findings support the latter's position. Risk arbiters (mediators, the courts, Congress/ Parliament, regulatory agencies) ideally stand off-stage seeking to determine in a neutral fashion the extent to which risk should be accepted or how it should be limited or prevented and what compensation should be given to those who have suffered harm from a situation judged to be hazardous. In reality, risk arbiters are rarely as neutral as they should be; instead, they frequently they tend to side with risk generators. Finally, risk informers, primarily the mass media, take the role of a 'chorus' or messengers, placing issues on the public agenda and scrutinising the action.

Renn (1992) suggests a hybrid of several of these roles: the issue amplifiers who observe actions on stage, communicate with the principal actors, interpret their findings and report them to the audience. Environmental popularisers such as Paul Ehrlich, Barry Commoner, Jeremy Rifkin and Jonathan Porritt are prime examples of this.

Hilgartner and Bosk depict the interaction among different arenas of public discourse as characterised by several key features. First, these multiple arenas an: connected by a complex set of linkages both social and organisational. As a result, activities in each arena thoroughly propagate throughout the others. Second, one finds a huge number of 'feedback loops' that either amplify or dampen the attention given to problems in public arenas. Consequently, you find a relatively small number of successful social problems that occupy much of the space in most of the arenas at the same time. This synergistic pattern is typical of policy-making on matters relating to risk and the environment.

In their study of 228 Washington-based 'risk professionals', Dietz and Rycroft (1987) found a policy community with a dense network of communication which stretched across environmental groups, think-tanks, universities, law and consulting firms, corporations and trade associations, the EPA and other executive agencies. Environmental organisations were especially active in outreach activities including contacts with corporations and trade associations with whom 85 per cent of respondents communicated in a typical month. Similarly, the personnel flows across organizations, another component of the exchange network, was substantive, although working for an environmental group led to a low probability of finding employment with one of the other groups.

Dietz and Rycroft depict the environmental risk policy system as a hybrid in the sense that it has a strong base in science but at the same time is driven by the ideological conflict between environmentalists and corporate and governmental participants. This creates a measure of volatility in so much as science is the cornerstone of the system yet many key decisions are resolvable only in political terms. Nevertheless, the picture that emerges from this survey study is one of a policy community that is permeable but nevertheless closely linked and oriented towards a shared discourse on issues relating to environmental risk. Among other things, this means that any approach to risk that attempts to emphasise sociocultural facts over material ones will probably be considered off target and therefore inappropriate for inclusion on the shared agenda of risk professionals (Dietz and Rycroft 1987: 114).

10.6 Power and the social construction of environment risk

Freudenburg and Pastor (1992) have observed that the social constructionist approach to risk is well positioned to discuss risk construction in the context of power. In a similar fashion, Clarke and Short (1993) note that constructionist arguments - in contrast to those anchored in psychology and economics - tend to focus on how power works in framing terms of debate about risk.

Both sets of authors share the belief that this relationship is especially important because official viewpoints, with their significantly greater access to the mass media, strongly suggest that public fears regarding technical risks are clearly irrational; that is, claims about public irrationality are in themselves ways of framing risk issues. By implication, policy formulations that originate with the community of risk professionals (see the previous section) are presented as rational, objective ·assessments of what is considered safe and what is not. If this view is accepted, then the central task is said to be educating the public to realise that they are overreacting and that nuclear power, herbicides, bioengineered organisms, etc., are not really the hazards that they appear to be. In order to allay public fears, risk analysts develop quantitative measures through which to compare the risks inherent in different policy choices and their relative costs and benefits (Nelkin 1989: 99).

This is not to imply that the people are always right and the knowledge of the experts invariably 'brittle' (Wynne 1992). Rather, a social constructionist perspective would argue that each represents a competing frame but the dominant rationality that comes from the risk establishment is superimposed over the popular frame due to a power differential. Thus, Wynne (1992: 286) demonstrates in the case of a public controversy over the herbicide 2,4,5- T in the United Kingdom that the firsthand empirical knowledge of farm and forestry workers was directly relevant to an objective risk analysis. However, scientists flatly refused to consider this knowledge as legitimate, thereby denigrating and threatening the social identity of the local citizens.

Nowhere is this differential more evident than at public information meetings or hearings that are routinely stage-managed by risk generators and arbiters. At the public meetings concerning the building of the sewage detention tanks described earlier in this chapter, members of the public works department, local politicians (who strongly supported the project) and representatives of the private engineering firm who had recommended the building of the tanks all sat together on the elevated stage of the auditorium whose perimeters were adorned with charts, blown-up photographs and other 'props'. We citizens were restricted to a single question with no follow-up. Those who queried the suitability of the project were alternately bullied and patronised. On contentious issues the presenters did not hesitate to introduce a ream of previously unseen statistical evidence that we had no way of confirming or denying without days or weeks of further research.

Richardson et al. (1993) observed many of the same structural elements in the conduct of a set of environmental public hearings in 1984 on the proposed building of a bleached kraft pulp mill in Northern Alberta, Canada3. The members of the Alpac EIA Review Board who were conducting the hearing sat at a table facing the public on a stage. At one of several tables to the direct right of the Board were the representatives of Alberta-Pacific Forest Industries (Alpac), the company that sought to build the mill, their technical experts and their lawyer. Numerous Alpac consultants were scattered throughout the proceedings. Presenters were required to speak into microphones through which their words were recorded.

Kaminstein (1988) argues that embodied in the public presentation of scientific information at meetings concerning the health and safety aspects of toxic waste dumps is a rhetoric of containment which restricts discussion, avoids tough questions and pursues its own agenda. Drawing on three years of observation of meetings held to inform residents of Pitman, New Jersey, about the steps which Were being taken to clean up the Lipari landfill, the site of one of the worst dumps in the United States, Kaminstein concludes that residents were not so much informed or persuaded as controlled and defeated. The primary tool that scientific experts associated with the EPA and the Centers for Disease Control used to stille citizen initiatives was toxic talk - talk that stifles discussion and smothers public concern. The rhetoric of containment has multiple elements.

First, as was the case with the detention tank meetings, residents were bombarded with technical information. At one meeting, EPA officials distributed documents totaling 44 pages. Those in attendance were expected to assimilate an array of data, charts, graphs, tables and a slide show in rapid succession. At the same time, the facts that residents wanted were never available, and no explanation or interpretation was given as to the information that the consultant scientists presented.

The physical setting of the meeting room was also very similar to that experienced by those attending the detention tank sessions. At the front of the room was a large dais raised about two feet, a long table and nine large, high-backed chairs on which the scientists sat, creating a physical and psychological distance from the audience. Various dramatic props, for example, an enlarged photograph of an air-monitoring vehicle that looked like a recreational camper, were employed as rhetorical devices to pacify the residents and enhance the power of those in charge of the meeting.

The factual presentation style used by EP A officials and scientists was abstract, impersonal and technical, thus creating an impression of professional neutrality. It was the activist residents who became angry and confrontational, allowing officials to dismiss them as 'emotional'. Questions that dealt with the geology and hydrology of the area, future tests and plans for the clean-up were addressed but those which dealt with health risks were avoided or deflected. Officials and scientists used language in their presentations that was technical, ambiguous and intellectual, making it impossible for any meaningful dialogue to develop between experts and residents over the nature and magnitude of the risks faced by the community of Pitman.

Toxic talk techniques such as this are strategically successful if ethically reprehensible. It allows scientific experts and government officials to direct the discussion, set the risk agenda and discourage future citizen participation. Popular concerns and risk frames are subordinated to those that are preferred by the powerful in society. As Kaminstein (1988: 10) notes, these kinds of exclusionary devices permit agencies such as the EPA legally to fulfIl their mandate to hold public meetings while at the same time leaving residents feeling that they are fighting a losing battle just to be heard.

That is not to say that members of the public never attempt to assert themselves in settings such as these. For example, in the Alberta case, some participants fought to wrest control from regulators over the scope of the review, the venues and over definitions of legitimacy, as well as attempting to subvert the dominant discourse that was imposed by the pro-development forces (Richardson et al. 1993: 47). However, the constraints of the hearing process normally make effective citizen participation difficult, especially since the situation is structured so as to prevent public argument and reinforce the power of institutions.

Institutional risk analysts and regulators also exercise power on a broader plane. Structurally, they control the official risk agenda, acting as gatekeepers who are well placed to determine which issues are included or excluded from public discourse. For example, in the 1980s, imbued with the deregulatory climate within the Reagan administration (supported by senior EPA managers), Congress fatally slashed the budget of the Office of Noise Abatement and Control (ONAC) thereby also dooming most state and local noise abatement programmes (Shapiro 1993). Despite the continued risk posed by noise pollution to human health and environmental aesthetics, the issue stalled for lack of government action. In such circumstances, the risk itself does not diminish (in the case of noise pollution it in fact increased) but the risk establishment is able to manipulate its progress on the action agenda.

Freudenburg and Pastor (1992: 403) note that the social constructionist approach to technological risks would do well to look at other variables that sociologists have previously found to be associated with power. Thus gender may be significant here, insomuch as the scientific experts and bureaucratic officials who practise the rhetoric of containment are usually men while local citizen groups are disproportionately composed of women, many of whom lack power and authority in public life. Similarly, members of racial and ethnic minorities are routinely dismissed and discredited by the risk establishment, an experience that has led to the blossoming of the environmental justice movement. The relationship between power, inequality and the social construction of risk is equally evident in communities that have been marginalised by positions of economic, geographic or social isolation (Blowers el 01. 1991).

Finally, risk construction varies cross-nationally according to a number of different factors: the organisation of political and administrative structures, historical traditions and cultural beliefs. Within the field of risk analysis, a classic comparative study is Sheila Jasanoff's (1986) report entitled Risk Manaaemem and Political Culture. Drawing on case studies of national programmes for controlling carcinogens in several European countries, Canada and the United States, she concludes that cultural factors strongly influence goals and priorities in risk management. In Germany, the favoured approach has been to delegate resolution of all risk-related issues to technical experts. Jasanoff does not discuss it but even where a risk subject is strongly contested, technical rationality is applied in the form of a 'technology assessment' that includes representatives from government, industry and social movements (see Bora and Dobert 1992). In Britain and Canada, risks are examined through a mixed scientific and administrative process but scientific uncertainties are not always publicly broadcast. By contrast, in the United States risk determination has a much more public face surfacing in a wide variety of administrative and scientific fora. While this can produce greater analytical rigour and more democratic and informed public participation, it can also lead to more polarisation and conflict and thus to political stalemate.

Using the comparative method suggested by]asanoff, Harrison and Hoberg (1994) compared government regulation in Canada and the United States of seven controversial substances suspected of causing cancer in humans: the pesticides alar and alachlor, ureaformaldehyde foam insulation, radon gas, dioxin, saccharin and asbestos. Each country's approach was weighed according to five criteria for effectiveness: stringency; and timeliness of the regulatory decision; balancing of risks and benefits by decision-makers; opportunities for public participation; and the interpretation of science in regulatory decision-making.

As had Jasanoff, the researchers found that there were two contrasting regulatory styles. In each case:

> There was more open conflict over risks in the United States than Canada, with interest groups, the media, legislators and the courts playing a much more important role south of the border. The regulatory process in Canada tended to be closed, informal, and consensual, in comparison with the open, legalistic, and adversarial style of the US.
>
> (Harrison and Hoberg 1994: 168)

Both styles are said to have risks and benefits. The Canadian system is more conducive to scientific caution and formal democratic control but it lacks accountability, making it easier for political decisions to be cloaked in scientific arguments. The American system is more open but also more conflictual and vulnerable to interest group pressures and, as a result, less dependent upon scientific expertise.

10.7 Sum up

This comparative research provides further evidence that risk determination and assessment are socially constructed. National political structures and styles can be seen to have as much to do with deciding which environmental conditions will be judged to be risky and actionable as the nature of the scientific claim itself. Consequently, fundamentally sound environmental claims may be deflected or stalled, either due to collusion between regulators and scientists or because of political pressure from interest groups, either within or opposed to the environmentalist perspective.

-000-

Structure

11.1 Objectives

After going through this chapter the learner's will be :-

- able to undertand concept of Ecological Modernization
- contribution towards the concept.

11.2 Introduction

By ecological modernisation, mean an ecological switch of the industrialisation process in a direction that takes into account the maintenance of the existing sustenance base (1992: 334). Cast in the spirit of the Bruntland Report, ecological modernisation, like sustainable development, 'indicates the possibility of overcoming the environmental crisis without leaving the path of modernization'. The model is based on the work of the German writer, Huber (1982; 1985) who analyses ecological modernisation as a historical phase of modern society. In Huber's scheme, an industrial society develops in three phases: (I) the industrial breakthrough; (2) the construction of industrial society; and (3) the ecological switchover of the industrial system through the process of 'superindustrialisation'. What makes this latter phase possible is a new technology: the invention and diffusion of microchip technology.

Ecological modernisation rejects the 'small is beautiful' ideology inspired by Schumacher (1974) in favour of large-scale restructuring of production-consumption cycles to be accomplished through the use of new, sophisticated, clean technologies (Spaargaren and Mol 1992a: 340). Unlike sustainable development, there is no attempt to address problems of the less developed countries of the Third World. Rather, the theory focuses on the economies of Western European nations which are to be 'ecologised' through the substitution of microelectronics, gene technology and other 'clean' production processes for the older, 'end-of-pipe' technologies associated with the chemical and manufacturing industries. In contrast to Schnaiberg's 'treadmill of production' perspective, capitalist relations of production, operating as a treadmill in the ongoing process of economic growth, are treated as largely irrelevant (Spaargaren and Mol 1992: 340 1)

According to Udo Simonis (1989), a German environmental policy analyst, the ecological modernisation of industrial society contains three main strategic elements: a farreaching conversion of the economy to harmonise it with ecological principles, a reorientation of environmental policy to the 'prevention principle' (seeking a better balance between stopping pollution before it happens and cleaning it up later on) and an ecological reorientation of environmental policy, especially by substituting statistical probability for 'prove-beyond-a-doubt' causality in legal suits against polluters. Unfortunately, little is said about the social and political barriers that are likely to be faced in trying to implement these strategies, especially in countries other than Germany and the Netherlands where the environment is a major priority.

11.3 Ecological Modernisation

Ecological modernisation thinkers are to be commended for attempting to stake out a reasoned position between 'catastrophic' environmentalists who preach that nothing less than de-industrialisation would suffice in saving the Earth from an ecological Armageddon and capital apologists who prefer a business-as-usual approach (Sutton 2004: 146). Alas, the ecological modernisation perspective is hobbled by an unflappable sense of technological optimism.3 All that is needed, they suggest, is to fast-forward from the polluting industrial society of the past to the new super-industrialised era of the future. Yet, the silicon chip revolution, which is the basis of this super-industrialisation, is by no means environmentally neutral as the theory of ecological modernisation suggests (see Mahon 1985). Furthermore, it is worth remembering that nuclear power was also touted as a 'clean' technology until its more undesirable features became known.

As a sociological explanation, the theory of ecological modernisation is as much prescriptive as analytic. Spaargaren and Mol, for example, initially said little about the power relations that characterise environmental processes, assuming that somehow good sense must automatically triumph. Yet, as Gould el al. (1993: 231) have argued, sustainability, the guiding concept behind ecological modernisation, is as much a political economic dimension as an ecological one: what can be sustained is only what political and social forces in a particular historical alignment define as acceptable. Recognition of this is far more evident in Beck's concept of a risk-distributing society than in the ecological modernisation which Mol and Spaargaren see as imminent.

More recently, Mol and Spaargaren have offered up a revisionist version of ecological modernisation theory. The initial debates of the early 1980s, they caution, 'should be understood as an overreaction directed at the dominant schools of thought in environmental sociology and the environmental debate in the late 1970s and early 1980s' (2000: 18-19). In particular, ecological modernisation theory, they insist, was originally meant to challenge the notion put forward by both neo-Marxists and counter-productivity thinkers such as Rudolph Bahro and Barry Commoner that the modernisation project was in its death throes; that the widespread environmental and ecological deterioration of the time was prima Jacie evidence of this; and that things could be salvaged only by fundamentally recognising the core institutions of modern society.

Today, Mol and Spaargaren claim, these initial debates have become less relevant. Significantly, capitalism itself has evolved in a greener direction. For example, market-based instruments such as tradeable pollution credits have displaced previous strategies that emphasised heavy-handed state regulation and enforcement. Furthermore, ecological modernisation theorists themselves have incorporated critical comments from the earlier debate, reforming .and refining their analysis of social change. For example, they now claim to present a more nuanced position regarding capitalism, interpreting it 'neither as an essential precondition for, nor as the key obstruction to, stringent and radical environmental reform' (2000: 23).

Whereas the initial debate was frequently waged with neo-Marxists, now Mol and Spaargaren confide that they are making 'new theoretical alliances' (2000: 25) with them against their common foes - postmodernists and social constructionists. Political economists and ecological modernisationists, they argue, converge and agree in their criticism against strong social constructionism and in their view that environmental problems have a 'real' existence. Both can be considered as branches of the modernist project, assuming a firm stance against postmodern analyses of environmental problems and solutions (Mol and Spaargaren 2002: 35).

Mol and Spaargaren say they are irritated that outdated positions and criticisms from the 1970s and 1980s keep re-appearing with some regularity. For example, proponents of the New Environmental Paradigm continually threaten to go overboard, replacing sociology's former disregard of nature 'with some form of present-day biologism or ecologism' (2002: 27). Even more problematic, they assert, are those postmodern authors, most notably Bluhdorn (2000), who depict the ecological crisis as merely another 'grand narrative' to be deconstructed; and ecological rationality as 'nothing more than power, politics and big money'. This same virulent strain is evident in the views of'hard' or 'strict' social constructionists. Even Maarten Hajer (1995), whose case history of ecological modernisation as it is manifested in the politics of acid rain has been widely praised, is evidently considered to be suspect insofar as he 'seems to end up taking a position which is not too far away from where postmodernity would feel comfortable' (2002: 30). Finally, radical eco-centrists are dismissed because they criticise ecological modernisation for advocating a watered-down form of environmentalism which assumes that the crisis of the earth can be resolved by modifying attitudes, laws, government policies, corporate behaviour and personal lifestyles rather than by demanding fundamental structural change. Being in the camp of the radical ecologists, they warn, is 'about being a pessimist by nature' (2002: 33).

Despite their apparent rapprochement with the Schnaiberg school of political economy, Mol and Spaargaren still seem to place their faith in 'responsible capitalism' and the primacy of the market. For example, in his empirical research into the ecological modernisation of production ill the Dutch chemical industry, evidently a notorious polluter in the past, Mol

(1997) finds nothing but good news. Reacting to consumer pressure, Dutch chemical companies have initiated a spate of green measures, from the introduction of new technologies (low organic solvent paints) to new corporate instruments such as annual environmental reports, environmental audits and environmental certification systems. Together, he says, this represents 'a process of radical modernization' that has undercut any misguided 1970s and 1980s style demands for the dismantling of chemical production or even a shift to 'soft chemistry' (e.g. 'natural paints', which have failed to capture more than a one per cent share of the market in European countries). The institutions of modernity, Mol concludes, are by no means fading away; no massive movement away from a 'chemicalised' lifestyle can be identified and the erosion of trust in the scientific foundations of the chemical industry that might be inferred from Beck's risk society thesis is more or less absent.

Contributors to the treadmill of production perspective, however, arc considerably less enamoured of ecological modernisation theory than vice versa. In the definitely statement on this in a 2002 collection of articles entitled The Environmental Slate Under Pressure, Schnaiberg and his associates deny that the best hope for solving environmental problems is to embrace new technologies. In America, at least, environmental policy-making continues to be written within an economic framework and the green movement has failed to become a major political force. This is evident, they argue, in both industry evasion and dilution of recycling controls, and in the failure of the highly touted President's Council on Sustainable Development during the Clinton administration (1993 to 1999). Such cases fundamentally challenge the core postulates of ecological modernization theory.

Why do the treadmill analysts differ so broadly from the ecological modernisationists? Schnaiberg suggests, rather diplomatically, that it has to do with a difference in sampling approaches. That is, ecological modernisation (EM) theorists examine 'cutting edge' corporate innovations or 'best practice' industries and assume that these changes will eventually diffuse widely. Treadmill theorists are sceptical, observing that the EM successes heralded by Mol and his colleagues may simply represent a 'creaming' of a programme of ecological incorporation into production practices (Schnaiberg et al. 2002: 29). In short, EM theorists arc said to be naive for claiming that greener production practices in arenas such as the Dutch chemical industry constitute a powerful 'third force' and part of a trajectory toward a future characterised by sustainability. Rather, firms that make ecological improvements do so either under direct pressure from state regulation or social movement action. Alternatively, these improvements are not real, having been achieved only through 'creative accounting' or misreporting (p. 29).

To be fair, ecological modernisation theory has become 'an important lens through which changing economy-ecology relationships of industrial societies can be viewed' (Desfor and Keil 2004: 55). This is especially true for the policy-making arena where it has been widely embraced. Nevertheless, as Davidson and Frickel point out:

> For every empirical study supportive of the potential for ecological modernization, there are now a number of empirical analyses that raise numerous caveats regarding the propensity for industry actors to undergo the 'greening' process of their own accord, particularly when we move beyond the advanced countries of Western Europe.
>
> (2004: 477)

11.4 Sum up

At the end of the day, then, whether you regard environmental modernisation as visionary or deluded is ultimately a measure of your degree of faith in gradualism as against the necessity of more radical solutions. As Eckersley (2004: 74) has cautioned, ecological modernisation may well be able to promote greener growth through technological innovation, but eventually it risks being unmasked as 'an ideology free zone'. The more serious ecological problems persist, the more likely this is to occur.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

12.1 Objectives:

This lesson is devoted to make you to understand

- The basic concept of development,
- The relation of development with environment,
- The concept of sustainable development, and
- What does sustainable development involves?

12.2 Introduction

12.2.1 The Concept of Development

Development is about improving the well being of people. Raising living standards and improving education, health and equality of opportunity are all essential components of economic development. Prior to the second half of the twentieth century, the structures of imperial and colonial power dominated the world and made little provision for economic and social advance in what we now call the developing world. Colonial regions primarily supplied imperial powers with raw materials and cheap labour including slave labour, as late as the mid-nineteenth century. Within the richer countries of Europe, North America, and Japan, economic growth was of course central to the generally accepted goals of progress and modernization, but there was relatively little concern for issues of equity and social justice. By the end of the Second World War, perceptions and policy had changed drastically and economic and social improvement for the majority had become a major preoccupation of governments, and with the crumbling of colonial power relations this goal was extended to the poorer nations of the world. Economic development, with its social and institutional correlates, came to occupy an essential place in theory and policy, as well as in the Cold War competition between capitalism and communism.

The term development refers to social and economic development both within countries and internationally. Since the late 60s it has been increasingly recognized that global development is uneven and thus threatens the livelihood and lives of a large proportion of the world's population. Many development issues are in the news, from the impact of globalization, world trade agreements, food and malnourishment, to people having to become refugees, health and disease, and the need for fairer trade. In different ways these issues too affect our community now and will continue to do so in the future.

12.2.2 Environment and development

During the 1970s, as the environmental movement began to gather force, various ideological differences began to emerge depending on how people analyzed the nature of the problem, the causes of it, the likely consequences of it and the action needed to resolve it. Two examples of differing environmental ideologies are "Anthropocentrism" and "Ecocentrism". An Anthropocentric sees people as separate from nature and nature as a resource to be used for human benefit. They are of the views that all human activities must be in the primary interests of the humans for achieving the desired objectives and goals of the society, whether or not some of the features of the environment are kept intact or disturbed. Ecocentrism is an environmental psychology which views human activities in terms of their implications for the ecological ingredients, their relative effects, and balances. They are thus reformist in their objectives believing that environmental problems can be resolved by a mix of new technology, legislation and public awareness without any deeper changes. An ecocentric worldview is nature-centered and argues that human beings are one of the elements in the web of life and that protection of the biosphere is more important than individual human needs, especially if those needs cause damage to the environment.

People's perceptions of development issues are deeply influenced by the western political ideology of neo-liberalism (Harvey, 2005). In this, world views the rights of the individual and the attainment of human happiness are seen as supreme goals, based on the assumption that the individual is essentially rational and knows his/her own best interests. Although reinterpreted over time, peace, freedom, development, and the environment remain prominent issues and aspirations.

The satisfaction of human needs and aspirations is the major objective of development. It is about improving the well-being of the people. The essential needs of vast numbers of people in developing countries for food, clothing, shelter, jobs - are not being met, and beyond their basic needs these people have legitimate aspirations for an improved quality of life. A world in which poverty and inequity are endemic will always be prone to ecological and other crises. In terms of income and output the world may become richer in the time to come, but we have some questions to ponder on i.e. will the environment will be poorer? Will future generations be worse off as a result of environmental degradation?

In the 1970s and 1980s, world commissions were created to study such international concerns. The World Commission on Environment and Development was initiated by the General Assembly of the United Nations in 1982, and its report, Our Com-mon Future, was published in 1987 chaired by then-Prime Minister of Norway Gro Harlem Brundtland, thus earning the name the "Brundtland Commission." Its roots were in the 1972 Stockholm Conference on the Human Environment-where the conflicts between environment and development were first acknowledged-and also the 1980 World Conservation Strategy of the International Union for the Conservation of Nature, which argued for conservation as a means to assist development and specifically for the sustainable development and utilization of species, ecosystems, and resources. Later on The United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 (the so-called "Earth Summit") issued a declaration of principles, a detailed Agenda 21 of desired actions, international agreements on climate change and biodiversity, and a statement of principles on forests. Ten years later, in 2002, at the World Summit on Sustainable Development in Johannesburg, South Africa, the commitment to sustainable development was reaffirmed.

12.2.3 Sustainable development

To sustain means to maintain; keep in existence; keep going; prolong. If applied only in this sense, sustainability does not make much sense for human society. Human society cannot be maintained in the same state, whatever it should be. Human society is a complex adaptive system which is embedded in another complex system i.e. natural environment, on which it depends for support. In the environment there is always change and evolution and this ability for change and evolution must be maintained if the systems are to remain viable (able to cope with their changing system environment) and sustainable.

Sustainable development has been defined as the development that lasts long by wise and conservative methodologies. It is a subject of conflict between the environmentalists and economists. Economists consider sustainable development as that development through which material benefits are achieved irrespective of the harms created by it to the environment whereas environmentalists consider sustainable development as the development which has no affect on the quality of the environment.

The concept of sustainability is very old. The concept was first noticed among the Greeks. It was so much popular that provincial governors were rewarded or punished accordingly. The sustainability can also be traced back to Aristotle according to whom human well being is realised only partly by satisfying whatever people's preferences happen to be at a particular time; it is also necessary for the successive generations to leave behind sufficient resources so that future generations are not constrained in their preferences (Rao, 2000).

According to Harremeos (1996), Mankind has the potential ultimately to reach a solution, a sustainable society that can continue for generations. He also adds that the current development is, however, not even close to anything like sustainability and is infact decreasing the prospects of sustainability both in developed and developing countries. He also emphasise that the sustainable society cannot be achieved without fundamental changes in our basic thinking, ethical virtues, moral concepts and religious beliefs.

Vellinga et al. (1995) defined sustainable development as maintenance and sustainable utilisation of the functions (goods and services) provided by natural ecosystems and biospheric processes. According to him, conversely in a situation of unsustainability, where the limits of the biosphere's carrying capacity are exceeded, not all of the environmental functions can be fully fulfilled anymore.

Economic development without environmental considerations can cause serious damage in turn impairing the quality of life of present and future generations. Sustainable development attempts to strike a balance between the demands of the economic development and need for protection of the environment. It seeks to combine the elements of economic efficiency, intergenerational equity, social concerns and environmental protection. Although the term sustainable development has many interpretations, it generally refers to non declining human wellbeing overtime.

The concept of sustainable development aims at maximising the net benefits of economic activities , subject to maintaining the stock of productive assets (physical, human and environmental) overtime and providing a social safety net to meet the basic needs of the poor. Sustainable development therefore attempts to accelerate development in an environmentally responsible manner keeping in mind the inter-generational equity requirements. The question of inter generational equity is at the core of the definition of sustainability and prompt a debate on what are society's values and how to transfer these values to future generations. Paths viewed as economically optimum paths for development today may not be sustainable for future generations. If welfare considerations are taken into account, economically optimum paths may not be sustainable in the long run. Moreover, sustainable paths may not necessarily be economically optimal. The challenge is to achieve a balanced approach to development in terms of optimality and sustainability. Jacob, Gardener and Munro sustainable development seeks five broad requirements :

i) integration of conservation and development,

ii) satisfaction of basic human needs,

iii) achievement of equity and social justice'

iv) provision of social self-determination and cultural diversity and

v) maintenance of ecological integrity.

Modern world recognized sustainability concept in 1987 Brundtland Commission Report (WCED, 1987) when it stressed the need for sustainable development as Brundtland argued:

"The environment does not exist as a sphere separate from human actions, ambitions, and needs, and attempts to defend it in isolation from human concerns have given the very word "environment" a connotation of naivety in some political circles. The word "development" has also been narrowed by some into a very limited focus, along the lines of "what poor nations should do to become richer," and thus again is automatically dismissed by many in the international arena as being a concern of specialists, of those involved in questions of "development assistance." But the "environment" is where we live; and "development" is what we all do in attempting to improve our lot within that abode. The two are inseparable."

According to the report sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development has three principal components: economic growth, social equity and protection of the environment. Underlying the economic component is the principle that society's well being would have to be maximized and poverty eradicated through the optimal and efficient use of natural resources. The concept of "needs" emphasized in the Commission's definition refers, in particular to the basic needs of the world's poor, to which overriding priority should be given. The social component refers to the relationship between nature and human beings, uplifting the welfare of people, improving access to basic health and education services, fulfilling minimum standards of security and respect for human rights. It also refers to the development of various cultures, diversity, pluralism and effective grass roots participation in decision-making. The issue of equity, i.e., the distribution of benefits and access to resources remains an essential component of both the economic and social dimensions of sustainable development. The environmental component, on the other hand, is concerned with the conservation and enhancement of the physical and biological resource base and eco-systems.

Sustainable development is necessary for meeting the challenges like the integrity of ecosystem. As the rate of depletion of world resources is at a peak and the increase in population has taken place at a very fast rate leading to economic pressure, the concept of sustainability has to enter our planning. We need development at a faster pace but keeping sustainability in view. Sustainable development (SD) has become a mode for expressing the need world over to switch over from present dominant models of development which appear unable to balance the needs of people and the planet in the pursuit of peace and prosperity. Internationally, sustainable development is associated with development directions that maintain and mutually reinforce economic, environmental and social conditions.

Applied in practice this means that just as an economy (or region) in long-term recession is not sustainable, neither is a situation where many people are denied opportunity and face poverty and social exclusion. Equally, development that ignores the essential needs of the poorest people or erodes the quality of our environment is not sustainable development.

The goals of sustainable development have been firmly embedded in a large number of national, international, and nongovernmental institutions. At the intergovernmental level, sustainable development is now found as a central theme throughout the United Nations and its specialized agencies. Evidence of this shift can be seen in the creation of the Division of Sustainable Development within the United Nations Department of Economic and Social Affairs, the establishment of a vice president for environmentally and socially sustainable development at the World Bank, and the declaration of the United Nations Decade of Education for Sustainable Development.

12.3 Sustainable development involves

Sustainable development is thinking broadly about objectives and about effects (i.e. about costs and benefits in the widest sense) and not merely separating things out into economic, environmental, and social compartments. It seeks to pursue mutually reinforc ing objectives to improve the overall quality of life rather than pursuing individual objectives such as maximising short-term economic growth or improving some element of the environment without regard to other consequences.

At the heart of operationalizing sustainable development is the challenge of evaluating and managing the complex interrelationships between economic, social and environmental objectives. Economic growth, for example, is made possible through the creative powers of human beings that enable the transformation of nature into meeting basic needs and material conveniences of everyday life. This transformation process often entails the depletion of the natural environment that could result in air pollution, climate change and biodiversity loss. Policy makers are thus confronted with the hard decisions of establishing the right balance between economic and environmental goals. Because benefits accrue to different groups at different times, determining the level and rates of investment in each area at a particular time involves making difficult choices. The positive and negative economic, social and environmental consequences of policy changes need to be assessed. Areas of tradeoffs, where benefits in one or more spheres result in losses in another sphere, need to be identified and appropriate mitigation measures taken to minimize negative impacts.

Today many countries, both developed and developing, have embraced the concept of sustainable development. Understanding of this concept has evolved over time from the early focus on environmental dimension to the current emphasis on sustainable development as a process that integrates economic, social and environmental objectives. There is also recognition that achieving sustainable development requires far reaching policy and institutional reforms and the involvement of all sectors at all levels. Sustainable development is not the responsibility of only government or one or two sectors of society.

Sustainable development is incremental and builds on what already exists, and its achievement is as much a process as a fixed goal. Sustainable development is not an activity that has to be left to the long term. Rather, it constitutes a set of short, medium and long term actions, activities and practices that aim to deal with immediate concerns while at the same time address long-term issues.

Agenda 21 promotes national sustainable development strategies as mechanisms for translating a country's goals and aspiration of sustainable development into concrete policies and actions. A national sustainable development strategy is a way in which countries address the challenge of progressing towards the goals of sustainable development at the national, local and even at the regional levels.

The 1992 Earth Summit put it in simplest words that any human activity is sustainable if it can continue fairly indefinitely without causing harm to people or planet. Any activity which causes harm to people or planet is the opposite - unsustainable. At the Earth Summit in 1992, held in Rio de Janeiro, world leaders agreed that human activity was seriously damaging the environment and that issues of development, i.e. global wealth/poverty, were seriously damaging people's life chances in both poor and rich countries. The welfare of people and planet, issues of environment and development, are thus now seen as inextricably related, two sides of the same coin. The term sustainable development emerged as shorthand to embrace these twin concerns.

Davison (2001) points out that the industrial revolution and its subsequent technologies have lead to what we call 'progress' for the few. The triumphant history of industrialization is shadowed by a history of social oppression and ecological degradation. The vast, unprecedented affluence that has concentrated in highly technological societies is shadowed by poverty and pollution, the extent of which is also vast and unprecedented. This is so because much of our technology persistently lacks the ability to sustain ecological flourishing and social well-being.

Sustainable development is necessary for meeting the challenges like the integrity of ecosystem. As the rate of depletion of world resources is at a peak and the increase in population has taken place at a very fast rate leading to economic pressure, the concept of sustainability has to enter our planning. We need development at a faster pace but keeping sustainability in view.

Sustainable development is necessary for meeting the challenges like the integrity of ecosystem. As the rate of depletion of world resources is at a peak and the increase in population has taken place at a very fast rate leading to economic pressure, the concept of sustainability has to enter our planning. We need development at a faster pace but keeping sustainability in view.

According to WCED the operational objective of sustainable development are

i) reviving growth

ii) changing the quality of growth

iii) meeting essential needs for jobs, food, energy, water and sanitation,

iv) ensuring a sustainable level of population,

v) conserving and enhancing the resource base'

vi) reorienting technology and managing risk

vii) merging environment and economics in decision making

viii) reorienting international economic relations, and

ix) making development more participatory

12.4 Sum up

The time has come when economic planning should go together with environmental protection for sustainable development. The option before us is a sustainable or earthmanship society aimed at recycling and reusing the materials, conserving energy, controlling population and pollution and lowering the rate of consumption of materials including forests and energy so that the resources are not depleted and the environment does not deteriorate due to overloading with wastes and loss of vegetation cover.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

13.1 Objective:

This lesson is devoted to make you understand about the origin of term sustainable development and its historical perspective.

13.2 Introduction

Around the globe, throughout history, most modern human institutions have evolved in ways that are at best, oblivious, and, at worst, positively hostile to the health of environment.

Economic development, till today, is based on two fallacious premises: (1) it considers needs of mankind alone, and ignores the interdependent ecosystem, and (2) it treats the environment as a commodity. Man strives ceaselessly for monetary gains and is enslaved and obsessed by technological advancement, and by obtaining higher GNP. This obsession has spoiled the environment and is tending to ruin the carrying capacity (i.e., capacity of the ecosystem to support life) of Mother Earth. The land is degraded and eroded; the waters of rivers, lakes and oceans are so polluted with industrial wastes, that it is nearly unfit for either industrial use or for human consumption. The air is filled with gaseous and particulate pollutants that are toxic to life. Pesticides used to promote agricultural production and public health has severely poisoned the environment. The environment is still regarded as common property, each agent acting as if he owns it. Each agent of production and consumption regards the disposal cost of waste as zero and uses the environmental sector as long as it permits him to improve his own welfare. He does not have to pay anything to anybody. The reckless use continues, without any heed to the damage inflicted, and causes degraded environmental standards, unhealthy and detrimental to all.

13.3 The challenges we face

We recognize that poverty eradication, changing consumption and production patterns and protecting and managing the natural resource base for economic and social development are important objectives of and essential requirements for sustainable development. The deep fault line that divides human society between the rich and the poor and the ever-increasing gap between the developed and developing worlds pose a major threat to global prosperity, security and stability.

Globalization has added a new dimension to these challenges. The rapid integration of markets, mobility of capital and significant increases in investment flows around the world has opened new challenges and opportunities for the pursuit of sustainable development. But the benefits and costs of globalization are unevenly distributed, with developing countries facing special difficulties in meeting this challenge.

In other words we can say that economic growth is made possible through the creative powers of human beings that enable the transformation of nature into meeting basic needs and material conveniences of everyday life and in turn often entails the depletion of the natural environment that could result in air pollution, climate change and biodiversity loss.

Policy makers are thus confronted with the hard decisions of establishing the right balance between economic and environmental goals.

An equitable, environmentally and physically sustainable society that exploits the environment at the maximum sustainable rate would still be psychologically and culturally unsustainable. Sustainable development of human society has environmental, material, ecological, social, economic, legal, cultural, political and psychological dimensions that require attention. Some forms of sustainable development can be expected to be much more acceptable to humans and, therefore this has led to the evolution of new concepts, including that of sustainable development as a basis for overcoming the environmental challenges.

One of the most commonly cited definitions stresses the economic aspects by defining sustainable development as "economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs." Another takes a broader view by defining sustainable development as "the kind of human activity that nourishes and perpetuates the historical fulfillment of the whole community of life on earth."

13.4 History of Sustainability and sustainable development

13.4.1 The Evolution of the Concept

The report, Our Common Future, published by WCED, is taken as a starting point for most current discussions on the concept of sustainable development. The comprehensive report produced through a global partnership, constituted a major political turning point for the concept of sustainable development. But it is neither the starting point nor the possible end of the conceptual development process. As any conceptual process governed by general evolutionary theory, there are some significant conceptual precursors that have led to the WCED's definition of sustainable development, which in turn is followed by other conceptualization efforts. In this section focus is on the historical and conceptual precursors of the concept of sustainable development and is divided into three different historical periods: Pre-Stockholm, covering the period until the Stockholm Conference on Environment and Development (before 1972); from Stockholm to WCED (1972-1987); and Post-WCED (1987 onwards).

13.4.2 Pre-Stockholm

Nature has successfully demonstrated sustainable development for a few billion years, with blind disregard of the fate of individuals and even species. The principle of survival of the fittest with its effectiveness and dynamics, but also its cruelty and hardship, would not be accepted as a principle for sustainable development by the majority of humankind.

Some human societies have been sustainable in their environment over long periods of time by institutionalizing systems of exploitation, injustice, and class privilege that would be equally unacceptable today for most of humankind. The Religious beliefs and traditions historically have taught us to perceive and act on non-human nature in terms of particular human interests, beliefs, and social structures. Through religious beliefs and laws we have socialized nature, framing it in human terms. To a great extent we have done so to satisfy human needs, abilities, and power relations. Yet, at the same time, "religion has also represented the voice of nature to humanity" (Gottleib 1996). Spiritual teachings have celebrated and consecrated our ties with the non-human world, reminding us of our delicate and inescapable partnership with air, land, water, earth, fire (Five elements in Hindu religion) and other living beings.

Many writers have found the Judeo-Christian writings about "man's right to master the Earth" (Genesis 1:28) as an essential source for the havoc wrecked by Western societies upon the earth. Other religious environmentalists have discovered environmentally positive passages in classic texts, and they claim that Judaism and Christianity are more environmentally minded than they seem at first glance (Kinsley 1996). A critical review of the writing on both sides leads to the conclusion that religions have neither been simple agents of environmental degradation nor unmixed repositories of ecological wisdom (Gottleib, 1996). Although they have different contexts and structures, the core element of all of the indigenous traditions and beliefs is the importance of living in harmony with nature and society, which is one of the fundamental tenets of the concept of sustainability.

Thomas Robert Malthus (1766-1834) is considered to be the first economist to foresee the limits to growth caused by resource scarcity. By 1798, many of the evil effects of the industrial revolution had surfaced. Unemployment, poverty, and disease were already problems calling for remedial treatment. Contrary to the ideas of William Goldwin (1756-1836) and Marquis de Condorcet (1743-1794), Malthus said that "the vices and misery that plague society are not due to evil human institutions, but are due to the fecundity of the human race". This led to his theory of population. According to Malthus's theory, unchecked population increases geometrically, while subsistence increases arithmetically at best (Oser and Blanchfield 1997). Together with David Ricardo (1772-1823), who fundamentally agreed with his population theory, Malthus expressed his "environmental limits thinking" in terms of the limits on the supply of good quality agricultural land and the resultant diminishing returns in agricultural production (Pearce and Turner 1990). The Malthusian theory of "environmental limits" may be considered a precursor to the concept of sustainable development.

Some experts believe that the concept of appropriate technology (defined as technology that takes heed of the skill, levels of population, availability of natural resources) and pressing social needs is the immediate precursor to the concept of sustainable development.

The word sustainable comes to us from the foresters of the 18th and 19th century in Europe, when much of Europe was being deforested and the foresters became increasingly concerned, since wood was one of the driving forces in the European economy. Forests were being harvested, from an economic standpoint, using clear-cutting techniques which means that the loggers moved into a tract of forest and removed all of the trees in the tract. The forests that grew back after clear-cutting did not provide the wood fiber needed for the European economy. The foresters, and especially the German foresters, in response to this crisis developed scientific or sustainable forestry. The idea at the time was simple i.e. if enough trees were planted to replace the wood provided by the trees that were harvested every year, and the growth rate of the entire forest was scientifically monitored to ensure this, then the forest would be sustainable. It would always grow enough wood fiber to replace the wood fiber lost to harvesting. Thus, in this original idea, sustainable means that as a resource is used, it is replaced by growing additional amounts of the resource. In the modern context of the word, sustainable, this is a difficult context because there are many resources, such as oil or iron ore, that cannot be grown. Still, these resources, like the trees in Europe's forests, are finite. If all the oil is extracted, there will not be any more oil.

In 1968, the Club of Rome an international non-governmental organization (NGO) devoted to the study of the "world problematique," the term it coined to describe political, social, cultural, environmental and technological problems from a global, multidisciplinary and long term perspective. It brought together scientists, researchers, business people, and heads of state from all the continents, including former president of the USSR Mikhaïl Gorbachev, and Rigoberta Menchú Tum, Nobel Peace Prize laureate. Over the years, the Club of Rome produced a report "The Limits to Growth" published in 1972, brought the ecological limits to economic and demographic growth, to the door of world opinion. "Limits to Growth" is one of the first documents of importance to be published about the ecological limits to economic and demographic growth. It exposes the results of mathematical simulations conducted on demographic and economic growth correlated with the exploitation of natural resources. Beyond the controversy raised by the conclusions of The Limits to Growth that left no one indifferent-the report to this day remains one of the first thrusts toward a definition of the foundations of a development mode that we qualify today as sustainable.

According to DuBose et al. (1995), "sustainable development can be traced back at least as far as the mid-1960s, when appropriate technology was promoted as the way to develop the lesser developed countries." By the early 1970s, many organizations and individuals promoted appropriate technology for the developed world as well.

13.4.3 From Stockholm to WCED

The United Nations Conference on the Human Environment took place in the summer of 1972 in Stockhom, Swedan. The relationship between economic development and environmental degradation was first placed on the international agenda, when 113 nations gathered for the Stockholm Conference on the Human Environment, the first global environmental meeting. It recognized the "importance of environmental management and the use of environmental assessment as a management tool" (DuBose et al. 1995), representing a major step forward in development of the concept of sustainable development. After the Conference, Governments set up the United Nations Environment Programme (UNEP), which today continues to act as a global catalyst for action to protect the environment. Even if the link between environmental and developmental issues did not emerge strongly, there were indications that the form of economic development would have to be altered.

The environment and development could not for long remain in a state of conflict, became apparent after the Stockholm conference and in the years following, the terminology evolved to terms like "environment and development," "development without destruction," and "environmentally sound development" and finally, the term "eco-development" appeared in the UN Environment Program review in 1978. According to Tryzna (1995), however, the first major breakthrough in conceptual insight came from the International Union for the Conservation of Nature (IUCN). Working closely with the World Wildlife Fund for Nature and The United Nations Environment Programme, IUCN formulated the World Conservation Strategy, which was launched internationally in 1980, which provided a precursor to the concept of sustainable development. The Strategy asserted that conservation of nature cannot be achieved without development to alleviate poverty and misery of hundreds of million of people and stressed the interdependence of conservation and development in which development depends on caring for the Earth. Unless the fertility and productivity of the planet are safeguarded, the human future is at risk. This was a major attempt to integrate the environment and development concerns into an umbrella concept of "conservation." Although the term "sustainable development" did not appear in the text, the strategy's subtitle, "Living Resource Conservation for Sustainable Development," certainly highlighted the concept of sustainability (Khosla 1995).

In 1984, the United Nations Assembly gave Gro Harlem Brundtland, then Prime Minister of Norway, the mandate to form and preside over the World Commission on Environment and Development, today recognized for having promoted the values and principles of sustainable development.

The Commission's mandate was mainly to recommend means to the international community to preserve the environment through improved cooperation between developing nations and so-called developed nations, while considering existing relationships between peoples, resources, the environment and development. The purpose of the Commission's work was to draw up a profile of environmental issues and, finally, develop an action plan defining the objectives of the international community in matters pertaining to development and environmental protection.

An important footnote is that the work of the World Commission on Environment and Development were marked by two major environmental and human catastrophes that today are a part our history: the catastrophe in Bhopal, India (1984), caused by a toxic gas leak at a pesticides plant and resulting in the death of thousands of people and injury of thousands of others, as well as the explosion of four reactors of the Chernobyl nuclear plant in the Ukraine (1986). Radioactive fallout from this accident had and will continue to have negative effects on the health of affected populations and ecosystems.

The Commission's work led to the release in 1987 of the report Our Common Future, also called the Brundtland Report holds the key statement of sustainable development, which defined it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987). This definition marks the concept's political coming of age and establishes the content and structure of the present debate (Kirkby 1995). The conceptual definition of the Brundtland Commission contains two key concepts:

- The concept of "needs," in particular the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

By doing so, the Commission underlines the strong linkage between poverty alleviation, environmental improvement, and social equitability through sustainable economic growth. Not surprisingly, since it may be interpreted in so many different ways, the Brundtland Commission's definition of sustainable development has received a very wide acceptance. As noted by Pearce et al. (1989), it fits nicely into political sound-bites compared with its predecessor's "eco-development"; it is something to which everyone can agree, like motherhood and apple pie.

13.4.4 Post WCED

The other major stumbling block after WCED is the UN Conference on Environment and Development (UNCED), which is also known as the "Rio Conference," or the "Earth Summit." Preparation for the Conference, held in June 1992. Bringing together nearly 200 government representatives and a large number of NGOs, the Earth Summit gave rise to the Rio Declaration on Environment and Development, a key document reaffirming an international commitment to the principles of sustainable development.

UNCED led to production of major international documents at this meeting:

- Convention on Biodiversity;
- Framework Convention on Climate Change (and its corollary, the Kyoto Protocol);
- Convention to Combat Desertification;
- Statement of principles on the management, conservation and sustainable development of forests.

Although a great deal of importance was attached to the documents and declarations signed at the end of the conference, the most important legacy of UNCED was the very nature of the preparatory process, which, in most countries, involved participation of major stakeholders down to the grassroots level. This process took the concept of sustainable development to every corner of the world, exposing it to questions such as: What does it really mean for each and every community? How can we get beyond generalities and put them into practice? How do we know if we are moving toward a sustainable world?

Under the Rio Declaration, signatory countries agreed that protection of the environment and social and economic development are fundamental to reaching sustainable development. This declaration marks a significant step in the establishment of sustainable development priorities at the international level.

Considering the institutional foundation of WCED and the global realities in the mid-1980s, the definition of sustainable development provided by WCED contains much practical wisdom. It has been highly instrumental in developing the new world view that is emerging today. Having a consensus on a vague concept, rather than disagreement over a sharply defined one, was a "good political strategy" (Daly 1996). By 1995, however, "this initial vagueness was no longer a basis for consensus, but a breeding ground for disagreement" (Daly 1996). Acceptance of a largely undefined term as a basis sets the stage for a situation where whoever can pin his or her definition to the term automatically will win a large political battle for influence over the future.

13.4.5 The World Summit on Sustainable Development (2002)

In 2002, the World Summit on Sustainable Development held in Johannesburg, South Africa, was the occasion for participants to renew their commitment to the principles defined in the Rio Declaration and the Agenda 21 objectives, and also to progress in this sense by prioritizing certain targets. These include the elimination of poverty, changes to consumption patterns and non-viable production, and the protection and management of natural resources. Participants also broached the subject of globalization and ties linking health and development issues. Government representatives in attendance pledged to develop national sustainable development strategies to be implemented before 2005. Since 2002, some governments, international organizations and communities adopted and implemented the strategies, action plans and programs stemming from the directions outlined at the meeting.

The principles of sustainable development underpinned the Rio Earth Summit agenda where approval was given to the Agenda 21 document outlining a 'global partnership for sustainable development'. This massive document addresses a wide range of environmental and developmental issues and is intended to provide a strategy for implementing sustainable development throughout the world. The UN Commission on Sustainable Development (CSD) was created to monitor and promote the implementation of Agenda 21 in each country. By the mid-1990s most industrialised countries had published national sustainable-development strategies, and many local authorities have launched Local Agenda 21 strategies.

On 24th December 2009 the UN General Assembly adopted a Resolution (A/RES/ 64/236) agreeing to hold the United Nations Conference on Sustainable Development (UNCSD) in 2012 - also referred to as 'Rio+20' or 'Rio 20'. The Conference seeks three objectives: securing renewed political commitment to sustainable development, assessing the progress and implementation gaps in meeting already agreed commitments, and addressing new and emerging challenges. The Member States have agreed on the following two themes for the Conference: green economy within the context of sustainable development and poverty eradication, and institutional framework for sustainable development

Since UNCED, sustainable development has become part of the international lexicon. The concept has been incorporated in many UN declarations and its implementation, while complex has been at the forefront of world's institutions and organizations working in the economic, social and environmental sectors. However, they all recognize how difficult it has proven to grant the environmental pillar the same recognition enjoyed by the other two pillars despite the many calls by scientists and civil society signaling the vulnerability and precariousness of the Earth since the 1960s.

The reach of sustainable development has extended far beyond government into the world of business and civil society. The World Bank has sought to throw off its poor reputation with environmentalists by publishing environmental reports, holding regular seminars and sponsoring research on a wide range of environmental issues. The World Bank is also host to the Global Environmental Facility, which is the institution responsible for channeling financial assistance for sustainable development from Northern to Southern nations. The World Business Council for Sustainable Development, formed in 1995, is a coalition of 125 international companies from 30 countries and over 20 industrial sectors, with the broad aim of developing 'closer cooperation between business, government and all other organisations concerned with the environment and sustainable development and to encourage high standards of environmental management in business'. Many trade associations have also declared their support for sustainable development; for example, the insurance industry (which potentially has much to lose if climate change leads to rising sea levels, floods and storms) issued a Statement of Environmental Commitment in March 1995 signed by over 50 leading insurance companies. These international efforts have been widely replicated at the national level, where state-sponsored round-tables have brought together representatives from all sections of society--politicians, business, trade unions, churches, environmental groups, consumer groups--to discuss how sustainable development can be implemented. Despite this widespread enthusiasm, the precise meaning of sustainable development remains elusive.

13.5 Sum up

If IUCN takes credit for incorporating the phrase "sustainable development" for the first time into an international forum, the Brundtland Commission, through its report Our Common Future (1987), was the major political turning point that made the concept of great geopolitical significance and the catch phrase it has become today (Holmberg 1994). Since publication of this report, sustainable development increasingly has become

The core element of environmental discourse, leading to a very broad acceptance with very diverse interpretations. According to Holmberg (1994), by 1994 there were more than 80 different definitions and interpretations fundamentally sharing the core concept of the WCED's definition. Four decades ago, in Stockholm, we agreed on the urgent need to respond to the problem of environmental deterioration. Ten years ago, at the United Nations Conference on Environment and Development, held in Rio de Janeiro, we agreed that the protection of the environment and social and economic development are fundamental to sustainable development, based on the Rio Principles. To achieve such development, we adopted the global programme entitled Agenda 21 and the Rio Declaration on Environment and Development, to which we reaffirm our commitment. The Rio Conference was a significant milestone that set a new agenda for sustainable development.

Between Rio and Johannesburg, the world.s nations have met in several major conferences under the auspices of the United Nations, including the International Conference on Financing for Development, as well as the Doha Ministerial Conference. These conferences defined for the world a comprehensive vision for the future of humanity.

At the Johannesburg Summit, we have achieved much in bringing together a rich tapestry of peoples and views in a constructive search for a common path towards a world that respects and implements the vision of sustainable development. The Johannesburg Summit has also confirmed that significant progress has been made towards achieving a global consensus and partnership among all the people of our planet.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure:

14.1 Objectives

After studying this unit, you should be able to:

- Explain the economic, social and environmental components of sustainable development;
- Understand the concept of indicators of sustainable development; and

- Know the measures for the promotion of sustainable development.

14.2 Introduction

Around the globe there is some amount of concern towards the deterioration of environmental standards. The rise in economic welfare is increasingly accompanied by a considerable decline in the quality of environment and loss of ecological stability. There is pessimistic as well as optimistic view of various groups of environmentalists regarding this but the fact remains that there is acid rain, global warming, the greenhouse effect, erosion and sterility of soil, degradation of land, environmental pollution, and ozone layer depletion. Industrialization and globalization have changed the world. These trends have ushered in complex economic systems, and they frequently occur at the expense of biological and cultural diversity.

Development is a progressive transformation of economy and society. A development path which is sustainable in a physical sense could theoretically be pursued even in a rigid social and political setting. But physical sustainability cannot be secured unless development policies pay attention to such considerations as changes in access to resources and in the distribution of costs and benefits. Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation. Thus the goals of economic and social development must be defined in terms of sustainability in all countries developed or developing, market-oriented or centrally planned.

Over the past few decades, many definitions of sustainable development have been suggested and debated. When the World Commission on Environment and Development presented their 1987 report, Our Common Future, they sought to address the problem of conflicts between environment and development goals by formulating a definition of sustainable development as: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs," which has become the accepted standard definition. The United Nations attempted to reconcile these views in 1992 by convening the first Earth Summit in Rio de Janeiro. It was here that the international community first agreed on a comprehensive strategy to address development and environmental challenges through a global partnership. The framework for this partnership was Agenda 21, which covered the key aspects of sustainability i.e. economic development, environmental protection, social justice, and democratic and effective governance.

When it comes to describing sustainability in our world, we need to be concerned about three interconnected spheres of sustainability that describe the relationships between the environmental, economic, and social aspects of our world.

14.3 Components of Sustainable Development

The definition of sustainable development given by Brundtland Commission Report, Our Common Future, and further, Principle 1 of the Rio Declaration state that human beings are at the center of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature. In the extensive discussions and use of the concept since then, there has generally been recognition of three principal components of sustainable development i.e. Economic, Environmental and Social, which to be more specific are Economic growth, social equity and protection of the environment (Fig 15.1).

Fig. 15.1. The Three Components of Sustainability

Source: C Wanamaker

Sustainable development depends on the links between the economy, the environment and the society. Understanding the three parts and their links is the key to understanding sustainability, because sustainability is about more than just quality of life. It is about understanding the connections and achieving balance among the social, economic, and environmental components.

14.3.1 Economic Sustainability

From the point of view of neoclassical economic theory, sustainability can be defined in terms of the maximization of welfare over time. Most economists simplify further by identifying the maximization of welfare with the maximization of utility derived from consumption. An economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government and external debt and to avoid extreme sectoral imbalances.

Economic sustainability involves creating economic value out of whatever decisions we are undertaking. It is a balancing act. Profitability and cost of a decision must be balanced with the environmental and social impacts of its results. Sustainable development improves the economy without undermining the social or environmental imperatives. A sustainable community does not consume resources, energy and raw materials faster than the regenerative capacity of the natural systems. A sustainable community interacts with four types of capital: natural, human, social, and built capital. All four types of capital need to be cared for.

To a large extent environmental degradation is the result of market failure, that is , the non existent context or poorly functioning markets for environmental goods are services. In this context, environmental degradation is a particular case of consumption or production externalities reflected by divergence between private and social costs (or benefits). What ever is normally accounted economically as an externality should be internalized i.e many natural resources are shared and the true value of many environmental goods and services is not paid for by those who use them. For example, airlines do not pay for the carbon dioxide they put into the atmosphere. Likewise, the price of food does not reflect the cost of cleaning water bodies that have been polluted by run-off of agrochemicals from the land. Tobacco consumption highlights how areas of land are used for a product that is costly to the environment, to people's personal health and to society's resources to provide health care.

Economic and political decisions ultimately have an enormous impact on determining how the world's resources are used (and wasted). More fundamentally, our main economic measurement, Gross Domestic Product (GDP), generally fails to measure environmental impacts because they are "external costs" borne by society instead. If the cost of production included environmental impacts, the cost of safe disposal of many products and their waste, etc, that may help businesses think more about environmental factors in their products and services. In market-based economies as well as mixed economies, this would be crucial. When only the economic aspects of something are considered, it may not necessarily promote true sustainability.

14.3.2 Environmental Sustainability

From an ecological perspective, sustainable development provides for the integrity of both natural biological and physical systems and ensures their viability. The global stability of the biosphere depends upon it. Special significance is attached to the ability of such systems to self reproduce and adapt to various changes, as opposed to being preserved in a static condition within a vacuum or deteriorating and losing its biological variety.

There have been major negative impacts of development on the environment and on existing social structures. Many traditional societies have been devastated by development. Urban areas in developing countries commonly suffer from extreme pollution and inadequate transportation, water, and sewer infrastructure. Environmental damage, if unchecked, may undermine the achievements of development and even lead to collapse of essential ecosystems.

Deeper and wider concern for environmental degradation springs from two major sources i.e. 1) Rise in material production, effluents and use of synthetic materials 2) Increased demand for environmental goods. The first refers to the problems of environmental externality and the second, to depletion of natural resources. In addition to the increased supply of economic goods, there is also an increased demand for environmental goods. Environmental goods signify any external environmental conditions that affect human welfare.

Environmental component of sustainable development include the following requirements:

- At the center of attention there should be man who has the right to lead a healthy life in harmony with the nature;
- Equal opportunities for the development and conservation of environment for the present and future generations;
- sustainable use of renewable resources (such as fresh waters, aquifers, soil, biomass);
- minimizing use of non-renewal resources (fossil fuels, minerals and loss of biodiversity);
- meeting human needs involving access to natural resources, access to adequate healthy environment and basic services;
- Environmental protection should become an integral part of the over all socio-economic process and cannot be considered in isolation from it;
- Unlike in conventional nature conservation practices, the emphasis should be shifted to eco-awareness raising activities relating to economy, above all, to eliminate the causes, not effects;
- Socio-economic development should be given a clear sense of direction toward the improvement of people's living standards within the allowable boundaries of ecosystem's economic capacity; and
- bringing ecology into minds and world perceptions of people and their education systems.

In the environmental sustainability the main focus is on natural resources used either in specific projects or the wider programmes of human activities. The assumption is that economic development is necessary to create wealth for socio-economic development and hence improving the citizen's quality of life. Natural resources are necessary to economic development but there are limits to their supply. In this sense development should proceed but always at a rate that can assure sustainable use of resources.

Uncontrolled use of resources may result in environmental degradation, resulting in the following:

- Reduction in the quantity and quality of resources available for further consumption and production.
- Overuse of the waste-absorbing capacity of the environment.
- Loss in biodiversity.
- Declining environmental resilience resulting in increased incidence of hazards.
- Increasing pressure on land for future built-up environment.

There are several items that are directly related to environmental sustainability. One of the concepts which is of utmost importance is the proper management of our natural resources. Unlike economists, whose models provide no upper bound on economic growth, physical scientists and ecologists are accustomed to the idea of limits. Natural resource degradation, pollution and loss of biodiversity are detrimental because they increase vulnerability, undermine system health, and reduce resilience, which is important often, to avoid catastrophic ecosystem collapse.

Unlike traditional societies, modern economies have only recently acknowledged the need to manage scarce natural resources in a prudent manner because human welfare ultimately depends on ecological services. Ignoring safe ecological limits will increase the risk of undermining long-run prospects for development. Several researchers argue that environmental and geographic factors have been key drivers of past growth and development.

14.3.3 Social Sustainability

In social sector, the primary objective is to achieve scientifically grounded parameters of living standards, increase life expectancy, improve the living environment of people, develop their social activities, family planning, rationalization of personal consumption scales and patterns, providing equal access to education, medical assistance and health recovery; social protection of the elderly, physically challenged and other vulnerable target groups, etc. The social component of sustainable development refers to the relationship between nature and human beings and is also oriented to preserve stability of public and cultural systems, cultural diversity, pluralism, effective grass root's participation in decision-making and the reduction of the amount of societal conflict.

Living standards that go beyond the basic minimum are sustainable only if consumption standards everywhere have regard for long-term sustainability. Yet many of us live beyond the world's ecological means, for instance in our patterns of energy use. Perceived needs are socially and culturally determined, and sustainable development requires the promotion of values that encourage consumption standards that are within the bounds of the ecological possible and to which all can reasonably aspire.

Social sustainability parallels the ideas regarding environmental sustainability. Reducing vulnerability and to maintain the health (i.e., resilience, vigor and organization) of social and cultural systems, and their ability to withstand shocks, is important. Enhancing human capital (through education) and strengthening social values, institutions and equity improve the resilience of social systems and governance.

Social development usually refers to improvements in both individual well-being and the overall social welfare, that result from increases in social capital - typically, the accumulation of capacity for individuals and groups of people to work together to achieve shared objectives. Social capital is the resource which people draw upon in pursuit of their aspirations and is developed through networks and connectedness, membership of more formalized groups and relationships of trust, reciprocity, and exchanges. The institutional component of social capital refers mainly to the formal laws as well as traditional or informal understandings that govern behavior, while the organizational component is embodied in the entities (both individuals and social groups) which operate within these institutional arrangements. We can assume that human capital (e.g., education, skills, etc.), and cultural capital (e.g., social relationships and customs) are also included within social capital - although fine distinctions do exist. A socially sustainable system must achieve distributional equity, adequate provision of social services including health and education, gender equity, and political accountability and participation.

Social sustainability is based on the concept that a decision promotes the betterment of society. In general, future generations should have the same or greater quality of life benefits as the current generations do. This concept also encompasses many things such as human rights, environmental law, and public involvement and participation. Failing to put emphasis on the social part of decision or action can result in the slow collapse of the spheres of sustainability and society as well. One great example of social sustainability is the passing of the Clean Water Act in 1972 (and amendments in 1977) and the Safe Drinking Water Act in 1974. Overall, these sets of laws were great pieces of legislation that set minimum water quality standards for both surface and drinking water. The clean water act also served to protect our nation's water supply by making it essentially illegal to discharge pollutants in adjacent rivers, lakes, and streams.

14.4 Component Goals

Ecological limits and equitable standards encourage consumption that is ecologically possible for all economic activities and equitable resource allocation ensure economic growth that allows all people to meet their needs. The basic goals of sustainable development can be achieved as mentioned below:

Population control prevents population from exceeding the productive potential of the ecosystem.

Resource conservation protects all natural system's carrying capacity and sustainable yield identify the productive potential of the ecosystem.

Resource retention reduce the rate of depletion for non-renewable resources

Species diversification conserve and protect plant and animal species

Adverse impact minimization prevent damage to the ecosystem caused by pollution

Community control prevent the exploitation and degradation of ecosystems

Broad national/international framework jointly manage the biosphere

Economic viability pursue economic well being

Environmental quality make environmental quality a corporate goal, and

Environmental audit track the progress of environmental management systems.

The most essential socio-economic parameters of sustainable development in light of the Plan of Implementation of the World Summit on Sustainable Development are:

- Sustainable livelihoods and quality of life;
- Poverty alleviation;

- Changes in consumption and production patterns;
- Health care and improvement;
- Improvement of demographic situation;
- Counteracting crime in the life of society.

An expansion in population can increase the pressure on resources and slow the rise in living standards in areas where deprivation is widespread. Though the issue is not merely one i.e. population size but of the distribution of resources. Sustainable development can only be pursued if demographic developments are in harmony with the changing productive potential of the ecosystem.

14.5 Indicators of Sustainable Development

Since sustainable development goes well beyond economic issues, linking the economy, environment, and society, no comprehensive economic theory related to sustainable development exists. However, progress toward sustainable development is often measured by a variety of indicators, which can be used at the local, regional, national or international level. It is widely acknowledged that indicators of sustainable development are important tools to increase focus on sustainable development and to assist decision makers at all levels to adopt sound national sustainable development policies. The 1992 Earth Summit recognized the importance and called upon countries and the international community to develop such indicators. In response, the Commission on Sustainable Development (CSD) approved in 1995 Indicators on Sustainable Development and culminated in a set of 58 indicators, based on a Theme/Sub-theme framework. The set of indicators was adopted by the CSD in 2001 after extensive consultations and national testing programmes. The World Summit on Sustainable Development in 2002 and subsequent sessions of the CSD encouraged further work on indicators for sustainable development by the countries in line with national conditions and priorities and invited the international community to support efforts of developing countries in this regard.

A number of reasons for requirement of finding indicators of sustainable development are:

- Indicators of sustainable development are needed to guide policies and decisions at all levels of society: village, town, city, county, state, region, nation, continent and world.

- These indicators represent all important concerns: An ad hoc collection of indicators that just seem relevant is not adequate. A more systematic approach must look at the interaction of systems and their environment.
- The number of indicators should be as small as possible, but not smaller than necessary. That is, the indicator set must be comprehensive and compact, covering all relevant aspects.
- The process of finding an indicator set must be participatory to ensure that the set encompasses the visions and values of the community or region for which it is developed.
- Indicators must be clearly defined, reproducible, unambiguous, understandable and practical. They must reflect the interests and views of different stakeholders.
- From a look at these indicators, it must be possible to deduce the viability and sustainability of current developments, and to compare with alternative development paths.
- A framework, a process and criteria for finding an adequate set of indicators of sustainable development are needed.

Indicators of sustainable development are more of nature of indices that reflect the state of overall concepts or social goals such as human development, sustainable development, the quality of life, or socioeconomic welfare. Indicators provide early warnings about non sustainable trends of economic activity and environmental deterioration.

The sustainable development includes economic performance, social equity, environmental measures, and institutional capacity as its basic components Examples are located in the box to the left. Within the economic performance component, the indicators selected are well-known and commonly used measures at the national and international levels, reflecting important issues of economic performance, trade, and financial status. Consumption and production patterns are also represented, providing additional coverage of material consumption, energy use, waste generation and management, and transportation.

The economic issues like international cooperation, consumption and production patterns, financial resources and mechanisms, transfer of technology, etc. have indicators such as real GDP per capita, growth rate (%), exports of goods and services, imports of goods and services, depletion of mineral resources (% of proven reserves), annual energy consumption per capita, ratio of consumption of renewable sources over non-renewable resources (%), etc.

Freshwater resources, planning and management of land resources, combating desertification and drought, sustainable mountain development, promoting sustainable agriculture and rural development, combating deforestation, conservation of biodiversity, biotechnology are the priority areas for sustainable development and various indicators of these environmental components of sustainable development are Green House Gases their emission /concentrations, SOx, NOx emissions, Toxic Contamination (POC, heavy metal) land conversion; land fragmentation, species abundance, waste generation (municipal/ industria/agriculture), water Resources and the demand/use intensity residential/industrial/ agriculture and demand/supply ratio; forest resources and their use intensity, forest area degraded, protected area forests, fish resources, fish catches; soil degradation -land use changes/ top soil loss; Oceans/Coastal Zones Emissions- oil spills; depositions Water quality Coastal zone management; ocean protection Environmental Index Pressure index, etc.

The quantity and quality of social interactions that underlie human existence, including the level of mutual trust and extent of shared social norms, help to determine the stock of social capital. Thus social capital tends to grow with greater use and erodes through disuse, unlike economic and environmental capital which are depreciated or depleted by use. The various indicators of social component of sustainable development like poverty, demographic dynamics and sustainability, promoting education, public awareness and training, protecting and promoting human health, human settlements including traffic and transport, etc. are employment rate, total fertility rate, population growth rate, population density, access to safe drinking water, exposure of urban population to various types of polluting gases, motor vehicles in use, number of megacities, expenditure on low cost housing, infra structure expenditure per capita, etc.

Equity and poverty alleviation are important. Thus, social goals include protective strategies that reduce vulnerability, improve equity and ensure that basic needs are met. Future social development will require socio-political institutions that can adapt to meet the challenges of modernization - which often destroy traditional coping mechanisms that disadvantaged groups have evolved in the past.

In its broadest sense, the strategy for sustainable development aims to promote harmony among human brings and between humanity and nature. The pursuit of sustainable development requires:

- a political system that secures effective citizen participation in decision making.
- an economic system that is able to generate surpluses and technical knowledge on a self-reliant and sustained basis
- a social system that provides for solutions for the tensions arising from disharmonious development.
- a production system that respects the obligation to preserve the ecological base for development,
- a technological system that can search continuously for new solutions,
- an international system that fosters sustainable patterns of trade and finance, and
- an administrative system that is flexible and has the capacity for self-correction.

These requirements are more in the nature of goals that should underlie national and international action on development. What matters is the sincerity with which these goals are pursued and the effectiveness with which departures from them are corrected. Some of the general considerations which are important for sustainable development in our policy are:

- The plans for environmental management should be integrated in all the developmental activities of all sectoral authorities who have the primary responsibility for environmental protection.
- A mass education and awareness programme from primary school children to professionals, policy makers, decision makers and everybody in between;

- The departments of environment at the centre and in the states have to perform a watch dog role and clubbing with other departments counter productive;
- Key to success in environment lies in cooperation between central and state governments; environmental management including Impact assessment should be a statutory obligation for all development projects.

14.6 Environmental priorities for sustainable development in India

Keeping in view the rapid environmental degradation following environmental priorities have been identified for sustainable development in India:

1. Population stabilisation

As we know that world population is around 6 billion and India has crossed 1 billion mark and since the last 100 years, its population has increased 4 times. Due to multiplication of people, there has been shrinkage of resources and demographic pressures lead to economic pressures.

This increase in population has led to following stresses:-

i) Decrease in land availability: Due to increase in the population, there has been a disastrous decrease in land availability.

ii) Increase in industrialisation: Due to increase in population, the needs of people are multiplying at an enormous rate. Therefore, there is an increase in demand of furnished goods and in turn require more and more industries which contribute to release of more and more gases in the atmosphere and global warming.

iii) Deterioration of sanitary conditions: Due to increase in the population and lack of space, there is decrease in sanitation facility and deterioration in the sanitation conditions.

iv) Economic losses: Increase in population leads to economic losses. It has also cause shortage of food supply. Thus, there is a need to develop stability in the population for sustainability.

2. Integrated land use planning

Land is one of the important components of the life support system and have been overused and abused. Ours is predominantly an agricultural country where land comes first. There are a number of competing demands on land like agriculture, forestry, grasslands urban and industrial development and transportation. For proper land use, planning is very important otherwise it would lead to wastage and degradation of land so land has to be used wisely.

3. Healthy croplands and grasslands

India has performed well in agriculture over the years and the production has increased tremendously. But with growing population, there is an urgent need to boost productivity per unit area per unit of time. This can be made possible in India by:

- closing the gap between actual and potential yields and thus growing vertically rather horizontally in agriculture.
- introducing genetics especially genetic engineering in agriculture.
- With the help of biotechnology, it may be possible to release considerable land from present agricultural holdings.
- Strategies to reduce the top soil loss.
- Moreover, the problem of grasslands and overgrazing have not received deserved attention. This has resulted in eco-degradation due to the fact that we have the world's largest number of livestock which are very poor productivity wise. Hence, a concerted effort is needed.

4. Woodland and revegetation

The cause of decline in the forest cover is due to demand of the forest based goods. To meet the demand, the forests are being felled at an alarming rate causing ecological disturbances like floods, removal of topsoil increase in CO2 (global warming) etc. Coupled with these problems, there is a widening gap between the demand and supply of wood for diverse uses. So, the strategy to meet the shortages has to be chalked out against two major objectives of forestry:-

(i) Affording long term ecological security

(ii) Supply of goods and services to the people and industry through a well thought out plan of production.

To achieve these objectives, 3 broad types of forestry need to be practised namely conservation, production and social forestry.

i) Conservation forestry - it will cover natural vegetation in watersheds, fragile ecological areas and the biosphere reserves, national parks etc. Where no commercial exploitation can be allowed.

ii) Production or commercial or industrial forestry - it aims at meeting the raw material demands of all forest based industries.

iii) Social, community or agro-forestry: Basically, this is a multi purpose forestry for food, timber, fuel and fodder to meet village needs that would relieve pressure on the conservation forests.

5. Conservation of biological diversity

The biological wealth of our country is fairly considerable but the diversity of various species is at a great risk due to large scale human interferences. Our efforts at conservation should be directed mainly towards the conservation offlora and fauna including big cats; large mammals; plants, forest flora in particular; micro-organisms and marine biological wealth. To retain this biological diversity

a) it is extremely important to base the conservation effort on an ecosystem basis and not on a specie basis.

b) All the sanctuaries and national parks have to meet the minimum area demand of the species that they are supposed to contain.

c) More and more biosphere reserves should be declared.

6. Control of water and air pollution

All development is accompanied by some form of pollution. In our country, the major sources of pollution are domestic wastes, thermal power, industries, irrigation, auto-exhaust emissions and abuse of agricultural chemicals. Pollution creates some problems like Global warming, health deterioration, disturbance of ecological balance.

7. Development of non-polluting renewable energy systems

Energy is a very important input for development and there is a correlation between the level of development and the amount of energy used by a country.

Energy resources are of two types namely renewable and non-renewable. The non-renewable forms of energy are regarded as energy capital. Most of the non-renewable energy resources like coal, petroleum, fuelwood, etc. are highly polluting. There is need to develop the non-polluting renewable energy resources like micro-hydel, solar, wind, tidal, ocean and geothermal.

8. Recycling of wastes and residues

In order to maintain stable economic growth in future, it is necessary that resources are carefully used and technologies for recycling wastes and residues are evolved. There is a global realisation that a nation that will not be able to recycle materials will not be able to sustain itself because one time use will lead to scarcity.

9. Ecologically compatible human settlements and their improvement

The absence of housing causes a lot of human misery with consequent degradation of physical health, economic, social and cultural environment in urban, slums and in rural areas. There is absence of water supply and sanitation systems in the slums creating unhygienic conditions and various health hazards. If we are serious about improving the living conditions of the weaker sections of the society, it is important that the life styles of urban people become less energy demanding and less consumptive. Village people should be made self sufficient so that their demands are met in villages only.

10. Environmental education and awareness

Today, one of the major priorities of the central government is the environmental education. In fact, with the acceptance of the Tiwari Committee Report (1980), the country has accepted the need for environmental education.

The non-formal sector must cater to educate adult, rural-youth and non-student youth, tribal and forest dwellers, children, public representatives, senior-executives and administrators and foundation courses for probationary officers from various services including armed forces.

11. Updating environmental laws

While there are a number of central and state laws and enactments which have direct or indirect relevance to the environment, none except perhaps Water and Air Acts, take care of short and long range effects on environment. There is an urgent need to update the existing laws. In fact, this has to be done as a regular activity so that laws are able to meet the newer environmental challenges and insulate the country from future environmental damage.

14.7 Sum up

Sustainable development is the concept of meeting the needs of the present without compromising the ability of future generations to meet their needs. The terms originally applied to natural resource situations, whereas today, it applies to many disciplines, including economic development, environment, food production, energy, and social organization. Sustainable development is usually defined to comprise three basic components i.e. economic, social and environmental. These three components involve: a) economic activity should serve the common good, be self-renewing, and build local assets and self-reliance. b) Environmental - humans are part of nature, nature has limits, and communities are responsible for protecting and building natural assets. c) Social - to achieve equity i.e. the opportunity to all for full participation in all activities, access, benefits, and decision-making of a society.

The three spheres of sustainability encompass many concepts which explain how decisions and actions can have an impact on the overall sustainability of our world. Sustainable development efforts will also promote the integration of the three components of sustainable development, economic development, social development and environmental protection, as interdependent and mutually reinforcing pillars. Poverty eradication, changing unsustainable patterns of production and consumption and protecting and managing the natural resource base of economic and social development are main objectives of, and essential requirements for, sustainable development. An economic state where the demands placed upon the environment by people and commerce can be met without reducing the capacity of the environment to provide for future generations. It can also be expressed in the simple terms of an economic golden rule for the restorative economy: leave the world better than you found it, take no more than you need, try not to harm life of the environment, make amends if you do.

The use of ecosystems and their resources in a manner that satisfies current needs while allowing ecosystems a chance to replenish the ecosystem by itself and to maintain ecological processes and functions, biological diversity and productivity over time as well avoidance of pollution that damages biological systems.

Good governance within each country and at the international level is essential for sustainable development. At the domestic level, sound environmental, social and economic policies, democratic institutions responsive to the needs of the people, the rule of law, anti-corruption measures, gender equality and an enabling environment for investment are the basis for sustainable development.

It is widely acknowledged that indicators of sustainable development are important tools to increase focus on sustainable development and to assist decision makers at all levels to adopt sound national sustainable development policies. The indicators are the monitoring tools to assess the sustainability of Social, economic and environmental components of sustainable development.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

15.1 Objectives:

The main objectives of this lesson is to equip you with **:**

- Basic concept and scope of environmental audit
- The components of environmental audit

- The main steps involved in environmental auditing
- The types of environmental audit
- The tools and techniques used in the process of environmental auditing, and
- The benefits of conducting environmental audits

15.2 Introduction:

The concern for the environmental protection has increased manifold in the recent years and all of us are worried about health hazards that are posed by environmental deterioration. The main challenge of the 1990s enunciated by the Earths Summit at Rio is to work for sustainability and achieve it. Sustainable development will only become a reality if we adopt methods of production that generate less wastes and emissions than traditional industrial processes and certain good practices to utilize our natural resources more effectively. The environmental audit is an efficient tool to achieve this goal.

Environment, health and safety and safety auditing dates back to the early 1970s when a handful of companies, working independently and on their own initiatives, developed audit programmes as internal tools to review and evaluate environmental problems at the operating unit level. Since then, the discipline has experienced a significant degree of growth and evolution. Today, several hundred companies in the USA, Canada, and Europe have established formal audit programmes designed to provide senior management with assurance that operations are being managed in accordance with established governmental standards and good industry practices.

Environmental auditing is a process whereby an organisation's environmental performance is tested against its environmental policies and objectives. These policies and objectives need to be clearly defined and documented. An environmental audit is but one of many environmental management tools which are used to assess, evaluate and manage environmental and sustainability issues. This tool can be used in various ways but also has its limitations.

To a great extent this revolution parallels several events, this revolution parallels certain events like

- There has been a proliferation of regulatory requirements over the past two decades, leading to an increasing uncertainty as to whether a given operating facility was in compliance with those requirements.

- The public is increasingly demanding assurance from top management that the company's operations are in compliance and that effective means are in place for managing environmental risks.

- The doctrine of safe harbour, which in past served to protect corporate directors from liability claims, has today given way to litigation, regulations, publicity and public pressure.

The International Chamber of Commerce Position paper on environmental auditing adopted on November 29, 1988 defined Audit as a systematic examination of performance to ensure compliance with requirements during the operational phase of industrial activity including the following components:

- Full management commitment
- Audit team objectivity
- Professional competence
- Well-defined and systematic approach
- Written reports
- Quality assurance.
- Follow-up

The complete definition of environmental auditing given by International Chamber of Commerce (ICC, 1991) is:

"A management tool comprising a systematic, documented, periodic and objective evaluation of how well the environmental organisation, management and equipment are performing with the aim of contributing to safeguarding the environment by facilitating management control of environmental practices and assessing compliance with company policies, which would include meeting regulatory requirements".

We can also say that environmental audit is

- An activity of verification of records.
- Evaluation of managerial effectiveness.
- A comparison of output with expectations
- An assessment of avoidable errors and wastes
- An assessment of risk.
- An investigation into field conditions.
- Validation of environmental data, records and reports.
- A basis to provide recommendations to improve the environmental management system.

15.3 Concept

The concept of environmental audit has emerged from the behaviour of a progressive person who often puts himself the questions that is Am I on right path? Can I choose better, how has the other chose?

Hazards of various industrial/ developmental activities have initiated the introspection analysis and the title of environmental audit.

The audit is sometimes confused with an Environmental Impact Assessment (EIA). An EIA is a tool used to predict, evaluate and analyse environmental impacts before a project commences, whereas an environmental audit looks at environmental performance for an existing operation or activity.

15.4 Scope of the Audit

As the prime objective of audits is to test the adequacy of existing management systems, they fulfill a fundamentally different role from the monitoring of environmental performance. Audits can address one topic, or a whole range of issues. The greater the scope of the audit, the greater will be the size of the audit team, the time spent onsite and the depth of investigation. Where international audits need to be carried out by a central team, there can be good reasons for covering more than one area while onsite to minimize costs.

In addition, the scope of an audit can vary from simple compliance testing to a more rigorous examination, depending on the perceived needs of the management. The technique is applied not only to operational environmental, health and safety management, but increasingly also to product safety and product quality management, and to areas such as loss prevention. If the intention of auditing is to help ensure that these broad areas are managed properly, then all of these individual topics must be reviewed.

15.5 Components of Auditing

Assessment

It provides expert judgement/opinion on hazards, associated risks and management and control measures. It helps identify knowable hazards. In addition, it also estimates the significance of risks and assesses current practices and capabilities. It is used to provide the basis for recommendations to improve the organisation's management system and environmental performance.

Verification

This process determines and documents performance by evaluating the application of, and adherence to, policies and procedures. It certifies the validity of data and reports, evaluates the effectiveness of management systems and verifies that regulations and policies are being adhered to. Verification assists in identifying gaps in organisational policies and standards.

15.6 Elements of an environmental audit

The two principal are

a) External audit

b) Internal audit

a) The External audit

This is commonly referred to as a state of environment (SOE) report. It involves studying the environmental conditions prevalent in the district, state etc. i.e. at macro level. The information requirement for such report is considered to be formidable. Much of the data though is regularly collected in routine by the local authorities or out side agencies.

b) The Internal Audit

While the State of Environment report become a base for the assessing the actual quality of the local human environment, the internal audit assesses the policies and practices of the authority which includes three facets like

1. The review of internal practices: This assesses the direct environmental impact of the activities of the organization, the energy efficiency of the buildings, vehicles, the recycling or disposal of wastes. The review of practices is an aspect of the audit appropriate to any organization or enterprise.

2. The Policy Impact Assessment: This concerns the environmental impacts of the local authority in its role as regulator, enforcer, educator and service provider. Some of the policies are intended to influence the environment e.g. Pollution control and landscape policies. Others can be primarily social or economic in their impact but have important environmental side effects.

3. The Management Audit: This is when the auditors assess whether the organizational structure, job descriptions, patterns of responsibility and communication help or hinder environmental effectiveness.

15.7 Basic steps in Environmental audit

The basic steps in the typical audit process are:

Pre-audit activities

These comprise audit scheduling; team selection; logistical arrangements; preparation of background paper, education on Environmental audit and developing the audit plan.

Audit process or Onsite Activities

Key activities include interaction with the local staff, understanding management system; understanding plant process and operating systems; assessing the strengths and weaknesses; gathering audit evidence, evaluating audit findings and reporting audit findings to management.

Post audit activities

Objectives of these activities are preparation of environmental audit report, ensure the audit results are clearly communicated to the appropriate level of management; ensure all findings and observations are addressed by management; evaluate effectiveness of audit and provide solutions and recommendations for improving future audits and share lessons learned during the audit.

The base of any environmental audit is that its findings are supported by documents and verifiable information. The audit process will seek, on a sampled basis, to track past actions, activities, events, and procedures to ensure that they are carried out according to systems requirements and in the correct manner. Document trails are vital in verifying verbal answers to questions and ensuring that persons are carrying out their duties and tasks according the correct procedures and training.

Having audit teams that include specialist skills and who come back annually to repeat audits, will tend to level out any variance caused by individual skills and experience. The essence of any environmental audit is to find out how well the environmental organisation, environmental management and environmental equipment are performing. Each of the three components are crucial in ensuring that the organisation's environmental performance meets the goals set in its environmental policy. The individual functioning and the success of integration will all play a role in the degree of successor failure of the organisation's environmental performance.

15.8 Different types of environmental audits

The audits can be various types:

Environmental Management Audits

These are audits which are specifically designed to check and evaluate the effectiveness of environmental management systems. Sound environmental management at a site or in an operation depends upon procedures, work instructions, guidelines, specification, training programmes and monitoring systems being implemented by the employees of the organisation operating on the site. If these employees are not given the right instructions, training and procedures within the system, they cannot be expected to carry out their work effectively.

Thus, the first stage in auditing an operation is to check the presence, absence and functioning of the environmental management system (which could be formal or informal). This then creates a baseline against which one can check the environmental functioning of an organisation more effectively and objectively.

Environmental Compliance Audits

Environmental compliance (or performance) audits are specifically designed to test compliance (which covers both legal compliance and corporate compliance) to environmental policies, objectives, laws, by-laws, ordinances, regulations and standards.

These types of audits will often also include more numerical testing and specific checks on, for example, compliance with requirements in water and air permits and licences.

Environmental Assessment Audit

An environmental assessment audit is an instrument used to check that an Environmental Impact Assessment complies with the minimum legal requirements and also checks to ensure that due legal process has been followed. This particular audit is used to assist in EIA quality control and to reduce unnecessary costs and inconvenience, should the EIA be appealed against.

Waste Audits

Waste audits are environmental audits which specifically look at the waste management component of an operation or site. In such audits, the various aspects of waste management would be reviewed and the methods, procedures and systems checked and verified. In cases where site management are reluctant to undertake full site environmental audits, it is often easier to motivate for a specialised waste audit because the results of this will often more readily generate data and actions which can save money.

Environmental Due Diligence Audits

Environmental due diligence audits are described in different ways but are essentially audits which look at the actual and potential environmental liabilities of a site or operation. They are most commonly carried out as a precursor to the purchase of property which has been or is likely to be used for industrial or commercial purposes. Often, they form a part of a wider financial due diligence audit which looks at the various business risks associated with the purchase of property. The kind of issues that can emerge from environmental due diligence audits include past dumping or burying of hazardous waste which may result in pollutants contaminating the groundwater. In such circumstances, the owner of the land where the waste was buried could be held liable for the clean up costs. It is important, when purchasing property, to ensure that the new owner is not taking over someone else's hidden environmental liabilities.

Supplier Audits

A supplier audit is an audit carried out by a client to test the environmental compliance of a contractor or supplier. It should be an audit using the environmental conditions included in the contract document. In the absence of any specific conditions, it could be an audit of the supplier's environmental management system with special reference to the client's business. It is often said that in any organisation, one's contractors are the weakest link in the chain of operation. This is not necessarily a reflection on the quality of the contractor's service but acknowledgement of the fact that the contractor will not necessarily have the same goals and objectives as the client organisation. The contractor and client will have a contractual relationship which is often based upon the supply of a specific product or service. If the client wishes a contractor to have exactly the same approach to environmental policy and systems as his own, then this needs to be included in the contract. Furthermore, the compliance with such policies and systems need to be regularly audited. Thus a supplier or contractor audit is one where the contractor is audited against the environmental requirements of the contract.

15.9 Some of the tools and techniques used in auditing

Checklists

Checklists are very useful tools to use to ensure that different tasks or topics are included during the audit. They are very useful in specialised cases where a complex range of issues and questions need to be asked to ensure that nothing is missed. One of the limitations of checklists is that there is a tendency to rely too much on a checklist and not look at matters that arise beyond the contents of the checklist or secondary questions and issues that may develop as a result of other information or observations. A checklist with all the sections carefully ticked off is not necessarily a true reflection of, say, a fully compliant site. If questions or check items have, for some reason, been left off or forgotten, this could have a significant impact upon the conclusions of the audit. It is for that reason that additional information needs to be used in support of checklists.

Questionnaires (Audit Protocols)

Audit protocols or audit questionnaires provide the basis and structuring for most audits. They are based upon checklist questionnaires but are more complex and include more detail and sometimes logistical information and data relating to the audit and the site being audited. When developing protocols, every effort should be made to avoid generating questions that can be answered by a simple "yes" or "no". The purpose of questions in protocols is to trigger supplementary questions, additional information not specifically asked in the question and encourage a two-way dialogue.

Questioning

Questioning is one of the most crucial aspects of auditing yet from a training and awareness point of view, it is often given the least attention. Questions should be posed in a neutral, friendly manner to prevent the auditee feeling defensive or threatened by the nature and content of the questions. The purpose is information gathering in nature and not an interrogation. The questioner must therefore be sensitive to the perspective of the auditee and avoid making the questions accusatory, judgemental or aggressive.

Observation

Observation is a vital component of an auditing exercise. Observation is a disciplined activity which must be carried out in a very deliberate and controlled manner. Human behaviour being what it is, there is often a tendency to "see what we want to see rather than see what is there". Similarly, one may make an observation and see a fragmentary part of a scene or activity and assume the rest, rather than checking the entire scene. The idea of looking at something twice is important because it is part of the process that checks that the observation is accurately noted, analysed and recorded.

Photographs

Photographs are a very valuable aid in the audit process. However, in order to use them, a number of important practical points must be borne in mind. The first point is that formal approval to bring a camera on to site for the audit must be obtained before the audit begins.

"Drill Down" Sampling

Drill down sampling refers to the process of investigating data as far back as possible, going right back, for example, to the point where the operator read the pressure dial and wrote the reading down on a clipboard. It is necessary, on a sampled basis, to drill down to information or action source in a number of situations to check whether a system is working and that the data being generated through the system's requirements, is

actually being generated, recorded and utilised. Generally, as one finds more errors, faults and non conformances, one tends to increase the size and scope of the drill down sampling to explore whether the problems are of an isolated nature or whether they reflect a systems breakdown.

Research

It is useful to try and undertake some background research and investigation into the site or company to be audited. Familiarisation with the operations, products, raw materials reports, press material and newspaper articles all provides useful background information to supplement questioning sessions and help understand the operational processes.

16.10 Benefits of Environmental Audit

Environmental audit is the tool which can play a very important role in environmental management.

- The environmental audits create an assurance to comply with the regulations and standards laid down by the environmental authorities
- Development in environmental management
- Improvement in environmental performance
- Create awareness to environmental issues
- Reduction in potential liabilities
- Improvement in sharing of information

- Reduction in potential pollutants and health hazards
- Reduction in consumption of water and other raw material
- Improvement in productivity
- Abatement of environmental pollution

15.11 Sum up

Environmental audits form part of a process. Although they are individual events, the real value of environmental audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time. It can sometimes take as long as three iterations of an audit before sustainable environmental change and improvement can be tracked clearly. This is because the audit will often identify the need for behavioural change which cannot always be implemented immediately, particularly if training programmes have to be altered and terms and conditions of service changed. Although environmental audits are carried out using policies, procedures, documented systems and objectives as a test, there is always an element of subjectivity in an audit. This flexibility reflects the fact that different auditors have different life and professional skills and experience and they may bring different interpretations to site situations and circumstances.

-000-

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

16.1 Objectives:

This lesson on Environmental legislation will make you understand and know about the

- **The environmental provision in the constitution of India**
- **Various Environmental Acts and rules promulgated in India**

16.2 Introduction

Rapid economic, scientific and technological advancements have shown massive repercussions in the form of degradation of ecological balances. Due to large scale occurrence of environmental crises, the global community has expressed major concern over environmental protection and environmental development. Amidst some serious endeavors, significant developments took place in the international scenario.

In a sincere effort of tackling pollution control the attention of the world was drawn towards environment in the United Nations Conference on Human Environment held at Stockholm in June 1972. The Declaration on Human Environment was passed containing twenty-six principles, with the main object of overcoming environmental problems related to the development of States and to provide clean and healthy living conditions.

The important mile stone achieved towards the preservation of the environment was the Earth Summit convened by the UN General Assembly at Rio de Janeiro from 3rd to 14th June, 1992. The Conference saw the largest gathering of world leaders ever in the history - deliberating and chalking out a blue print for the survival of the planet. It added a new dimension on the issues of environment and development in international negotiations.

The main objective of the Summit was to find an equitable balance between the economic, social and environmental needs of present and future generations and to lay down a foundation for global partnership between developed and developing countries, on one hand, as well as governmental agencies and non governmental organisations. Amongst the various achievements of the Rio Conference was the signing of two conventions, one on biological diversity and another on climate change.

The World Summit on Sustainable Development was held at Johannesburg, where after 10 years of the Rio Conference, the Summit reaffirmed sustainable development as a central element of the international agenda and gave new impetus to global action to fight poverty and protect environment. The Summit's plan of implementation is a seventy-one page document that is intended to set the world's environmental agenda for the next ten years and is expected to be a model for future international agreements. The plan of implementation aims at building further on the achievements made at UNCED and make commitment to undertake actions and measures at all levels to implement Rio principles and Agenda 21.

16.3 Impact in India

In the early years of Indian independence, there was no precise environmental policy. Government tried to make attempts only from time to time as per the growing needs of the society. The period of 1970s witnessed a lot of changes in policies and attitudes of the Indian Government when its attitude changed from environmental indifference to greater and subsequently, manifold steps were taken to improve environmental conditions. However, it must be accepted that only with the strengthening of public interest litigations and an enhanced commitment from the Central Government during the late 1970s, did an expansion of constitutional provisions to include aspects relating to the environment take place.

The year 1972 marks a watershed in the history of environmental management in India. This is because prior to 1972, environmental concerns such as sewage disposal, sanitation and public health were dealt with by different federal ministries and each pursued these objectives in the absence of a proper coordination system at the federal or the intergovernmental level. When the twenty-fourth UN General Assembly decided to convene a conference on the human environment in 1972, and requested a report from each member country on the state of environment, a Committee on human environment under the chairmanship of Pitambar Pant, member of the Planning Commission, was set up to prepare India's report. With the help of the reports, the impact of the population explosion on the natural environment and the existing state of environmental problems were examined.

16.4 Environmental Legislations in India

16.4.1 Constitutional provisions for Environmental Protection in India

The Constitution of India originally adopted, did not contain any direct and specific provision regarding the protection of natural environment. Nevertheless, on a careful analysis of various provisions prior to the 42nd Constitutional Amendment, reveals that some of the

Directive Principles of State Policy showed a slight inclination towards environmental protection. These directive principles individually and collectively impose a duty on the State to create conditions to improve the general health level in the country and to protect and improve the natural environment. These Directives were and are still not judicially enforceable. Taking note of the Stockholm Conference and the growing awareness of the environmental crises, the Indian Constitution was amended in the year 1976. This gave it an environmental dimension and added to it direct provisions for the preservation of ecological and biological diversity.

Article 48-A

The State's responsibility with regard to environmental protection has been laid down under Article 48-A of our Constitution which comes under Directive Principles of State Policy. According to this article "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country".

Article 51-A(g)

Environmental protection is a fundamental duty of every citizen of this country under Article 51-A(g) of our Constitution which reads as, "It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures."

Article 21

Article 21 of the Constitution is a fundamental right which reads as follows:

"No person shall be deprived of his life or personal liberty except according to procedure established by law."

Article 47

The State's responsibility with regard to raising the level of nutrition and the standard of living and to improve public health has been laid down under Article 47 of the Constitution which reads as follows:

"The State shall regard the raising of the level of nutrition and the standard of living of its people and the improvement of public health as among its primary duties and, in particular, the State shall endeavour to bring about prohibition of the consumption except for medicinal purposes of intoxicating drinks and of drugs which are injurious to health."

The 42nd amendment to the Constitution was brought about in the year 1974 makes it the responsibility of the State Government to protect and improve the environment and to safeguard the forests and wildlife of the country. The latter, under Fundamental Duties, makes it the fundamental duty of every citizen to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

16.5 Environmental acts

16.5.1 Water (Prevention and Control of Pollution) Act, 1974

One of the major environmental enactments of India came just two years after the Stockholm Conference in 1974. The Water (Prevention and Control of Pollution) Act was passed for the purpose of prevention and control of water pollution and for maintaining and restoring the wholesomeness of water. The Water Act represented India's first attempt to deal with an environmental issue from a legal perspective.

This Act represented India's first attempts to comprehensively deal with environmental issues. The Act prohibits the discharge of pollutants into water bodies beyond a given standard, and lays down penalties for non-compliance. The Act was amended in 1988 to conform closely to the provisions of the EPA, 1986. It set up the CPCB (Central Pollution Control Board) which lays down standards for the prevention and control of water pollution. At the State level, the SPCBs (State Pollution Control Board) function under the direction of the CPCB and the state government. These boards are entrusted with the tsk of monitoring the state of wter pollution in the country and laying down standards of permissible and impermissible levels of pollution.

16.5.2 Water (Prevention and Control of Pollution) Cess Act, 1977

This Act provides for a levy and collection of a cess on water consumed by industries and local authorities. It aims at augmenting the resources of the central and state boards for prevention and control of water pollution. Following this Act, The Water (Prevention and Control of Pollution) Cess Rules were formulated in 1978 for defining standards and indications for the kind of and location of meters that every consumer of water is required to install.

From this period onwards, the Central Government has been considered as highly environmentally active. In 1976, the Constitution of India was amended to insert the separate fundamental duties chapter. The 1980s witnessed the creation of many eco-specific organizations. In the year 1980, the Forest (Conservation) Act was passed for the conservation of forests and to check on further deforestation.

16.5.3 The Forest (Conservation) Act, 1980

This Act was adopted to protect and conserve forests. The Act restricts the powers of the state in respect of de-reservation of forests and use of forestland for non-forest purposes (the term "non-forest purpose" includes clearing any forestland for cultivation of cash crops, plantation crops, horticulture or any purpose other than re-afforestation).

16.5.4 The Wildlife (Protection) Act, 1972

Knowing the importance of wildlife resources and in order to conserve these resources India has taken important steps by setting Indian Board of Wildlife (1952), creation of wildlife parks sanctuaries, Wildlife (Protection) Act (1972), became a party to Convention of International Trade in Endangered Species of flora and fauna (CITES, 1976) and by starting conservation projects for individual species like Hangul(1970), Lion(1972), Tiger(1973), crocodile(1974), etc.

The Wildlife (Protection) Act (1972) establishes a network of ecologically-important protected areas. The Act empowers the central and state governments to declare any area a wildlife sanctuary, national park or closed area. There is a blanket ban on carrying out any industrial activity inside these protected areas. It provides for authorities to administer and implement the Act; regulate the hunting of wild animals; protect specified plants, sanctuaries, national parks and closed areas; restrict trade or commerce in wild animals or animal articles; and miscellaneous matters. The Act prohibits hunting of animals except with permission of authorized officer when an animal has become dangerous to human life or property or so disabled or diseased as to be beyond recovery. The near-total prohibition on hunting was made more effective by the Amendment Act of 1991.

16.5.5 The Air (Prevention and Control of Pollution) Act, 1981

It was enacted by invoking the Central Government's power under Art 253. The Air Act contained several distinguishing features. The preamble of the Air Act explicitly reveals that the Act represents an implementation of the decisions made at the Stockholm Conference. Also, a notification relating to Noise Pollution (Regulation & Control) Rules was made in the year 2000 with the objective of maintaining Ambient Air Quality Standards in respect of noise.

To counter the problems associated with air pollution, ambient air quality standards were established, under the 1981 Act. The Act provides means for the control and abatement of air pollution. The Act seeks to combat air pollution by prohibiting the use of polluting fuels and substances, as well as by regulating appliances that give rise to air pollution. Under the Act establishing or operating of any industrial plant in the pollution control area requires consent from state boards. The boards are also expected to test the air in air pollution control areas, inspect pollution control equipment, and manufacturing processes.

National Ambient Air Quality Standards (NAAQS) for major pollutants were notified by the CPCB (Central Pollution Control Board) in April 1994. These are deemed to be levels of air quality necessary with an adequate margin of safety, to protect public health, vegetation and property. The NAAQS prescribe specific standards for industrial, residential, rural and other sensitive areas. Industry-specific emission standards have also been developed for different industries like iron and steel plants, cement plants, fertilizer plants, oil refineries and the aluminium industry. The ambient quality standards prescribed in India are similar to those prevailing in many developed and developing countries.

To empower the central and state pollution boards to meet grave emergencies, the Air (Prevention and Control of Pollution) Amendment Act, 1987, was enacted. The boards were authorized to take immediate measures to tackle such emergencies and recover the expenses incurred from the offenders. The power to cancel consent for non-fulfilment of the conditions prescribed has also been emphasized in the Air Act Amendment.

The Air (Prevention and Control of Pollution) Rules formulated in 1982, defined the procedures for conducting meetings of the boards, the powers of the presiding officers, decision-making, the quorum; manner in which the records of the meeting were to be set etc. They also prescribed the manner and the purpose of seeking assistance from specialists and the fee to be paid to them.

16.5.6 Noise Pollution (Regulation & Control) Rules, 2000

This act aimed at regulating and controlling noise from sources like, industrial activity, construction activity, generator sets, loud speakers, public address systems, music systems, vehicular horns and other mechanical devices. The prescribed Ambient Noise Levels are to be complied with. A loud speaker should not be used except after obtaining written permission from the authority. If the noise level exceeds the ambient standards by 10 dB, a complaint can be lodged to the authority.

16.5.7 Environment (Protection) Act, 1986.

In the wake of the Bhopal gas tragedy, the Government of India enacted the Environment (Protection) Act, 1986. The laws that existed prior to the enactment of EPA essentially focused on specific pollution (such as air and water). The need for a single authority which could assume the lead role for environmental protection was answered through the enactment of EPA. It is in the form of an umbrella legislation designed to provide a framework for Central Government to coordinate the activities of various central and state authorities established under previous laws. It is also in the form of an enabling law, which delegates wide powers to the executive to enable bureaucrats to frame necessary rules and regulations.

This Act is an umbrella legislation designed to provide a framework for the co-ordination of central and state authorities established under the Water (Prevention and Control) Act, 1974 and Air (Prevention and Control) Act, 1981. Under this Act, the central government is empowered to take measures necessary to protect and improve the quality of the environment by setting standards for emissions and discharges; regulating the location of industries; management of hazardous wastes, and protection of public health and welfare.

From time to time the central government issues notifications under the EPA for the protection of ecologically-sensitive areas or issues guidelines for matters under the EPA. Some notifications issued under this Act are:

a) The Environmental Impact Assessment of Development Projects Notification, (1994 and as amended in 2006). As per this notification, All projects listed under Schedule I require environmental clearance from the Ministry of Environment and Forests (MoEF). Projects under the delicenced category of the New Industrial Policy also require clearance from the MoEF. All developmental projects whether or not under the Schedule I, if located in fragile regions must obtain clearance from MoEF. Industrial projects with investments above Rs 500 million must obtain MoEF clearance and are further required to obtain a LOI (Letter Of Intent) from the Ministry of Industry, and an NOC (No Objection Certificate) from the SPCB and the State Forest Department if the location involves forestland. Once the NOC is obtained, the LOI is converted into an industrial licence by the state authority. The notification also stipulated procedural requirements for the establishment and operation of new power plants. As per this notification, two-stage clearance for site-specific projects such as pithead thermal power plants and valley projects is required. Site clearance is given in the first stage and final environmental clearance in the second. A public hearing has been made mandatory for projects covered by this notification. This is an important step in providing transparency and a greater role to local communities.

b) Doon Valley Notification (1989), which prohibits the setting up of an industry in which the daily consumption of coal/fuel is more than 24 MT (million tonnes) per day in the Doon Valley.

c) Coastal Regulation Zone Notification (1991), which regulates activities along coastal stretches. As per this notification, dumping ash or any other waste in the CRZ is prohibited. The thermal power plants (only foreshore facilities for transport of raw materials, facilities for intake of cooling water and outfall for discharge of treated waste water/cooling water) require clearance from the MoEF.

d) Complementing the above ***Acts is the Atomic Energy Act of 1982***, which was introduced to deal with radioactive waste. In 1988, the Motor Vehicles Act, was enacted to regulate vehicular traffic, besides ensuring proper packaging, labelling and transportation of the hazardous wastes. Various aspects of vehicular pollution have also been notified under the *Environment (Protection)* Act, 1986. Mass emission standards were notified in 1990, which were made more stringent in 1996. In 2000 these standards were revised yet again and for the first time separate obligations for vehicle owners, manufacturers and enforcing agencies were stipulated.

16.6 Some legislations concerning hazardous waste

There are several legislations that directly or indirectly deal with hazardous waste. The relevant acts are the Factories Act, 1948, the Public Liability Insurance Act, 1991, the

National Environment Tribunal Act, 1995 and some notifications under the Environmental Protection Act of 1986. A brief description of each of these is given below.

16.6.1 Factories Act, 1948 and its Amendment in 1987

The Factories Act, 1948 was a post-independence statute that explicitly showed concern for the environment. The primary aim of the 1948 Act has been to ensure the welfare of workers not only in their working conditions in the factories but also their employment benefits. While ensuring the safety and health of the workers, the Act contributes to environmental protection. The Act contains a comprehensive list of 29 categories of industries involving hazardous processes, which are defined as a process or activity where unless special care is taken, raw materials used therein or the intermediate or the finished products, by-products, wastes or effluents would:

- Cause material impairment to health of the persons engaged
- Result in the pollution of the general environment

16.6.2 Public Liability Insurance Act (PLIA), 1991

The Act covers accidents involving hazardous substances and insurance coverage for these. Where death or injury results from an accident, this Act makes the owner liable to provide relief as is specified in the Schedule of the Act. The PLIA was amended in 1992, and the Central Government was authorized to establish the Environmental Relief Fund, for making relief payments.

16.6.3 National Environment Tribunal Act, 1995

The Act provided strict liability for damages arising out of any accident occurring while handling any hazardous substance and for the establishment of a National Environment Tribunal for effective and expeditious disposal of cases arising from such accident, with a view to give relief and compensation for damages to persons, property and the environment and for the matters connected therewith or incidental thereto. A claimant making an application may also make an application for immediate relief under the Public Liability Insurance Act.

Under the EPA 1986, the MoEF has issued several notifications to tackle the problem of hazardous waste management. These include:

16.6.4 Hazardous Wastes (Management and Handling) Rules, 1989, which brought out a guide for manufacture, storage and import of hazardous chemicals and for management of hazardous wastes.

16.6.5 Biomedical Waste (Management and Handling) Rules, 1998, were formulated along parallel lines, for proper disposal, segregation, transport etc. of infectious wastes. Proper segregation of wastes and labelling as specified. Installation of Pollution Control Systems like incinerators, autoclaves or microwaves and meeting the prescribed limits of emissions were made mandatory. Compliance with the dead-lines stipulated to install the pollution control systems were given, as also guidelines for transportation of such waste.

16.6.6 Municipal Solid Wastes (Management and Handling) Rules, 2000, whose aim was to, enable municipalities to dispose off municipal solid waste, in a scientific manner.

16.6.7 Hazardous Wastes (Management and Handling) Amendment Rules, 2000, a recent notification issued with the view to providing guidelines for the import and export of hazardous waste in the country.

16.7 Sum up

Environmental laws are generally framed and implemented to protect natural resources. In fact they may be framed to regulate the production and emission of pollutants, to minimize the effect of pollutants or to regulate production processes that affect the environment. It is important to note that the implications of enforcing environmental laws are also reflected on the economic, political, social and cultural status of the country. Hence, environmental laws are important instruments for enforcing cleaner and efficient practices to safeguard the environment.

-000-

COURSE NO : SOC-C-203 **LESSON NO. 17**

ROLE OF GOVERNMENTAL AND NON GOVERNMENTAL ORGANISATIONS (NGO's) FOR SUSTAINABLE DEVELOPMENT

UNIT - III

DR. SANJAY SHARMA
Assistant Professor
Deptt. of Env. Science
University of Jammu.

Structure

17.1 Objectives

This lesson will make you understand the following :

- What is NGO
- Their role in environmental education

- Their role in achieving sustainability
- Knowledge about some important NGO's
- The role of Government in achieving sustainable development

17.1 Introduction

Environmental modification is as old as the history of human development. In the last century, development and modification have come much faster then ever before. Development has been so rapid that nature had no time to adapt to these changes and to human requirement and greed.

The last century has seen an unmanageable increase in population, placing a tremendous burden on natural resources. There is not enough food for the world's hungry. Also, the earth itself is worn out due to excessive farming, use of chemicals and pesticides and excessive use of ground water. Water resources are badly polluted and emission of toxic fumes from industry and vehicles has deprived us of clean air. Industrialization and a growing consumer economy have led to the creation of huge mega-polies with their problems of undisposed garbage and uncontrolled sewage.

To combat these problems, world bodies like the United Nations and the World Commission on Environment and Development have been formulating ideas for environmental protection and sustainable development. Several international conferences have been held on this subject, starting with the first one in Tbilisi in 1977 to the Earth Summit in Rio de Janeiro, the Population Summit at Copenhagen, the world Summit on Sustainable Development in Johannesburg and several others. It is clearly evident that 25 years after the first conference in Tbilisi, there has not been an appreciable change in lifestyles or the level of awareness. Countries have put their own interests ahead of environmental protection and the future of coming generations.

Sustainable development is an approach to decision making that takes a long term focus, incorporates social, economic and environmental factors, and recognizes the interdependence of domestic and global activities. It is an ethical principle that incorporates a commitment to equity between the current generation and those that will follow; and between the poor and the more affluent. Even though considerable progress has been made on integrating environment and development in such fields as ecological economics, integrated assessments, and complex systems analysis, the integrative endeavour is still in its infancy, and influenced significantly by political upheaval, growing population pressures, environmental degradation, and human misery in many parts of the world.

There are an increasing number of organizations from developing countries as well as both new and more established ones in the industrialized countries, doing important work, helping to raise important issues or tackle various problems. In recent years, development and environmental NGOs are learning that they can be more effective, and their work can have more positive effects, if they work with the actual communities and help them to empower themselves.

Another growing trend is the move towards bridging the gaps between central and local governments and between government and the private sector, civil society, and people's organizations. The trend has been to establish inter-agency committees, councils, or commissions, while the policies have been expressed in national environmental strategies, green plans, and national Agenda 21s developed in consultation with the sectors involved.

A broad strategy has to be national but worked out through a dialogue involving the components of the state because the mechanism is often more effective when decentralized. Increasingly stress has been the need to establish effective consultation within countries, often down to local-community levels, and the need to empower community-based organizations. On the other hand, strong national policies and programmes allow countries to be in better positions to negotiate at the global forums. It is necessary to develop a dialogue between business, industry, commerce, environmental and developmental NGOs, and citizens' groups and to try to build consensus at the local and national levels.

17.2 Non-Governmental Organisations (NGOs)

NGOs have become increasingly important agents of the development process in every country, in all of their main areas of work such as humanitarian relief, long-term development, policy formation and political advocacy. Non-governmental organizations (NGOs) have become quite prominent in the field of international development in recent decades. The term NGO encompasses a vast category of groups and organizations. The World Bank, for example, defines NGOs as "private organizations that pursue activities to relieve suffering, promote the interests of the poor, protect the environment, provide basic social services, or undertake community development." A World Bank Key Document, "Working with NGOs" adds, "In wider usage, the term NGO can be applied to any non-profit organization which is independent from government. NGOs are typically value-based organizations which depend, in whole or in part, on charitable donations and voluntary service. Although the NGO sector has become increasingly professionalized over the last two decades, principles of altruism and voluntarism remain key defining characteristics."

By another definition "A non-governmental organization is a permanent organization of individuals or groups of individuals qualified in relevant fields and operating independently from government influence. NGOs may derive funding from governments and may have governments and government officials as members provided that such funding or membership does not limit the organization's ability to express its views independently."

17.3 Role of Non-government Organizations (NGOs)

There is a current view that NGOs constitute a viable alternative to government as channels of development assistance, particularly in developing countries. NGOs can promote the organization and empower of the poor, particularly poor women, through a combination of micro-credit, awareness-raising, training for group members, and other social services.

Non-governmental organizations play a vital role in the shaping and implementation of participatory democracy. Their credibility lies in the responsible and constructive role they play in society. Formal and informal organizations, as well as grass-roots movements, should be recognized as partners in the implementation of environment Agenda. The nature of the independent role played by non-governmental organizations within a society calls for real participation; therefore, independence is a major attribute of non-governmental organizations and is the precondition of real participation.

NGOs can constitute a valuable source of information and could be responsible for collection, collation and presentation of such information on an on-going basis to government agencies. They can form action group to help government agencies at the central, state, district and villages levels for he implementation of action plan and work as pressure groups to force action where the political and administrative systems are inactive or ineffective. NGOs can advise the government on the weaknesses of existing legislation or administration and recommend measures for strengthening or improving these systems or their performances.

17.4 Role of NGOs in imparting environment education

NGOs are very important agents of change as far as environment education is concerned. NGOs also provide a very valuable channel for feed-back. No government can achieve concrete results if its policies and programs are not supported by voluntary agencies.

The main ways in which voluntary agencies can be helpful are:

- To aid and advice the government
- To educate the people at large and to create general awareness .
- NGOs can undertake the education of the general public towards wildlife conservation and play a major role by providing a range of educational and motivational aids as well as participate directly in public education.
- Research in another area in which the NGOs can contribute usefully. The Bombay natural history society (BNHS) has been playing an important role in this respect, specially in the field of bird ecology.
- Likewise, NGOs can bring out useful publications at popular and scientific levels e.g. the BNHS journal, WWF newsletter, 'cheetal', 'sanctuary' magazine etc.

17.5 Microfinance and Sustainable Community Development

Microfinance is defined as efforts to improve the access to loans and to saving services for poor people. Increasingly, microfinance is being referred to as an effective means of poverty reduction. Several studies have pointed out the importance of microfinance in empowerment, particularly women empowerment.

Well-being as an out put of microfinance not only covers the economic indicators, but also other indicators such as community education, environment, recreation and accessibility to social services. It is related to the quality of life. In the developing countries, sustainability is linked more closely to issues of poverty and the gross inequalities of power and resources. This is due to the fact that in the Third World countries, the ecological system sometimes conflicts with the socio-economic needs of local people who depend on a local ecosystem for their survival. In contrast, in the developed countries, more priority is given on environmental aspect of sustainable development. In these countries, since the wealth of the nation and of most individuals has reached a certain level, therefore sustainability has been fueled primarily by concern for such issues as climate change, biodiversity, the deprivation of the natural environment, and the over-consumption of natural resources - especially non-renewable. In order to gain economic sustainability, NGOs through microfinance help the communities to reduce poverty, create jobs, and promote income generation.

17.6 Capacity Building and Sustainable Community Development

Capacity building is another strategy of NGOs that helps to bring about sustainable community development. Capacity building is an approach to develop and build independence. It can be a mean to achieve end, with an intent to enable others i.e. from individuals through to government departments, to have greater capacity to work together to solve problems.

Capacity building is an approach to development and not a set of pre-determined activities. There is no single way to build capacity. NGOs, through the provision of education, skill and knowledge, develop the capacity of community towards achieving sustainable development. In fact, NGOs act as a capacity builder to help the community to develop the resources, build awareness, motivate participation and finally improving the quality of community's lives.

Empowerment at the level of individual empowerment (changes in skills, knowledge, consciousness and awareness, hope, action and beliefs in abilities to affect change) and changes in wider social structures and processes that result in increased resources and opportunities is an outcome of community capacity building. Furthermore, with regards to sustainability, capacity building has been identified as one of the key strategies for increasing the potential towards sustainable development. For example, in a program to train women to establish a small enterprise, a positive result will be that women have co-operated to start the enterprise, but a sustainable outcome will depend on whether women have the capacity to make it work and derive an income from it without external financial or technical assistance.

17.7 Self-reliance and Sustainable Community Development

Self-reliance is another strategy that affects sustainable community development. Effective community development is dependent on the foundation of self-reliance. The concept of self-reliance is strategically the essence of community development and is related to other concepts like mutual-help, self-help, participation of the indigenous people and rural progress. Self-reliance encourages the necessity for people to use local initiatives, their abilities and their own possessions to improve their condition. Self-reliance is increasingly being adopted as modus operandi for community development. Self-reliance means that the people rely on their own resources and are independent of funds sourced outside the community as reliance on external resources will lead to the loss of autonomy and independence of the community. On the other hand, autonomous communities can flourish only in the absence of such external dependency. Therefore, to attain self-reliance, community workers (e.g. NGOs) and community groups must discover their own potential to use as sources of wealth for the development of the community.

Motivating and mobilizing people to be self-reliant and to participate in development activities become an important objective of the NGOs. Another strategy of the NGOs focuses on developing the capacities of the people to better meet their own needs through self-reliant local action through the intervention of an outside change agent (NGOs and other agents) who helps the community realize its potentials through education, organization, consciousness raising, small loans and the introduction of simple new technologies. Therefore, NGOs, through the strategy of self-reliance, can facilitate sustainable development of the community.

In India the NGOs are working with different objectives and are involved in creating environmental education and awareness, nature conservation, pollution control, afforestation and social forestry, floristic and faunal studies, rural development, wildlife conservation and waste utilization, and eco-development. Most of these are education oriented.

17.8 Some important NGOs

The roles of some of the important NGOs in India is discussed as below

Kalpavriksh (KV)

The organization started in 1979 as a movement opposed to the destruction of delhi's green areas. The main functions of KV are to inculcate understanding and concern on environmental issues, especially among youth, to conduct research in environmental problems; to campaign on environmental issue to evolve holistic environmental perspective. KV is developing work books, audio-visual aides and other material on environment for the school and college level. They are also involved in conducting nature walks camps, conducting research on environmental subjects, such as impact assessment study of the Narmada valley project, Pesticide use in India, air pollution in Delhi and mining activities in Dehradun district and was responsible for developing India's National Biodiversity Strategy and Action Plan in 2003. Kalpvriksh is functioning as a resource group of NCERT and other agencies on environmental education.

Kerala Sastra Sahitya Parishad

The kerala sastra sahitya parishad, has over the last three decades, grown into an important national institution with a membership of over 25,000 with around 900 units spread over the state of kerala. The activities of the parishad encompass eco-development, creating an awareness on water and energy conservation, encouraging the use of non-conventional sources such as smokeless chulhas. It has several periodicals and publications to its credit to popularize science and to generate scientific outlook among all sections of the people. It has made creative use of the folk arts in its programs. It was also awarded Indira Gandhi Paryavaran Puraskar for 1988 in acknowledgement of its outstanding work for the protection of the environment.

World Wide Fund for Nature-India (WWF India)

WWF earlier called as World Wide Life Fund, commenced activities in 1970 in Bombay. This organization has approximately 200 volunteer associates and 10,000 subscriber supporters. The major activities of this organization are conservation of the country's natural heritage through support to research, field project, education and training, to raise funds for conservation.

Bombay Natural History Society (BNHS)

It started work in September 1883 in Bombay. Now BNHS is truly important national institution with a high international reputation. Through its systematic and scientific studies, the society has contributed significantly to increasing knowledge of our mammals, birds, reptiles, and other fauna and flora.

BNHS has taken a significant part, in the campaigns for conservation of our natural heritage, notably for saving the invaluable tropical forests of silent valley in kerala. The society's achievements have aroused public awareness of the need for preservation of nature and have helped the country in legislating for the protection of wild life.

The indra Gandhi paryavaran puraskar for 1987 was awarded by the government of India to the society in acknowledgement of the outstanding work done by it for nature education research and conservation of the environment.

Chipko movement

The Dasohli Gram Swarajya Mandal in Gopeshwar, which pioneered the now world famous chipko movement, is a group which progressed from development work to activism and typifies the story of most development groups. In the field of environment, the forestation work of the chipko movement as today noted at all levels of government. The chipko movement brought a country wide general consciousness about the importance of conserving forest and the trees for development. The chipko's plan in fact, a slogon of planting five f's - food, fodder, fuel, fertilizer and fiber trees to make communities self sustained in all their basic needs.

Appiko movement

The appiko movement started in 1983 in Karnataka, which means hugging of trees. This movement was initiated on the forest departments felling of trees in Salkane forest in Sirsi district. The main objective of this movement is to protect and plant trees and to teach the people to minimize the use of forest resources.

17.9 Role of Governments in Sustainable development

Increasingly, major international environmental agreements are being translated into domestic implementation strategies and programmes. Leading governments around the world are already making significant changes in order to address the challenges of sustainable development, seeking to achieve progress that does not penalize future generations. Governments can be inspired to develop a range of new mechanisms and structures to underpin a shift to sustainability, lead by the experience of other leading governments.

The environmental priorities and prime objectives of government is to

a) ensure sustainable and equitable use of resources for meeting the basic needs of the present and future generations without causing damage to the environment

b) prevent and control future deterioration in land, water and air which constitute our life-support systems

c) take steps for restoration of ecologically degraded areas and for environmental improvement in our rural and urban settlements;

d) prevent further damage to and conserve natural and man-made heritage;

e) ensure that development projects are correctly sited so as to minimize their adverse environmental consequences;

f) ensure that the environment and productivity of coastal areas and marine ecosystems are protected;

g) conserve and nurture the biological diversity, gene pool and other resources through environmentally sustainable development and management of ecosystems, with special emphasis on our mountain, marine and coastal, desert, wetlands, riverine and island ecosystems; and,

h) protect the scenic landscapes, areas of geomorphological significance, unique and representative biomes and ecosystems and wildlife habitats, heritage sites/structures and areas of cultural heritage importance.

i) carry out environmental impact assessment of all development projects right from the planning stage and integrate it with their cost-benefit considerations. Appropriate costs of environmental safeguards and regeneration would continue to form an integral part of the projects;

j) ensure that all projects above a certain size and in certain ecologically sensitive areas should require compulsory prior environmental clearance;

k) incorporate environmental safeguards and protection measures, in policies, planning, site selection, choice of technology and implementation of development projects like agriculture, water resource development, industry, mineral extraction and processing, energy, forestry, transport and human settlements;

l) encourage research, development and adoption of environmentally compatible technologies; and to promote application of the modern tools of science and technology for conservation, bridging of large gaps in supply and demand as well as control and monitoring of natural resources;

m) elicit and ensure participation of people in programmes for environmental improvement and for integrating the environmental concerns in planning and implementation of development programmes;

n) create environmental consciousness through education and mass awareness programmes;

o) aim at moderation of process of demand unleashed by the developmental process itself by taking measures to recycle waste materials and natural resources, conserve energy, conserve use of natural resources in industrial products by measures like wood substitution and generally try to reach moderation's in life styles consistent with sustainability and human dignity;

p) develop appropriate organizational structures and a pool of professional manpower to serve as the cadre for environmental management service; and,

q) Effectively implement the various environmental laws and regulations for environmental protection through creation or strengthening of the requisite enforcement machinery.

r) to establish or enhance an existing dialogue with non-governmental organizations and their self-organized networks representing various sectors, which could serve to: (i) consider the rights and responsibilities of these organizations; (ii) efficiently channel integrated non-governmental inputs to the governmental policy development process; and (iii) facilitate non-governmental coordination in implementing national policies at the programme level;

s) Encourage and enable partnership and dialogue between local non-governmental organizations and local authorities in activities aimed at sustainable development;

t) Involve non-governmental organizations in national mechanisms or procedures established to carry out Agenda 21, making the best use of their particular capacities, especially in the fields of education, poverty alleviation and environmental protection and rehabilitation;

u) Take into account the findings of non-governmental monitoring and review mechanisms in the design and evaluation of policies concerning the implementation of Agenda 21 at all levels;

v) Review government education systems to identify ways to include and expand the involvement of non-governmental organizations in the field of formal and informal education and of public awareness;

w) Make available and accessible to non-governmental organizations the data and information necessary for their effective contribution to research and to the design, implementation and evaluation of programmes.

What has been India's stand on environmental protection? How far has our governing body succeeded in their avowed aims of cleaning up the environment? Various acts have been passed down the years, too innumerable to be put down here. The Ministry of Environment and Forests laid down its objectives:

A. Conservation & survey of flora, fauna, forests and wildlife

B. Prevention and control of pollution

C. Afforestation & regeneration of degraded areas

D. Protection of environment, all within the frame work of legislations.

The main tools utilized for this include:

A. Surveys and impact assessment

B. Control of pollution

C. Regeneration programmes

D. Support to organizations and NGOs

E. Research to solve solutions

F. Training to augment the requisite manpower

G. Collection and dissemination of environmental information

H. Creation of environmental awareness among all sectors of the country's population.

17.10 Sum up

Through the years, the ministry has passed innumerable laws to help them in their task of environmental protection. Sadly, all the regulations and acts have not done enough to protect the environment. The greed of many in the governing bodies has led to misuse of the laws and ruthless exploitation of the land, leading to ecological destruction and social injustices. Most leaders of industry, too, have been lacking in a social conscience. They have exploited our country's resources and polluted our earth, water and air. Public apathy has not helped either. We, as citizens of this country have not made our voices heard. The opening up of our economy and globalization has put a greater pressure on our resources, further vitiating our fragile eco-system.

-000-

Structure

18.1 Objectives

The main objective of this Lesson is to equip you with

- The Chipko movement and its Ecological Foundations

18.2 Introduction

The Chipko movements is historically, philosphically and organisationally an extension of the traditional Gandhian satyagraha. The special significance lies in the fact that is took place in post-independent forms of this satyagraha has been provided by Gandhians, including Sri Dev Suman, Mira Behn and Sarala Behn. Sri Dev Suman was initiated into Gandhian satyagraha at the time of the Salt Satyagraha. He died as a martyr for the cause of the Garhwali people's right to survive with dignity and freedom. Both Mira Behn and Sarala Behn were close associates of Gandhi. The settled in the interior of the Himalayas and estabilished ashrams. Sarala Behn settled in Kumaon and Mira Behn lived in Garwal till the time she left for Vienna due to ill health. Equipped with Gandhian world view of development based on justice and ecological stability, they contributed silently to the growth of woman power and ecological consciousness in the hill areas of Uttar Pradesh. The influence of these two European disciples of Gandhian on the heritage of struggle for social justice and ecological stability in the hills of Uttar Pradesh has been immense and they separated a new brands of Gandhian activists who provided the foundation for the chipko movemnet. Sardarlal Bahuguna is prominent among the new generation of workers deeply inspired by these Gandhians influenced by Sri Dev Suman, he joined the independence movement at the age of 13. Later, he worked with Mira Behn in Bhilangana Valley and was trained in her ecological vision. In an article written in 1952, Mira Behn had stated that there was 'Something Wrong in the Himalaya'.

Year after year the floods in the North of India seem to be getting worse, and this year they have been absolutely devasating. This means that there is something radically wrong in the Himalayas, and that 'something' is, without doubt, connected with the forests. It is not, I believe, just a matter of deforestation as some people think, but largely a matter of change of species.

Living in the Himalayas as I have been continuously now for several years, I have become painfully aware of a vital change in species of trees which is creeping up and up the southern slopes - those very slopes which let down the lood waters on to the plains below. This deadly changeover is from Banj (Himalayan Oak) to Chir pine. It is going on at an alarming speed, and because it is not a matter of deforestation, but of change from the one kind of forest to another, it is not taken change from one kind of forest to another, it is not taken sufficient, seriously. In fact the quasi-commercial Forest Departmnet is inclined to shut its eyes to the phenomenon, because the Banj brings them in no cash for the coffers, whereas the Chir pine is very profitable, yielding as it does both timber and resin.

Mira Behn had thus identified not merely deforestation but change in species suitable to commercial forestry as the reason for ecological degradation in the Himalayas. She recognised that the leaf litter of oak forests was the primary mechanism for water conservation in the Himalayan mountain watersheds.

The Baaj leaves, failing as they do, year by year, create a rich black mould in which develops a thick tangled mass of undergrowth (bushes, creepers, and grasses), which in their turn add to the leaf-moulded deposit and the final result is a forest in which almost all the rain water becomes absorbed. Some of it evaporates back into the air and the rest percolates slowely down to the lower altitudes, giving out here and there beautiful sweet and cool springs. It would be difficult to imagine a more ideal shock-absorber for the monsoon rains than a Banj forest.

The Chir pine produces just the opposite effect. It creates with its pine needles a smooth, dry carpet, which absorbs nothing and which at the same time prevents the development of any undergrowth worth the name. In fact, often the ground in a Chir pine forest is as bare as a desert. When the terrential rains of the monsoon beat down on these southern slopes of the Himalays, much of the pine-needle carpet gets washed away with the water and erosion invariably takes place, because these needles, being non-absorbent, create no leaf-mould, but only a little very inferior soil, which is easily washed out from the rocks and stones."

Inheriting these early lessons in ecology. Bahuguna was later able to transfer this ecological perspective to Chipko. The rapid spread of resistance in the hills of Uttar Pradesh and its success in enforcing changes in forest management was also largely due to the awareness created by folk poets like Ghanshyam Raturi and grassroots organisational efforts of a number of people including Man Singh Rawat, Chandi Prasad Bhatt and Dhoom Singh Negi. Bhatt, who later became well known for his work, became an activist at the behest of Bahuguna in 1959 when theiy met a bus station in Gopeshwar where Bhatt was working as a booking clerk and Bahuguna, along with Rawat and Raturi, was waiting for a bus during an organisational trip through Gopeshwar. Having found Bhatt a promising activist, Bahuguna invited him to join them.

The Chipko movement is the contemporary expression of a continuing heritage of peaceful resistance by the people of Uttrakhand. In the post-independence period, under the coordination of Sarala Behn, the Gandhians organised themselves into the Uttrakhand Sarvodaya Mandal in 1961. The Sarvodaya movement in the Sixties was organised around four major issues.

1. The organisation of woman
2. Fight against alcohol consumption

3. Fight for forest rights.

4. The establishment of local forest based small industries.

While the fight against alcohol consumption provided the platform for the organisation of women, the increasing conflict over forest produce between the local and non-local industries provided the rallying point for popular protest during the sixties. In 1968 the people of Garhwal renewed their resolve to fight for their forests in a memorial meeting held at Tilari on 30 May.

The platform for the organisation of women was thus ready by the seventies and this decade saw the beginning of more frequent and more vocal popular protests on the rights of the people to protect and utilise local forests. In 1971 Swami Chidanandji of Rishikesh undertook a month long march to bless the people in their struggle. The year 1972 witnessed the most widespread organised protests against commercial exploitation of Himalayan forests by outside contractors in Uttrakashi on 12 December, and in Gopeshwar on 15 December. It was during these two protest meetings that Raturi composed his famous poem describing the method of embracing the trees to save them from felling :

Embrace the trees and

Save them from being felled;

The property of our hills,

Save them from being looted.

While the concept of saving trees from felling by embracing them is old in Indian culture, as was the case of Bishnois, in the context of the current phase of the movement for forest rights in Uttrakhand this popular poem written in 1972 is the earliest source of the now famous name 'Chipko'. In 1973 the tempo of the movement in the two centres - Uttarkashi and Gopeshwar- reached new heights. Raturi and Bhatt were the main organisers in these two places. While a meeting of the Sarvodaya Mandal was in progress in Gopeshwar in April 1973, the first popular action to chase contractors away erupted spontaneously in the region, when the villagers demonstrated against the felling of ash trees in Mandal forest. Bahuguna immediately asked his colleagues to proceed on a foot march in Chamoli district following the axemen and encouraging people to oppose them wherever they went Later in December 1973, there was a militant non-violent demonstration in Uttrakashi in which thousand of people participated. In March 1974, twenty seven women under the leadership of Goura Devi saved a large number of trees from a contractor's axe in Reni. Following this, the government was forced to abolish the private contract system of felling and 1975 the Uttar Pradesh Forest Corporation was set up to perform this function. This was the first major achievement of the movement and marks the end of a phase in itself.

Bureaucratisation, however, cannot replace a civilisational response to the forest crisis. The ecological limits of forest extraction was hardly recognised and estimated. Ecological problems were accentuated leading to increased suffering of women who were responsible for bringing water, collecting fodder, etc. During the next five years Chipko resistance for forest protection spread to various parts of the Garhwal Himalayas. It is important to note that it was no longer the old demand for a supply of forest products for local small industries but the new demand for ecological control on forest resource extraction to ensure a supply of water and fodder that was being aired. In May 1977 Chipko activists in Henwal Valley organised themselves for future action. In June of the same year, Sarala Behn organised a meeting of all the activists in the hill areas of Uttar Pradesh which further strengthened the movement and consolidated the resistance to commercial fellings as well as excessive tapping of resin from the Chir pine trees. In Gotars forests in the Tehri range the forest ranger was transferred because of his inability to curb illegal over-tapping of resin. Consciousness was so high that in the Jogidanda area of the Saklana range, the public sector corporation. Garhwal Mandal Vikas Nigam, was asked to reguilate its resin-tapping activity.

Among the numerous instances of Chipko's successes throughout the Garhwal Himalayas in the years to follow, are those in Adwani, Amartssar and Badiyargarh. The auction of Adwani forests took place in October 1977 in

Narendernagar, the district headquarters. Bahuguna undertook a fast against the auction and appealed to the forest contractors as well as the district authorities to refrain from auctioning the forests. The auction was undertaken despite the expression of popular discontent. In the first week of December 1977, the Adwani forests were scheduled to be felled. Large groups of women led by Bachhni Devi came forward to save the forests. Interstingly Bachhni Devi was the wife of the local village head, who was himself a contractor, Chipko activist Dhoom Singh Negi supported the women's struggle by undertaking a fast to the forest itself. Women tied sacred threads to the trees as symbol of a vow of protection. Between 13 and 20 December a large number of women from fifteen villages guarded the forces while discourses on the role of forests in Indian life from ancient texts continued nonstop. It was here in Adwani that the ecological slogan : 'What do the forests bear ? Soil, water and pure air was born.

The axemen withdrew only to return on 1 February 1978 with two truck-loads of armed police. The plan was to encircle the forests with the help of the police in order to keep the people away during the celling operation. Even before the police could reach the area volunteers of the movement entered the forests and explained their case to the forest labourers who had been brought in from distant places. By the time the contractors arrived with the police each tree was being guarded by three volunteers who embraced the trees. The police, having been defeated in their own plan and seeming the level of awareness among the people, hastily withdrew before nightfall.

In March 1978 a new auction was planned in Narendranagar. A large popular demonstration was organised against it and the police arrested twenty-three Chipko volunteers, including women. In December 1978 a massive feeling programme was planned by the public sector Uttar Pradesh Forest Development Corporation in the Bahuguna region. The local people instantly informed Bahuguna who started a fast unto death at the felling site, on 9 January 1978. On the eleventh day of his fast Bahuguna was arrested in the middle of the night. This act only served to further strengthen the commitment of the people. Folk poet Ghanashyam Raturi and priest Khima Shastri led the movement as thousands of men and women from the neighbouring villages joined them in the Badiyargarh forests. The people temained in the forests and guarded the trees for eleven days, when the contractors finally withdrew Bahugune was released from jail on 31 January 1979.

The cumulative impact of the sustained grassroots struggies to protect forests was a re–thinking of the forest management strategy in the bill areas. The Chipko demand for the declaration of the Himalayan forests as protection forests instead of production forests for commercial exploitations was recognised at the highest policy–making level. The late Prime Minister, Mrs. Indira Gandhi alter a meeting with Bahuguna, recommended a fifteen year ban on commercial green felling in the Himalayan forests of Uttar Pradesh.

The moratorium on green felling gave the Chipko movement breathing time to expand the base of the movement and Bahuguna undertook a 4,780 km long arduous Chipko foot march from Kashmir to Kohima to contact villagers in the long Himalayan range and to spread the message of Chipko. At the same time, activist found it opportune to spread the movement to other mountain regions of the country.

18.3 Ecological Foundation of the Chipko Movement

Both the earlier forest satyagrahas and their contemporary form, the Chipko movement, are rooted in conflicts over forest re–sources and are similar cultural responses to forest destruction. What differentiates Chipko from the earlier struggles is its ecological basis. The new concern to save and protect forests through Chipko satyagraha did not arise from a resentment against further encroachment on people's access to forest resources. It was a response to the alarming signals of rapid ecological destabilisaton in the hills. Villages that were once self–sufficient in food were forced to import food as a result of declining food productivity. This in turn, was related to the decrease in soil fertility in the forests. Water sources began to dry up as forests disappeared. The so–called 'natural disasters'. such as floods and landslides, began to occur in river systems which had hitherto been scable. The Alaknanda disaster of July 1970 inundated 1,000 km of land in the hills and washed away many bridges and roads. In 1977 the Tawaghat tragedy took an even heavier toll. In 1978 the Bhagirathi blockade resulting from a big lanslide above Uttarkashi led to massive floods across the entire Gangetic plains.

The over–exploitation of forest resources and the resulting threat to communities living in the forests have thus evolved from concerns for distribution of matrial benefits to concerns for distributon of material benefits to concerns for distribution of ecologically generated material costs. During the first stage, the growth of commercial interests resulted in efforts to exclude competing demands. The beginning of large–scale commerial exploitation of India's forest resources led to the need for 1977, the spirit of public interest ecological science was captured in the slogan : What do the forests bear? Soil water and pure air. This was a response to the commonly accepted partisan science based slogan: What do the forests bear? Profit on resin and timber.

The insight in these slogans symbolised a cognitive shift in the evolution of Chipko. The movement underwent a qualitiative transformation from being based merely on conflicts over resources to conflicts over scientific perceptions and philosophical aproaches to nature. This transformation also led to that element of scientific knowledge which has allowed Chipko to reproduce itself in different ecological and cultural contexts. The slogan has become the scientific and philosophical message of the movement, and has laid the foundations of an alternative forestry science which is ecological in nature and oriented towards public interest. The commercial interest has the primary objective of maximising exchange value through the extraction of commercially valuable species. Forest ecosystems are therefore reduced to timber mines of commercially valuable species. 'Scientific forestry' in its present form is a reductionist system of knowledge which ignores the complex relationships within the forest community and between plant life and other resource like soil and water. Its pattern of resource utilisation is based on increasing 'productivity' on these reductionist lines. By ignoring the systems linkages within the forest ecosystem, this pattern of resource use generates instabilities in the ecosystem and leads to a counter-productive use of natural resources at the ecosystem level. The destruction of the forest ecosystem and the multiple functions of forest resources adversely affects the economic interests of those groups of society which depend on the diverse resource function of forces for their survival. These include soil and water stabilisation and the provision of food, fodder, fuel publiser, etc.

These conceptual issues assume tremendous importance in view of the fact that we are entering into an era in which large amounts of financial resources are being handed over to Non-Government Organisations (NGOs) who are rapidly becoming the new managers of old development projects." The self-reliance, decentralisation and sacrifice intrinstic to voluntary action is being threatened by treating NGOs as the new delivery system. It is in this context that the debate on these two philosophies of nature and political action becomes central to the debate on development. The urgency of establishing a new economy of permanence, based on ecological principles, is felt with each new environmental disaster in the Himalayan region which spells destruction for the Gangetic basin. Chipko's search for a strategy for survival has global implications. Chipko's demand is conservation of not merely local forest resources but the entire life-support system, and with the option for human survival. Gandhi's mobilisation for a new society in which neither man nor nature is exploited and destroyed, marked the beginning of this civilisational response to the threat to human survival. Chipko's agenda includes carrying forward that vision against the heavier odds of contemporary crises. Its contemporary relevance as well as its significance for the future world, is clearly indicated in the rapid spread of the ecological world view throughout the vast stretch of the Himalayan region, following the historical 5,000 km trans-Himalaya Chipko foot march led by Bahuguna, and subsequently through other vulnerable mountain systems such as the Western Ghats, Central India and the Aravallis.

The history of Uttara Kannada has been the history of people's struggle against commercial forest policy. The destruction of tropical natural forests and the raising of monoculture plantations of teak and Eucalyptus caused irreversible changes in the forest ecosystem. The destruction of mixed species denied people access to biomass for fodder, fertiliser, etc. The clear felling of natural forests has led to severe soil erosion and drying up of perennial water resources. Moved by the destruction of essential ecological processes, the youth of Salkani village in Sirsi lanuched a Chipko movement which was locally known as 'Appiko Chaluvali.' They embraced the trees to be felled by contractors of the forest department. The protest within the forest continued for thirtyeight days and finally the felling orders were withdrawn. The success of this agitation spread to other places and the movement has now been launched in eight areas covering the entire Sirsi forest division in Uttara Kannada and Shimoga districts. These areas included Mathghatta, Salkani, Balegadde, Husei, Nedgod, Kelgin Jaddi, Vanalli and Andagi. The rapid spread of the movement was based on evidence provided by villagers that the forest department was over-exploiting the forests. Villagers' complaints were later confirmed by official visits by scientists and politicians. In the forest of Kalase, with an area of 151.75 hectares earmarked for selection-cum-improvement felling for the year 1983-84, a total of 590 trees above the girth limit of 2 metres was earmarked for felling. The Indian Plywood Mills had extracted a total of 125 trees belonging to eight species in the 1982-83 season. Thus a total of 715 trees spread over 151.75 hectares, or 4.05 trees per hectare were to be extracted. With an additional 5 per cent added for damage, the total number expected to the felled was 4.25 trees per hectare.

Represntatives of the Lakshminarasimha Yuvak Mandali who launched the Appiko movement in September 1983 maintained that (*a*) there was an excessive concentration of trees carmarked for felling in easily accessible areas, and (*b*) there was excessive damage to trees during the course of felling. In 1 hectare plot sampled it was found that eleven trees had been marked for cutting, out of which eight had been felled. In the process of felling these eight trees, as many as five trees had been damaged. This rapacious destruction of forest resources was undermining the ecological survival of local communities, who finally stopped felling through non-violent direct action as seen in the case of Chipko.

The objective of the Appiko movement is three-fold. To protect the existing forest cover, to regenerate trees in denuded lands and, last but not least, to utilise forest wealth with due consideration to consvervation. All these objectives are implemented through locally established Parisara Samrakshna Kendras (environmental conservation centres).

The Appiko movement has created awareness among villagers throughout the Western Ghats about the ecological destruction of their forest wealth. People now closely monitor the exploitation of forests by the forest department, and have been able to show the discrepancy between professed and actual practice of forest management. In December 1984, villagers of Gerasoppo range of Honavar forest division were able to record the felling practices and damage to forests due to timber exploitation. Their observations were as follows :

	Forest Rule	*Actual Practice*
1.	No tree will be felled on slopes and catchment areas of rivers (protection forests)	Trees are felled in catctment areas of Sharavati river (Honavar forest division on steep slopes)
2.	In evergreen forest areas only two trees per acrs will be lelled.	In evergreen forest areas seven trees were felled in one acre (Marked)
3.	Minimum girth of trees felled should be 2.5 meters.	Two marked trees (Nos. 542 and 111) felled had a girth of 1.80 meters and 1.50 metres respectively. Thirtyseven trees, with a girth of over 50 csm and thrity two trees with a girth of over 10 cms were damaged.
4.	The distance to be manitained from one tree to another tree to be felled should be 50 metres.	The distance from tree No. 75 to tree No 80 which had to be felled was only 4.60 metters.
5.	Trees to be felled shall be lopped of their branches to reduce damage.	No lopping was done while felling trees.
6.	No tree either dead, diseased or green should be felled neat streams on the water line.	Eight trees felled on an 80 degree slope, seven trees felled on 75 degree slope, and ten trees were felled on the water line.
7.	Dragging of logs is not allowed.	Dragging of logs was done extensively all over the piace.

The top soil up to six inches was ripped off totally by dragging logs. This soil will be carried to the Sharavati river, raise its bed and the water level, and cause floods in an area which receives 250 incres of rainfall every year. Besides destablising the catchment area, commercial exploitation has also deprived people of their use of forest biomass for basic needs. An 80– year old man, Rama Naik of Mattingadde village, narrated his experience. “ We had enough of medicinal trees. There was enough bamboo and cane for us. But after independence the felling of trees began and now everything is gone. There is no cane left. People’s greed to make fast money has ruined us.

18.4 Sum up

In the context of this conflict between commercial demands and the demands for ecological stability and survival, the Appriko activists believe in the Chipko philosophy that ‘the basic products of the forests in the Western Ghats are soil, water and pure air’ whic form the basis of life in the Deccan Plateau. They are not fuelwood and timber which are regarded as ultimate proucts from these forests in the market economy.

-000-

Structure

19.1 Objectives

The main objective of this Lesson is to equip you with

- The conflict over Limestone Quarrying in the Doon Valley
- Ecological Crisis
- Impacts of Quarrying
- People's Response

19.2 Introduction

Water is a fluid resource, constantly moving between the atmosphere, land and sea; flowing through minerals, plants and soil. Mountain catchments are the source of all water streams, creating rain through their orography, and capturing it in the natural reservoirs created by forests and geological structures. Mining in the catchments can lead to ecological havoc in the water systems. It can generate severe conflicts between the role of minerals in the market economy, for which they must be mined and removed, and the role of geological structures in nature's economy of maintaining the water cycle.

Be it coal for the generation of energy, iron ore for export and the growth of the national steel industry, bauxite for feeding the Japanese aluminium plants, or limestone for the cement industry-exploitation of mineral resources is the material basis of the industrial economy.

Yet in every region citizens are willing to lay down their lives to stop mining operations which, behind the facade of development, destroy the material basis of the survival of large numbers of local people. Women of the Gandhamardan Hills and of the villages of the picturesque Doon Valley, the tribals of Chhattisgarh, Singrauli, and Santhal Parganas have carried out month long blockades against mining operations in their hills. If, for various geological reasons, the mountains of India are repositories of the richest minerals, they are also the central features of our life-support systems.

While historically human settlements have tended to flourish mainly in the plains, Indian civilisation recognised the central role of mountains in ensuring survial in the densely populated river basins and valleys. The mountains in which our major rivers rise have, accordingly, been protected. Mountain watersheds have often been treated as sacred and have been conserved. The sacred Himalaya is the source of the major rivers of North India-the Ganga, the Yamuna, the Brahmaputra and their many tributaries. The Vindhya and Satpura Ranges feed the Tapti, the Narmada, the Sone, the Mahanadi, etc. The Western Ghats are the origin of the major rivers of peninsular India like the Godavari, the Krishna and the Kaveri. These rivers are the lifeline of the economy, and the mountains from which they renew their flow are the foundation for a stable economy.

The main contribution of the mountains to the country has been their role in providing perennial water resources. Through their orographic influence, mountains induce precipitation of water from the atmosphere. Through their natural forest cover, along with their geological structures, mountains convert seasonal rainfall into perennial water resources. Unfortunately, the hydrological role of the mountains has been totally ignored by the champions of industrial growth for whom the mountains are mere sources of unexploited raw materials.

The most well known people's movement against ecologically destructive mining is in the Doon Valley villages of Nahi-Kala and Thano, where activists of the Chipko movement are working with local communities to draw attention to the fact that mining of limestone has totally undermined the material basis of survival of the people.

Miles away from the Doon Valley, in Orissa, adivasi women of the 'Save Gandhamardan' movement embraced the earth singing Mati Devata, Dharam Devata (the earth is our God) to blockade the movement of vehicles of the Bharat Aluminium Company, BALCO had come in search of bauxite deposits in Gandhamardan after having destroyed the hydrological stability and sanctity of another important mountain-Amar Kantak-the source of the waters of the Narmada, the Sone and the Mahanadi rivers. The destruction of Amar Kanatak was a high cost to pay for reserves which were much smaller than the original estimate. To feed its one lakh tonne aluminium plant at Korba in Madhya Pradesh. BALCO has moved to Orissa to exploit the sacred Gandhamardan Hills, a storehouse of invaluable plant diversity and water resources. The forests of Gandhamardan have a rich stock of herbs with high medicinal value and feed twenty-two perennial streams and four waterfalls which feed the Ong and Sukhtel tributaries of the Mahanadi.

Since 1985 the tribals have obstructed the work of BALCO and have refused to be tempted by the company's offer of employment. Even police help has failed to weaken their determined protest.

The conflict is totally unnecessary because aluminium production has turned out to be a losing enterprise in India in market terms. BALCO incurred a loss of Rs. 77 crores in 1985-86 alone. Its cumulative net loss up to March 1986 stood at Rs. 317 crores. Future prospects of the company to make profits also seem dismal. The irrationality of destroying precious water resources for the mining of bauxite when we already have a surplus of aluminium is evident. The mining activity is not dictated by the needs of the people but by the demands of industrialised countries which are closing down their own aluminium plants and are encouraging imports from countries like India. Japan has reduced its aluminium smelting capacity from 12 lakh tonnes to 1.04 lakh tonnes and is importing 90 per cent of its aluminium requirements. Several Japanese companies have expressed a desire to set up joint ventures in India's export processing zones to manufacture aluminium products with buy-back arrangements. The survival of the tribals of Gandhamardan is thus threatened because the wealthy countries want to preserve their environment and their luxurious lifestyle.

The export imperative that has been guiding the mining industry in India is no less destructive to the people living in the iron ore rich Western Ghats. The export-oriented Kudremukh iron ore mines produce 7 million tonnes of concentrated iron ore from the magnetite deposits of the extremely high rainfall zone of the Tungabhadra catchment. Nearly 21 million tonnes of tailing washed annually into the reservoir of the Tungabhadra project drastically reduces its water storage capacity and total life.

Open cast mining in the iron ore belt of North Goa, between Honda and Usgeo, has disrupted the hydrological balance of Goa's hills. Professor Marathe of the Indian Institute of Technology, Bombay, has shown that the annual loss of groundwater due to mining in the belt amounts to 0.28 metres.

Whether it is iron ore in Goa or Karnataka, bauxite in the hills of Madhya Pradesh or Orissa, coal in the nation's energy capital Singrauli, limestone in the Doon Valley or magnetite in Kumaon, Open cast mining on catchment slopes has drastically reduced the water resources of the country. Mining increases surface run-off and decreases infiltration. The increased run-off combined with the choking of water courses with overburdens and fines are causing floods and droughts in regions which had stable and perennial supplies of water. In the context of the unprecedented water scarcity facing the country, the role of mining in the hydrological destabilisation of mountain watersheds can no longer be ignored. The movements of local people against ecologically destructive mining are movements for water security and survival.

19.3 The Conflict Over Limestone Quarrying in the Doon Valley

The Doon Valley is a distinct ecobiome in the district of Dehradun, situated in the Himalayan foothills of the state of Uttar Pradesh (UP). Recently, it has become the focus of a serious conflict over the mode of utilisation of the rich limestone deposits located in the Mussoorie Hills which form the northern boundary of the Valley. For one interest group (including the operators of the limestone quarries and the scientific and technical agencies of the state government in charge of geology and mining), the most productive use of the limestone deposits in the Valley lies in their extraction for commercial and industrial use. For the other and much larger interest group (consisting of the local communities, both rural and urban), the most productive use of the same limestone deposits lies in their in situ function in conserving the large volumes of rain water that falls in the Mussoorie Hills during the monsoon every year. The economic activities as well as the survival of the local communities depend almost exclusively on this vital water resource. It is clear that these two functions of the limestone deposits are antagonists and mutually exclusive utilisation based on one actually negates the other.

During the last three decades, the limestone industry in the Doon Valley, consisting of both quarrying of limestone and its processing, received a lot of encouragement, which led to its accelerated growth. For the people residing in the Valley, this growth has threatened the material basis of survival through the destructive impact of the limestone industry on the hydrological balance of the Valley. Damage to vital resources such as water, through the destruction of the essential ecological processes controlling the hydrological balance of the Valley, has been perceived the people as a violation of their political and economic right to recent though often minimal share of the vital resources that are ended for their biological and economic sustenance.

This issue of violation, through ecological destruction, of the people's rights, has been presented before the Supreme Court of India in an attempt to seek justice which is apt to be denied in the economic world when it is dominated by profit motives and market forces. This initiative to seek justice, which is rather exemplary, come from the Rural Litigation and Entitlement Centre in Dehradun, and was supported by interventions from citizens' pressure groups, such as the Save Mussoorie Society and the Friends at the Doon. The petition was also supported by those official agencies whose concern coincided with that of the citizens. These agencies included the Department of Environment of the Government of India and the City Board of Mussoorie. The litigation in the course of decision in accordance with the due process of law of the Supreme Court of India. The historical and ecological background of the conflicts over natural resources in the Doon valley will be analysed here.

19.4 Fragile Ecosystems of the Doon Valley

The Disruption of essential ecological processes, caused by the exploitation of natural resources by violating the ecological principles, is registered very quickly in the sensitive and unstable ecosystems comprising the local ecobiome. In such regions, conflicts over natural resources are apt to become acute within a short time. The Himalayas, which are said to comprise the youngest mountain system of the world, form one such fragile super ecobiome, whose fragility is due in some degree to their inherent geological instability and furthermore to the violence of the monsoon rains that they arrest and moderate.

The Doon Valley is bounded on the north-east by the Lesser Himalayan Ranges, and on the eastern half of its south-west by the Shivalik Ranges. The two most important rivers of North India, the Ganga and the Yamuna, demarcate its south-eastern and north-western boundaries, respectively. The 'fragility' of the Doon Valley is further accentuated by the presence of a major boundary fault passing through the northern parts of the Valley and by the unusually heavy rainfall of about 2.000 mm per year. The average width of the Valley is about 20 km, and the length is nearly 70 km. The Doon Valley ecobiome comprises two distinct sub-catchments, one formed by the drainage basin discharging into the Ganga a little south of Rishikesh, and the other formed by the drainage basin discharging into the Yamuna near Rampur Mandi (just outside Dehradun district).

Thus the Doon Valley forms a sub-catchment for the Ganga-Yamuna rivers system which carries the vital water resources for the northern part of the Indian subcontinent.

The Lesser Himalayan Ranges, which form the northern boundary of the Doon Valley, are part of the Great Himalayan Range. The Shivalik Ranges, which form the southern boundary of the Valley, are alluvial formations that are younger than the Himalayas, as they were formed by the debris which was swept down from the mountains. The Shivalik Ranges present a stiff face to the plains, while a long and gentle slope meets the foot of the Himalayas to form a shallow longitudinal valley. These valleys or longitudinal depressions formed between the Shivaliks and the Himalayas are generally called 'Duns'. They are not continuous but are cut through by streams that drain the adjacent mountains. In some places the Duns disappear with the merging of the Shivaliks and the Lesser Himalayas. The lower parts of these Duns are generally covered by a deposit of boulders, so that the floor of the Valley is considerably higher than the level of the plains beyond the Shivaliks.

Owing to this elevation of the Duns and the short distance over which the drainage from them meets the water courses in the plains, the landscape is marked by deep gorges and gullies, which cut through the unconsolidated strata that form the floors of these valleys. For the same reason, tapping of underground water through wells has not been as feasible in the Valley as in the plains.

19.5 The Ecological Crisis Generated by Quarrying

Quarrying in the Doon Valley has disturbed the ecosystem drastically. The limestone belt in the Mussoorie Hills lies in a tectonically active zone, and a geological thrust was created by the extension of the older pre-tertiary rocks of the Mussoorie Hills over the younger tertiary rocks of the Doon Valley. The thrust is disturbed by a series of offshoot faults, rendering the region geologically unstable.

The extraction of minerals by open cast mining first disturbs the land-soil-vegetation system by the removal of the vegetation, the top soil, and the overburden, for surface quarrying. This disturbance would be associated with surface mining anywhere. It is, however, accentuated locally by the precipitous slopes and high rainfall, which add to the land's instability caused by mining.

The actual process of extraction of limestone thereafter creates the second ecological impact on land resources, which is unique to the fragile and sensitive ecosystems that characterise the Doon Valley. The use of explosives to remove the rocks further weakens the already weak rock structure. Explosives also activate faults in the dislocation zone of the main boundary thrust, where the quarries in the Mussoorie area are located. The result is induced slope failure and landslides, which are increasing in the region since the mining operations began.

19.6 Effects of steep gradients and High rainfall

The steep gradient of the hills and the high rainfall in the Valley contribute further to this instability, as has already been indicated Landslides raise the beds of streams and rivers, by piling up debris in these drainage channels. The combination of heavy monsoons, bare slopes, and silted river beds, leads to flood in a valley that was endowed by nature with excellent drainage. Floods in turn further destroy land resources downstream, because sited river beds lead to unpredictable changes in the course of others which begin to cut their banks. The upper parts of the streams are thus intricately linked with the lower parts forming a ecological minimum in which manipulation of land resources upstream leads the destruction of land resources downstream. These induced abilities in land resources have been so large in magnitude that they are conspicuously visible.

19.7 Further Impacts of Quarrying

The impact of quarrying is also reflected in the flow characteristics the springs and streams in the Doon Valley. As in the last few years, quarrying has led to the most drastic changes in the surface characteristics of the catchments—both in terms of extent and density-decline in the lean period base flow in the streams can linked with it. The lean period flow in the Rajpur and Bijapur personal systems, which tap the water from the Rispana.

The disturbance has been further accentuated by the impact of the disposal of overburdens and 'fines' on the hill slopes, and by the landslides induced by mining related activities in this sensitive region. The resulting debris covers large areas of the hill slopes below the limestone belt. As the debris deposited has little water infiltration capacity, there is a drastic decline in the effective catchment area in the Mussoorie Hills which in turn leads to surface run-off.

Thus the situation of the limestone belt is such that the real impact of quarrying on the hydrological characteristics of the hill surface will, through the deposition of debris, be several times as extensive as the total area of the quarries. The area of land under debris may even be several orders of magnitude greater than the leasehold area of quarrying. Moreover during heavy rainfall, which is common in the Doon Valley, debris is carried by the run-off to the river beds. This in turn raises the river beds, changes the course of rivers, leads to soil erosion in the adjoining agricultural land and forests, and blocks the vital canal systems of the Valley. The ecological impact of quarrying, in terms of destabilised land and water resources, is clearly indicated by the transformation of the boulder beds of the Doon Valley rivers into debris covered beds following the introduction of quarrying.

More than a century ago, Williams reported that there was no 'Kunkar' (kunkur', 'kunkar', 'coacher', etc., coarse limestone sheets or nodules) or 'bajri' (limestone debris) available in the Valley. According to him, 'the geological formation of the Valley itself, a vast shingle-bed interspersed with (tracts of) sand, having a partial covering of loam, forbids the existence of kunkar, the substitute for which is stone metalling, procured by breaking up the boulders found in the mountain torrents'.

Devastating Silting and Flooding

This description remained applicable to the Doon Valley until recently, when the impact of three decades of quarrying became painfully evident through the deposition of materials carried down by the mountain 'offents during each monsoon. As a result, the boulder strewn bea of the .... were transformed into ever rising depositories of debris. In the Rispana river bed, boulders disappeared about ten years ago, while in the Tons river bed a major inflow of debris about 6 feet (nearly 2 metres) in height was recorded after the 1982 mansoon. The Baldi river's bed has been rising constantly, threatening roads and bridges in the area of Sahastradhara, which lies about 1 km upstream of its confluence with the Song river. Buildings near the only bridge over the Baldi river have already been washed away, and the cumulative piling up of 'bajri' will, in the near future, pose a serious threat of floods in large parts of the Valley.

devastation of the Mediterranean forests and grasslands by the suppliers of Rome's

Such floods have already begun to affect villages on the banks of the Asan, the Baldi, and the Song rivers. Distance does not save these remote villages from the destructive impact of quarrying, as they are part of the overall ecobiome, being linked to one another by a common drainage channel, and to that extent belonging to a natural ecological unit. The upper parts of the streams have an impact on the lower parts, and quarrying upsteam affects activities further downstream, sometimes quite drastically.

Besides damaging land and property along the river beds, the debris loaded flow in rivers has started choking canal works, thus heavily increasing their maintenance costs and the vulnerability of the water distribution system. Costs for removal of the debris in the canals, which were insignificant until the last decade, have risen to Rs. 5 lakhs in the last monsoon. The Irrigation Department, which looks after the Doon Canals, has to employ a large labour force to work around the clock throughout the monsoons, so that the canal head is not blocked by silt and other debris. The maintenance team is involved in such activities as not allowing the rivers to change their course in order to ensure that the water reaches the canal head, clearing out debris from the canal head and the canals.

At times the torrent is so powerful and the load of silt is so heavy that it is physically impossible to remove the silt quickly. In mid August 1983. Dehradun city went without water for several days because the Rajpur Canal was entirely silted up. It is expected that within a period of ten years the entire canal works will be threatened by rising torrents and the concomitant destruction of flood protection works. Unfortunately, the cost associated with the destruction of this vital water conservation and distribution system has so far not been recognised as a negative externality of quarrying, because the processes by which quarrying threatens water resources have not been recognised. Through water, the impact of quarrying is carried to the human settlements, which depend on these water resources for survival.

Vital Importance of Water Resources

The destruction of the processes of renewability of water resources has, in the past, led to the collapse of human societies and civilisations. For instance. 'There is a strong link between the fall of Rome and the devastation of the Mediterranean forests and grasslands by the suppliers of Rome's sustenance.' There is every indication, that unless the processes of destruction of water resources are reversed, large parts of India, which are proud of their ancient civilisations will face serious water problems well before the turn of this century, and Chaturvedi believes that by the beginning of the twenty-first century water demand might exceed the ultimate usable resources in different states of India.

These assessments have been borne out by the water famine faced by Tamil Nadu, particularly Madras city, while Uttar Pradesh, for which the water crisis was projected to start in the eighties, is already facing severe and absolute water shortages which cannot be overcome by engineering solutions. In such a situation the creation of drought in water rich regions like the Doon Valley can only aggravate the problem.

In tropical regions, water resources are widely maintained through a very delicate balance with the local ecosystems, such that even small disturbances can completely destabilise water supplies because of the climate, the heavy seasonal rainfall, and the high mountain ranges which are the catchments of many of the major rivers. Hydrological destabilisation through deforestation or other in-effective land management in these catchments often increases instant run-off, leading to floods in the monsoons and drought in the lean season. This degree of destruction of water resources would not, however, be caused by a similar land use abuse in ecobiomes where the rainfall distribution and the slopes of catchment areas are not so extreme. Yet, the rapid destruction of water resources, which is especially problematical in tropical countries threatens the healthy biological survival of human communities and forecloses opportunities for their economic development.

19.8 The Local Situation

The decrease in water supply, coupled with ever increasing demands from industry and a rapidly growing urban population, has created scarcity of the most vital resource for human survival and development. This scarcity in turn leads to social costs by diverting human resources from productive work to the drudgery of water collection or attempts to ensure supplies.

Nearly 70 per cent of the Doon Valley population is dependent on public water supply. Water shortages mean longer queues, longer waiting hours, and less water collection for those families. On the average, those dependent on the public supply spend 2 hours a day on water collection, while in certain localities the waiting time is nearly 4 hours. Besides this wastage of human work potential, water scarcity is becoming a source of serious social conflicts among those who are the victims of such water resource destruction.

The impact of this crisis in water resources is unequally divided between different groups of human society, such that 70 per cent of the population which cannot afford private water connections is increasingly deprived of water. Of the 30 per cent which has a piped supply in their homes, about 5 per cent can overcome natural shortages by capital-intensive technological solutions to which they along have access. Underground storage wells and pumps can provide twenty-four hours daily supply of running water in homes which can afford an initial capital investment of Rs. 5,000 to Rs. 6,000. The ecological crisis clearly affects the poor more drastically than the rich, despite the prevalent myth that concern for a 'stable ecology' is a luxury which only the latter can afford.

In the villages in the hills, the impact of destruction of water resources is even more drastic than in the towns. The drying up of springs or a decrease in spring discharge means the destruction of the only alternative available to most villagers. While nature treats all humans equally, development plans do not. Only 20 per cent of the total population of India is supplied safe drinking water, and scarcely 50 per cent of the total rural population is provided this vital resource. Most water development is for urban areas. Such villages as those in the Doon Valley, which were provided safe drinking water by nature in the form of springs, will join the 1.52 lakh 'no-source' villages once their springs run dry. For the government this will mean an insignificant increase in the statistics, but for the women in those villages it will mean longer distances over tough terrain and longer hours to collect an essential resource for their families. For the families of these women, especially the children, it will mean increasing disease and morbidity.

While the water resources which are provided by the Mussoorie Hills have been treated as valueless in the controversy over limestone quarrying, they have an undeniable value for the well-being and very survival of the people of the Valley. The destruction of an economic value which degrades the quality of life and threatens the survival of the citizens. The natural endowment of these mountain ranges is an essential part of the resource base for the survival and economic activity of the people in the region.

The economic value of nature has been completely ignored by conventional economics and conventional models of progress and prosperity. The deepening ecological crisis is, however, making it imperative that nature's values and functions be taken into account through proper ecological audits. Such ecological audits of economic activities should assign a value to natural functions on the basis of the cost of technological alternatives to deliver the same set of goods and services. Thus the value of water resource potential of the Mussoorie Hills is the cost of the technical installations that would provide the people with the same quantity and quality of water. Quite obviously, the damage involved is equivalent to the destruction of a gigantic waterworks which pumps more than 500 cusecs (500×28.32 dm per second) of water from the Yamuna river and distributes it to all the villages that are currently served by nature. The natural water installation that is being destroyed will in theory cost the public many thousands of millions of rupees to replace.

19.9 Hidden Extemalities of Limestone Quarrying

Limestone quarrying in the Doon Valley has come into direct conflict with other important economic activities on which the majority of the residents of the Valley depend for their livelihood. Traditionally, four main sectors of economic activity have flourished in the Doon Valley. The unique material endowment of the region has given it a unique comparative advantage for agri-horticulture, tourism, education such as schools and research institutions, and knowledge-intensive manufacturing based on a favourable climate and a clean environment. These diverse economic activities are ecologically consistent with one another, as they are all based on the stability of land and water resources. Agriculture and horticulture are directly dependent on them as central inputs, while tourism and knowledge based industry are supported by the environmental capital of a stable ecobiome. However, limestone quarrying and the processing units which have been established to support it, have destroyed the resource base on which other activities survive and prosper. The 'growth' recorded by the limestone industry has, thus, to be seen against the background of the decay of other economic activities and not independently of it.

Undermining of Food Production

Agriculture is the oldest economic activity of the Doon Valley, and the villagers tapped the abundant and perennial streams to irrigate their fields. The plateau was ably served by the ancient Rajpur Canal, at the head of the Rispana torrent coming from the adjacent foothill. This tapping of water before its disappearance into the boulder bed was a successful indigenous technology of water management. Due to the geological character of the Doon Valley, the profitable and successful construction of wells has been impossible except in villages near Rishikesh or near the sources of the Suswa and Asan rivers. This has made canal irrigation vital for agriculture as well irrigation is next to impossible.

As already discussed, the central ecological impact of quarrying is the destruction of land and water resources, both of which are vital inputs for food production. Also, as explained earlier, abundant rainfall combined with stable catchments provided by the Mussoorie Hills had earlier formed the most important base for a stable agricultural economy in the Valley.

The destabilisation of the resource base has destabilised food production. In most of the villages that lie below quarries the irrigation channels have been destroyed by the flow of silt and other debris from mines or from mining roads. Village Bhitarli in the Tons catchment was self-sufficient in foodgrains and had surplus food and milk production before the quarrying operations destroyed the food and fodder base of the village. But the submersion of the irrigation channels led to a drastic reduction in food production, and the loss of grazing land has decreased the cattle population of eight households (randomly surveyed) from 194 to 37.

The entire area below the limestone belt can no longer be used for grazing, and large areas have practically no vegetation as they are covered by debris from the mines. The few pockets of shrubs and forest that remain are of no use for cattle, because of the perpetual danger of boulders rolling down the slopes as a result of blasting. An important economic activity based on animal husbandry is therefore being eroded, and the decline in cattle population in areas affected by mining is as much as 40 per cent. The decline in livestock population affects the production of milk, the production of energy for farm operations, and the production of animal dung that provides soil fertility for sustainable agriculture-the last function being the most important one in hill agriculture. The overall result is a collapse of the food production system.

As a consequence of these problems, villagers living near the quarries are becoming increasingly dependent on non-agricultural incomes. The quarries provide employment to many of these incomes. The quarries provide employment to many of these villagers who had been rendered unemployed indirectly by the quarrying operations. Those who cannot withstand the hard labour in the quarries have, reportedly, turned to brewing illicit liquor and smuggling firewood as a means of survival. Both items have a ready market in the nearby human settlements.

Quarrying affects agricultural activity not only in the villlages in the vicinity of the quarries but also in the villages in the other parts of the Valley served by the canal network. As indicated earlier, destruction of the hydrological stability of the region means that there is less water than was proviously available for irrigation who it is most needed. The increasing difficulty in the distribution of water interferes with the timely availability of irrigation water and this leads to increased crop failure. The growing of Basmati rice famous for its flavour, is on the decline in the Valley, thus reflecting the failure of the Valley to utilise its relative advantages of climate and water resources. In an early Settlement Report it was stated that ‘the canals are, without doubt, the making of the Doon’. The destruction of the irrigation potential through the canal system may soon prove to be the unmaking of the Doon. The lime rush which has been profitable for the quarry operators could be the only factor behind the ecological, and hence economical collapse of the Valley.

Official Response to the Signs of Disaster

The Heavy negative externalities of limestone quarrying in the Doon Valley have long aroused popular protests. This contradiction came to a climax when a large number of leases were due for renewal at the end of 1982. In 1981 the Department of Industries of Uttar Pradesh had appointed a committee to decide the policy for renewal of the leases. According to the recommendations of this committee, quarrying was to be discontinued in the Sahastradhara area because of its impact on the Baldi Nadi (river) and the consequent ill-effects on tourism. In the Arnigad Valley, quarrying was to be selectively continued while avoiding violation of mining rules or leased rights. It was further recommended that all quarrying on the main highway linking Dehradun and Mussoorie was to be discontinued. In the Bhitarli Valley, leases were to be renewed on merit.

Continuation of quarrying was recommended in the Nun Valley. In Banog, block quarrying was recommended on the condition that the Kempty Falls and the water pumping station for the township of Mussoorie was not damaged. In the Song Valley, total ban was recommended because of the practice of dip slope mining as the stability of the entire mountain war in dancer. On these grounds, nine out of eighteen leases that were due for renewal were recommended to be allowed to continue. Others, however were not recommended to be allowed to continue apparently on the basis of ecological considerations as well as for safety reasons. Contrary to the recommendation of selective renewal, the Government of Uttar Pradesh decided to impose a blanket ban on the renewal of these quarrying leases. The decision was, however, challenged in the High Court by the quarry operators, who obtained ‘stay’ orders allowing them to continue quarrying even in those quarries which had been recommended for closure. The stay order led to confusion among the local monitoring agencies for the quarries. The quarry operators reportedly interpreted any control and monitoring by the official agencies as interference in their activity which had been approved of by the Court. The result was severe and reckless quarrying, as the operators tried to maximise their production in a period of uncertainty about future possibilities.

In the perspective of this lack of control by official agencies, public interest litigation at the Supreme Court of India was the only alternative available for the protection of the citizens rights to vital resources, as well as for the assertion of social control on activities related to the utilisation of common natural resources owned by the community or government for public use.

19.10 The People's Response

The resistance to the extraction of limestone from this vulnerable ecosystem was in three phases. In the first phase, the local village organisations politically resisted the mining activities. The resistance was quickly interpreted as a block to national progress and the organisations of villagers were subverted by converting them into co-operatives and providing them with small leases. Without the support of science or the state, the villagers lost their campaign.

The second phase was characterised as a conflict between the state and the lessees. The Uttar Pradesh government tried to withdraw a lease in 1977 on the grounds that it would affect the 'natural beauty and ecology' of the region. The Court called on technical experts to inform its decisions. The technical experts were partisan scientists, who perceived minerals as isolated from soil and water and vegetation and who perceived the economic value of minerals only in extraction and mining. The experts informed the Court that quarrying in the lease areas does not necessarily affect the environmental and ecological balance in regard to water, soil and other related factors. Without counter-arguments from ecology as public interest science, even the state could not control mining in the Doon Valley.

In the third phase, citizens groups in Dehradun and Mussoorie fought a similar case in the Supreme Court, this time informed by public interest science. The balance shifted, and the same expert who in 1977 had stated that quarrying was ecologically safe now said of the same quarry that 'the lease area is situated right in the immediate catchment area of a nullah and is thus subjected to conspieuous denudation by flow of water. Rectification of the situation calls for a permanent closure of this mine. The emergence of public interest science supporting public interest litigation in the Doon Valley created a new countervailing force favouring public interest. The ecological knowledge was generated with people's participation in an ecosystems study of the Doon Valley undertaken by the authors for the Department of Environment. The study was completed in May 1983 and in June 1983 it was used to file a public interest litigation against limestone quarrying. The study showed that in the partison, reductionist viewpoint of an economy based on the exchange value of resources, these resources are seen as isolated from one another. In this fragmented perspective, the most efficient use of limestone is its extraction for meeting the commercial industrial demands. From the ecological viewpoint, limestone in its fractured form provides the best and the largest aquifer that can sustain the supply of water resources to the Valley. The most efficient and economic use of the mineral in this perspective which views limestone in its relationship with other resources is its conservation for the sustained supply of water on which all economic activities in the Valley depend. ‘Scientific’ mining and ‘scientific’ geology in the reductionist framework is based on partial and incomplete knowledge of the diverse properties and functions of mineral resources. It is based only on specific and particular properties which provide maximum exchange value to the mineral. But minerals have properties and functions beyond those that are commercially exploitable, some of which are only reliable in situ. Mineral extraction in the reductionist framework is blind to the other functions, treats them as non-existent, and thus destroys them by maximising benefits from the commercial exploitation of individual resources.

The Court acted as a public interset science laboratory where scientific ideas were tested, verified and developed into a countervailing force challenging the power of partisan expertise. Public interest litigation backed by public interest science was successful in controlling mining.

On 12 March 1985 a Supreme Court bench consisting of Justice P.N.Bhagwati, Justice A.N.Sen and Justice R.Misra, who had been hearing the public interest litigation against limestone quarrying in the Doon Valley, passed an order closing permanently or temporarily, fifty-three limestone quarries out of sixty within the geographical limits of the Doon Valley or the Dehradun Tehsil. The honourable bench, introduced the order in the following words :

This is the first case of its kind in the country involving issues related to environment and ecological balance and the questions arising for considerations are of grave moment and of significance not only to the people residing in the Mussoorie hill range forming part of the Himalayas but also in the implications to the welfare of the generality of the people living in the country. It brings into sharp focus the conflict between development and conservation and serves to emphasise the need for reconciling the two in the larger interest of the country.

The bench justified the closure of mining operations on the grounds that it is a price that has to be paid for protecting and safeguarding the right of the people to live in a healthy environment with minimum disturbance of ecological balance and without avoidable hazards to them and to their cattle, homes and agricultural land and undue affection of air, water and environment. With this order the Supreme Court of India has set a precedence in accepting a stable and healthy environment as a human right and has intervened on behalf of citizens for just and sustainable development.

One of the mines that was allowed to continue operations by the interim order of the Supreme Court was the Nahi-Barkot mine operated by C.G. Gujral. The lease of the mine had expired in the 1982 and for four years, the quarry had been operated on the basis of an interim injunction from the local court in Dehradun.

On 16 September 1986 the people of Nahi-Kala along with Chipko activists launched a non-violent resistance against the ecological havoc being caused by the mine. The ecological impact of limestone quarrying in the Nahi-Kala region is more acute since the area had rich resources of forests and water and since the mine is located at the origin of water resources and on steep slope on the hill top. In a report to the Supreme Court of India the local divisional forest officer wrote that the vegetation is undergoing serious damage by the mining activity. The trees on the nala barrier have been badly damaged. At some places the trees are four to five feet under debris. The land instability generated by quarrying, road construction and the related landslips also obstruct and deplete the natural flow of water in the streams, seriously affecting the local irrigation system.

The waterfall at the source of Sinsyaru is now dry. The increase in the level of the beds of Sinsyaru Khala, Bidhalna and Jakhan rivers has led to enhanced cutting and erosion of the banks, destroying some of the best farm lands. This report also mentions that the nala is continuously widening, causing great damage to the agricultural fields of the village Barkot'. According to a study conducted by Kalpavriksha, as part of UNU study, the quarry is also a serious threat to the lives of villagers and their cattle. Irresponsible blasting at the quarry site has reportedly killed a number of cattle while grazing. As a result, five of the seven families living near the quarry site have been forced to abandon their lands and houses and have moved away. Kalam Singh who heads one of the two families who have decided to stay on, had to face the wrath of the quarry mafia when his young daughter was kidnapped by some labourers working in the quarries.

The record of functioning of the limestone quarry at Nahi-Kala is a record of irregular and unscientific quarrying that has violated several rules. The Uttar Pradesh Directorate of Geology and Mines had reported that the concerned limestone quarry was served a notice by the Directorate of Mine Safety on the grounds of excess vertical height of the steps, quarrying on faces steeper than a 60° slope and the rolling down of the mineral extracted.

19.11 Sum Up

On 15 March 1987, the movement celebrated six months of struggle. The struggle has not been easy. For six cold months, the volunteers had to spend nights under a tent near Sinsyaru Khala to make sure that their natural wealth is not turned into profits but is available for their children as a source of sustenance Local courts have served the peaceful satyagrahis with notices of arrest while C.G. Gujral and his men have made many attempts to attack the people. On 30 November 1986 four truck loads of fifty men armed whith sticks attacked the satyagraha camp. Chamandai ran down from the village and told the men that the quarry would be operated only over her dead body. They dragged her for a few hundred feet but finally had to turn back overcome by the power of her peaceful protest.

On the morning of 20 March 1987, four truckloads of goondas armed with revolvers, spears, knives, iron rods and sticks attacked the volunteers in the Sinsyaru Khala camp of the Chipko movement, there was another attack in the evening on the non-violent but determined volunteers. This left a large number of men, women and children wounded.

Itwari Devi and Chamandai who were leading the movement were stoned and Ramesh Kukreti and his colleagues received serious injuries and had to be rushed to the Doon Hospital 20 km away. While the spirit of satyagraha has remained alive in Chipko, the movement has transcended beyond its original association of hugging trees in the Garhwal Himalayas. The Chipko movement in the Doon Valley shows that the movement is not merely an issue of hugging trees, but of embracing the living resources of nature in all its diversity, including the living mountains and living waters. On 25 December, 1986, the 100th day of the struggle, Ghanshyam 'Shailani', the folk poet who gave the movement its name in a song he wrote in 1971, spent the whole day singing new songs about the Chipko against quarrying in the Doon Valley. With his songs, the strength of the Doon Valley Chipko is renewed to fight an extended battle for the protection of nature :

A fight for truth has begun
at Sinsyaru Khala
A fight for rights has begun
in Malkot Thano
Sister, it is a fight to
protect our mountains and forests
They give us life
Hug the life of the living trees and
streams to your hearts
Resist the digging of maintains which kills
our forests and our streams
A fight for life has begun
at Sinsaru Khala

-000-

Structure

201 Objectives

After going through this chapter ,the learner will be able to understand

- Formation of Narmada Bachao andolan
- Reasons for the environmental movement

20.2 Introduction

Narmada Bachao Andolan (NBA) is a non-governmental organisation (NGO) that mobilised tribal people, adivasis, farmers, environmentalists and human rights activists against the Sardar Sarovar Dam being built across the Narmada river, Gujarat, India.

Their mode of campaign includes hunger strikes and garnering support from noted film and art personalities (notably Bollywood film actor Aamir Khan). Narmada Bachao Andolan, together with its leading spokespersons Medha Patkar and Baba Amte, were the 1991 recipient of the Right Livelihood Award

20.3 Background

Post-1947, investigations were carried out to evaluate mechanisms in utilizing water from the Narmada river, which flows into the Arabian Sea after passing through the states of Madhya Pradesh, Gujarat and Maharashtra. Due to inter-state differences in implementing schemes and sharing of water, the Narmada Water Disputes Tribunal was constituted by the Government of India on October 6, 1969 to adjudicate over the water disputes.[2] This Tribunal investigated the matters referred to it and responded after more than 10 years. On December 12, 1979, the decision as given by the Tribunal, with all the parties at dispute binding to it, was released by the Indian Government.

As per the Tribunal's decision, 30 major, 135 medium, and 3000 small dams, were granted approval for construction including raising the height of the Sardar Sarovar dam.

In 1985, after hearing about the Sardar Sarovar dam, Medha Patkar and her colleagues visited the project site and noticed the project work being shelved due to an order by the Ministry of Environment and Forests, Government of India. The reasons for this was cited as "non-fulfillment of basic environmental conditions and the lack of completion of crucial studies and plans". What she noticed was that the people who were going to be affected were given no information, but for the offer for rehabilitation. Due to this, the villagers had many questions right from why their permission was not taken to whether a good assessment on the ensuing destruction was taken. Furthermore, the officials related to the project had no answers to their questions. While World Bank, the financing agency for this project, came into the picture, Patkar approached the Ministry of Environment to seek clarifications. She realized, after seeking answers from the ministry, that the project was not sanctioned at all, and wondered as to how funds were even sanctioned by the World Bank. After several studies, they realized that the officials had overlooked the post-project problems.

Through Patkar's channel of communication between the government and the residents, she provided critiques to the project authorities and the governments involved. At the same time, her group realized that all those displaced were only given compensation for the immediate standing crop and not for displacement and rehabilitation.

As Patkar remained immersed in the Narmada struggle, she chose to quit her Ph. D. studies and focus entirely on the Narmada activity. Thereafter, she organized a 36-day long, solidarity march among the neighboring states of the Narmada valley from Madhya Pradesh to the Sardar Sarovar dam site. She said that the march was "a path symbolizing the long path of struggle (both immediate and long-term) that [they] really had".This march was resisted by the police, who according to Patkar were "caning the marchers and arresting them and tearing the clothes off women activists".

20.4 Formation

There were groups such as Gujarat-based Arch-Vahini (Action Research in Community Health and Development) and Narmada Asargrastha Samiti (Committee for people affected by the Narmada dam), Madhya Pradesh-based Narmada Ghati Nav Nirman Samiti (Committee for a new life in the Narmada Valley) and Maharashtra-based Narmada Dharangrastha Samiti (Committee for Narmada dam-affected people) who either believed in the need for fair rehabilitation plans for the people or who vehemently opposed dam construction despite a resettlement policy.

While Patkar established Narmada Bachao Andolan in 1989, all these groups joined this national coalition of environmental and human rights activists, scientists, academics and project-affected people with a non-violent approach.

20.5 Aftermath

Medha Patkar (right) and other NBA activists demonstrate in front of the Madhya Pradesh Chief Minister's residence for replacement and rehabilitation of all those affected by the Sardar Sarovar dam.

Within the focus of Narmada Bachao Andolan towards the stoppage of the Sardar Sarovar dam, she advised addition of World Bank to their propaganda.Using the right to fasting, she undertook a 22 day fast that almost took her life. In 1991, her actions led to an unprecedented independent review by the World Bank. The Morse Commission, appointed in June 1991 at the recommendation of The World Bank President Barber Coinable, conducted its first independent review of a World Bank project. This independent review stated that "performance under these projects has fallen short of what is called for under Bank policies and guidelines and the policies of the Government of India." This resulted in the Indian Government pulling out of its loan agreement with the World Bank. In response, Patkar said "It is very clear and obvious that they used this as a face-saving device",suggesting that if this were not to happen, the World Bank would eventually would have withdrawn the loan. The World Bank's participation in these projects was eventually cancelled in 1995.

She further undertook a similar fast in 1993 and resisted evacuation from the dam site.In 1994, the Bachao Andolan office was attacked reportedly by a couple of political parties, where Patkar and other activists were physically assaulted and verbally abused.[12] In protest, a few NBA activists and she began a fast and 20 days later, they were arrested and forcibly fed intravenously.

20.6 Supreme Court's decision

Patkar led Narmada Bachao Andolan had filed a written petition with the Supreme Court of India [the nation's apex court] seeking stoppage of construction on the Sardar Sarovar dam. The court initially ruled the decision in the Andolan's favor thereby effecting an immediate stoppage of work at the dam and directing the concerned states to first complete the rehabilitation and replacement process.

The Supreme Court also deliberated on this issue further for several years but finally upheld the Tribunal Award and allowed the construction to proceed, subject to conditions. The court introduced a mechanism to monitor the progress of resettlement pari passu with the raising of the height of the dam through the Grievance Redressal Authorities (GRA) in each of the party states. The court's decision referred in this document, given in the year 2000 after seven years of deliberations, has paved the way for completing the project to attain full envisaged benefits. The court's final line of the order states, "Every endeavour shall be made to see that the project is completed as expeditiously as possible".

Subsequent to the court's verdict, Press Information Bureau (PIB) featured an article which states that:

"The Narmada Bachao Andolan has rendered a yeoman`s service to the country by creating a high-level of awareness about the environmental and rehabilitation and relief aspects of Sardar Sarovar and other projects on the Narmada. But, after the court verdict it is incumbent on it to adopt a new role. Instead of `damning the dam` any longer, it could assume the role of vigilant observer to see that the resettlement work is as humane and painless as possible and that the environmental aspects are taken due care of"

20.7 People involved

Amongst the major celebrities who have shown their support for Narmada Bachao Andolan are Booker Prize winner, Arundhati Roy[15] and Aamir Khan.[16].1994, saw the launch of Narmada:A valley Rises, by filmmaker Ali Kazimi.This film documents the five week long Sangharsh Yatra of 1991. The film went on to win several awards and is considered by many to be a classic film on the issue. In 1996, veteran documentary film maker, Anand Patwardhan, made an award-winning documentary on this issue, titled: 'A Narmada Diary'

20.8 Sum up

The Narmada dam's benefits include provision drinking water, power generation and irrigation facilities. However, the campaign led by the NBA activists has held up the project's completion, and the NBA supporters have indulged in physical attacks on local people who accepted compensation for moving. Others have argued that the Narmada Dam protesters are little more than environmental extremists who use pseudoscientific agitprop to scuttle the development of the region, and that the dam will provide agricultural benefits to millions of poor in India

-000-

Structure

21.1 Objectives

After going through this chapter you will be able to understand :-

- socio cultural sustainability in society
- population and industrial growth and sustainability.

21.2 Introduction

Over the course of this century, the relationship between the human world and the planet that sustains it has undergone a profound change. Settled agriculture, the diversion of water courses, the extraction of minerals, the emission of heat and noxious gases into the atmosphere, commercial forests and gentic manipulations are some of the examples of human interventions in natural systems during the course of development. Population explosion, industrialisation, urbanization and green revolution have brought out many changes in the quality of our environment (Dhaliwal el al., 1992). These changes in the environment have put the survival of man in danger. In terms of incomes and output, the world will be a much richer place in the next century but the environment may be much poorer. Future generations will have to be worse off as a result of environmental degradation that results from economic decisions made today. The scale of economic activity may not be sustainable in the face of increasing pressure on natural resources.

Sustainable development is the development that lasts. A specific concern in this concept is that who enjoy the fruits of economic development today may be making future generations worse off by excessively degrading the earth's resources and polluting the earth's environment. The term sustainable development was brought into common use by the World Commission on Environment and Development (Brundtland Commission) in its report, Our Common Future (WCEP, 1987). The idea of sustaining the earth has proved a powerful metaphor in raising public awareness and focussing on the need for better environmental stewardship. According to Bruntland Commission, sustainable development is development that" meets the needs of the present without compromising the ability of future generations to meet their own needs". For achieving sustainable development, we require no less than a global movement and significantly increased political will and public pressure in order to persuade industry, governments and institutions to take responsibility for their actions. Sustainable development contains within it two key concepts. The concepts of needs, in particular the essential needs of the world's poor, to which overriding priority should be given and the idea of limitations imposed by the state of technology and social organisation on environment's ability to meet present and future needs (WCED, 1987).

Sustainable development requires that the adverse impacts on the quality of air, water and other natural elements are minimised so as ,to maintain eco-system's overall intergrity.

Sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological developments and institutional change are all in harmony and enchance both current and future potential to meet human needs and aspirations. It is a dynamic process intended to meet the needs of economic development without compromising the environment, now and for the future.

The concept of sustainable development received tremendous interest at the United Nations Conference on Environment and Development (UNCED), commonly known as the Earth Summit, at Rio de Janeiro in June 1992. This Conference of over 100 heads of state and scientific experts from all over the world focussed on the impact of unregulated economic development on a deteriorated global environment. In a historic agreement UNCED adopted Agenda 21, a multipoint, comprehensive plan designed to deliver a sustainable future. UNCED also established the Commission on Sustainable Development (CED), which is responsible for monitoring progress in implementing Agenda 21 (Trivedi et at., 1994).

21.3 Population Growth and Sustainable Development

Man has been interfering with nature since the dawn of civilization. However, his impact on the environment was not felt because the population of man was quite less. With the advent of agriculture and advances made in industrial sector, the population of man started increasing tremendously. The sustain ability development is intimately linked to the dynamics of population growth From the beginning of human species until the end of World War I , it took more than 10,000 generations to reach a world population of a little more than two billion. But in just past 45 years, it has gone from a little over 2 billion to 5.7 billion and in the coming 45 years it will be 9-10 billion.

Developed countries have disproportionate impact on the global environment as compared to developing countries. A child born in a country where levels of material and energy use are high places a greater burden on the earth's resources than a child born in a poorer country. For example, a child born in USA will have 30 times more impact on earth's environment during his or her life time than a child born in India (Gore, 1994). Thus, the affiuent of the world have a responsibility to deal with their disproportionate impact.

The following facts speak volumes on the disastrous fallout from the unchecked population growth.

- At 5.7 billion, the global baby boom is alarming. It will touch 6 billion by 1998. With the annual increase of 94 million, the world population is set to touch 8.5 billion by 2025 and 12.5 billion by 2050.
- By 2025, the population ratio between the developed North and developing South is estimated to be 1 : 5.
- About 54 per cent of the global population growth is confined to South Asia and Africa.
- Thirty per cent of the developing world's population is living on about one dollar a day. Sixty-two per cent of the world's poor are in South Asia.
- The richest fifth of the population control 83 per cent of the world's wealth while the poorest fifth account for barely 1.4 per cent of the global income cake. No wonder, an average person in the developed world consumes 12 times more energy than one in the poor South. About 52 per cent of India's population lives below the poverty line of less than Rs.110/-per month.

The failure of the 'family planning programme has been the principal reason for India's continuing backwardness. (The benefits of economic growth are offset by population explosion. Therefore, in India we must adopt a rational, women-centred, welfare-oriented humane approach to family planning if we are really to achieve substantial reductions in population growth rate. The Draft National Population Policy submitted by a 10- member group, headed by Dr M.S. Swaminathan on May 21, 1994 is the latest of the recommendationsyts main thrust is the decentralisation of the family planning programme to delink population planning from political process and to set up an autonomous Population Commission along the lines of Planning Commission or the Election Commission. The chief merit of the recommendations is that the funds should go direct to panchyats. What is more, the programme will offer employment to the educated' rural youth and impart to our villages some semblance of modernity.

Dr M.S. Swaminathan has rightly stated that the time has come to Shift from "think nationally, act locally" to "think, act and plan locally and support nationally". With panchyats having been given the pride of place, it is but natural that grassroot organisations should frame their own socio-demographic charters, keeping in mind the concepts of gender equality, education for all, integrated health, habitat hygiene, nutritional security and employment.

Family planning is more widely accepted in societies that provide their people with basic needs and services like housing, health care and education. This is true even in countries with low incomes like Costa Rioa, Sri Lanka, Jamaica and Botswana. These countries have reduced their fertility rates through high levels of "social investment" especially in education for women. What they spend for health and education is more than four times what they spend for the military.

For a happier and healthier tomorrow, strong support has to be provided to women so that they acquire their rightful place in society. The growing emphasis on the education of girls, the raise in marriage age, new employment opportunities for women, and the new legislation granting freedom and parallel rights to women should help produce a qualitative change in the social setting. But more than in urban India, we need to have a closer look at the conditions of women in rural areas. The draft National Population Policy does incorporate some of these basic thoughts. Once we begin to draw sustenance from common sense and the common man's wisdom, it will be easier to tackle the world's toughest numbers game.

21.4 Urbanisation and Sustainable Development

Today, 25 percent of India's population, i.e., 21.7 crore people, lives in urban areas. On an average, a fourth of this number lives in slums. In large cities, the figures are even higher. More than half of Bombay's 100 lakh population lives in slums. Calcutta has 5 lakh pavement dwellers who live, sleep, cook and defecate on the roads. Even a well planned city like Chandigarh, built for 5 lakh people, a figure it was supposed to reach by 2000, is already inhabited by 7.7 lakh people. Nearly, a fourth of them are slum-dwellers. By 2000, a third of India's population will live in urban areas. The number of cities with more than a population of 10 lakh (class I cities) has increased from ·216 in 1981 to 300 in 1991 (Anonymous, 1994).

Industrial revolution led to the development of cities where people began to concentrate in large numbers and urbanization thus caused profound social, economic and environmental changes. In large cities population congestion has given rise to acute shortage of clean air. The atmosphere is badly polluted with exhaust gases ejected by numerous factories, plants heating installations and vehicles. Low quality fuels used in most of the vehicles generate large amount of pollutants such as lead and sulphur dioxide. So oil refineries should be persuaded to reduce the lead content in petrol and vehicles should be designed to accommodate unleaded fuel. Vehicles should be provided with emission control equipment such as catalytic convertors. Urbanization contributes to air, water and noise pollution to a great extent. Therefore, the development of smaller urban centres needs to make the wheel of progress more sustainable.

21.5 Industrial Growth and Sustainable Development

Industry has always been and continues to be the prime cause of economic development all over the world. Economic development and sound environmental management are complementary aspects of the same agenda. Without adequate environmental protectitm, development will be undermined; without development, environmental protection will fall while the primary aim of new economic policy is to accelerate industrial development, improve operational efficiency and competitiveness, enhance export and induce greater foreign investments. Inevitably, it will have both overt and convert as well as positive and negative environmental consequences. The kind of industries that grow fast determine the severity of pressure on natural resources and the· consequent environmental repercussions. Irrespective of the nature of growth, greater industrialization means greater extraction of resources and, therefore, greater disposal of wastes.

In general, industries and industrial operations should' be encouraged that are more efficient in terms of resource use, that generate less pollution and waste, that are based on the use at renewable rather than non- renewable resources and that minimise irreversible advance impacts on human health and environment. There are 17 industries which have been declared most polluting-sugar, fertilizer, cement, fermentation and distillery, aluminum, petro-chemcials, thermal power, caustic soda, oil refineries, tanneries, copper smelters, zinc smelters, iron and steel, pulp and paper, dye and dye intermediaries, pesticides and pharmaceutical The latest of figures released by the Ministry of Environment and Forest on March 30, 1993, show a total of 1629 units in the country which fall under these categories. Of these, 805 have complied with the pollution control standards laid down by the Ministry. As many as 76 units have been closed down following the action initiated by the State pollution Control Board. Of the remaining 555 units which were set up before 1981, are yet to comply with the standards.

Industries produce hazardous waste. In 1984, some 325-375 million tonnes of hazardous wastes were generated world- wide. These nazardous industrial wastes if discharged untreated would cause many environmental problems rational Environmetal Engineering Research Institute, Nagpur, has eveloped some low cost pollution abatement systems for small scale industries, use of bio- technology from waste treatment and hazardous waste management. Incentives should be given to polluters to set up common effluent treatment plants. Industry should be encouraged to use non- conventional energy resources, a substantial amount of research and development efforts should be made to tat non-conventional energy resources.

21.6. Global Warming: A Threat to Sustainable Development

Global warming is a big hindrance in the way of sustainable development. Environmental resources like atmosphere and water may be regarded as global public goods. Their preservation not only benefits the local population, but also that of other countries: The politicians and even laymen have expressed concern over global warming and its consequences. The world temperature had risen by only 4°C over the last 18,000 years. But in the industrial era since 1850, it has increased by 0.5 - l°C. If the trend continues, the global temperature is expected to rise by 2-5°C by the middle of next century (Dhaliwal and Kler, 1995). 'Greenhouse gases are the primary cause of global warming. Developed countries are the principal contributors of greenhouse gases. According to one view, the climatic changes, because of the greenhouse gases, affect agriculture and forestry most but do not cause any damage to the industry. Since the income of developed countries comes mostly from industry, they do not lose much from global warming while the developing countries, which rely on agriculture, are the losers. But actually, global warming is an externality, in which the polluters are also the victims.

The developed and developing countries both contribute toward greenhouse gases. But the developed countries are in strong position to reduce emissions effectively as they have high levels of per capita fossil fuel consumption. The implementation of Climate Change

Convention adopted at Rio Conference, therefore, rests on the initiative the developed countries take in the coming years. This, in turn, depends on the political consensus that the developed countries are able to achieve on the issue. Chloroflurocarbons (CFCs) have a very high global warming potential, but fortunately these will be phased out quite rapidly in two decades with the implementation of Montreal Protocol.

It is obvious if satisfactory progress is to be made in phasing out greenhose gases, life styles have to be changed urgently. These do not necessarily imply a drop in living standards or a sacrifice of facilities and services that most prosperous nations enjoy. But some changes will be essential. For instance, greater use of public transport or renewable energy technologies and the implementation of energy efficient rneaures, several of which are feasible but are being delayed as a result of institutional, price related and altitudinal barriers. Without any lead from largest polluters of the world, it is unlikely that any progress will be made worldwide in limiting emissions.

On the other hand, the developing countries are major losers, if they are not prepared for this prospect. So the governments will have to quickly change their perceptions and establish partnership with centres of excellence and expertise outside the governments. The developed countries have a culture and tradition of policy- related research in institutions of higher learning and they have a major voice in decision making. A similar approach has to be followed in the developing countries. India must take lead in this regard, because not only infrastructure for meaningful research exists here but it has also a very important role to play in the global negotiations as a major developing country.

21.7 Military Conflicts and Nuclear War

Among the dangers facing the environment, the possibility of nuclear war or military conflict of a lesser scale involving weapons of mass destruction, is undoubtdly the greatest. Certain aspects of the issues of peace and security bear directly upon the concept of sustainable development. Arms competition and armed conflict create major obstacles to sustainable development. They make huge claims on scarce material resources. They pre-empt human resources and wealth that could be used to combat the collapse of environmental support systems, the poverty and under development that in combination contribute so much to contemporary political insecurity.

Nuclear war is a threat to civilization. It has been authoritatively explored by the scientists that smoke and dust ejected into the atmosphere by a nuclear war could absorb enough solar radiation to remain aloft for sometime, preventing sunlight from reaching the surface of the earth, causing a widespread and prolonged cooling of land areas. There would be severe repercussions for plant life generally and for agriculture in paricular, disrupting the production of food to sustain survivors of the war. A nuclear war cannot be won and must never be fought. In the aftermath, there would be no difference between the so called victor and vanquished. Biological warfare could release new agents of disease that would prove difficult to control.

The absence of war is not peace, nor does it necessarily provide the conditions for sustainable development. Competitive arms races~ breed insecurity among nations through spirals of reciprocal fears. Nations need to muster resources to combat environmental degradation and mass poverty. By misdirecting scarce resources, arms races contribute further fo insecurity. So nations must seek security through cooperation, agreements and mutual restraint. Since it is often uncertainty and insecurity that prompt international conflict. It is of utmost importance that governments become aware of imminent environmental stress before the damage actually threatens core national interests.

21.8 Environment and Development Projects

Every development project, especially large infrastructural projects like dams, railways, highways, etc. are bound to have environmental and larger social, economic and cultural implications. The pros and cons of development projects should be weighed against environment. While initiating such project, it should be observed that national objectives of both environment as well as development should be best served.

The development projects like dams, roads and railway lines also cause environmental destruction alongwith the development. Dams cause threat of flood and waterlogging and also disrupt the existing drainage system. Inland fishery projects aimed at immediate profit maximization may upset the ecological balance. In order to build dams large forest areas are to be submerged. For such projects thousands of families are to be displaced and thousands of age old trees are to be felled. In some cases, social, economic and environmental costs are unacceptably high. Certain railway and highway projects cause a great increase in noise and air pollution.

A development at the cost of greenery and ecology cannot be called as sustainable development. Therefore, in order to achieve sustainable development, the construction of such projects should have a pace with environmental requirements. It should be ensured that development projects are correctly sited so as to minimise their adverse environmental consequences. This is the only basis for truly sustainable development.

21.9. Biotechnology : A Way To Sustainable Development

Uncontrolled mechanisation, over exploitation of natural resources, deforestation an~ the extensive use of chemical fertilizers and pesticides in agriculture have brought about many changes in different components of environment. The consumption of pesticides in India increased form 12,048 tonnes in 1965-66 to 80,000 tonnes in 1991, and is expected to reach 100,000 tonnes by the year 2000. Excessive use of pesticides has resulted in multiplication of insects. Over 200 major pests attack crops and some of them have developed resistance to pesticides. Harmless and helpful insects and birds are often killed indiscriminately. The use of herbicides inhibits the activity of microorganisms. The total consumption of nutrients in the form of fertilizers has increased from about 65 thousands tonnes in 1951-52 to 11.4 million tonnes in 1990-91 in India and the consumption is estimated at about 180 million tonnes by the turn of the century. Intensive use of nitrogenous fertilizers has led to increase in the level of nitrates in ground waters. A recent study has associated human cancer with nitrate uptake. Some phosphorous also enters surface water by run off from high concentration areas.

The alarming increase in population has necessitated increased production of agricultural products. As area for cultivation is more or less inelastic this increase has to be achieved by harvesting the maximum from available land resources. Biotechnology offers new techniques for enhancing productivity, profitability and stability of our farming systems as compared to synthetic pesticides and fertilizers. The workhorse of biotechnology are microbes and today they seem to provide many solutions to man-made problems. Biotechnology answers are emerging rapidly not only for detoxifying the environment through bio-remediations but also to enhance our natural resource utilization by bioconversion and application of probiotics. There are four major categories of bio-technological applications involved in solving environmental problemsenvironmental monitoring, bioremediation, eco-protection through safer bio-alterantives and waste minimization (Jayaraman, 1993).

The use of environmentally friendly biopesticides in controlling agricultural pests should be adopted as a step towards sustainable development. -Biopesticides are biological control agents like bacteria, viruses, fungi and insects which work for pest control in plants. These are safer as compared with their toxic chemical counter-parts. They are persistent and give lasting control and they do not accumulate in food chain. Resistance to biological pesticides does not develop very easily.

In the face of concern for environmental pollution and sustainable agriculture, interest in the integrated use of organic manures and organic fertilizers should be renewed. The legume green manuring offers considerable potential as a source of organic matter and nitrogen for crops. Development of biofertilizers as alternatives to the chemical ones is an important area of environment protection and a way to sustainable development. Biofertilizers are the tiny organisms (nitrogen fixing bacteria, algae and fungi) that fix atmospheric nitrogen in plant or soil to supply required nitrogen nutrients for the growth of plants. They improve post harvest fertility of soil and do not leave residual toxicity. So by adopting ecofriendly practices we can contribute our share towards sustainable development.

21.10 Nature Management and Sustainable Development

The suryival and well-being of a nation depends on sustainable development. It is a process of social and economic development, betterment that satisfies the needs and values of all interest groups without foreclosing future options. To this end, we must ensure that demigod on the environment from which we derive our sustenance, does not exceed its carrying capacity for the present as well as future generations.

Over the years, there has been progressive pressure on the environment and the natural resources, the alarming consequences of which are becoming evident in increasing proportions. These consequences detract from the gains of development and are worsening the standard of living of the poor who are directly dependent on natural resources. It is in this context that we need to give a new thrust towards conservation and sustainable development. We can meet the challenges of sustainable development by redirecting the thrust of our developmental process, so that the basic needs of our people are fulfilled by making judicious and sustainable use of our natural resources. Conservation which covers a wide range of concern and activities is the key element of the policy for sustainable development. Development requires the use and modification of natural resources, conservation ensures the sustainability of development for the present and in the future (Khoshoo and Sharma, 1992).

India has more than 17 per cent of land under forest cover and more than 54,000 km2 of wetland under protection. Its living resources include 45,000 species of plants, about 370 mammals, 1200 birds, 60,000 insects, 180 amphibians, 1700 fishes and 400 reptiles. India has more than 75 per cent of 425 families of flowering plants all over the world. It has 421 wildlife sanctuaries and 66 national parks covering 4 per cent of its total area (Punita, 1993). However, over-exploitation of resources has left our biodiversity exposed to various ecological threats.

We should reinforce our traditional ethos and build up a conservation society living in harmony with nature and making frugal and efficient use of resources guided by the best available scientific knowledge in order to ensure sustainable development. We must control future deterioration in land, water and air which constitute our life support systems and should take steps for restoration of ecologically degraded areas and for environmental improvement in our rural and urban settlements. Research, development and adoption of environmentally compatible technology should be encouraged and application of modern tools of science and technology for conservation, bridgening of large gaps in supply and demand as well as control and monitoring of natural resources should be promoted. Sustainable use of forests and other ecosystems should be pioneered that would allow species to survive despite commercial activity.

Moreover, to achieve sustainable development, people need to change their life style and wasteful unsustainable habits. If we want to bequeath future generations the life chances we ourselves enjoy, doing as we please may no longer be an option. The consumption patterns of both rich and poor must change rapidly in order to achieve sustainable development. The pressure on resources which will be needed in future is aggravated by disparity through the wasteful and excessive utilization and destruction of the non-renewable ones by the affiuent and the excessive utilisation and the destruction of renewable ones by the poor.

With less than a quarter of the world's population, industrial countries, consume four-fifth of its natural resources and generate around three quarters of all the waste produced every year. On the other hand, poor women wake up before dawn, walk miles to the over-dwindling forests to cut and bundle wood, and then carry their heavy headloads tens of kilometers to nearby town to get, at best, half-a-meal a day. So in their desperate attempt to survive today, people are forced to forsake their tomorrow and overuse their environment.

Moreover, the energy consumption of the poor is not environment friendly, e.g., the woman who cooks in an earthern pot over an open fire uses perhaps eight times more energy than the affiuent neighbour with a gas stove and aluminium pans. The poor who light their homes with a wick dipped in ajar of kerosene get 1/50th of illumination of a 100 watt electric bulb but use just as much energy. So there is a need for a global strategy to cope with both excessive affiuence and widespread poverty because without greater equity and respect for human rights there can be no real sustainable development.

21.11 People's Participation

The participation of people in programmes for environmental improvement and for integrating the environmental concerns in planning and implementation of development programmes, should be ensured. Environmental consciousness through education and mass awareness programmes,' should be created. The family and its immediate community is the most logical acti~ point for meeting the needs of children and youth for fully developing their energies and talents, and for implementing international, national and local policies to achieve sustainable human development. The village level institutions should be designed to ensure community participation in the management of environmental resources (Desh Bandhu et at., 1990).

Sustainable development is not a task for the Government alone, but each member of the society has his share to contribute in the form of refined and sustainable habits, e.g., to use public transport, to recycle waste, to switch off the light or turn down the AC., etc. A guilty conscience cannot be comforted with the excuse that no individual action can make a worthwhile contribution to solving such vast problems. To achieve sustainable development we will need to change our life style. The long term goal should be to get people to put all their actions through a green Quality filter, just as today they base decisions on financial, health, social and legal considerations, or as the United State based World Watch Institute puts it, "When most people see a large automobile and think first of the air pollution it causes, rather than the social status it conveys, environmental ethics will have achieved."

It has become a tendency on the part of common man to accept dirt and filth as part of daily life that is responsible for our cities remaining dirty. There is just no public awareness or participation, which is essential for sustainable development of cities. What participation can achieve can be seen in the success of Exnora International in Madras. Through a simple garbage collection programme called Civic Exnora , the voluntary organisation covers 20 per cent of the city (Anonymous, 1994a) .. Clearly, if change has to come, it will have to be spearheaded by a massive national citizens movement.

Women have an important role in solving environmental problems. However very few women have been involved in decision making with regard to policies, programmes, or funding for environment despite the international target of 30 per cent of women in leadership positions by 1995, and equal representation by men and women by 2000 (Ress, 1992).

Therefore, to achieve sustainable development great changes must be brought about in thinking of the people. A sustainable society should understand and take actions on the following principles :

- It should recognise that earth has a limited supply of non-renewable resources
- 111 should restrict its options within the limits posed by natural resource supplies by conservation, recycling and using renewable resources
- It should cooperate with nature rather than trying to overcoming it
- It should realise that all actions have hidden effects that must be determined while making cost-benefit analysis
- It should minimise waste and reduce pollution
- It should stress on individual responsibility and actions to achieve a sustainable future

21.12 Sustainable Development : Future Scenario

The future of sustainable development closely linked with environmental science. Rarely has an academic subject become such a major issue in the public consciousness as environment. Within a few years, environmental science has progressed from a rather quite and obscure branch of science to a subject of international importance. Education, business, politics, law, agriculture, engineering, medicine, public health and even international affairs are all affected by the sudden upsurge of ecological and environmental concern. It is absolutely essential for humanity to put environmental considerations first in the management of business, industry and agriculture. It is imperative for the world's peoples to control population growth more effectively before human crowding becomes intolerable. Anything short of major reorientation of life style would, suffice to alert total environmental destruction. It was this global concern for the protection of environment which led to the largest governmental conference to be held on this planet. The Earth Summit, the United Nations Conference on Environment and Development, was held at Rio de Janeiro in Brazil on June 3-14, 1992, which was attended by representatives of 178 countries including 103 Heads of Governments of both developing and developed countries. The conference adopted three historical agreements which would go a long way in ensuring sustained development with minimum disturbance to ecosystem in future (Anonymous, 1992a).

(i) **Agenda 21.** It is the non-binding action plan on global environment and development, and covers more than 100 programme areas ranging from poverty alleviation and strengthening the role of various sectors of civil society to protect the atmosphere, soil, waters and mountains of the planet. Agenda 21 represents the very first global action plan intended to promote sustainable development. It reflects the development priorities of 178 developing and donor countries as no other document has hitherto done. In fact, it is the first attempt to define a framework for action where the interconnected issues of economy, environment, poverty and development are recognized.

(ii) **Framework Convention on Climatic Change.** The ultimate objective of this convention is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and l to enable economic development to proceed in a sustainable manner. Most ofthe Governments present in Rio signed the Climate Convention, the notable exception being Malaysia, who called the convention, "meaningless" because of its lack of binding targets for greenhouse reductions.

(iii) Biodiversity Convention. The objectives of this convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of utilization of genetic resources. This convention is more favourable to the' aspirations of the developing countries, particularly the right to compensation for damage done to biological diversity and sharing the benefits of biotechnology developed from the genetic material. These points made the United States shy away from signing the treaty, but 153 other countries including all other developed nations signed. The treaty has come into force with effect from December 30, 1993.

The Earth Summit negotiators agreed on the need for a U.N. Commission on Sustainable Development. The Commission is expected to be a high-level entity with a range of independent powers, along the lines of the U.N. Commission on Human Rights. The Commission would serve as a world watchdog to ensure that countries were keeping the promises made at the Earth Summit, particularly those laid out in Agenda 21, the Conference's blueprint for action to mesh the needs for global economic development with protection of the environment. The 47th U.N. General Assembly has formally established the Commission.

Agenda 21 and Conventions on Biodiversity and Climatic Change are considered as passport to a better common future for mankind. However, the following five areas need priority attention if we are to achieve the goals which prompted the convening of Earth Summit (Swaminathan, 1992) :

(i) Population. Population containment and achieving a balance between human population and natural resource endowments are absolutely essential for sustainable advances in quality of life. Education and economic opportunities for women, reduction in infant mortality and care for the girl child should receive top priority to achieve success in family planning programmes.

(ii) Poverty. About 82.7 per cent of the global income goes to about 20 per cent of the world population and only 1.4 per cent of the global income goes to the poorest billion. A high proportion of the income of the poor is spent on the purchase of food. Concurrent attention needs to be paid to food production, distribution and income generation to achieve nutrition security. For converting the goal of food for all into reality, a policy on jobs for all is extremely essential. In India, about 100 million new jobs will have to be created till 2000 AD, if we are to ensure every citizen access to food. There is a need for economic entitlements to be linked with ecological obligations at every level.

(iii) **Pollution.** Containment and elimination of all forms of air, water and soil pollution need urgent attention, if sustainable food security is to be achieved. Environmental sanitation requires much higher priority from the citizen as well as the Government.

(iv) **Protection of life-support system.** Protection ofland, water, fauna, flora and atmosphere must become the joint responsibility of the people and the Government. Involvement of local people in the management of natural resources is essential for promoting sustainable advances in food production.

(v) **Public policy and action.** The greening of public policy is essential for both food security and poverty alleviation. It must be ensured that technology, training and trade become environment-friendly.

21.13 Sum up

The unsustainable lifestyles of over a billion people and the unacceptable levels of poverty experienced by another billion are the root causes of the major environmental problems of today. In case, these two issues are attended with due urgency and seriousness, the Road from Rio will lead us to a better common future. Development which is not equitable will not be sustainable and there can be no better future for mankind unless there is a little better common present (Swaminathan, 1992).

Development must not come at the expense of future generations or threaten other species' survival. We have, in fact, leased the earth from our descendants and must, therefore, administer and look after it with great care. Our environment is something we inherit and something which every generation owes to the coming ones. Einstein once said that two things are unlimited-one is the universe and other is man's foolishness. We can only hope that the latter does not lead him to go on blindly polluting his environment untill he falls victim to his own folly. "If everyone does as he pleases in the short run, we are all loosers in the long run" says Gro Martem Brundtland.

Therefore, we shall have to adopt a way of living which recognises that earth has a limited supply of resources, that humans are a part of nature, and that they are not superior to it. In the words of Mahatma Gandhi, "Earth provides enough to satisfy every man's need, but not any man's greed." So to fulfill our responsibility to our children to ensure that they have the same chance to enjoy themselves as we have had, there is a need to present the challenge of sustainable development to people as an opportunity to be taken and not a threat to be avoided.

"We who are adults must ask ourselves
what is the use of anything we do, if
it does not help children? Let us
commit ourselves. We owe this to every child"

Mother Teresa

-000-

Structure

22.1 Objectives

The main objective of this Lesson is to equip you with

- Women and Environment
- Women and Development

22.2 Introduction

In the recent past, the rapid development activities seem to have lost touch with our ancient tradition and wisdom in protecting the natural ecological balance. The ecological imbalance caused by the developmental activities by utilising the locally available natural resources, forestry, agricuttural and industrial technology based on outdated models. The pressure of Population and growing demand for resources and the poverty which depend directly on natural resources for their suruiral, has also taken a heavy toll of the environment. The development of third world societies has had particularly negative effects on the situation of poorer women, both in rural and urban contents. As household become poorer and employment more difficult, women are often the more vulnerable.

The UN Decade for women was based on the assumption that the improvement of women's economic position would automatically flow from an expansion and diffusion of the development process. Yet, by the end of the Decade, it was becoming clear that development itself was the problem. Insufficient and inadequate 'Participation' in 'development' was not the cause for women's increasing underdevelopment. It was rather their enforced but asymmetric participation in it, by which they bare the costs but were excluded from the benefits that was responsible. The displacement of women from productive activity by the expansion of development was rooted largely in the manner in which development projects appropriated to destroyed the natural resource base for the production of sustenance and survival. It destroyed women's productivity both by removing land, water and forests from their management and contral, as well as through the ecological destruction of soil, water and vegetation systems so that nature's productivity and renewability were impaired. While gender subordination and patriarchy are the oldest of oppressions they have taken on new and more violent forms through the project of development the reductionist mind superimposes the roles and forms of power of western male oriented concepts on women, all non–western peoples and even on nature rendering all three 'deficient', and in need of 'development'. Diversity, and unity and harmony in diversity, become epistemologically unattainable in the context of maldevelopment (increasing sexist domination) and nature's depletion (deepening ecological crises) commodities have grown, but nature had shrunk. The poverty crisis of the south arises from the grow my scarcity of water, food, fodder and fuel, associated with increasing maldevelopment and ecological destruction. This poverty crisis touches women most severely first because they are the poorest among the poor and then because with nature they are the primary sustainers of society.

22.3 Women and Environment

It is difficult to define quite where 'environment' begins or ends for women in developing countries. As childbearers, family caretakers and consumers; as food–products, fuel and water gatherers and users; as field, forest, factory and office workers, women are primary managers, and often preservers of natural resources. As activists and leaders women are involved in campaigns to promote environmental awareness and Protection.

Women’s work is generally undervalued

Women’s work is generally undervalues. As a result, women constitute a disproportionate number of the poorest groups of people and are victims of hunger, illiteracy, poor health, scarce social and technical services, inadequate population policies, and other consequences of poverty. In addition women’s participation and influence is inadequately represented in decision–making spheres concerning environment and development issues affecting the quality of their lives.

Poverty requires women to exploit natural resources

Because of their daily tasks in the care of the family and community, women in developing countries effect and are affected by their environment. Poverty requires women to exploit natural resources in their daily tasks, rather than conserving them. Similarly, environmental degradation restricts the ability of women to overcome poverty.

Women Play Multiple Roles

Women play multiple roles in the family, the community and the economy women may produce food and income. There are natural linkages between the daily tasks involved in carrying out these roles and the natural and human resource environments. They are the main producers of food for domestic consumption. They are the main drawers and carriers of water. They produce almost all the fuel–wood for domestic use. In urban areas, shelter, sanitation, potable water, and a host of other social services are critical activities for women.

Women and men differ in their perceptions of their environment and its appropriate or potential use :

For example, women may perceive a local forest as a source of food, fuel and medicine for household use while men may perceive the value of the local forest as the sale of the cut trees in the market. Additionally because women are often dependent on free goods such as water, fuel wood and fodder, they have a special interest in environmental protection and rehabilation. The environmental knowledge acquired by many women is both useful and detailed. Close daily contact makes women, more than men, familiar with properties and uses of the natural environment e.g. disease and draigh resistant crops and tree varieties, efficient fuel wood, and medicinal plants. A survey in Sierra Leone revealed that women could identity 31 different forest products while men were only able to identify. Women thus represent a valuable information source on the local environment.

Women are not only resource managers. They are also the victims of environmental mismanagement and contribute to environmental degradation. Where the resource base is declining or degraded, it is women who must search further and longer for fuel and water. It is women who are easily marginalized into unproductive lands. Increased time and labour burdens are often manifested by stress, ill health and malnutrition. Environmental protection and repair projects with specific social objectives often fail to recogine the deferring needs of women and men; consequently, projects are planned with unequal benefits accruing to both. While it is evident that women in developing countries are often the victims and agents of environmental degradation, it is important to balance this view with the recognition that women and central to resource management and are participating in, and leading, ecology movements in many countries. One example of women's grass roots environment activity is the Chipko movement in India. This movement began as a response to the deforestation of the natural forest with the reforestation by a single commercial species, eucalyptus. Indigenous forests provided food, fuel, fodder, household utensils, dyes, inedicines, and income generating products. Replacement by a single-spaces had drastically affected rural women's ability to maintain a subsistence household. As well as women's grass roots activities, there are some examples of donor–sponsored resource projects which have been enhanced by women's participation in the planning design and implementation e.g. the Andhra Pradesh Social Forestry Project in India, indicates that initiatives to address women's needs and aspirations have accrued direct benefits to women and their communities and enhanced overall project success. The process of women's participation, both as agents and beneficiaries, brings many benefits. Such benefits include raising the status and self–esteem of women Economic gains may accrue from new income earnings opportunities like small–scale local enterprises (Soil, fuel and water conservation, seed selection waste recycling, local exchanges of indigenous knowledge). Material benefits extend to the well-being of the family and community such as increased food security, child nutrition, health and education. Women's participation in resource decision making contributes directly to the protection and rehabilation of the environment.

Women and Natural Resources : Biomass plays a crucial role in meeting daily survival needs in the vast majority of the rural household in the country : food, fish, fuel (fire wood, crop wastes and cowding, organic manure, green mukh and forest litter), building materials (timber and thatch) and medicines (herbs), are all different forms of biomass. Unfortunately industrialisation and urbanisation and the advance of the cash economy have greatly affected the country's biomass base. The destruction of biomass with deforestation and devegetation and its transformation away from rural and household needs and towards urban and industrial needs is having a major impact on the lives of all those who live with in the non-monetised biomass-based subsistence economy. But women not only with in these cultures but in all rural cultures, face the maximum threat.

With the growing awareness of energy and environment. Problems several efforts have been made in recent years by the govt. to promote new technologies like biogas plants, fuelwood, plantations, fuel conserving smokeless chulhas, handpumps etc. These can reduce the regours of rural living, improve health and meet fundamental household needs.

Drinking water : Water carrying is another extremely strenuous activity undertaken by women and it consumes an enormous amount of their time. Available information indicates that women spend long hours and traverse long distances, especially in the hill areas in the arid and semi-arid part of the country. In villages of Karnataka, a study shows this can be from one to 1.4 hours per household a day, whereas in villages of eastern Uttar Pradesh it can be as much as one to 3.9 hours a day on an average. Vina Mazumdar, Director of the Centre for Women's Development Studies in New Delhi, points out : "Irrigation gets high priority in most plans for rural development, but the supply of water for drinking and washing receives scant attention." Very few attempts have been made even to combine irrigation and domestic water supply schemes. Lack of clean drinking water most affects the health of children. But among adults, women are more exposed to hazards of polluted water than men.

Women and Male Migration : Male migration, a common phenomenon in large parts of rural India, is an important factor affecting the work burden of women. A number of factors have led increased migration in search of job opportunities : population growth, increased pressure on land, and a technological transformation in agriculture itself that has promoted landlessness. Migration of agricultural labour from Bihar and eastern Uttar Pradesh to Punjab now takes place on an extensive scale. Similarly in fishing villages in Kanyakumari district men have begun to migrate more and more. The destruction of forests and grazing lands has put extreme pressure on tribal and nomodic people, forcing them into landlessness and migrating in search of jobs. Andrea Menetee Singh of ILO points out that life of women left behind in the village can be hard. "If oral tradition is any indication folk songs, for instance, the emotional price the woman pay for their husbands' emigration is very high,' says Singh. Divorce rates are high among emigrant which means that the proportion of women deserted after emigration may be fairly high. Surveys in Bombay slums have also shown that men who have migrated without their families have a high incidence of venereal disease, which probably means that they are transmitting these diseases to their wives on home visits.

Household Fuel : Collecting fuel is an important daily chore for most rural women. In Pura, to gather 1.74 tonnes of firewood every year, each firewood gathering household spends an average of 2.51 hours daily, makes 172 trips in a year and each round trip is about 8.54 km. Madhura Swaminathan, in a study of an Himalayan village wing in Chamoli district, Uttar Pradesh, points out that one or more members of each household daily walk 5km uphill and spend six to 10 hours on the job. The average daily time spent by each household is 7.2 hours. In 75 percent of the households, only women go out to collect wood.

Generally three trips are made every four days though many women go daily.

Swaminathan comments on the life of women in these village : "Leaving their homes at dawn after nearly an eight–hour day, they return to the village with their load of wood What is the normal working day all over the world is just the first of the day's tasks for these women. On returning home, the women go about their household work which includes rearing of cattle. And finally they put in a few hours of work on the land." In both the villages, three meals are cooked every day. Because of heavy male migration from the area, women are also being forced to pur more and more time into agriculture.

Head loaders :– It is usual sight these days to see hundreds of weary women with heavy bundles of wood by their side at the Ranchi railway station early in the morning. For these women, mostly tribals, this is just a part of a gruelling two day cycle of work. Increasing numbers of tribals and other poor are taking to unauthorised cutting and selling of fire-wood. It is an important source of income for poor people. The Xavier Institute of Social Studies has published a striking report on headholders in Ranchi by T. Bhadur and V. Swin. A study of 170 household spread across nine villages, it shows that headloading has emerged as an important profession only over the last 15 to 18 yrs.

A Two Day Cycle :– The Ranchi firewood sellers, mainly tribal women, usually begin their day at 2 A. M. because they must complete household chores before setting out on the 8km to 10km walk to the surrounding forests to coaled wood. Seven or eight years ago, the forests were just a kilometre or two away. The wood is sold in the nearest town : Ranchi. To reach the market early, the women must leave their villages the previous evening by train or bus and spend the night at the railway station. Each women can carry at best a 20kg headload, which sells for Rs. 5.50 to Rs. 6.50. Work begins again as soon as they return. It is possible that at least 2 million to 3 million people are headloading today, making headloading India's biggest source of employment in the energy sector. Studies show that large numbers of headloaders are women. Collecting firewood is hazardous for headloaders and often means negotiating rough terrain. Besides, these poor people are provided with no medical facilities and any illness is a liability for them. In most headloading areas women are malnourished. Headloader's children are often neglected. They are often uncured for even during illness. In conditions of acute poverty, headloading is often the only occupation available. In Palamau district of Bihar, for instance, where the incidence of bonded labour is very high, bonded labourers often take to headloading because this is the only activity that can earn them some cash : Rehabilitated bonded labourers have also taken to headloading. To deter headloaders, a toll system has been introduced in some states. The Girnar forests are surrounded by several tools stations; headloaders have to pay a toll of 10 paise for every headload. Madhya Pradesh forest officials considering Sagreiyis suggestion that forest departments cut wood themselves and auction it to headloaders. Forest officials argue that they cut trees in a scientific manner in accordance with silvicultural rules, but experience shows that corruption often prevents this from happening.

Some Solutions :– The worst thing about headloading is that there is no real policy. Various solutions have been suggested which are listed below :

1. Cooperatives of tribals and forest department would be set up to lesson the mistrust.
2. Headloaders could be provided with alternative employment. Women could make handicrafts and their products could be bought by Forest Department and in turn be given wood at subsidized rates.
3. Headloaders could undertake tree Plantations themselves

22.4 Woman and Development :– There was a growing awareness of the widespread discrimination of women, which was being given a forceful voice in the women's movement. At Mexico in 1975, it was concluded at the International Women's Year Conference that :

(a) in no country were women being equally integrated into either the economy or the decision making apparatus.

(b) that development efforts had tended to favour men at the expense of women.

A further concern expressed that modernization programmes and development had actually worsened the position of women :

(a) It had displaced women from traditional roles, and thereby from their traditional sources of power and status.

(b) It had widened the gap between men's and women's incomes.

(c) The combined effect of development had in fact resulted in increased dependence of women.

'Social' aspects of developments :

1. New institutions that would be more responsive to women's needs were seen as necessary. Women had to be included in the development process as both participants and beneficiaries.

   Thus, the mushrooming of women's Bureaux and Directorates in many Third World Countries.

2. Women's economic participation and contribution were invisible.

3. In many countries, the introduction of technologies had contributed to a undersized male sector, whereas women were left in a labour intensive 'backward' sector.

It all pointed to one direction. Women had to be integrated into the development process. Assumption that more enlightened planning will remove the obstacles to women's participation. The attempts to integration that followed

(a) were conditioned by men's acceptance of women's participation in an institutional structure already controlled by males.

(b) aimed at providing women with access to skills and materials resources already provided in principle to men in order to increase their cash earnings. Assumption that benefits of development can be redistributed through participation in the market.

(c) Since much of women's labour was already allocated to unpaid household production attention focussed on subsidiary activities or additional activities.

Relation between the two areas of women's contribution to economy was examined only in terms of a complementary SDOL rather than dependency.

The two main goals of 'integration of women in development' can be seen as:

(a) to increase the welfare of women;

(b) to harners hitherto unutilized labour power and human resources for national development.

This view translated into essentially three types of strategies :–

1. Welfare oriented strategies,
2. Equity oriented strategies,
3. Anti Poverty strategies.

The introduction of schemes compatible to women's child rearing and household responsibilities were important Home based income generating opportunities were another aspect of this approach.

22.5 Sum up

Thus direct programmes to enhance the productivity of female labour and direct participation of women in the market are seen as remedial measures. The provision of direct inputs to facilitate women's entry into the market, such as credit on educational opportunities, to make them better able to compete with men in the job market have been main features. Vocational training programmes to provide women with marketable skills became a major trend in development schemes.

-000-