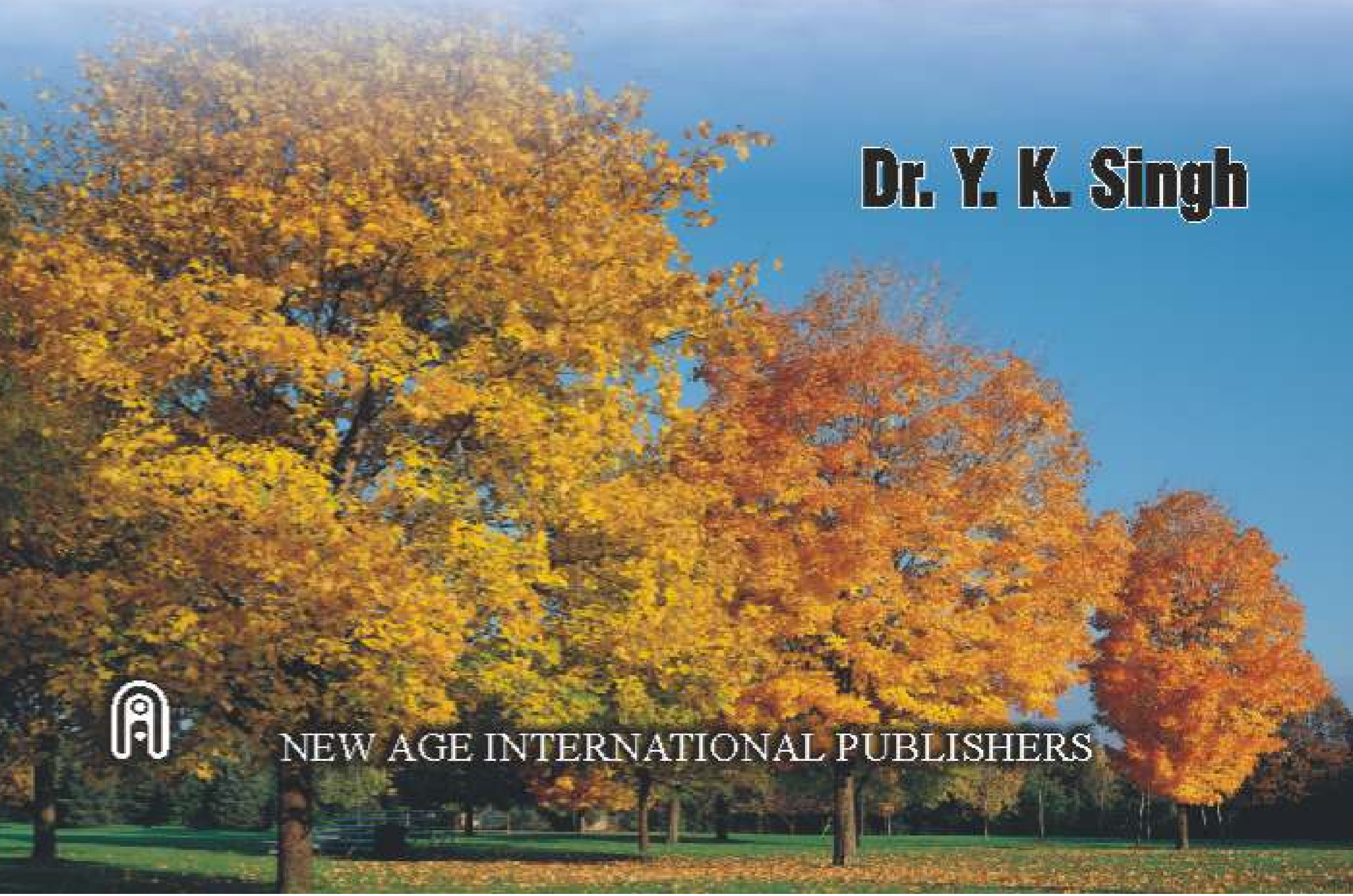
NEW AGE

ENVIRONMENTAL SCIENCE

Dr. Y. K. Singh



NEW AGE INTERNATIONAL PUBLISHERS

ENVIRONMENTAL SCIENCE

THIS PAGE IS BLANK

ENVIRONMENTAL SCIENCE

Dr. Y. K. Singh
Lecturer
Department of Education
Mahatma Gandhi Chitrakoot Rural University
Chitrakoot (Satna) Madhya Pradesh

PUBLISHING FOR ONE WORLD

NEW AGE INTERNATIONAL (P) LIMITED, PUBLISHERS
New Delhi · Bangalore · Chennai · Cochin · Guwahati · Hyderabad
Jalandhar · Kolkata · Lucknow · Mumbai · Ranchi
Visit us at **www.newagepublishers.com**

Published by New Age International (P) Ltd., Publishers

ISBN (10) : 81-224-2330-2

ISBN (13) : 978-81-224-2330-3

PUBLISHING FOR ONE WORLD

NEW AGE INTERNATIONAL (P) LIMITED, PUBLISHERS
4835/24, Ansari Road, Daryaganj, New Delhi - 110002
Visit us at **www.newagepublishers.com**

PREFACE

Education is a process of development which includes the three major activities, teaching, training and instruction. Teaching is social as well as a professional activity. It is science as well as art. Modern education is not in a sphere but it has a long and large area of study. Now a days most part of the world population is facing different problems related with the nature and they are studying the solutions to save the nature and global problems, but on the second hand we even today do not try to understand our local problems related to the nature. So for the awareness of the problems of nature and pollution the higher education commission has suggested to add the **Environmental Science** in the course of different levels. Environmental Science is also well known as Environmental Studies in the Indian Colleges and Universities. Before that it was the part of the science but now a days it is a very common subject and higher education commission has suggested including it as a general paper in all the courses.

Awareness in the field of environmental sciences is becoming a global talk. People worldwide are realizing its importance as they are able to smell a Polluted tomorrow. Careful handling of todays' environment would only serve as a legacy for tomorrows' generation. Hence, we need to be judicious in exploiting our resources optimally. To ensure a sustainable development we need to know something about how our environment works. Environment can be defined as the set of conditions that surround an organism or the complex of socio cultural condition that affect an individual. Environmental Science is the systematic, scientific study of the environment in combination with living organisms.

Most of the universities have introduced this new content as course of **Environmental Science** or **Environmental Studies/Environmental Science** in B.Ed. Course. The present book has been written by including some content of print and non-print media. Now this book is especially for modified syllabus of B.T.C./B.Ed./ M.Ed. of Indian & Foreign Universities/ Training Institute & Education Colleges Recognized by National Council of Teacher Education, New Delhi.

The author has consulted several books in designing, organizing and preparing the script of this book. I express my sense of gratitude to all sources which have been used directly or indirect1y for the instructional material and the sequence. The credit goes to my well-wisher, who has

P R E F A C E

helped me in this attempt. I warmly acknowledge her assistance extended to me. The practical suggestions for the improvement and modification of instructional material and sequence for the text are most welcomed in this hope that book will prove useful to students and educators.

Dr. Y. K. Singh
AA-39, Suryodaya Vihar
Ansal Colony, Shastri Nagar
Kutti Chopla, Near PVC Mall, Meerut,
Uttar Pradesh, India
E-mail: yksingh1@rediffmail.com

CONTENTS

THIS PAGE IS BLANK

CHAPTER

1 Environmental Science : Definition, Scope and Importance

INTRODUCTION

The science of Environment studies is a multi-disciplinary science because it comprises various branches of studies like chemistry, physics, medical science, life science, agriculture, public health, sanitary engineering etc. It is the science of physical phenomena in the environment. It studies of the sources, reactions, transport, effect and fate of physical a biological species in the air, water and soil and the effect of from human activity upon these.

Environment Explained

Literary environment means the surrounding external conditions influencing development or growth of people, animal or plants; living or working conditions etc. This involves three questions:

1. What is Surrounded

The answer to this question is living objects in general and man in particular.

2. By what Surrounded

The physical attributes are the answer to this question, which become environment. In fact, the concern of all education is the environment of man. However, man cannot exist or be understood in isolation from the other forms of life and from plant life. Hence, environment refers to the sum total of condition, which surround point in space and time. The scope of the term Environment has been changing and widening by the passage of time. In the primitive age, the environment consisted of only physical aspects of the planted earth' land, air and water as biological communities. As the time passed on man extended his environment through his social, economic and political functions.

3. Where Surrounded

The answer to this question. It is in nature that physical component of the plant earth, viz land, air, water etc., support and affect life in the biosphere. According to a Goudie environment is the representative of physical components of the earth where in man is an important factor affecting the environment.

(*i*) **Definitions of Environment :** Some important definitions of environment are as under:

1. **Boring:** 'A person's environment consists of the sum total of the stimulation which he receives from his conception until his death.'

   It can be concluded from the above definition that Environment comprises various types of forces such as physical, intellectual, economic, political, cultural, social, moral and emotional. Environment is the sum total of all the external forces, influences and conditions, which affect the life, nature, behaviour and the growth, development and maturation of living organisms.

2. **Douglas and Holland:** 'The term environment is used to describe, in the aggregate, all the external forces, influences and conditions, which affect the life, nature, behaviour and the growth, development and maturity of living organisms.'

(*ii*) **Scope of Environment:** The environment consists of four segments as under:

1. **Atmosphere:** The atmosphere implies the protective blanket of gases, surrounding the earth:

(*a*) It sustains life on the earth.

(*b*) It saves it from the hostile environment of outer space.

(*c*) It absorbs most of the cosmic rays from outer space and a major portion of the electromagnetic radiation from the sun.

(*d*) It transmits only here ultraviolet, visible, near infrared radiation (300 to 2500 nm) and radio waves. (0.14 to 40 m) while filtering out tissue-damaging ultra-violate waves below about 300 nm.

The atmosphere is composed of nitrogen and oxygen. Besides, argon, carbon dioxide, and trace gases.

2. **Hydrosphere:** The Hydrosphere comprises all types of water resources oceans, seas, lakes, rivers, streams, reserviour, polar icecaps, glaciers, and ground water.

(*i*) Nature 97% of the earth's water supply is in the oceans,

(*ii*) About 2% of the water resources is locked in the polar icecaps and glaciers.

(*iii*) Only about 1% is available as fresh surface water-rivers, lakes streams, and ground water fit to be used for human consumption and other uses.

3. **Lithosphere:** Lithosphere is the outer mantle of the solid earth. It consists of minerals occurring in the earth's crusts and the soil *e.g.* minerals, organic matter, air and water.

4. **Biosphere:** Biosphere indicates the realm of living organisms and their interactions with environment, viz atmosphere, hydrosphere and lithosphere.

Element of Environment

Environment is constituted by the interacting systems of physical, biological and cultural elements inter-related in various ways, individually as well as collectively. These elements may be explained as under:

(1) Physical elements

Physical elements are as space, landforms, water bodies, climate soils, rocks and minerals. They determine the variable character of the human habitat, its opportunities as well as limitations.

(2) Biological elements

Biological elements such as plants, animals, microorganisms and men constitute the biosphere.

(3) Cultural elements

Cultural elements such as economic, social and political elements are essentially man-made features, which make cultural milieu.

ENVIRONMENT STUDIES: IMPORTANCE

Importance of Environment Studies: The environment studies enlighten us, about the importance of protection and conservation of our indiscriminate release of pollution into the environment.

At present a great number of environment issues, have grown in size and complexity day by day, threatening the survival of mankind on earth. We study about these issues besides and effective suggestions in the Environment Studies. Environment studies have become significant for the following reasons:

1. Environment Issues Being of International Importance

It has been well recognised that environment issues like global warming and ozone depletion, acid rain, marine pollution and biodiversity are not merely national issues but are global issues and hence must be tackled with international efforts and cooperation.

2. Problems Cropped in The Wake of Development

Development, in its wake gave birth to Urbanization, Industrial Growth, Transportation Systems, Agriculture and Housing etc. However, it has become phased out in the developed world. The North, to cleanse their own environment has, fact fully, managed to move 'dirty' factories of South. When the West developed, it did so perhaps in ignorance of the environmental impact of its activities. Evidently such a path is neither practicable nor desirable, even if developing world follows that.

3. Explosively Increase in Pollution

World census reflects that one in every seven persons in this planted lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land. Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.

4. Need for An Alternative Solution

It is essential, specially for developing countries to find alternative paths to an alternative goal. We need a goal as under:

(1) A goal, which ultimately is the true goal of development an environmentally sound and sustainable development.

(2) A goal common to all citizens of our earth.

(3) A goal distant from the developing world in the manner it is from the over-consuming wasteful societies of the "developed" world.

5. Need To Save Humanity From Extinction

It is incumbent upon us to save the humanity from exinction. Consequent to our activities constricting the environment and depleting the biosphere, in the name of development.

6. Need For Wise Planning of Development

Our survival and sustenance depend. Resources withdraw, processing and use of the product have all to by synchronised with the ecological cycles in any plan of development our actions should be planned ecologically for the sustenance of the environment and development.

7. Misra's Report

Misra (1991) recognized four basic principles of ecology, as under:

(*i*) Holism

(*ii*) Ecosystem

(*iii*) Succession

(*iv*) Conversation.

Holism has been considered as the real base of ecology. In hierarchical levels at which interacting units of ecology are discussed, are as under:

Individual<population<community<ecosystem<biome<biosphere.

Misra (1991) has recognised four basic requirements of environmental management as under:

(*i*) Impact of human activities on the environment,

(*ii*) Value system,

(*iii*) Plan and design for sustainable development,

(*iv*) Environment education.

Keeping in view the of goal of planning for environmentally sustainable development India contributed to the United Nations Conference on Environment and Development (UNCED), also referred to as "Earth Summit" held at Rio de Janciro, the Capital of Brazil, 3rd-14th June, 1992.

NEED FOR PUBLIC AWARENESS

It is essential to make the public aware of the formidable consequences of the Environmental Degradation, if not retorted and reformative measures undertaken, would result in the extinction of life. We are facing various environmental challenges. It is essential to get the country acquainted with these challenges so that their acts may be eco-friendly. Some of these challenges are as under:

1. Growing Population

A population of over thousands of millions is growing at 2.11 per cent every year. Over 17 million people are added each year. It puts considerable pressure on its natural resources and reduces the gains of development. Hence, the greatest challenge before us is to limit the population growth. Although population control does automatically lead to development, yet the development leads to a decrease in population growth rates. For this development of the women is essential.

2. Poverty

India has often been described a rich land with poor people. The poverty and environmental degradation have a nexus between them. The vast majority of our people are directly dependent on the nature resources of the country for their basic needs of food, fuel shelter and fodder. About 40% of our people are still below the poverty line. Environment degradation has adversely affected the poor who depend upon the resources of their immediate surroundings. Thus, the challenge of poverty and the challenge environment degradation are two facets of the same challenge. The population growth is essentially a function of poverty. Because, to the very poor, every child is an earner and helper and global concerns have little relevance for him.

3. Agricultural Growth

The people must be acquainted with the methods to sustain and increase agricultural growth with damaging the environment. High yielding varities have caused soil salinity and damage to physical structure of soil.

4. Need to Ground water

It is essential of rationalizing the use of groundwater. Factors like community wastes, industrial effluents and chemical fertilizers and pesticides have polluted our surface water and affected quality of the groundwater. It is essential to restore the water quality of our rivers and other water bodies as lakes is an important challenge. It so finding our suitable strategies for consecration of water, provision of safe drinking water and keeping water bodies clean which are difficult challenges is essential.

5. Development And Forests

Forests serve catchments for the rivers. With increasing demand of water, plan to harness the mighty river through large irrigation projects were made. Certainly, these would submerge forests; displace local people, damage flora and fauna. As such, the dams on the river Narmada, Bhagirathi and elsewhere have become areas of political and scientific debate.

Forests in India have been shrinking for several centuries owing to pressures of agriculture and other uses. Vast areas that were once green, stand today as wastelands. These areas are to be brought back under vegetative cover. The tribal communities inhabiting forests respects the trees and birds and animal that gives them sustenance. We must recognise the role of these people in restoring and conserving forests. The modern knowledge and skills of the forest deptt. should be integrated with the traditional knowledge and experience of the local communities. The strategies for the joint management of forests should be evolved in a well planned way.

6. Degradation of Land

At present out of the total 329 mha of land, only 266 mha possess any potential for production. Of this, 143 mha is agricultural land nearly and 85 suffers from varying degrees of soil degradation. Of the remaining 123 mha, 40 are completely unproductive. The remaining 83 mha is classified as forest land, of which over half is denuded to various degrees. Nearly 406 million head of livestock have to be supported on 13 mha, or less than 4 per cent of the land classified as pasture land, most of which is overgrazed. Thus, our of 226 mha, about 175 mha or 66 per cent is degraded to varying degrees. Water and wind erosion causes further degradation of almost 150 mha This degradation is to be avoided.

7. Reorientation of Institutions

The people should be roused to orient institutions, attitudes and infrastructures, to suit conditions and needs today. The change has to be brought in keeping in view India's traditions for resources use managements and education etc. Change should be brought in education, in attitudes, in administrative procedures and in institutions. Because it affects way people view technology resources and development.

8. Reduction of Genetic Diversity

Proper measures to conserve genetic diversity need to be taken. At present most wild genetic stocks have been disappearing from nature. Wilding including the Asiatic Lion are facing problem of loss of genetic diversity. The protected areas network like sanctuaries, national parks, biosphere reserves are isolating populations. So, they are decreasing changes of one group breeding with another. Remedial steps are to be taken to check decreasing genetic diversity.

9. Evil Consequences of Urbanisation

Nearly 27 per cent Indians live in urban areas. Urbanisation and industrialisation has given birth to a great number of environmental problem that need urgent attention. Over 30 percent of urban Indians live in slums. Out of India's 3,245 towns and cities, only 21 have partial or full sewerage and treatment facilities. Hence, coping with rapid urbanization is a major challenge.

10. Air and water Population

Majority of our industrial plants are using outdated and population technologies and makeshift facilities devoid of any provision of treating their wastes. A great number of cities and industrial areas that have been identified as the worst in terms of air and water pollution. Acts are enforced in the country, but their implement is not so easy. The reason is their implementation needs great resources, technical expertise, political and social will. Again the people are to be made aware of these rules. Their support is indispensable to implement these rules.

VARIOUS TYPES OF ENVIRONMENT

According to Kurt Lewin, environment is of three types which influence the personality of an individual as under:

(*a*) Physical Environment,

(*b*) Social and Cultural Environment, and

(*c*) Psychological Environment.

These may be explained as under:

1. Physical Environment

Physical environment, refers to geographical climate and weather or physical conditions wherein and individual lives. The human races are greatly influenced by the climate. Some examples are as under:

(*a*) In the cold countries i.e. European countries the people are of white colour. Likewise, in Asian and African countries, that is, in hot countries people are of dark complexion.

(*b*) The physique of an individual depends on climate conditions as the individual tries to adjust in his physical environment.

(*d*) The human working efficiency also depends on the climatic conditions.

2. Social Environment

Social Environment includes an individual's social, economic and political condition wherein he lives. The moral, cultural and emotional forces influence the life and nature of individual behaviour. Society may be classified into two categories as under:

(*i*) An open society is very conductive for the individual developement.

(*ii*) A closed society is not very conductive for the developenment.

3. Psychological Environment

Although physical and social environment are common to the individual in a specific situation. Yet every individual has his own psychological environment, in which he lives. Kurt Lewin has used the term 'life space' for explaining psychological environment. The Psychological environment enables us to understand the personality of an individual. Both-the person and his goal form psychological environment.

If a person is unable to overcome the barriers, he can either get frustrated or completed to change his goal for a new psychological environment. But adopting this mechanism, the individual is helped in his adjustment to the environment.

STRUCTURE OF ENVIRONMENT

Environment is both physical and biological. It includes both living and non-living components.

(i) Physical Environment

The Physical Environment is classified into three broad categories viz.

(*i*) Solid,

(*ii*) Liquid

(*iii*) Gas.

These represent the following spheres:

(*i*) The lithosphere (solid earth)

(*ii*) The hydrosphere (water component) and

(*iii*) The atmosphere

As such, the three basic of physical environment may be termed as under:

(*i*) Lithospheric Environment

(*ii*) Hydrospheric Environment

(*iii*) Atmospheric Environment

The scientists have classified them into smaller units based on different spatial scales, *e.g.*

(*i*) Mountain Environment

(*ii*) Glacier Environment

(*iii*) Plateau Environment

(*iv*) Coastal Environment

(ii) Biological Environment

The biological of the environment consists of:

(*i*) Plants (flora)

(*ii*) Animals (fauna).

Thus, the biotic environment further be divided into floral environment and faunal environment. All the organisms work to form their social groups and organizations at several levels. Thus, the social environment is formed. In this social environment the organisms work to derive matter from the physical environment for their sustenance and development. This process gives birth to economic environment. Man claims to be most skilled and civilized of all the organisms. This is the reason why his social organisation is most systematic. The three aspects of man, *e.g.* physical, social and economic, function in the biotic environment as under:

(i) The Physical Man

The 'Physical Man' is one of the organisms populations or biological community. He is in need of basic elements of the physical environment like habitat (space), air, water and food. Besides, like other biological populations, he releases wastes into the ecosystem.

(ii) The Social Man

The 'Social Man' performs the following functions:

(*a*) Establishing social institutions,

(*b*) Forming social organisations,

(*c*) Formulating laws, principles and policies,

(*d*) Taking steps to safeguard his existence, interest and social welfare.

(iii) The Economic Man

The economic man derives and utilises resources from the physical and biotic environment with his skills and technologies. The economic function makes the man an environment/ geomorphic process as he transports matter and energy from one component of the ecosystem to the other. There may be any following two situations:

(*a*) His exploitative functions may be in harmony with the natural environment. Such, functions do not necessarily involve change in the working of the ecosystem.

(*b*) These functions may exceed the critical limit. Consequently, the equilibrium of the environment/ecosystem is disturbed and a great number of environment and ecological problems crop up. These are determental to man him besides to whole population of human species in a given ecosystem.

QUESTIONS

1. What is Environment? Discuss the scope of Environment.
2. Describe the importance of environment studies.
3. "The need for public awareness about environment is of vital importance." Discuss.
4. Discuss the various types of environment.

Short Answer Type Questions

1. Define environments.
2. Discuss the scope of environment.
3. Write a note on the importance of environment studies.
4. Write a note on the need of public awareness about environment.
5. Write a note on physical environment.
6. Write a note on biological environment.

CHAPTER 2

Environmental Science : Natural Resources

INTRODUCTION

A natural resource may be defined as any material given to us by nature which can be transformed in a way that it becomes more valuable and useful.

For an example wood is used for making furniture. Yarn obtained from cotton is used for weaving cloth. Likewise, various machine, tools and household goods are made of metals. Now furniture, clothes, machine, tools are more valuable than their raw form *i.e.* raw form *i.e.* wood, cotton and metal, respectively. The wood, metal resources. It is impossible to obtain valuable items from any resources. Thus, water, minerals, forests, wildlife as well as human beings are resources. Any material may be called, as a resource provided and appropriate technology is available to transform that into more valuable goods.

Renewable and Non-renewable Resources

On the basis of continuity, the resources are classified as under:

(1) Renewable Resources

(2) Non-renewable Resources.

1. Renewable Resources

Resources, which can be renewed along with their exploitation, are always available for use. Hence they are called renewable resources. For instance, forests are renewable. If trees are felled for wood, original forest covers may be maintained through planning new trees *i.e.* a forestation. Likewise, solar energy and wind energy are examples of renewable resources.

2. Non-renewable Resources

The formation of some resources like iron ore, coal, mineral oil etc. has taken several thousand years. Once they are used in unlimited way, they cannot be easily replaced. Thus, their exploitation at large scale will result in their fast depletion. Some such resources are called non-renewable resources or exhaustible.

3. Cyclic Resources

For resources there is no final use as they can be used continuously. For example, water used in industry and domestic ways can be cleaned and used again for similar or other purpose. Such resources are given the name of Cyclic Resources.

FOREST RESOURCES

1. Importance of Forest Resources

The importance of forest resources can be explained as under:

1. **Ecological Balance:** Forests and wildlife are essential to maintain ecological balance of an area.
2. **Renewable Natural Resources:** Forests are an important renewable natural resources.
3. **Eco-system:** Trees dominate forest ecosystem; their species content varities in different parts of the world.
4. **Economic Development:** Forest contributes to the economic development of the country because they provide goods and services to the people and industry.
5. **Environment Quality:** The forest enchance the quality of environment by influencing the life supporting system.
6. **Safeguard against Pollution:** Forest check air pollution and soil erosion. Thus, they exercise safety and against pollution.
7. **Soil Conservation:** Forest save the hill-slopes from landslides.
8. **Wind Erosion:** In deserts, trees reduce wind erosion by checking wind velocity.
9. **Check the Extension Balance:** The forest checks strong gales and keeps the soil intact beneath the roots of trees and thus checks extension of desert.
10. **Maintains Ecological Balance:** The forest check pollution of air through increasing oxygen content of the air.
11. **Attract Rainfall:** By causing condensation of water vapour in clouds, forests attract rains.
12. **Control Floods:** The floods are controlled because forests dry up rainwater like sponge.
13. **Linked with Cultural and Civilization:** Forests are linked with our cultural and civilization.
14. **Supply of Raw Material:** Forest supply wood, which is used as under:

    (*i*) Fuel,

    (*ii*) Raw material for various industries as pulp, paper, newsprint, board;

    (*iii*) Timber for furniture items;

    (*iv*) To be used in packing articles like fruits, tea etc.

    (*v*) For preparing matches, sport goods *etc.*

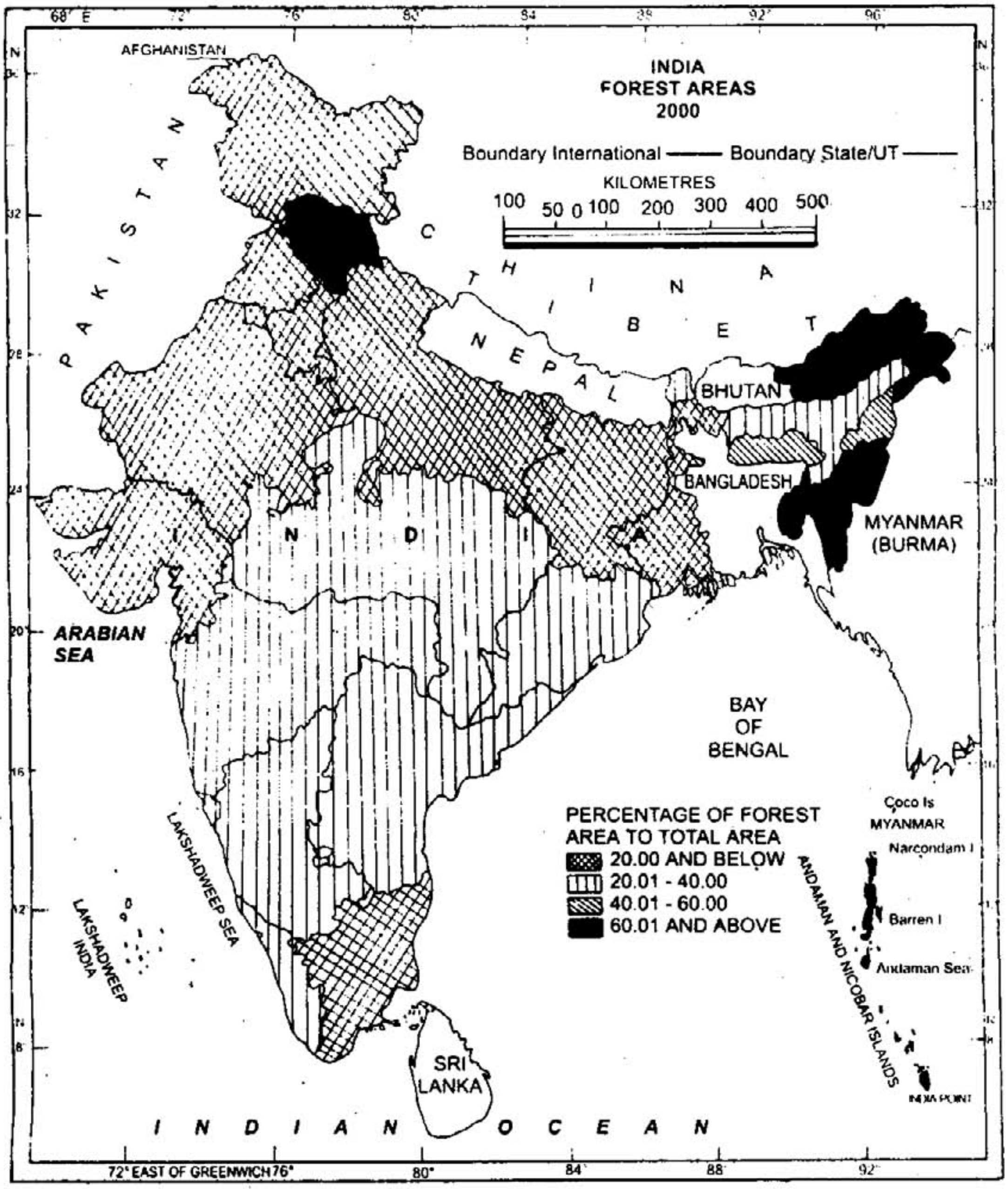


Fig. 2.1 Forest Areas of Different States.

15. **Minor forest products:** Some examples of minor forest products, are canes, gums, resins, dyes, flocks, medicines, tannins, lac, fibres, katha etc.
    1. For tribal people are provided with food like tuber, roots, leaves, fruits, meat from birds and other animals etc.
16. **Employment opportunities:** About eight crore people are employed in wood based industries like paper and match and small and cottage industries. Besides, those who are employed in the forest department in various states.
17. **Revenue Receipts:** The forest provide Rs. 400 crores per year as revenue to the government.
18. **Fodder for Cattle:** Forest provide fodder to cattle.
19. **Foreign Exchange Earners:** Forest produce a great number of articles like essential oils, resins and dyes. Which find market in foreign countries. Nearly Rs. 50 crores are earned in foreign exchange through selling lac, terpentine oil and sandal wood oil to abroad.

Thus, the forests are nation's wealth. They are useful to us directly and indirectly.

Areas Covered with Forests in India

Forests are a estimated form time to time. Some data collected in the basis of researches made, are as under:

Brewbaker (1984)

According to Brewbaker, to 2890, total forest are of the world in 1990 was nearly 700 Mha. By 1975 it was reduced to 2890 Mha. It was also pointed out that it would be merely 2370 Mha by 200 A.D. Major reduction will be in tropics and subtropics (40.2), shown in Figs. 2.2 and 2.3.

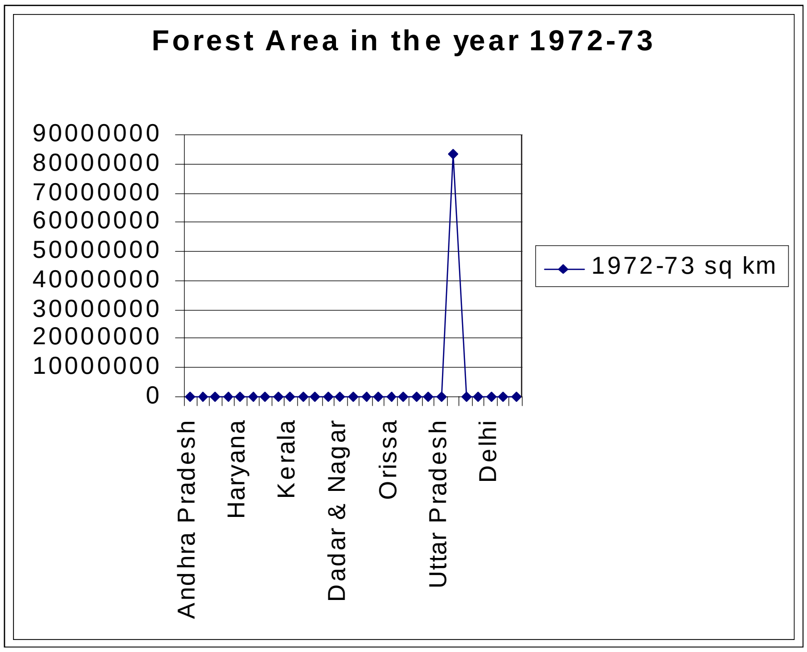


Fig. 2.2

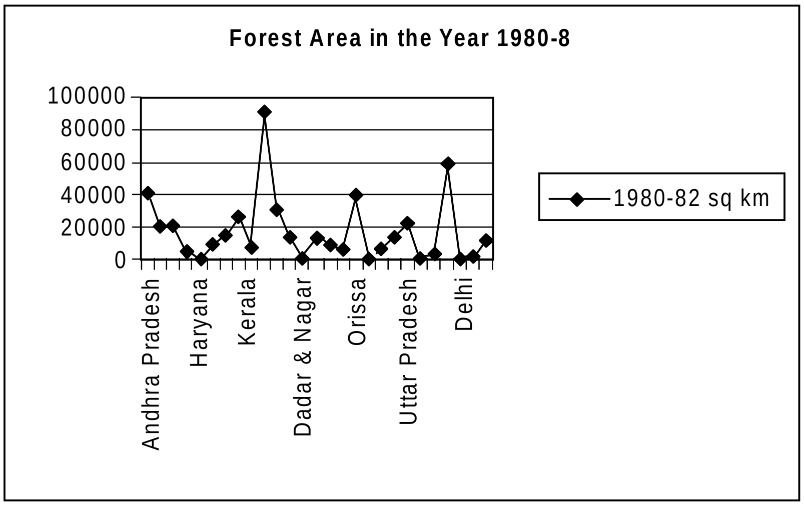


Fig. 2.3

C.F.C. (1980)

According to Central Forestry Commission (CEF) (1980) in India the forest cover was around 74.8 Mha. It was 22.7% of the total land mass. A detailed study of forests carried out by CEF reveals the position of forests in India as under:

(*a*) The tropical dry deciduous (38.7%).

(*b*) The tropical moist deciduous (30.9%) type.

(*c*) The tropical thorn 6.9%

(*d*) The tropical dry evergreen 0.1%

(*e*) The pure coniferous (high mountainous area) 6.3%

(*f*) The sal forest 16%

(*g*) The teak forest 13%

(*h*) The broad-leaved excluding Sal and Teak 55.8%

(*i*) The Bamboos including in plantations 8.8%

Ownership

(*a*) The total forest are nearly 96% (71.63 Mha) forest area is Government owned.

(*b*) 2.6% (1.95 Mha) forest area is owned by corporate bodies.

(*c*) 1.2 Mha forest area is in private owneship.

Total area under forests in different states during 1972-75 and 1980-82 is as under:

	Total Forest Area (Sq. Km)	
State/U.T.	**1972-75**	**1980-82**
Andhra Pradesh	49049	40435
Assam	21055	19796
Bihar	22687	20139
Gujrat	9459	5057
Haryana	757	401
Himachal Pradesh	15075	9130
J & K	22335	14361
Karnataka	29480	25656
Kerala	8611	7376
M.P.	108568	90215
Maharashtra	40682	30350
Manipur	15090	13575
Dadar & Nagar Haveli	177	70
Meghalaya	14390	12458
Nagaland	8154	8095
Tripura	6330	5138
Orissa	48383	39425
Punjab & Chandigarh	1120	499
Rajasthan	11294	5972
Tamil Nadu	16676	13187
U.P.	25869	21022
West Bengal	83476483	
Sikkim	1761	2883
Arunachal Pradesh	51438	58104
Delhi	18	10
Goa, Daman & Diu	1221	1139
Mizoram	13860	11970
Total	**551886**	**457046**

State Percentage of Forests Area

The following is the list of percentage of total area in a state occupied by forests (Fig. 2.4).

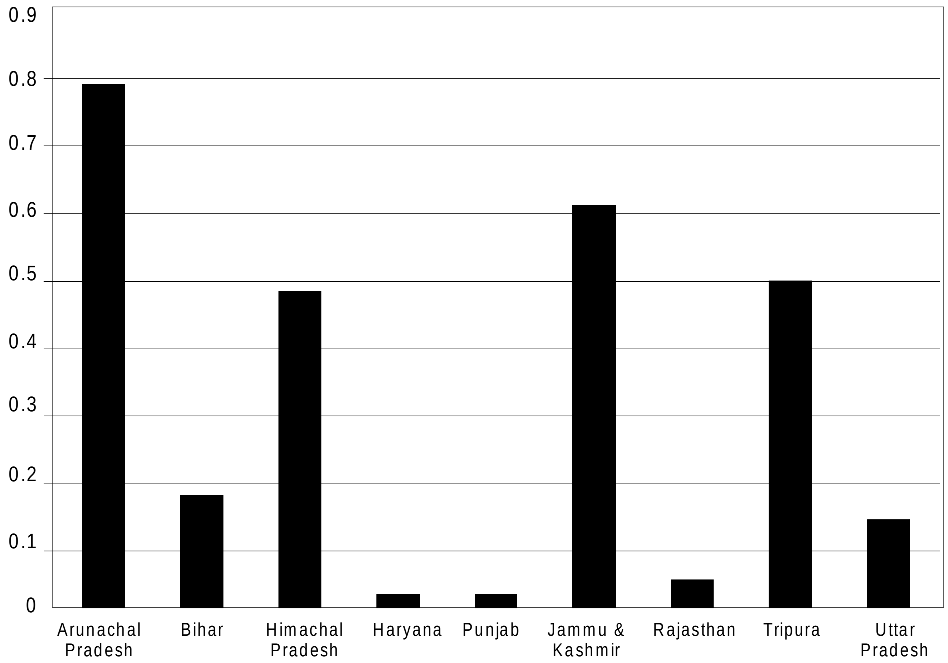


Fig. 2.4 State percentages of forest area

1.	Arunachal Pradesh	79%
2.	Bihar	17%
3.	Himachal Pradesh	48%
4.	Harayana	2%
5.	Punjab	2%
6.	Jammu & Kashmir	61%
7.	Rajasthan	4%
8.	Tripura	50%
9.	Uttar Pradesh	13%

Distribution of Forests

The forest region in India are divided into eight distinct forest regions. These are as under:

(i) The Western Himalayan region

The region extends from Kashmir Kumaon. Here are the forest of pine, confers and broad-leaved temperate trees. Higher up, forests of blue pine spruce and silver fir occur.

(ii) The Eastern Himalayan region

This region comprises Darjeeling, Kureseong and the adjacent tract. The temperate zone has forests of oaks, laurels, rhodendrons, maples, alder and brich.

(iii) The Assam region

This region comprises the Brahamputra and the Surma valleys and the interveing hill ranges. The region has evergreen forests, occasional thick clumps of bamboos and tall grasses.

(iv) The Ganga plain region

This region covers the area from the Aravali rangers to Bengal and Orissa. Widely different types are found only in small areas in the forests.

(v) The Deccan region

This region has various kinds from scrub jungles to mixed decidous forests.

(vi) The Malabar region

This region is rich in forest vegetation. Besides, it produces important commerical crops, such as cocount pepper, coffee, tea. Besides, rubber, cashewnut and eucalyptus trees.

(vii) The Andaman region

This region is rich in evergreen, semi-evergreen, mangrove, beach and diluvial forests.

To conclude, there are nearly 45,000 species of plants including shrubs in the country. The vascular flora, which forms the conspicuous vegetation cover itself comprises 15,000 species.

OVER CONSUMPTION ON FORESTS REASONS

Population is increasing tremendously in our country. It has already crossed thousands of millions. Meeting its ever-increasing demand has resulted in over consumption of forests.

1. Fuel wood, Timber and Pulpwood

The data show that (FAO, 1981) consumption of wood in developing countries is exactly the reverse of the developed ones. In the former, wood is used 82% for firewood and 18% respectively, In India, firewood demand is mostly in rural areas because the alternative source of energy, are yet to reach there. The National Commission on Agriculture (NCA) had indicated a substantial rise in demand for wood by 200 A.D. for firewood and industry as is evident from the table given below:

Table 2.1

Requirement of Wood (Mt.)

Category	Requirement in 1980 m^3 of total		Requirement in 2000 m^3 of total		Additional requirement m^3 % increase	
Fuelwood	188.600	87.5	225.000	78	36.4	19
Timber	22.720	10.5	46.755	16	24.0	106
Pulpwood	4.175	2.0	17.695	6	13.5	323
	215.495	100	289.450	100	73.9	34

2. Wood for Packing Purposes

Wood is needed, on a large scale, for our fruit industry, tea etc. It is estimated that for wooden crates nearly 0.5 Mm^3 of wood is need (U.P. 01, J & K, 0.25 M, H.P. 0.15 Mm^3).

3. Paper Board and Newsprint

With the rapidly increasing population growth our per capita consumption of paper is increasing from 2 kg to 4.5 kg per year. Bamboos and hardwood are the chief sources (70%) of raw materials for paper and board. Growing demand for 2.45 Mt will enhance dependence on bamboo and hardwood.

It is evident from the data that the pulpwood had gone to nearly 6 percent of the wood requirement by 2000. More than half of the pulpwood comes from bamboo as is shown in following table.

Category	Requirement in 1980 Mt% of total		Requirement in 2000 Mt% of total		Additional requirement Mt% of % increase	
Pulp and paper	2.165	51	3.546	51	1.381	64
Non-industry	2.109	49	3.459	49	1.350	64
Strial requirement	4.274	100	7.005	100	2.731	64

There is a substantial in newspaper industry. As per data per capita requirement have gone upto 1. 1 kg by 2000, thus, the newsprint capacity was raised to 1.289 Mt. Following are the estimated requirements for raw materials for newsprint.

Year	Capacity Requirement (Mt)
1981	0.467
1986	0.596
1991	0.770
1996	1.000
2000	1.289

It is evident that shortfall of newsprit would grow rapidly as well as continuously by the passage of time.

DEFORESTATION : MEANING AND RESULTS

Meaning of Deforestation

Deforestation is the process of felling trees indiscriminately resulting in nude or semi-nude surface of the hill hitherto covered by thick forests.

Causes of Deforestation

Main causes responsible for deforestation are as under:

(*a*) Felling of trees to meet the ever increasing demand of the cities.

(*b*) Grazing by the local cattle, goats, sheep etc. They not only destroy the vegetation but also pull out the roots of plants. After denudation of our Himalayas, the process of deforestation started in the Shivalik range. Shivalik sal forests were over-exploited for industry use, *i.e.* railway sleepers etc. Consequently, the foothills of the Shivaliks are in semi desert conditions.

(*c*) Meeting out the growing hunger for land. It has hit the ecology of the country badly very soon India is likely to have more of wasteland than productive land. Large-scale deforestation has badly affected the weather facing almost each year more of bleak than the normal weather.

(*d*) The increase in shifting (jhum) cultivation in North east and Orissa has also laid large in forest tracts bare. As the jhum cycle is shortened to six years only (in some districts, even 2-3 years only), too short period does not provide enough time for natural repair of damaged ecosystem.

(*e*) A major cause of deforestation has been the construction of hill roads. About a decade back, they were about 30, 000 km long. Most of these roads are in state and most fragile belt of Himalayas. Road construction damaged the protective vegetation cover both above and below roads. It blocked natural and pollution streams.

Formidable Picture of Deforestation

Deforestation has been causing tremendous land erosion and land slides. India is losing about 6,000 million ton of top soil annually due to water erosion in the absence of trees. The loss worked out from the top soil erosion in 1973 was Rs. 700 crore, in 1976, 1977 and 1978 it was Rs. 889 crore. Rs. 1,200 crore and Rs. 1,091 crore respectively. The figures in recent years have risen formidably too high. Increasing number of livestock and migrating glaziers have led to degradation of forests and the consequent devastation. Data show that about two decades back these were nearly 1200 thousand sheep and goats in alpine areas of U.P. In addition, there also visited about 25,000 migratory graziers. There were also about 5-7,000 buffaloes owned by Gujars. Consequently, the forestry stock decreased from 13.79 m3/head in 1981 to 2.66 m3/head in 2001.

The following table shows that there has been a grave reeducation in forest land:

Land use	**Area (Mha)**	**Change in forest cover (%) of total geographical are of the country**	
1972-75	1980-82		
(*a*) Forests land Closed forests Open/degrated	46.10	35.43	(–) 3.25
forests Mangroves	8.80	10.00	(–) 3.25
Mangroves	0.30	0.27	(–) 0.02
	55.20 (16.83%)	**45.70 (39.94%)**	**(–) 2.89**
(*b*) New-forest land Agricultural land, grassland, shrub land, non-forest planation, barren land	255.70	267.40	(+) 3.58
(*c*) Others Areas under snow, fog, cloud, shadow *etc.*	17.12	14.86	(–) 0.69
(*d*) Total	**328.00**	**328.00***	

*Excluding Andaman & Nicobar Island (based on NRSA, 1984).

Evil Consequences of Deforestation

With deforestation ecological balance maintain by nature breaks away. Floods or drought are the terrible consequences. The trees, increase rainfall of an area, as well as conserve the water which falls on the ground rain. Consequent to deforestation, the plant reduces evaporation allowing water to remain in solid for a long time.

In our country unabated deforestation over grazing and the growing hunger for land has hit the ecology of India badly. If it goes on, we may soon have more of wasteland than productive land. Large-scale deforestation has badly affected the weather. Evil consequences of deforestation can be summed up as under:

1. Adverse Effect on Productivity

It is noticed that the devasting effects of deforestation in India include soil, water and wind erosions, estimated to cost over 16,400 crores every year. Deforestation affects productivity of our croplands in two ways as under:

(*i*) The deforestation increase the soil erosion increase manifold. The soil so washed leads to an accentuated cycle of floods and drought.

(*ii*) Deforestation creates to use cowdung and crop wastes as fuel mainly for cooking. As a result no part of the plant goes back to loss in soil fertility.

2. Land/Erosion and Landslides

Deforestation has been causing tremendous land erosion and landslides. Data reflect that about 6,000 million ton of topsoil is lost annually due to water erosion in the absence of trees. The loss worked out from the topsoil erosion in 1973 was Rs. 700 crore. The figures for the years 1976, 1977 and 1978 are Rs. 889 crore, Rs. 1,200 crore and Rs. 1,091 crore respectively.

3. Low Per Capita Forestland

As far as per capita forestland is concerned, India today is the poorest in the world. The per capita forestland in India is 0.10 hectare compared to the world average of 1 hectare.

TIMBER EXTRACTION: MINING, DAMS AND THEIR EFFECTS IN FORESTS AND TRIBAL PEOPLE

Timber Extraction

It is estimated that India is losing 15 million hectares of forests cover year. If this trend continuous unchecked, it could take only a period 9 of 20 years hence to reach to zeroforest value in our country. During a period of 25 years (1951-1976) India has lost 4.1 million hectares of forests area. Trees have been felled in large number of fuel, fodder, valley projects, Industrial uses, road construction etc. India consumes nearly, 170 million tonnes of firewood annually, and 10-15 million hectares of forests cover is being stripped every year to meet fuel requirements. The rise in fuelwood consumption can be noticed from the comparative study of the fuel consumption in earlier years. It was 86.3 million ton in 1953. It reached about 135 million ton in 1980. During a period of 20 years (1951 to 1971) forests have been cut for various purposes as under:

(1) For Agriculture (24-32 lack hectares)

(2) River valley projects (4.01 lakh hectares)

(3) Industrial uses (1.24 lakh hectares)

(4) Road construction (0.55 lakh hectares)

(5) Miscellaneous uses (3.88 lakh hectares)

In this way, a total of 3.4 million hectares of forests were lost during this period. The disastrous of the heavy deforestation are visible. Nearly 1 percent of the land surface of India is turning barren every year due to deforestation. In the Himalayan range, the rainfall has declined from 3 to 4 percent.

Mining

It is often remarked that in our country most mining work has been unscientific. Consequently no heed is paid to environment protection. The consequences have been disastrous. For example:

(1) They have developed large tracts that lost productivity.

(2) There have been water and air pollution, despoliation of land and deforestation, noise and ground vibration problems *etc.*

As such, to ameliorate the situation, the mined areas to be reclaimed for agriculture, forestry, fisheries and recreation. During last 20-30 years, a number of mining operation have been started in the country. These operations affected forest and cultivated land areas. Such operations have been taken mainly in U.P., Bihar, M.P., Orissa and Andhra Pradesh. The result are as under:

(1) The use of land scale for townships, communication, excavation and transport affected the socioeconomic and ecology of these areas.

(2) Ecological problems developed in coal mine areas in Ranchi, Hazaribagh (Bihar), Bina Project (U.P.) and Singular complex at Gorbi (U.P.) and Jayant (M.P.).

Some illustrations are as under:

(1) Ranchi

In Ranchi several hundred sq. km. of land has been converted to bad lands.

(2) Singrauli

In Singrauli complex forests and hillocks have been erased due to construction of high power transmission lines, roads and rail tracks. Establishment of other factories as cement and super thermal power stations around coal mines have resulted into environment degradation.

Reclamation of Mined Areas

There are two successful cases of reclamation of mined areas in India. These are as under:

(1) Neyveli Lignite Corporation Ltd. in Tamil Nadu.

(2) Stone Quarries of Sayaji Iron Works in Gujarat.

It is felt, there is need to have legal protection and to revise the Mines and Minerals (Regulations and Development) Act, 1957 (MMRD Act) to bring in it the environment concerns.

Dams

We can classify the environment side effects of river valley and hydel projects into three categories as under:

(*i*) Impacts within and around the area covered by the dam and reservoir.

(*ii*) Downstream effects caused by alternation in hydraulic regime, and

(*iii*) Regional effects in terms of overall aspects including resources use and socio-economic aspects.

The impacts caused by construction of dams and reservoir in including the following effects and consequences:

(1) The various change in the microclimate.

(2) The loss of vegetal cover.

(3) Soil erosion.

(4) Variation in water table.

(5) Enhanced seismic activities due to pressure of water.

It should be kept in mind that the nature and magnitude of the impacts vary with the project locations and the conditions therein. It can be elucidate with the help of illustration:

(1) In hilly tracts, blasting operations for road construction can cause considerable damage to the environment through the following activities:

  (*a*) Loosening of hill sides and resultant landslides,

  (*b*) Sedimentation of reservoirs

  (*c*) Drying up of spring and flash floods.

(2) The creation of new settlements for the workmen and rehabilitation of project outsees in the watershed areas may result in the aggravation of the seriousness of advance impacts. In our country a number of big, medium and minor dams are undertaken mainly for three purposes-irrigation, power generation and water supply. The country's first Prime Minister, Jawharlal Nehru, hailed these dams as the Temples of Modern India. They have increased agricultural production, power generation and reduced dependence in imports.

However, on the contrary to the advantages enumerated above, some experts opine that the social, environmental and even economic cost of these dams, far outweighs their benefits. They hold that the most important social consequences of big dams has been the displacement of million of tribals from their homeland and their eventual influx into urban areas, almost as refugees. This is the reason why the scientists, environmentalists, journalists, social activists, lawyers and bureaucrats have now raised their voice against big dams.

Results of opposition

Mounting opposition from scientists and environmentalists has completed the Govt. to review a number of proposed dams in the light of their impact on local tribals, flora and fauna as under:

(*i*) First was the scrapping of the silent valley project in Kerala.

(*ii*) Second example is Koel and Karo project in Bihar. This was also given up due to opposition from local people. They held that it would have displaced several thousands of Santhal tribals in the area.

Four Major Projects

The four major projects which have generated much controversy are as under:

(*i*) Sardar Sarovar Project, Gujrat.

(*ii*) Narmada Sagar Project, M.P.

(*iii*) Bodhghat Project, M.P.

(*iv*) Tehri Dam Project in U.P.

Although the above projects have been given environment clearance, struggle is still on the force of the Govt. to drop these projects. A brief description of these projects and their possible effects are as under:

1. Sardar Sarovar (SS) Project

This project is near Navagam in Bharuch district of Gujrat.

It is one of the costliest projects affecting villages in three states—M.P., Maharashtra and Gujrat. If it is carried out, its effects would be as under:

(*i*) About 245 villages will be submerged, of which about 193 in M.P. alone.

(*ii*) Over 75,000 (nearly 50,000 in M.P. alone) people will be evicted.

(*iii*) Additional displacements is likely to be caused during social and environment rehabilitation work undertaken to repair the dislocation and damages caused by the project.

It is evident that compensatory afforestation and setting of wildlife sanctuary will displace or affect other villagers in the area. The relevancy is evident from the fact that it has been officially admitted that nearly 43,000 ha of land will be needed for rehabilitation of SS oustees.

2. Narmada Valley Project (NVP)

It claims to be the world's largest river valley project. It has attracted the greatest attention. The 30 big dams and over 3,000 medium and minor dams are envisaged at cost of Rs. 25,000 crore. Its effects are anticipated as under:

(*i*) It would displace over one million people, mostly tribals.

(*ii*) It would submerge 56,000 ha fertile agriculture land.

(*iii*) Total forest areas nearly 60,000 ha. will be destroyed.

(*iv*) Nearly 25 species of birds will be deprived of their habitats.

3. Bodhghat Project

This project is on Indravati river in M.P. The project is in heavily forested Bihar district. Its effects are anticipated as under:

(*i*) The project will destroy teak and sal forests.

(*ii*) It will spell doom for the last surviving wild buffaloes.

The criticisms of the project forced the Govt. and the World Bank to reconsider it.

4. Tehri Dam

This Dam is proposed on the Bhagirathi river in U.P. at the foothills of Himalayas. It is Soviet-financed and challenged in the Supreme Court. Its effects are envisaged as under:

(*i*) This Dam will displace over 85,000 people.

(*ii*) It will totally immerse the Tehri town and completely or partly submerge nearly 100 villages.

(*iii*) The site of the Dam is prone to intense seismic activity.

(*iv*) The 3,200 million ton of water that the Dam would impound, could cause a major earth tempor.

(*v*) In the event of a disaster, the entire religious townships of Deoprayag, Hardwar and Rishikesh would be devastated.

(*vi*) Thousand of hectares of rich, agriculture land will be drowned.

WATER RESOURCES: USE AND OVER-UTILIZATION OF SURFACE AND GROUND WATER

Water claims to be an important resource. An important use of water in our country is for irrigation. Besides, water is also required in large amounts for industrial and domestic consumption.

Significant of Water

The significant of water needs no elucidation. It is as under:

(1) It is revealed by the history of human civilization that water supply and civilization are most synonymous.

(2) Several cities and civilizations have disappeared due to water shortages originating from climatic changes.

(3) Millions of people all over the world, particularly in the developing countries, are losing their lives every year from water-borne disease.

(4) An understanding of water chemistry is the basis of knowledge of the multi-dimensional aspects of aquatic environment chemistry, which involve the sources, composition, reactions, and transport of the water.

(5) About 97% of the earth's water supply is in the ocean, which is unfit of the remaining 3%, 2% is locked in the polar ice-caps and only 1% is available as fresh water in rivers, lakes, streams, reservoirs and ground water which is suitable for human consumption.

Unlike land, which remains available as it is, the availability of water varies from place to place and time to time. Our country is a monsoon land. The bulk of rainfall is confined to a brief period of 3-4 months that is from July to October. As such, large part of the country lacks surface water supply for a greater part of the year.

Surface Flow

1. River

Surface flow takes place through 14 major river systems. They are Brahmani, Bhrahmaputra, Cauvery, Ganga, Godavari, Indus, Krishna, Mahanadi, Mahi, Narmada, Periyar, Sabarmati, Subarnarekha and Tapti. Between them, the position is as under:

(*a*) They share 83% of the drainage basin,

(*b*) They account for 85% of the surface flow,

(*c*) They house 80% of the total population on the country.

Besides, there are 44 medium and 55 minor river system. These rivers are fast flowing, monsoon fed and originate in the coastal mountains of the major river viz Brahamputra, Ganga and Indus basins along with Godavri. They cover more than 50% of the country.Only 4, Brahamputra, Ganga,Mahanadi and Brahmani are perennial. Their minimum discharge is of 0.47 Mm^3/km^3 year.

2. Lakes and Ponds

Lakes: Lakes are inland depressions that contain standing water. They may vary in size from small ponds of fewer acres to large seas covering thousands of square miles. They may range in depth from a few feet to over 5,000 feet.

In a lake, there are three to five well recognized horizontal strata namely:

(*i*) Shallow water near the shore forms the littoral zone. It contains upper warm and oxygen rich circulating water layer zone. The littoral zone includes rooted vegetation.

(*ii*) Sublittoral zone-extends from rooted vegetation to the non-circulating cold water with poor oxygen *i.e.* hypolimnion.

(*iii*) Limnetic zone is the open water zone away from the shore.

(*iv*) Profundal zone is the deep-water area beneath limnetic zone and beyond the depth of effective light penetration.

(*v*) Abyassal zone is found only in deep lakes, since it being at about 2,000 metres from the surface.

Pond: Ponds are considered as small bodies of standing water so shallow that rooted plants can grow over most of the bottom. Most ponds and lakes have outlet streams and both are more or less temporary features on the landscape the reason is filling, no matter how slow, is inevitable.

Stratification of Ponds

Ponds have little vertical stratification. In them littoral zone is large than and limnetic zone and profundal zone. In a small pond the limnetic profundal zones are not found. The warm top layer, the epilimnion is heated by the sun and homogenised by the wind and other currents. On the contrary to it, the deep cold layer, the hypolimnion is not heated by sun and not circulated by wind. The basis upon which the layers are maintained is strictly thermal and is caused by the fact that the warmer water is lighter than the colder water. After the formation of a thermocline, no exchange of water occurs between the epilimnion and hypolimnion.

Physico-Chemical Properties of Lakes and Ponds

Lakes have the tendency to become thermally stratified during summer and winter to undergo definite seasonal periodicity in depth, distribution of heat and oxygen. Light also penetrates only to a certain depth, depending upon turbidity.

Kinds of Lakes

On the basis of physical factors and productivity, etc., different classifications of lakes exist:

(1) Based on temperature

Hutchnson (1957) classified lakes into *dimitic, monomictic* and polemicist lake.

There are as under:

(*i*) The dimictic lakes exhibit two overturns every year, while monomictic lakes present only a single overturn per year.

(*ii*) The monomictic lakes may be *cold monomictic* and monomictic.

(2) Cold Monomictic

It is characterized by a circulation only during summer:

(*i*) Warm Monomictic: It has a circulation in winter as well.

(*ii*) Polomictic lakes present circulation throughout the year.

Based on the human acid content the lakes of world have been classified into *clear water lakes and brown water lakes,*

(*a*) The brown water contains high humus content.

(*b*) Clear water takes may be divided into two types as under:

(i) The oligotrophic type

Its water is poor in nutritive plant material and show nearly equal distribution of oxygen during summer and winter months. Its mud bottom contains little organic material;

(ii) The eutrophic type

It is rich in nutrients. At greater depth below the thermo cline in summer eutrophic lakes show a considerable reduction in oxygen content and their mud bottom is composed of typical muck.

3. Lotic Ecosystems or Moving Water

Moving water or lotic ecosystems include rivers, streams, and related environments. They are of various sizes ranging from Ganga, Yamuna, Hindon, Kali Nadi, Sutlez, Gomti, *etc* to the trickle of a small spring. Likewise, there is distinction on the basis of flow. On one hand there are raging torrents and waterfalls and on the other hand, the rivers whose flow is so smooth as to be almost unnoticeable. Every river varies considerably over its length, as it charges from a mountain brook to a large river.

Main Characteristics of Lotic Environment: Moving water differ from lakes and ponds as under:

(*i*) Current is a controlling and limiting factor.

(*ii*) Land water interchange is great because of the small size and depth of moving water systems as compared with lakes.

(*iii*) Oxygen is almost always in abundant supply except when there is pollution.

(*iv*) Temperature extremes tend to be greater than in standing water.

(*v*) The most distinctive features of moving water ecosystems are those related to their motion *i.e.* the rate of flow and the streams velocity. The rate of flow refers to the volume of water passing a given observation point during a specific unit of time; It is measured in units such as m^3/sec, ft^3 or acre-feet/sec.

(a) Rapidly flowing water

Rapidly flowing water can be defined as the portion of the streams in which the flow is both rapid and turbulent. Consequently everything that is not attached or weighty is swept away by the current. This includes organisms and sediment particles alike. The substrate tends to be rock or gravel. The fragments are gradually rounded and smooth by the water.

(b) Slowly flowing water

A slowly flowing water ecosystem is a very different type of system from the fast streams. The flow is both slower and more likely to be laminar. The results are that the erosive power of the stream is greatly reduced, hence, smaller sediment particles (sit) and decaying organic debris, are deposited on the bottom. Besides, the slow streams have higher temperature. Consequently, planktonic organisms, espeically protozoans, occur in large number in this ecosytem. In some moving streams, the bottom muds contain more organic material than mineral fragments. In slow water streams oxygen concentration is main limiting factor. The high level of animal activity, along with an active detritus stream. Besides, the low level of turbulence means that less oxygen is in corporate into the water at surface. Thus the dissolved oxygen content of a slowly moving stream is likely to be much lower than that of a fast-moving stream.

4. Estuaries

Water of all streams and rivers eventually drain into the sea. Estuaries is the place where this freshwater joins the salt water. As such estuaries are the transitional zones between the sea and rivers and are the sites of unique ecological properties. They are semienclosed coastal bodies of water that have a free connection with the open and within which seawater is measurably diluted with freshwater from river. However, all the rivers are not open into estuaries. Some rivers simply discharge their runoff into the ocean. Estuaries are not alike. Instead they differ in size, shape and volume of water flow, they are influenced by the geology of the region in which they occur. As the river reaches the encroaching sea, the stream carried sediments are dropped in the quiet water. These accumulate to form deltas in the upper reaches of the mouth and shorten the estuary.

The Position of Surface Water in the Country

India has been bestowed with substantial surface water resources. Overall water resources of the country have been assessed at 1880 km^3 annually. Of thus, it may be possible to harness about 690 km^3 of water for beneficial use. In addition, Ground Water Resources of the Country are assessed at about 452 km^3.

Storages

India has constructed a large number of storages and diversions for harness its vast ware potential.

(1) Live storages built-up in the completed projects so far is about 163 km^3.

(2) Another 7 km^3 of live storage will be available from project under construction.

(3) 131 km^3 from projects under consideration.

(4) In addition, there is a large number of small tanks whose storage adds upto about 30 km^3.

Total Hydro-Power Potential of the Country has been assessed at 84,000 mW at 60 per cent load factor. Presently, Completed and on-going Schemes will exploit about 15,600 mW *i.e.* 20 per cent of the assesses potential. Hydropower installed capacity at the end of the Sixth Plan was 14, 450 mW. Forming about 34 per cent of the total installed capacity.

In the absence of information on actual water use by various sectors, estimates made in this regard (1985) indicated that water use may be of the order of 530 km^3 is from surface Water and 180 km^3 from Ground Water. Out of this, 470 km^3 is for Irrigation and 70 km^3 for other including Domestic (16.7 km^3), Industrial (10 km^3) and Thermal Plants (2.7 km^3) requirements. A recent assessment puts domestic requirements in 1991 at about 26 km^3.

Basin-wise Water Resources Development for 12 Major River Basins is given in the following table:

The surface water resources continue to the contaminated with run-off water from agricultural fields, containing pesticides, fertilisers, soil particles, waste chemicals from industrial and sewage from cities and rural areas.

During the dry months, water scarcity is faced even in the places like Cherrapunji and Konkan, which receive heavy rainfall. Due to the unequal distribution of rainfall our countrymen face problems of flood and famine in some parts every year.

The mass balance of annual rainfall that about 70% is lost by direct evaporation and transpiration by plants, while the remaining 30% goes into the streamflow shows it. The approximate breakup of this streamflow, as consumed by man, is 18% for irrigation, 2% for domestic use, 4% for industrial and 12% for electrical utilities. Irrigation for agricultural purposes and electric power plants are the major consumer of water.

Growth Water

Ground water resources are abundant only in the northern and coastal plains. In other parts its supply is not adequate. Ground water is roughly 210 million m^3. This quantity includes recharge through infiltration, seepage and evaporisation. Even at present, our country has not been able to provide safe drinking water to all villages and towns.

Ground water contains dissolved minerals from the soil layers through which it passes. In the process of seepage through the ground, the water gets depleted of most of the microorganism originally present in the surface water. Though the salt content may be excessively high on occasions, it is generally superior as a domestic water source. Surface water contains a lot of organic matter and mineral nutrients, which feed algae and large bacteria populations.

The total replenishable Ground Water Resources in the Country have been provisionally estimated at 45.23 million hectares meters per year. Of this, 6.93 million hectares metres is for drinking, industrial and other uses leaving 38.34 million hectares metres as utilisable Ground Water Resources for Irrigation.

Basin-wise/State-wise break-up of the potential is given in the Table 2 (next page).

Over-utilization of Water

It transpires from our water budget that, in case average annual rainfall of entire country and its total area are taken, the total water resources are of the order of 167 million hectare meters. In fact, only 66 million-hectare meters of water can be utilised by us for irrigation. As there are some financial and technological constraints we plant to use it fully only by 2010 A.D. By 1951 only 9.7 million ha metre water was used for irrigation. By 1973 it was as much as 18.4 million ha metres.

It is observed that Agriculture sector is the major user of water. The water used for irrigation which was two decades back nearly 40% has gone up to 73% by 2000 A.D. Irrigation use is very inefficient. Hence, 25-30% efficiency and method of irrigation are to be changed drastically. From the data on water use shown in the table given as under, it becomes evident that irrigation including for livestock and including power use is 79.6% and 13.7% water respectively. Thereafter, come domestic (3.5%) and industrial (3.3%) uses.

In case the land area is taken up as a unit, the position could be different. By 1984-85 the land under irrigation almost tripled to 67.5 million ha.

Table 2.2

Water Use (India) 2000 A.D. (Available Water 1900 Million Cubic Metre Per Year)

Uses	Taken	Consumed	Returned
Irrigation and	869	783	86
Livestock Power	150	5	145
Industry	35	10	25
Domestic	38	8	30
Total	**1092**	**806**	**286**

After a period of five years *i.e.* by 1990 another 13 million ha were to be brought under irrigation, thus, the total figure was 80 million ha. This may be adjudged against the total potential of 133 million ha by 2010 A.D. Here it may be kept in mind that it is the gross sown area and not net sown area. The former *i.e.* net sown area at present, more than 3% of the net sown area is under irrigation.

It is estimated by World Health Organization (WHO) that water thirsty countries are across the oceans. Nordic water supply (Norwegian company) has been transporting fresh water *i.e.* clean drinking water in giant floating bags across the oceans. These floating bags are made long. Each contains 35,000 tonnes of water. The floating water bags are made of a polyester plant to build new bags of the size of supertanker, 300 metres long and a capacity of 1,00,000 tons water. In this way the Nordic company is engaged in the business of towing fresh water from Turkey to Greek island. Its future plans include transporting water from Iran to Saudi Arabia and along Caribbean and Red Sea.

Water Supply

In our country water supply is scanty. We have more than 3000 towns, but hardly 2000 have an organized water supply. It is essential to augment coverage of water supply in urban as well as rural sectors. At present the position of water supply is as under:

(1) Low daily per capita supply,

(2) Inefficient distribution,

(3) High leakage and ill managed system.

This is the position in towns. In rural sector progress in water supply has been very slow. There are about six lakh villages involved in which our 76% population lives.

Previously they were provided safe drinking water through piped water supply systems or hand pumps operated tube wells. Efforts are on and it is an expected picture that supply could be brought to about more than one lakh villages. The picture is somewhat improved during the Water Supply and Sanitation Decade (WSSD) (1981-90).

To solve the water problem, some other precautionary measures are to be taken. We have to use minimum water. The quantity of water returning after use becomes the waste water. The data for water use in our country show that waste that by 2000 A.D. out of 1900 Mm^3 of water available, the country had used about more than 50% of the available water (about 1092 Mm^3) for four major consumptive uses-irrigation, power generation, domestic and industrial uses.

It is held that for sustainability at least more than half of the total available water should be used annually. The country has overshot the 50% mark by 2000 A.D. which is not in our ecological interest.

Water Resources Management

Some of the central and corresponding state originations concerned with specific aspects of water resources management are as under:

(1) Central Pollution Control Board	Concerning	Water Quality
(2) Central Water Commission	Concerning	Surface Water
(3) Central Ground Water Board	Concerning	Ground Water
(4) Indian Metrological Department	Concerning	Precipitation
(5) Central Public Health and Sanitation	Concerning	Water Supplies
Environment Engineering	and	Sewage Disposal
(Ministry of Urban Development)		
(6) Ministry of Agricultural and ICAR	Concerning	Water use for Agricultural
(7) Department of Environment Wildlife (Ministry of	Concerning	Environment Forests and Impact

Assessment Environment and Forest)		
(8) Department of Forest Management	Concerning	Watershed
(9) Department of Power	Concerning	Hydroelectric Power

MEASUREMENT TO CHECK OVER-UTILIZATION OF WATER RESOURCES

In our country the Ministry of Water Resources is entrusted with the function of laying down policies and programmes for development and regulation of the country's water resources. Under its jurisdiction come the following:

(1) Sartorial planning,

(2) Co-ordination,

(3) Policy guidelines,

(4) Technical examination and tech-economic appraisal of projects,

(5) Providing central assistance to specific projects.

(6) Facilitation of external assistance and assistance in the resolution of interstate water disputes,

(7) Policy formulation, planning and guidance in respect of minor irrigation,

(8) Command area development

(9) Development of ground water resources etc.

Evidently, its jurisdiction is quite wide. It was in September 1987 that the National Water Resources council adopted the National Water Policy. The council laid stress on the truth that 'Water' is a prime natural resource, a basic human need and a precious national asset. As such, its over consumption and wastage should be discontinued at every cost. It held that planning and development of water resources need to be governed by national perspectives.

Since 1987, a great number of issues and challenges have emerged in the development and management of the water resources sector. As such, it was felt necessary to review the National Water Policy. The same was done and the (Revised) National Water Policy was adopted by the National Water Resources Council in its fifth meeting held on 1 April 2002 at New Delhi. All the states besides the centre are required to adopt immediate measures in order to achieve the desired objectives of the policy, each state has to formulate its own State Water Policy, backed with an operational action plan in a time-bound manner, the period so stipulated is a period of two years.

Assessment of Water Resources

It is assessed that the average run-off in the river system of the country is 1,869 km^3 (cubic kilometers). It is estimated that of this, the utilisable portion by conventional storage and diversion is about 690 km^3. Besides it, the replenishable grounder water potential in the country is estimated at 432 km^3. A fall is visible in the per-capita availability of water at national level from about 5,177 m^3 (cubic meters) in 1951 to the estimated level of 1,869 m^3 in 2001 with great variation in water availability in different river basins.

Irrigation Development

India has a culturable area of 1850 lakh hectares of which 1410 lakh ha. is sown area.

Sustained and Systematic Programme for Development of Irrigation Facilities in the Country was taken up with the advent of Planned Development in 1951. The Irrigation potential creation during the Pre-Plan Period was 226 lakh ha. of which 97 lakh ha. were from Major and Medium Irrigation and 129 lakh ha. from Minor Irrigation Schemes. The cumulative irrigation potential increased to about 675 lakh ha. by the end of 1984-85. Of this 300 lakh ha. were from Major and Medium Irrigation Projects and 375 lakh ha. form Minor Irrigation Schemes. The target of additional potential during the Seventh Plan was 129 lakh ha. of which 43 lakh ha. was from Major and Medium Irrigation Projects and 86 lakh ha. from Minor Irrigation Schemes. The Approval Outlay for the Seventh Plan was about Rs. 14,360 crore for Major, Medium and Minor Irrigation Programmes and about Rs. 1,671 crore for the Command Area Development Programme.

The additional irrigation potential achieved during 1985-90 in regard to Major and Medium Irrigation was 30 lakh ha and 84.4 lakh ha. Minor Irrigation Schemes. The main thrust of the Development Policy for the Irrigation Sector is toward achieving the assessed target of 1,130 lakh ha. of gross irrigation potential; in the country based on convention methods of diversion and storages by 2010 AD. or so. are expected to be irrigation eventually from Major and Medium Projects and the balance by Minor Schemes.

Plan wide Development

In every plan/five year efforts were made to create and utilize potential and ground water/resources of the country.

Plan achievements in this direction are as under:

Table 2.3

Plan Position of Irrigation Created and Utilised

Plan Period	Potential created (mha)	Potential utilised (mha)
Pre-Plan period	9.70	9.70
First Plan (1951-56)	12.20	10.98
Second Plan (1961-66)	14.33	13.05
Third Plan (1961-66)	16.57	15.17
Annual Plan (1966-69)	18.10	16.75
Fourth Plan (1969-74)	20.70	18.39
Fifth Plan (1974-78)	24.72	21.16
Annual Plan (1978-80)	26.61	22.64
Sixth Plan (1980-85)	27.70	23.57
Seven Plan (1985-90)	29.92	25.47
Annual Plan (1990-92)	30.74	26.31

Eight Plan (1992-97)	32.95	28.41
Ninth Plan (1997-98)		
Annual Plan (1997-98)	33.62	28.90
Annual Plan (1998-1999)	34.27	29.78
Annual Plan (1999-2000) (Provisional)	35.10	30.44
Ninth Plan (1997-2002) (Provisional)	42.77	37.12

Source: Planning Commission Document-Ninth Plan (1972-2002) and Annual Plan (2000-2001).

Common Area Development Programme

The Centrally-Sponsored Command Area Development (CAD) Programme was launched at the beginning of Fifth Plan (1974-75) with the special objective of ensuring a faster and better utilization of irrigation potential in selected Major and Medium Irrigation Projects in the Country. Its main objective were as under:

(1) To improve the utilization irrigation potential.

(2) To optimise agriculture production and productivity from irrigation lands on a sustainable basis.

(3) To integrate all functions related with irrigated agriculture through a multidisciplinary team under an area development authority.

Programme broadly covers on-farm development works which include construction of Field Channels, field drains, land-leveling and shaping wherever necessary, farm roads, consolidation of holdings and realignment of boundaries, Introduction of Warabandi or rotational supply of water and Setting-up off WFH wireless network for better communication in order to ensure equitable and assured supply of irrigation even to the tail end holdings, arrangement for supply in inputs and credit, agriculture extension, construction of markets and godowns, and development of ground water for conjunctive use. The programme covering 152 selected major and medium irrigation projects in 20 states and two union territories with total cultural command area of a little over 200 lakh ha. is being executed through the various command area development authorities.

During the seventh plan, more emphasis was laid on improving water management and water delivery system, adaptive trials, training of field-level staff and farmer, monitoring and evaluation of the programme and involvement of farmers in water management.

Financing of C.A.D. programme is from three sources, namely central assistance to states on matching basis for certain selected items, state government's own sources and institutional credit for works, land development, marketing and storage.

From 1986-87, the financing pattern has been revised, according to which construction of field Channels from outlets for five to eight ha. Blocks is being financed on matching grant, 50 per cent to be borne by the centre and the remaining by states. In the seventh plan, allocation for CAD programme was Rs. 500 crore in the central sector against which an expenditure of Rs. 497 crore was incurred.

It was decided to include on pilot basis suitable minor irrigation project of State/UTs north-eastern region including Sikkim Jammu and Kashmir and Himachal Pradesh for command area development.

The ultimate objective of CAD programme is to provide agricultural production in Command Area. Every CAD administrator has been advised to undertaken intensive crop-cutting experiments for each crop season so that the rise in agricultural productivity in Irrigation Commands can be effectively monitored. The Central Government has also decided to provide cent percent cost of training of Orientation of Senior-level Officers involved in the Programme.

By March 1990, physical achievement under the programmed includes 111 lakh ha. of area provided with field channels, 19 lakh ha. of land-levelled and 49 lakh ha covered under the Warbandi.

Note : Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

Major and Medium Irrigation Projects

The irrigation projects with a Culturable Command Area (CCA) of more than 10,000 ha. are classified as major projects and project with a CCA of more than 2, 000 ha. and upto 10,000 ha, are categories as medium projects.

Between 1951 and 1985, 246 Major and 1,059 medium project were taken up for execution. Among them, 65 Major and 626 Medium Projects were completed by 1985. During the seventh plan, 18 new medium project were taken up. Out of the 199 major and 462 medium projects in hand, 37 major and 185 medium projects are expected to have been completed during the seventh plan period.

In 1974, 60 major and medium irrigation projects were begun, with a Culturable Command Area (CCA) of about 15 mha. Later on, a number of projects were included while a few were deleted. At present, the number of programmes with CCA of 22.78 mha. The projects are spread over 28 States and two Union Territories. The great concern is reflected from the fact that since inception, and amount of Rs. 2,452.33 crore has been spent for different activities of the programme. An amount of Rs. 148.27 crore has been spent during 2001-2002.

The programme involves execution of On Farm Development (OFD) works. A few of them are as under:

(1) The construction of field channels and field drains.

(2) The land levelling and shaping.

(3) The conjunctive use of surface and groundwater.

(4) Warabandi or a rotational system of distribution of irrigation water is undertaken. The sole aim behind it, is to ensure equitable and timely supply of water to farmer's fields.

Suitable measure and adopted, for example, adapting trials/demonstrations and training of farmers and functionaries of implementing departments are encouraged with a view to disseminate the technical know-how among farmers with mainly two purposes:

(*i*) First, for adopting suitable pattern and

(*ii*) Second, for improving farm practices without deterioration of soil health.

During the ninth plan 1997-2002. The ministry has identified three items of work as thrust areas, these items of workers are as under:

(*i*) Participatory Irrigation Management (PIM),

(*ii*) Reclamation of waterlogged in the command of on-going CAD projects, and

(*iii*) Dissemination of technical knowledge to farmers and functionaries.

It is rightly realized that the popular participation, that is, the involvement of farmers in the management of irrigation is essential for better utilizations of water for irrigation with a view to encourage an incentive to Farmers Associations/Water Users' Associations, a one-time function grant of Rs. 500 per ha. (To be shared as Rs. 255 per ha, by state and Rs. 50 per ha. by Farmers' Associations) is provided to registered and function Farmers' Associations. Emphasis is laid on dissemination of technical know-how among functionaries and farmers. Keeping it in view, adaptive trials/demonstrations in the farmers' fields and training of farmers and functionaries has been an important activity. It would be called a great achievement that upto March 2002, 441 projects had been included for treatment of waterlogged areas in the CAD commands.

Minor Irrigation Scheme

Ground water development, which constitutes bulk of the Minor Irrigation Programme, is essentially a People's Programme implemented primary through individual and co-operative efforts with finance obtained mainly from institutional sources. To encourage use of water-saving devices such as Sprinklers, Drip Systen, Hydrams, Water Turbines and Hand Pumps, the Government subsidies are made available to Small and Marginal Farmers for their purchase.

Minor Irrigation Schemes provide instant and reliable source of irrigation to cultivators. It also provides critical help in improving the status of irrigation and controlling water-logging and Salinistion in Canal Command, Minor Irrigation Surface Water Projects, which are financed through plan Funds, often chronically drought-affected areas. Initial investment on these schemes is comparatively low and they can be completed quickly. Moreover, these schemes are labour-intensive and offer employment to the rural people. Growth of irrigation potential from Minor Irrigation Schemes is shown in Table 2.4.

Table 2.4

Minor Irrigation Potential (Comulative)

Period	**Potential (Lakh Hectate)**
Ultimate Potential (by 2010 AD)	550.00
Potential at the end of 1950-51	129.00
First Plan	140.00
Second Plan	147.50
Third Plan	170.00

Annual Plan (1968-69)	190.00
End of the Forth Plan	235.00
End of the Fifth Plan	273.00
End of the Annual Plan (1979-80)	300.00
End of the Sixth Plan	375.00
End of the 1987-88	422.70
End of the 1988-89	439.00
End of the 1989-90 (Anticipated)	458.50
End of the 1990-91 (Target)	478.20

Note : Courtesy Research Division Ministry of Information and Broadcasting Govt. of India.

Minor Irrigation Schemes Comprise all groundwater and surface water schemes, having a culturable Command Area (CCA) up hectares individually. The development of groundwater is mostly done through individual and cooperative efforts of farmers, with the help of institutional finance and through own saving. Finance is arranged for surface minor irrigation schemes from the public sector outlay.

The following table reflects the Irrigation potential created and utilised under minor irrigation during the various plan periods:

Table 2.5

Irrigation Potential Created and Utilised Under Minor Irrigation

Period (mha)	**Potential created (mha)**	**Potential utilised**
Upto 1951 (Per-plan period)	12.90	12.90
First Plan	14.06	14.06
Second Plan	14.75	14.75
Third Plan	17.00	17.00
Annual Plans (1966-69)	19.00	19.00
Forth Plan	23.50	23.50
Annual Plans (1978-80)	27.30	27.30
Sixth Plan	30.00	30.00
Seventh Plan	35.52	35.25
Annual Plan	46.61	43.12
Eight Plan	50.35	46.54
Annual Plan	57.62 (P)	53.05 (P)
Annual Plan (1988-1999)	58.79 (P)	53.78 (P)
Annual Plan (1999-2000)	59.38 (P)	54.23 (P)
Annual Plan (2000-2001)	67.32 (P)	51.19 (P)

It is since the Seventh Five Year Plan that the Ministry of Water Resources has been implementing the Centrally sponsored Plan Scheme “Rationalization of Minor Irrigation Statistics (RMIS)”. Under this scheme, the first census of minor irrigation projects with reference year 1986-87 was conducted in all the States/UTs execpt Rajasthan. Its report projects was conducted with reference year 1993-94. Its report was published in March 2001.

Thereafter, the third census of minor irrigation project with reference year 2000-2001 was conducted in all the States/UTs except the UTs of Daman and Diu and Lakshadweep.

It is felt that some Regions are lagging behind. Hence Central Loan Assistance is being given to the North-Eastern States, Jammu and Kashmir and Himachal Pradesh. KBK districts of Orissa are also being provided with the assistance since 1999-2000 for minor irrigation works.

To condude, a great endeavor is being made at the Government level to economise the expenditure of water for irrigation purpose.

REGULATION OF GROUND WATER UTILIZATION AND RESTRICTING ITS OVERUTILIZATION

Water is vital for realising full potential of agriculture sector and Country’s Development. Optimum development and efficient utilization of our water resources, therefore, assumes great significance.

The erstwhile Department of Irrigation was redesignated as Ministry of Water Resources in October 1985, and assigned the nodal role for development, conservation and management of water as a National Resource. Water being the most crucial element, National Water Policy was adopted in September 1987. The policy recommends need for integrated and multi-disciplinary approach to planning, formation and implementation of projects. It also lays down priority areas for planning and operation of systems. Highest -priority has been assigned to drinking water followed by irrigation, Hydropower, navigation, industrial and other users. The Policy further recommends that the quality of Surface and Ground Water should be monitored.

In Flood Management Sector, the need for having a ‘Master Plan’ for Flood Control and Management for each Flood Prone- basin through sound Watershed Management was recognised in the policy and establishment of extensive network for flood forecasting recommended. The policy further recommended the erosion of land by sea or river be minimised by suitable cost-effective measures. Therefore, planning and management of this resource and its optimal, economical and equitable use with application of Science and Technology has become a matter of utmost urgency.

The Ministry is responsible for broadly laying down Policies and Programmes for development and regulation of the Country’s Water Resources. Its role essentially covers Sectoral Planning, Coordination, Policy Guidelines, technical examination, assistance in water resources projects and facilitation of external help and assistance in resolution of disputes as a result of inter-state problems.

The Central Ground Water Authority

The Central Ground Water Authority was set up in 14th January 1997 under the Environment protection Act, 1986. It is vested with the responsibility of making an assessment of the groundwater potential of the country through hydrological surveys, exploration, evaluation and monitoring of ground water regime.

Present Position of Ground Water

The total replenishable groundwater in India is estimated to be about 43.39 million-hectare metres per year (about 43.86 billion cubic metres). Out of it, about 7.13-mha m/yr of groundwater is reserved for domestic and industrial uses and 36.26-m.h.a m/yr is available for irrigation. According to an estimate, there has been a development of 37.24 per cent of available groundwater resources.

It is a sad affair that out of 5,711 block/talukas/mandals/watersheds in the country, 310 block/talukas/mandals/watershed are categoriesed as "over-exploited". Over exploited indicates the stage of groundwater development which exceeds the annual replenishable recharge. Besides, 160 blocks/talukas/mandals/watersheds are found and classified 'Dark' *i.e.* the stage of ground water development is more than 85 per cent.

Various Steps

Various steps in the direction of regulation and control of the development and management of ground water resources in the country are taken as under:

(1) National Commission for Integrated Water Resources Development Plan

The National Commission for Integrated Water Resources Development Plan was constituted in September 1999. The commission submitted its report to the union Government in December 1999. The report is quite exhaustive and valuable. Several recommendations are made. These are mainly for development of water resources for drinking, irrigation, industrial, flood control, transfer of surplus water to deficit area etc.

(2) Central Water Commission

The Central Water Commission (CWC) New Delhi, is the National Apex Organization in Water Resources Development charged with the responsibility of initiating, co-ordinating and furthering in consolation with state government concerned, schemes for control, conservation and utilizations of water resources for irrigation, flood control, Hydro-power Generation and navigation through the Country. With its rich expertise built over the last four decades, CWC has developed considerable technological know-how in planning, investigation, design, project appraisal and management of Water Resources Development. It is sharing its knowledge and expertise with the Developing Countries. The commission's work are divided into four functional wings *viz* Water Planning, Design and Research, River Management and Planning and Progress supported by Administration and Co-ordinate Wing.

The commission has set-up a National of 570 Hydrological Observation Stations. Since most of the Stations were set-up during 1960's and early 1970's Data Records are now available for nearly two decades. Besides, Guage and Discharge Observation and Sediment Flow Measurements are carried out in selected 248 Stations and Water Quality observation in stations are in operation in the Ganga Basin over the Past Two Decades. During 1978-85, Water Quality Monitoring with respect to Population Loads, was conducted at 42 Selected Stations on the Ganga under a 'Special Scheme' and a Status Report' on water quality of the Ganga System was published in Auguest, 1987. Although the 'Special Scheme' was closed, Water Quality Monitoring in the Ganga System was continued and the 'Status Report' on the water quality of Ganga System published in 1987 is being up-dated.

The Ministry of Water Resources constituted in February, 1990 an Environment Monitoring Committee under the Chairmanship of Member, Water Planning, Central Water Commission, with representatives of concerned Ministries to have periodical and effective monitoring of the implementation of environmental conditions laid down by the Ministry of Environment and Forests at the time of clearance of projects. Out of the 82 Irrigation Multi-purpose and Flood Control Projects for which the Ministry of Environmental Monitoring Organization of Central Water Commission has stipulated environmental safeguards and site visits by the committee.

The project authorities of the remaining 72 projects have been requested to set-up Project-Level Environment Monitoring Committee and Report the progress to the Environmental Monitoring Committee. The committee has already visited and assessed the situation in respect of Three Projects identified for close monitoring.

(3) Central Soil And Material Research Station

The Central Soil and Material Research Station, New Delhi, is a premier organization which deals with Geo-mechanics and construction of material problems relevant River Valley Project Construction. It plays an active role in imparting knowledge to Engineers involved in the construction, designs *etc.* by holding nation level workshops with the help of the United Nations Development Programme Experts.

(4) Subordinate Organizations

The Ministry of Water Resources has the following Six Subordinate Organization:

(1) Central Water and Power Research Station, Pune;

(2) Central Ground Water Board;

(3) Farakka Barrage Project, Murshidabad;

(4) Ganga Flood Control Commission, Patna;

(5) Bansagar Control Board, Rewa;

(6) Sardar Sarovar Construction Advisory Committee, Vadodara.

(5) Central Water and Power Research Station

The Central Water and Power Research Station, Pune, is devoted to applied and fundamental research in energy resources and water-borne transport, Research activities for the stations are carried-out in Ten Laboratories. since 1979, it is the Reorganised Regional Laboratory if the United Nations Economic and Social Commission for Asia and Pacific for studies related to Inland Waterways and Water-borne Transport. It’s clientele is drawn from Arab Countries, Africa and South-East Asia.

(6) Central Ground Water Board

The Central Ground Water Board, New Delhi, is the National Apex Organization to carry-out and guide scientific development and management of Ground Water Resources from the National Perspective. It handles all waters relating to Hydro-Geological Surveys, exploration, assessment, development and scientific management of the country’s Ground Water Resources. The main activities of the organization include Macro- level Hydro-Geological Surveys and Investigations, Deep-Exploratory Drilling Coupled with Geo-physical Logging and Pump-Tests to study Hydro-Geological Features and National-wise Monitoring of Ground

Water Regime and its quality through a network of Hydrograph Stations. Data generated from investigations undertaken by the board provides a scientific base for preparation of Hydro-geological Maps, Atlases, delineation of Ground Water Worthy Areas and Formulation of Ground Water Development Schemes. Beside advising the state governments on planning, financing and administration of Ground Water Development Schemes, the board undertakes, 'Water Balance Studies' and organizes training of personal of all levels and disciplines of its own and other state and Central Government Organisation including nominees of International Organisations.

The board has completed an area of 29.89-lakh sq. upto the end of March 1990, out of the total area of 32.9 lakh sq k.m. of the Country under Hydro-geological Surveys and planned to complete the remaining by 1991. For the monitoring of Ground Water Regime, the board established a National Network of 12, 450 Hydrographs Stations. Ground water levels are being monitored by these stations quarterly in January, April/May, August and November. Data is analysed to study impact of various input and output components on Ground Water Regime. The board is presently having a fleet of 92 different kinds of Drilling Rigs for Ground Water Exploration.

The board, through its, 'Specialises Cells' has initialed studies in the Field of Mathematic Modelling, Data Storage and Retrieval and Ground Water Pollution.

It has also provided assistance to the National Drinking Water Mission for locating sites for drinking water and to suggest suitable and economic structures to tap Ground Water for Drinking Purpose in the Rural Areas.

Note : Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

RIVERS IN INDIA

Rivers in our Country may be classified as:

(*i*) Himalayan Rivers,

(*ii*) Peninsular Rivers,

(*iii*) Coastal Rivers,

(*iv*) Rivers of the Inland Drainage Basin.

(i) Himalayan Rivers

The Himalayan Rivers are perennial as they are generally snow-fed and have reasonable flow throughout the year. During the monsoon, the Himalayas receive very heavy rainfall and the rivers discharge the maximum quantity of water causing frequent floods.

(ii) Peninsular Rivers

The Peninsular Rivers are generally rain-fed and therefore, fluctuate in volume.

(iii) Coastal Rivers

A large number of the streams are Non-Perennial. The coastal streams, especially on the West Coast are short in length and have limited Catchment Areas. Most of them are flashy and non-perennial.

(iv) Rivers of the Inland Drainage Basin

The streams of the Inland Drainage Basin, is the largest in India receiving waters from an area which comprises about one-quarter of the total area of the Country. Its boundaries are well defined by the Himalayas in the North and the Vindhyas in the South. The Ganga flows through Uttar Pradesh, Bihar and West Bengal in India and enters Bangladesh thereafter. It has Two Main Headwaters in the Himalayas: the Bhagirathi and the Alkananda, the former rising from the Gangotri Glacier at Gomukh and the latter from a Glacier short of the Alkapuri Glacier. The Ganga is joined by a number of Himalayas Rivers including the Yamuna, Ghaghra, Gomti, Gandak and Kosi. The Western-most River of the Ganga System is the Yamuna, which rises from the Gangotri Glacier and joins the Ganga at Allahabad. Among the important rivers flowing North from Central India into the Yamuna and the Ganga and the Ganga are the Chambal, Betwa and Sone.

Test Brahmaputra

The Brahmaputra and the Barak Rivers flowing from East to West in North-eastern Region are International Rivers and have immense Water Resources Potential, which is still in the initial stages of development.

The Godavari

The Godavari River in the Southern Peninsula has the Second-Largest River Basin covering 10 percent of the area of India. Next to it is the Krishna Basin in the region while the Mahanadi has the third-largest basin. The Basins of the Narmada in the uplands of the Deccan flowing to the Arabian Sea and of the Kaveri in South falling into the Bay of Bengal are about the same though with different character and shape.

The Tapti and the Penner

Two other River Systems, which are small but agriculturally important, are those of the Tapti in North and the Penner in the South. These West-Coast Rivers are of great importance as they contain as much as 14 per cent of the Country's Water Resources while draining only 12 per cent of the land area.

Note : Courtesy Research and Reference Division Ministry of Information and Broadcasting, Govt. of India.

RURAL WATER SUPPLY PROGRAMME

India implements the Largest Government Sponsored Rural Water Supply Programme in the World. Although supply of drinking water is primarily the responsibility of stage governments, the Union Government supports the programme with fully centrally sponsored Accelerated Rural Water Supply Programme (ARWSP).

NDWM

In order to provide further managerial, technical and financial support to the programme, National Drinking Water Mission (NDWM) was launched in 1986. All the programmes were coordinated under the umbrella of NDWM to achieve the goal of International Drinking Water Supply and Sanitation Decade (IDWSSD) by providing 100 per cent coverage for rural villages by March 1990.

NDWM had a clear goal of covering residual problem villages (1.62 lakh at the begining of the seventh plan) by 1990. In order to achieve the same, it provided low-cost appropriate technological solution to identify problems associated with supply of safe drinking water through the application of scientific and technological inputs. Nearly 85 per cent of the programme is to provide spot sources through Level Operation and Maintenance (LOM) pump called India mark II is presently being exported to nearly 40 countries World over.

Mini-mission Areas

Some 55 pilot Project called mini-mission areas covering various status and union territories and Five Submission were taken up during the seventh plan. A problem village has been defined as one with no source of safe drinking water within a distance of 1.6. or within a depth of 15 metres. One problem villagers face are those where available water has excessive salinity, iron, fluoride or other toxic elements or where diseases like cholera, guinea worm, etc are endemic.

After covering problem villagers identified in the Sixth and Seventh Plan, water supply facilities were proposed to be extended to villagers as per liberalized norms *i.e.* within a distance of 0.5 km. and enhancing present norm of water supply from 40 litres to 70 litres per capita per day and provide one source (tubewell with hand-pumps or stand-post) for a population of 150 against the existing norm of 250-300 persons. Priority was being accorded for coverage of SC/ST habitations and water supply for the economically and socially background areas.

States were advised to allocate atleast 25 per cent of ARWSP funds for the Schedule Castes and another ten per cent of Schedule Tribes. At the commencement of the seventh plan, 161, 722 problem villages remained to be covered with safe drinking water facilities. The mission had been successful in covering 1,53,390 problem villages in the Seventh Plan. Remaining 8,332 villages which had spilled over to the Eight Plan were to be covered in the first two years of the Eight Plan *i.e.* by 1992.

Against the Seventh Plan outlay for Central Assistance to States/UTs under ARWSP and Technology Mission Schemes for Rs. 1207 crore, Rs. 1906 crore had actually been released and utilised and Rs. 423 crore had been provided in 1990-91 for ARWSP/Mini-Mission and submission and national drinking water mission and Rs. 6.43 crore under State Sector MNP.

Through NDWM, science and technology inputs had been harnessed in a big wat including Remote-sensing and satellite imagery, geographical, investigations, etc. to effect scientific source finding. Steps were also initiated to investigation of water purification from laboratories to commercial production and then on to field for removing salinity, excess iron and excess fluoride.

Looking at the success of India’s Performance in the rural drinking water supply, for the first time a flobal consulatation national development programme and the Government of India between 10-14 September, 1990 where 125 countries and various multi-lateral and bilateral agencies were represented through 600 delegates. The challenge set up for the next decade is “Some for all, rather than more for some”.

The New Delhi Global Consultation

The New Delhi global consultation recommended four guiding principles which are:

(*i*) Protection of the environment and safeguarding of health through the integrated management of water resources and liquid and solid waters.

(*ii*) Institutional reforms promoting, attitudes and behaviour, and the full participation of women and all levels in sector institutions.

(*iii*) Community management of services, backed by measures to strengthen local institutions in implementing and sustaining water and sanitation programmes.

(*iv*) Sound financial practices, achieved through better management of existing assests and widespread use of appropriate technologies.

Note : Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

FLOOD MANAGEMENT

Floods are annual features in one part of the Country or the other causing damage to the crops and property, destruction of communication and at times heavy loss of human-life and livestock.

National Flood Control Programm

After heavy floods in 1954, the Government of India announced a National Flood Management Programme. The programme was divided into these phases immediate, short-term and long-term:

(*i*) The immediate phase was adopted for intensive collection of data and execution of emerge flood protection measures.

(*ii*) The short-term measures for flood protection include construction of Spurs and embankments of select sites.

(*iii*) The construction of storages, reservoirs on rivers/tributaries and additional embankments were the main long-term measure adopted. Out of the total geographical area of 329 million ha of the country, area prone to floods and area which can be provided reasonable degree of protection as assesses by R.B.A. are 40 million ha. and 32 million ha. respectively.

Even after the implementation of short and long-term measures, providing a certain degree of protection against floods to the flood prone areas, the flood loss continued to show increasing trend. More realistic and relational approach for flood management under the existing resources contains would be to strive for a reasonable degree of protection against floods by structural measures and supplement it by resorting to non-structural measures.

MEASURES AND ACHIEVEMENTS

(1) Since the launching of the National Flood Control Programme, an expenditure of about Rs. 2710 crore have been incurred on the Flood Control Sector till the end of the Seventh Plan. In the Seventh Plan, an Approval Outlay of Rs. 947.39 crore has a share of Rs. 797.43 crore by States and Union Territories and Rs. 149.93 crore by the Centre.

(2) Since 1954 nearly 15,467 km of new embankments, 30,199 km of drainage channels, 765 town-protection works and raising the level of about 4,705 villages have been completed upto March, 1989. These achievements have been executed at an

expenditure of Rs. 2493.56 crore and have benefitted 13.64 million ha. In addition, Anti-sea Erosion Measures to protect coast-line especially in Kerala were taken up. Out of the 320 km of vulnerable coast-line 311 km have been protected upto March, 1990.

(3) Upto 42 km existing sea walls have been strengthened. Rs. three point five crore have been allocated as Central Loan Assistance to Kerala during 1990-91. In Karnataka, 73.3 km of the coast-line, out of 280 km is vulnerable to sea erosion and 12.89 km of coast-line been protected upto March 1990.

(4) A number of reservoir projects had been completed which have helped in mitigating flood-peak in the down-stream reaches. Notable among these are Hirakud Dam on the Sutlej, Pong Dam on the Beas and Ukai Dam on the Tapti. All these works have afforded a reasonable degree of protection.

(5) The Country on the whole experienced good and well-distributed rains. Rainfall was normal and well-distributed in 32 out of 35 Metrological Sub-divisions of the Country and 84 per cent of the Districts recorded excess of normal rainfall. The rain was deficient in Andaman and Nicobar Island, Lakshadweep and Kerala meteorological sub-divisions. Heavy rains/flash floods in Andhra Pradesh, Rajasthan, Orissa and Kerala characterized the over-all flood situation. Assam, Bihar, Uttar Pradesh, Madhya Pradesh and West Bengal also experienced moderate to high-intensity floods. It is reported that an area of 4.9 million ha, have been affected by floods during 1990 monsoon season and a population of 16.2 million were affected and crops worth Rs. 28.1 crore in an area of about 2.8 million reported to have been damaged. In all, nearly 882 human-lives and damages to the crops, houses and public utilities were reported to be the tune of Rs. 41.25 crore.

Forecasting

Flood Forecasting Activities have been vastly extended and expanded over the years since 1959 by covering almost all major inter-state river basins. Currently, the flood forecasting network compromising 157 flood forecasting stations covers 72 river basins. These sites were operational during 1990-flood season. The flood forecasting network is also supported by 500 meteorological stations, which collect and transmit data through 400 wireless stations to various control rooms for processing and issue forecasting.

During the flood season 1990, the number of Flood Forecast issued having benefitted the state and UTs was about 3,500. About 95 per cent of these forecasts were within perimissible range of accuracy. With great thrust being accorded to flood forecasting aspect under the eighth plan period, the number of flood forecasting stations were likely to increase to about 200 by the end of the eight plan period and to about 300 by the end of the century.

Thrust Area During the Eighth Plan Period

The working group on flood management in its report for the eighth plan (1990-95) laid stress on non-structural measures viz. flood forecasting and farning, flood plan zoning, flood froofing and disaster perparedness. Substantially, increased outlays for these activities had been recommended by the working group which are as follows:

(*a*) Flood forecasting Rs. 44.30 crore, (*b*) Flood plan Zoning Rs. 32 crore and

(*c*) Flood proofing Rs. 440 crore.

The following projections have been considered in the flood management sector:

(*i*) The Government of India reaches a memorandum of understanding with the Nepalese-Government in March 1988. Under the agreement it was proposed to set-up 45 hydrological and hydrometerological stations in Nepal for issuing flood forecasts for Nepal and India. The joint reconnaissance teams identified 15 of these sites and the required equipment for these stations were procured and transferred to the Nepalese Government. Reconnaissance survey for seven more stations was also done during May 1990.

(*ii*) The work of extension of flood forecasting network in the Brahmanputra and the Barak River Basins was given priority and include in the Action Plan of the Ministry of Water Resources Survey for seven more stations would be operational during 1991 flood season.

(*iii*) Real time data acquisition and In flow forecasting system using latest metero burust communication system for Krishna, Mahanadi and Chambal basin under the Dam Safety and Rehabilitation Programme was prepared and discussed with the World Bank.

(*iv*) Under a French Collaboration Progrmme, the River Baitarni was also proposed to be modernised for data acquisition as well as forecasting in the country.

Ganga Flood Control Commission

Ganga Flood Control Commission, Patna, established in April 1972, is primarily concerned with the preparation of a comprehensive plan for flood control in the Ganga basin and arranging its implementation in coordinated manner through the states in the basin. The commission, Anti-Water-Logging-Erosion and Anti-Erosion Schemes estimated to cost Rs. lakh each or more in the Basin

Note: Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India

DROUGHT PRONE AREAS PROGRAMME

The Drought-Prone Areas Programme was initiated as an Integrated Area Development Programme in 1973. The programme was conceived as a long-term measure for restoration of ecological balance and optimum utilisation of land, water, livestock and human resources to mitigate the effects of 'The drought in and 'The drought prone areas'. The programme has three basic objectives:

(*i*) To conserve, develop and harness land and other natural resources including rainfall with a view to improving and restoring ecological balance,

(*ii*) To minimise adverse effects of drought on crops and livestock production through integrated development of land, water resources, and adoption of appropriate technology,

(*iii*) To ultimately achieve drought proofing of the project area through integrating and dovetailing activities under this programme with State Sectoral Plans and Special

Programmes. The programme is under implementation in 615 block of 91 district in thirteen states. Present coverage of the programme is based on the recommendations of the 'Task Force on DPAP and DDP (1982)' as modified by the Inter Departmental Group (1984). Total area covered under the programme is about 5.54 lakh sq. km and the total population in the areas covered by the programme is about 775 lakh. The funds for the programme are shared by the Central Government and the states concerned on a 50:50 basis. An Outlay of Rs. 237 crore was provided for the programme in the Central Plan for the Seventh Plan Period.

Desert Development Programme

The objectives of this programme include controlling the process of desertification mitigate the effects of drought in desert areas, restoration of ecological balance in affected areas and raising productivity of land, water, livestock and human resources in these areas.

The objectives are sought to be achieved through activities such as a forestation with special emphasis on sand dune stablisation, shelterbelt plantation and grassland development, soil and moisture conservation and water resources development. The programme covers 131 blocks of 21 districts in five states. It also covers cold areas of Jammu and Kashmir and Himachal Pradesh. The area covered under this programme is about 3.62-lakh sq. km and the population area covered is about 150 lakh. This programme is implemented with 100 percent Central Financial Assistance. In 1989-90, allocations were made at the rate of Rs. 24 lakhs per 1000 sq. km., the ceiling per district hence will be Rs. 500 lakh. For cold desert areas, a lumpsum provision is made, the rate being Rs. 100 lakh per district per year for Himachal Pradesh and Rs. 150 lakh district per year for Jammu and Kashmir.

Since its inception, Rs. 291.33 crore has been spent under the programme. During the Seventh Plan Period, Rs. 194.04 crore has been spent under the programme.

Table 2.6 Depiction of the Physical Achievements Made Under The Programme Upto March 1990 Physical Achievements

Sector	**('000 hectare)**
(*i*) Area treated under soil and moisture conservation	91.28
(*ii*) Area treated under water resources development	34.90
(*iii*) Area covered under afforestation and pasture development	179.18

Note: Courtesy Research and Reference Division Ministry and Broadcasting Govt. of India.

INTER-STATE WATER DISPUTES

The water wealth of India is enormous. The National Water Policy of 1987 recognizes River Basin as a unit for the purpose of harnessing the water potential.

Reasons for Differences

Major River Basin of the Country are all almost Inter-state. With so many rivers flowing through more than one state, it is a natural phenomenon that differences would arise sometime or other amongst concerned states with regard to use and distribution of control of water of such rivers. This is especially so in view of the rapid pace of water resources development to meet the increasing demand for irrigation, Hydel-Power Generation, domestic and industrial water supply etc.

Effort to Resolve Disputes

Efforts are made, as far as possible, to resolve all disputes by negotiations amongst states concerned or with the assistance of the Centre. Adjudication through Tribunal is resorted to when warranted. Several of Inter-State Water Dispute have been resolved in the recent past.

1. Some of these are agreements regarding construction of Thein Dam (Ravi), Barakar, Ajoy, Mayurakshi, Mahanada, Subernrekha and Kanhar Rivers, some common rivers between Madhya Pradesh and Orissa and some between Maharastra and Madhya Pradesh.
2. Sharing of river waters of the Krishna, the Godavari and Narmada by concerned Basin States has been settled through respective Tribunals set-up by the Government under the Inter-State Water Dispute Act, 1956.
3. The Ravi and Beas Waters Tribunal, which was set-up on second April 1986, submitted its report to the Central Government on 30 January 1987.
4. In August, 1987 a further reference was made to the Tribunal comprising a Suo-moto Reference by the Central Government and reference received from Punjab, Harayana and Rajasthan Government's seeking explanation/guidance on certain points in the report.
5. Two major inter-state river dispute have not yet been resolved. They relate to utilisation of the waters of the Kaveri and the Yamuna.
6. The Kaveri Water Dispute had to be referred to a tribunal are still continuing. Keeping in view the response of the party states concerned, it should be possible to find solution to the Yamuna Water Dispute without recourse to a tribunal.

BARDS AND COMMITTEES

Necessary Boards and Committees are formed to resolve the disputes, if any arise among the states on the water distribution and allied issues. Some are as under:

(1) Bansagar Control Baord

In pursuance of an inter-state agreement among Madhya Pradesh, Uttar Pradesh and Bihar, the Bansagar Control Board was constituted in January, 1976 with headquarters at Rewa, Madhya Pradesh, by the Ministry of Water Resources for efficient, economical and early execution of Bansagar Dam and connected works on the Sone River (excluding Canal and Power Systems which will be carried-out by the respective states).

(2) Sardar Sarovar Construction Advisory Committee

The Sardar Sarovar Construction Advisory Committee, Vadodara in Gujrat, was set-up in accordance with the direction of the Narmada Water Disputes Tribunal for scrutinising estimates, technical features, designs of Units I and III (Dam and Power Portion) and Annual Works Programmes of the Project in Gujrat, which is an Inter-State Project benefiting Gujrat, Madhya Pradesh, Maharashtra and Rajasthan. The Dam and Power House Complex was completed by 1998. The project was expected to irrigation about 18 lakh hectares in Gujrat and provide 1450 mw Hydro-Power for peaking.

(3) Statutory Bodies

Four Statutory Bodies are functioning under the Ministry of Water Resources. These are: Narmada Control Authority, Brahamputra Board, Betwa River Board and the Tungabhadra Board. A brief description of these bodies is as under:

(a) Narmada Control Authority

The Narmada Control Authority was set-up in pursuance of the decision of the Narmada Water Disputes Tribunal. It started functioning from December, 1980 and was further strengthened during 1987 and 1990. The authority coordinates and directs Narmada Basin Development Project and takes such measures as are necessary or expedient for protection of environment and also prepares Schemes for the Welfare and Rehabilitation of Oustees and Other Affected Persons.

(b) Brahmaputra Board

The Government constituted the Brahmaputra Board under the Brahmaputra Act, 1980, with the specific object of preparing a 'Master Plan' for the control of Flood and Bank Erosion and Improvement of Drainage of the Brahmaputra Valley. Jurisdiction of the Board includes the Barak Valley.

(c) Betwa River Board

The Rajghat Dam Project on the Betwa, a Tributary of the Yamuna, is an Inter-State Project of Madhya Pradesh and Uttar Pradesh. In accordance with the inter-state agreement between the two states in 1973, Betwa River Board was constituted under the Betwa River Board Act, 1976 for early executions of Rajghat Dam Project.

(d) Tungabhadra Board

The Tungabhadra Board is incharge of the common portions of the Tungabhadra Project. The Krishna Water Disputes Tribunal had made specific provision in the award for the use of Tungabhadra Waters by Karnataka and Andhra Pradesh. The responsibility for carrying out this specific provision relating to the use of Tungbhadra Water has been entrusted to the Tungabhadra Board by the Tribunal. The board is also regulating the water for irrigation, Hydro-Power Generation and other uses of the Right Bank.

IRRIGATION AGREEMENTS

(1) Indus Water Treaty

India and Pakistan signed the Indus Water Treaty on 19 September, 1960, fixing and delimiting the rights and obligations of the Two Countries with regards to the use of the waters of the Indus River System. It came into force from first April, 1960. A Permanent Indus Commission representing both the Governments have established co-operation arrangements for implementation of the treaty.

(2) Indo-Bangladesh Joint Rivers Commission

The Indo-Bangladesh Joint Rivers Commission was set-up in July, 1972 to perform the following functions:

(*i*) To maintain liason between the Participating Countries in order to ensure the most effective joint efforts in maximizing the benefits from Common River System to both Countries:

(*ii*) To formulate flood forecasting and cyclone warnings;

(*iii*) To study flood control works and so recommended implementation of Joint projects;

(*iv*) To formulate detailed proposal on advance flood warnings, flood control and Irrigation Project so that the water resources of the region can be utilized on an equipment basis for the mutual benefit of the people of the two countries;

(*v*) To formulate proposal for countries to co-ordinate research on problems of flood control affecting both the countries.

Indo-Nepal Sub-Commission on Water Resources

The Indo-Nepal, sub-commission on water resources was set-up in August 1988, to deal with all aspects of Indo-Nepal Cooperation in the multiple uses of Water Resources for mutual benefit. In additional to the matter already under discussion at secretary-level and other meetings, the sub-commission shall identify new programes/Project for water resources development for cooperation between India and Nepal in specific sectors *viz.* irrigation, water-logging and drainage, hydro-electric power generation. Inland navigation, collection of hydrological data, measures to prevent and reduce losses due to floods, flood forecasting and flood warning, environment safeguard measures and transfer of technology suited to the requirement of both the countries.

Note: Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

DAMS: DESCRIPTION, BENEFITS AND PROBLEMS

A number of big, medium and minor dams have been envisaged under different river valley projects. These dams have been undertaken for irrigation, power generation and water supply. These dams, hailed as the Temples of Modern India by the country’s first Prime Minister, Jawaharlal Nehru, have increased agricultural production, power generation and reduced dependence on imports. A brief description of the dams and benefit accruing form them is as under:

Farakka Barrage Project

The Farkka Barrage Project is designed to subserve the need for preservation and maintenance of the Calcutta Port by improving the regime and navigability of the Bhagirathi-Hooghly River System. The Bhagirathi, the feeder canal and the navigation lock at the Farakka Barrage form part of the Haldi-Allahabad Inland Waterway for which an act has been passed.

The principles components of the Farakka Barrage Project are:

(*a*) 2,240 metre-long barrage across the Ganga, designed to pass a flood discharge of 76,455 cumec or 27 lakh, with rail-cum-road bridge, the necessary river draining works and a head regulator on the right side;

(*b*) 213 metre-long garrage across the Bhragirathi at Jangipur, designed to pass flood discharge of 1,700 cusecs or 60,000 cusecs;

(c) Feeder canal of 1,133 cusecs or 40,000 cusecs carrying capacity and 38.38 km-long taking off from the head regulator on the right-side of the Faraka Barrage, tailing-off into the Bhagirathi below Jangipur Barrage;

(d) Navigation works such as locks, channels, shelter navigation lights and other infrastructures.

VARIOUS DAMS IN THE COUNTRY AND BENEFITS THEREFROM

(1) Damodar River Valley Project

Damodar River Valley Project serves several objectives. This huge dam is, in fact, a series of small dams built on a river and its tributaries, serves as man-made lake that is now able to impound huge amount of rain water. In this way, it helps in flood control and soil protection. This water is used for irrigation during dry periods. Since catchments areas of dam are afforested, there is available additional wild land that helps to preserve ecosytems.

The water stored here is used for power generation *i.e.* hydle power or hydro-electricity. These projects also provide for inland water navigation, cheapest means of transport for heavy goods. They are also used to develop fish hatcheries and nurseries.

Damodar Valley Project consists of series of small dams of the tributaries of Damodar, flowing from Chotanagpur in South Bihar to West Bengal. The hydle power has been integrated in a common grid.

(2) Bhakra Nangal Project

This project has been built where two hills on either side of Satluj are very close to each other. It claims to be highest gravity dam in the world (height 226 metres from river bed). The project serves the states of Himachal Pradesh, Punjab, Harayana, Rajasthan and U.T. of Delhi.

(3) Indira Gandhi Rajasthan Canal Project

It is ambitious plan to bring new areas under irrigation. The water of the Beas and Ravi has to be diverted to Satluj. The Pong Dam on the Beas impounds 6,90,000 ha metres water. This dam helped in the division of Beas into Satluj in a regulated manner. It enabled Rajasthan canal to irrigation Ganganagar, Bikaner and Jaiselmer Districts. The main canal is 468 km long.

(4) Kosi Project

Kosi Project or river Kosi in North Bihar has a main canal to irrigate 8,73,000 ha of land in Bihar.

(5) Hirakud Dam

Hirakud Dam in Orissa is longest serves Karnataka and Andhra Pradesh. This 2.5 km long dam irrigates nearly 4,00,000 ha land.

(6) The Tungbhadra

The Tungbhadra Project serves Karnataka and Andhra Pradesh. This 2.5 km long dam irrigates nearly 4,00,000 ha land.

(7) The Nagarjunasagar

The Nagarjunsagar Project is built on river Krishna in Andhra Pradesh. It irrigates 8,67,00 ha land.

(8) The Chambal Project

The Chambal irrigation parts of M.P. and Rajasthan. There are many other such projects on different rivers in the country.

ENVIRONMENT PROBLEMS CREATED BY DAMS

We can study the environmental side effects of river valley and hydle-power projects in three categories as under:

(*i*) Effect within and around the area covered by the dam and reservoir.

(*ii*) Downstream effects consequent to the alternation in hydraulic regime,

(*iii*) Regional effects in terms of overall aspects including resources use and socio-economic aspects.

The Evil Impacts

The impacts caused by construction of dams and reservoirs include the following:

(*i*) Changes in the microclimate,

(*ii*) Loss of vegetal cover,

(*iii*) Soil erosion,

(*iv*) Variation in water level,

(*v*) Enhanced seismic activities due to pressure of water.

(1) Effects of Blasting

In hilly tracts, blasting operations for road construction can cause considerable damage to the environment through the following reactions:

(*a*) Loosening of hill sides and resultant landslides,

(*b*) Sedimentation of reservoirs,

(*c*) Drying up of spring and flash floods.

(2) The creation of new settlement for the workmen and rehabilitation of project oustees in the watershed areas may aggravate the seriousness of advance impact.

The Guidelines

The guidelines refer to the environmental components to be taken in view during site selection. These include the following points:

(*i*) Short and long-term impact on population in the unidentified and watershed areas;

(*ii*) Impact on wildlife,

(*iii*) Impact on land use,

(*iv*) Potential seismic impact of reservoir loading, (*v*) Water balance and hydrological regime,

(*vi*) Siltation,

(*vii*) Socio-economic impact such as rehabilitation of project oustees and been suggested in the guideline.

The costs for environment protection and mitigative measures should also be included in the overall estimates. These should include measures like:

(*i*) Compensatory afforestation

(*ii*) Restoration of land in construction areas,

(*iii*) Control of aquatic weed,

(*iv*) Control of water and soil diseases,

(*v*) Rehabilitation of project oustees.

SOME SAFEGUARDS

From the above it becomes clear that it is essential to guarantee mitigative and environmental safeguard before clearance of a project. The safeguard for the following are to be guaranteed:

(*i*) Submergence of valuable agricultural and forest areas,

(*ii*) Siltation of reservoirs consequent to degraded catchment conditions,

(*iii*) Satisfactory rehabilitation of those inhabitants who are ousted,

(*iv*) Loss of flora and fauna,

(*v*) Reservoir induced seismicity,

(*vi*) Water borne and soil borne diseases.

Opposition of Dams

The above-mentioned problems created by the dams have led to the opposition in various corners of the country. The experts hold it from time to time that the social, environmental and even economic cost of these dams, however, far outweighs their benefits. The most important social consequence of big dams has been displacement of millions of tribals from their homeland and their eventual influx into urban areas, almost as refugees. This is the reason why Scientists, environmentalists, journalists, social activities, lawyers and bureaucrats have taken up the cry against big dams.

Reaction

The ever-increasing opposition from scientists and environmentalists has forced the Govt. of review a number of proposed dams in the light of their impact on local tribals flora and fauna. Results are also seen. The Govt. had to scrap the Silent Valley Project in Kerala. Likewise, Koel and Karo Project in Bihar was also abandoned due to opposition from local people as it would have displaced several thousands for Santhal tribals in the area.

The following four major projects have generated much controversy:

(*i*) Sardar Sarovar Project, Gujarat.

(*ii*) Narmada Sagar Project, M.P.

(*iii*) Bodhaghat Project, M.P.

(*iv*) Tehri Dam Project in U.P.

Though these have been given environment clearance, pressure is being exercised on the Govt. to drop these projects. A reader of newpapers could go through the headlines as "Losses exceed Tehri Dam benefits," "Govt. forced to rivew dam projects". "Big dams spell doom", "How green was my valley", "The displacement factor" etc. A brief description of these dams is as under:

(1) Sardar Sarovar (SS)

Project near Navagam in Bharuch district of Gujarat is one of the costliest projects project affecting village in three states- M.P. Maharashtra and Gujarat. It is estimated that nearly 245 villagers will be submerged, of which about 193 in M.P. alone. As such, over 75,000 (nearly 50,000 in M.P. alone) people will be evicted.

Besides, additional displacement is likely to be caused during social and environmental rehabilitation work undertaken to repair the dislocation and damages caused by the project. Likewise, compensatory afforestation and setting of wildlife sanctuary will displace other villagers in the area. It is officially admitted that nearly 43,000 ha of land will be needed for rehabilitation of SS outees.

(2) Narmada Valley Project (NVP)

It claims to be the world's largest river valley project. The 30 big dams and over 3,000 medium dams are envisaged. It is estimated that it would displace over one million people, mostly tribals, submerge 56,000 ha of fertile agriculture land. Total forest are of nearly 60,000 ha will be destroyed. As a result, nearly 25 species of birds will be deprived of their habitats.

(3) Bodhghat Project

Bodhaghat Project on Indaravati river in M.P. is in Bastar district. It is feared that the project will destroy teak and sal forests, and spell doom for the last surviving wild buffaloes. The criticism of the project was so high and widespread that it forced the Govt. and the World Bank to reconsider it.

(4) Tehri Dam

Tehri Dam is on the Bhagirathi river in U.P. at the foothhills aof Himalayas; it is Soviet-financed and challenged in the Supreme Court. It is feared that it will displace over 85,000 people. It will totally immerse the Tehri town and completely or partly submerge nearly 100 villages. The site is prone to intense seismic activity. It is also held the 3,200 million ton of water that the Dam would impound could cause a major earth tremor. In case a disaster takes place the entire religious townships of Deoprayag, Hardwar and Rishikesh would be devastated. Thousand of hectares of rich, agricultural land will be drowned. The fear is not imaginary. In July/August 2004 the midable position took place.

DAM SAFETY ORGANIZATION (DSO)

There are about 1600 large dams in the country of which over 100 Dams are 30 metres in height and above. While these dams provide much needed water for irrigation and development of power, they also pose the potential hazard in the event of failure.

Realising the importance of hazards posed by the dams, the Government India constituted the Dams Safety Organization. New Delhi, in CWC in 1979. The organization assists the state governments to locate causes of potential distress and redress the affecting Safety of Dams and Allied Structures. It also advised and guides the state government in providing suitable remedial measures.

The organization has created awareness about the implications of Dam Hazard and the consequence of failure thereof. The organization devised guidelines and literature on dam safety inspections and modes and causes of failure to highlight the importance of monitoring the Safety Aspects of Dams. This organization is the Secretarial of the Nations Committee of Dam Safety created to follow-up the implementation of the recommendation of the 'Report on Dam Safety Organization'. It is also pursuing creation of Dam Safety Cells in various states and, in this connection, 12 States have so far set-up 'Dam Safety Cells' in their States.

Note: Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

MINERAL RESOURCE: USE AND EXPLOITATION ON THE ENVIRONMENTAL EFFECT OF THEIR EXTRACTION

Significance

The economic development of a country depends, to a great extent. On the availability of minerals, got as ores from the earth by mining Coal and iron are the basic minerals which man needs to develop iron and steel industry. Minerals like mica, copper, lead and zinc are of vast economic importance. Thorium and uranium are atomic energy minerals.

Position of Minerals in India

India is rich endowed with minerals like coal, bauxite, barytes, iron, one mica, gypsum, chromite, dolomite and limestone while it is deficient in minerals like asbestos, phosphates, lead, tungsten, tin platinum group of metals, gold and diamonds.

Need for an Appropriate Policy

An appropriate policy regarding extraction of minerals is needed in view of the limited availability and nature of minerals as under:

(1) Mineral resources are finite and non-renewable.

(2) Mineral resources constitute raw materials for many basic industries.

(3) Mineral resources are major resources of nations development.

National Mineral Policy

In view of the above Nations Mineral Policy has been adopted which encompasses the various Policy Guidelines, which have been issued from time to time. The policy also emphasizes certain new aspects and elements as under:

(1) Mineral Exploration in the seabed,

(2) Development of proper inventory,

(3) Proper linkage between exploitation of minerals and development of mineral industry,

(4) Preference to members of the scheduled tribes for development of small deposits in scheduled areasm

(5) Protection of forests, environment and ecology from the adverse effects of mining,

(6) Enforcement of mining plan for adoption of proper mining methods.

(7) Optimum utilizations of minerals, export of minerals in value added form and recycling of metallic scrap and mineral waste.

Under the constitution, mineral rights and administration of Mining Laws are vested in State Governments. The Central Government, however, regulated development of minerals under the Mines and Minerals (Regulation and Development) Act, 1957 and the rules and regulations framed under it. The statute empowers the Centre to formulate rules for the following:

(*i*) The grant of prospective licences and mining leases;

(*ii*) The conservation and development of minerals;

(*iii*) The modification of old leases.

The Mines and Minerals (Regulation and Development) Act, 1957, was amended in 1972 and major amendments were made in February 1987. The Mineral Concession Rules, 1960, 1958 was replaced by more comprehensive rules in 1988.

MINERALS RESOURCES

Principle minerals found in the country, along with their estimated reserves, are given below:

(1) Bauxite

Recoverable reserves of all grades of bauxite in the country are estimated at 283.3 crore tonnes. Important deposits occur in Andhra Pradesh, Bihar, Goa, Gujrat, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh.

(2) Barytes

The recoverable reserves of barytes are placed at 7.1 crore tonnes. Most of the reserves are located at Mangampet Taluka in Cuddapah District, Andhra Pradesh. Other minor occurrences are reported from Rajasthan, Tamil Nadu, Himachal Pradesh, Bihar, West Bengal, Maharashtra, Karnataka, Madhya Pradesh and Uttar Pradesh.

(3) Coal and Lignite

Coal is India's largest mineral resource and presently India is fifth largest of coal in the world. Vast deposits of coal of Gondwana formations occur in West Bengal, Orissa, Bihar, Madhya Pradesh, Andhra Pradesh and Maharashtra. It also occurs in tertiary formations in Assam, Arunachal Pradesh, Meghalaya, Jammu and Kashmir and Nagaland. Total reserves of coal are estimated at 17,046 crore tonnes comprosing 16,499 crore tonnes of non-coking coal and 547 crore tonnes of prime cocking. As compare with India's coal reserves lignite resources are relatively modest at 438.8 crore tonnes of which the bulk of the reserves are located in and around Neyyeli in Tamil Nadu. Significant lignite resources are in Rajasthan, Gujrat and Jammu and Kashmir.

(4) Chromite

Total recoverable reserves of Chromite, are estimated at 5.4. crore tonnes. Deposits of economic significance occur in Andhra Pradesh, Bihar, Karnataka, Maharastra, Manipur, Orissa and Tamil Nadu. However, refractory grade reserves of chromite are very meagre.

(5) Copper

Major and important copper ore producing areas are in Singhbhum District (Bihar), Balaghat District (Madhya Pradesh) and Jhunjhunu and Alwar District (Rajasthan). In addition, small production of copper ore comes from Khammam District (Andhra Pradesh), Chitradung and Hassan Districts (Karnataka), and Sikkim. Copper ore reserves in the Country are estimated at 63.2 crore tonnes with a metal content of about 82.8 lakh tonnes.

(6) Diamond

Total reserves and resources in the country are placed at 10.8 carats. main diamond bearing area in India is Panna belt in Madhaya Pradesh, Ramallakota and Bangampalle Chitradung rocks in Kurnool Districts and gravels of Krishan River Basin in Andhra Pradesh. Presently, the only Diamond Pipe under exploitation is at Panna.

(7) Dolomite

Total recoverable reserves of dolomite of all grades are placed at 46.08 lakh tonnes. Principal producing states for dolomite are Orissa, Madhya Pradesh, Gujrat, Bihar, Uttar Pradesh and West Bengal.

(8) Gold

There are three important gold fields in the country, namely, Kolar Field in Kolar District and Hutti Gold Field in Raichur District (both in Karnataka) and Ramagiri Gold Field in Anantapur district (Andhra Pradesh). Total in-situ gold ore reserves and resources are estimated at five crore tonnes with a total Gold content of 103.17 tonnes. However, Kolar Gold Field Mines an Hutti account for bulk of Gold Ore Reserves, equivalent to about 57.6 tonnes in in-situ Gold.

(9) Fireclay

India has vast resources of fireclay with recoverable reserves of 70.3 tonnes. Fireclay occurs in India mainly, associated with Coal Beds of Godwana and Tertialryt Basins. Major fireclay producing states are Bihar, Gujarat, Madhya Pradesh, Orissa, Tamil Nadu, Rajasthan, West Bengal and Andhra Pradesh.

(10) Fluorspar

Fluorspar mainly occurs in Gujrat, Madhya Pradesh and Rajasthan with total recoverable reserves estimated at 18.8 lakh tonnes.

(11) Gypsum

Total reserves and resources of gypsum in the country are estimated at 120 crore tonnes, of which recoverable reserves are 31.9 crore tonnes. Bulk of domestic production mineral gypsum comes from Rajasthan and Tamil Nadu, Jammu and Kashmir, Himachal Pradesh and Uttar Pradesh. Gujrat also produces small quantities.

(12) Graphite

Recoverable reserves of graphite are estimated at 46.5 lakh tonnes of which 31 lakh tonnes occur in Kerala and Bihar and the rest in Orissa, Rajasthan, Tamil Nadu and Andhra Pradesh.

(13) Limonite

Total reserves in limonite at 14.6 crore mainly in beach sands on Eastern and Western Coasts and Tamil Nadu are important.

(14) Iron Ore

India is favourable endowed with iron ore deposits recoverable reserves are estimated at 1197.7 crore tonnes of which 10, 267 tonnes are haematite and 171 crore tonnes magnitute Ore. Haematite mainly occurs in Bihar, Orissa, Madhya Pradesh, Maharashtra, Goa, and Karnataka. Large reserves of magnetite ore occur along West Coast, primarily in Karnataka with minor occurrences in Kerala, Tamil Nadu and Andhra Pradesh.

(15) Kaolin

India possesses vast resources of kaolin and ball clay with kaolin Resources being placed at 87.2 crore tonnes. Currently, principal producing states for Kaolin are Bihar, Gujrat, Rajasthan and West Bengal, Kerala, Haryana, Orissa and Madhya Pradesh also produce significant quantities. Ball Clay Kerala is chiefly produced in Rajasthan, Andhra Pradesh and Gujarat.

(16) Lead-Zinc

Lead-zinc ore occur in Rajasthan, Meghalaya, Gujrat, West Bengal, Uttar Pradesh, Andhra Pradesh, Tamil Nadu, Orissa and Sikkim. However, 95 per cent of the known resources are localised in south-central Rajasthan and the adjoining part of Gujrat. Total identified ore resources are placed at 38.3 crore tonnes equivalent to an in-situ mental content of 56 lakh tonnes of lead and 1.83 crore tonnes of zinc.

(17) Limestone

Limestine occurs extensively in the country and is produced in almost all states. Major Producing states are Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Gujrat, Bihar, Orissa, Rajasthan and Karnataka. Total recoverable reserves of Limestone of all grades are estimated Manganese Ore at 6935.4 crore tonnes.

(18) Manganese

Recoverable reserves of manganese ore are estimated at 15.4 crore tonnes. Rich deposists of Manganese Ore occur in Andhra Pradesh, Goa, Gujrat, Karanataka, Madhya Pradesh, Bihar and Orissa. Major producers are Orissa, Karnataka, Madhya Pradesh and Maharashtra.

(19) Mica

India is world's leading producer of sheet mica and accounts for about 60 per cent of global mica trade. Economic deposits of mica occur in three richest mica belts, accounts for almost 60 per cent of India's output in terms of value. Though large mica resources are existing, estimates have not far been made because of irregular nature of pegmatites as well as erratic nature of mica mineralisation in pegmatites.

(20) Nickel

Low grade latorited nickel occurs in Cuttack, Keonjhar and Mayurbhani Districts of Orissa. Main occurrence is in Sukinda Belt to Cuttack District. Minor occurrences are also reported from Bihar, Manipur, Nagaland, Maharasthra, Karnataka and Rajasthan. Total nickel ore resources are estimated at 23.1 crore tonnes.

(21) Phosphate Minerals

Deposists of Phosphorites are located in Chhatarpur, Sagar and Jhabua Districts of Madhya Pradesh, Udaipur, Jaisalmer and Banswara districts of Rajasthan and Dehradun and Tehri and Lalitpur District of Uttar Pradesh. Besides, apatite deposits of commerical importance are reported to occur in Bihar, Andhra Pradesh, Rajasthan, West Bengal and Tamil Nadu. Total recoverable reserves of Rock Phosphate are estimated at 11.5 crore tonnes and of apatite at 20 lakh tonnes.

(22) Tungsten

Recoverable reserves of tungsten ore are placed at 70 lakh tonnes with W 03 contents of 7,860 tonnes. Tungsten ore occurs in Rajasthan, Maharashtra, Karnataka, West Bengal and Uttar Pradesh. The only producing mine in the country is at Degana in Rajasthan.

(23) Magnesite

India is having large resources of magnesite, which is an important refractory mineral. Total recoverable reserves of magnesite are estimated at 22.2 crore tonnes. Presently, chief sources of magnesite are in the District of Salem in Tamil Nadu and Almora in Uttar Pradesh. Deposits of magnesite also occur in Chamili and Pithoragarh District of Uttar Pradesh, Mysore and Hassan District of Karnataka and in Jammu and Kashmir and Kerala.

(24) Kyanite and Sillimanite

Kyanitye and sillimanite are other important refractory minerals. Principal sources of supply of kyanite are Singhbhum deposit of Bihar and Bhandara deposit of Maharashtra. A small quantity is also produced form Karnataka and Rajasthan. Total recoverable reverses of Sillimanite are placed at 54.3 lakh tonnes.

(25) Other Minerals

Other minerals occuring in significant quantities in India are as under:

(*i*) Bentonite (Gujrat, Rajasthan, Bihar, Jammu and Kashmir and Tamil Nadu),

(*ii*) Corundum (Maharashtra, Madhya Pradesh, Karnataka and Andhra Pradesh),

(*iii*) Calcite (Rajasthan, Madhya Pradesh, Andhra Pradesh and Gujrat),

(*iv*) Fuller's Earth (Rajasthan, Madhya Pradesh, Andhra Pradesh),

(*v*) Felspar (Rajasthan, Andhra Pradesh, Tamil Nadu and Madhya Pradesh),

(*vi*) Garnet (Tamil Nadu, Rajasthan and Andhra Pradesh),

(*vii*) Steatite (Rajasthan, Uttar Pradesh, Andhra Pradesh, Tamil Nadu and Bihar), (*ix*) Wollastonite (Rajasthan and Gujrat), Zicro (Beach Sands of Tamil Nadu Kerala and Orissa),

(*x*) Quartz and other Silica Minerals are wide-spread and occur in almost all states.

(*xi*) The country has vast resources of building, dimension and ornamental stones such as granite, marble and slate.

While Granite is chiefly mined in Tamil Nadu, Karnataka, Andhra Pradesh and Rajasthan, Marble is extensively mined in Rajasthan, Uttar Pradesh and Gujrat. Principally Madhya Pradesh, Andhra Pradesh and Harayana produce slate.

MINERAL AND METAL PRODUCTION

Production of important minerals during 1997-98 to 2001-2002 (provisional is shown in following table):

Note: Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

M. Tonnes–Million tonnes, '000–Tonnes-Thousand tonnes, M.C.M.–Million Cubic Metre, Kg.–Kilogram

* The figure excludes the production of fireclay, if any recovered incidental to coal mining.

(R) 'R' shows previous years figures repeated as current data have not been received yet.

Note: (1) The value figures pertain to pithead value

(2) Data based on the return received under MCDR, 1998 except coal, lignite petroleum (Crude), natural gas (utilised) and minor minerals:

(*a*) Coal and Lignite: Coal Controller, Kolkata

(*b*) Petroleum (Crude) and Natural Gas: Ministry of Petroleum & Natural Gas, New Delhi.

(*c*) Minor Minerals: State Governments.

Environment Problem Created by Extracting and Mining

The environment side effect of extracting and mining projects can be studied in three categories as under:

(*i*) Effect within and around the area covered by the dam and reservoir.

(*ii*) Underground effects caused by emptying of area.

(*iii*) Regional effects in terms of overall aspects inclusive of resources use and socio-economic aspects.

(*iv*) It has also been participating in India Expeditions to Antarctica right from the very first expedition.

GSI with its headquarters at Calcutta functions six regions, three specialised wings and a training institute. Each year GSI takes up about 1100 investigations in geological mapping, mineral assessment, geotechnical and environment studies, air borne geo-physical surveys as well as geological and geophysical surveys in bordering seas. Output of these efforts is in the form of scientific and technical reports, professional papers, maps and inventories and various types of publications such as memoirs, records, bulletins, Indian minerals and Palentologica Indica.

(2) Indian Bureau of Mines

Indian Bureau of Mines (IBM) is a multi-disciplinary scientific and technical department.

Function

(1) It is primarily responsible for the conservations and scientific development of mineral resources other than coal, petroleum, natural gas, atomic minerals and minor minerals.

(2) It scrutinises mining laws before granting approval, undertakes inspection and study of mines and research on beneficiation of low-grade ores and minerals and on special mining problem.

(3) It provides technical consultancy service to the mining industry for survey and geological appraisal of mineral resources and preparation of feasibility reports on mining projects including beneficiation plants.

(4) It advises Central and state governments on all aspects of mineral industry, trade and Legislation. IBM has its headquaters at Nagpur with 12 regional offices and three well-equiped ore dressing laboratories and pilot plants.

(5) IBM function as a 'data bank' for mines and minerals and bulletins on different connected subjects. Important publications are: Indian Minerals Year Book (Annual), Bulletin of Mineral Information (Quarterly), Mineral Statistics of India (Half-yearly), Monthly Statistical of Mineral Production, Foreign Trade in Mineral and Metals (Annual) and Indian Mineral Industry at a Glance (Annual).

3. Public Sector Mining Undertaking

The Department of Mines has administrative responsibility for following undertakings:

(1) Hindustan Zinc Limited (HZL)—Zinc and Lead

(2) Hindustan Copper Limited (HCL)—Copper

(3) Bharat Gold Mines Limited (BGML)—Gold

(4) Bharat Aluminium Co. Ltd. (BALCO)—Aluminium

(5) National Aluminimum Co. Ltd., (NALCO)—Alminimum

(6) Mineral Exploration Cooperation Ltd. (MECL)—Exploration

(7) Sikkim Mining Corporation—Copper, Zinc and Lead.

4. Hindustan Zinc Limited

Hindustan Zinc Limited (HZL) was incorporated in January 1966 with the following purposes:

(1) To take over operation of the erswhile Metal Corporation of India.

(2) To develop mining and smelting capacities for zinc and lead.

Beginning with 500 tonnes per day at Mochia in Rajasthan and 3,600 tonnes per year lead smelter at Tundoo in Bihar, HZL has now seven operating mines with a capacity of 8,740 tonnes of Ore per day, Two Zinc Smelters with a capacity, of 30,000 tonnes per year.

In addition to production of primary metals—zinc and lead, the company produces a number of by-products such as cadmium, silver, sulphuric acid, phosphoric acid, fertilisers, zinc sulphate and copper sulphate.

Based on lead-zinc deposits of Rampura-Agucha in Bhillwara District, a new open pit mine at Rampura-Agucha and a new smelter at Chanderiya in Chittogarh District is under construction. Total cost of the project is estimated at Rs. 684 crore. The smelte will have a capacity of 70,000 tonnes zinc and 35,000 tonnes Lead per annum. It will be operational during 1991-92.

5. Hindustan Copper Limited

Hindustan Copper Limited (HCL) is 54,000 tonnes of Copper in concentrate products viz., Gold, Silver, Nickel, Selenium, tellurium etc. With a view to increase expansion of Malanjkhand Copper Project. It has set up a continuous cast copper wire rod plant at Taloja with an installed capacity of 60,000 tonnes per annum.

6. Bharat Gold Mines Limited

Bharat Gold Mines Limited (BGML) operates Kolar Gold Mines where gold mining started in 1880 under M/s. John Taylors Sons, a company incorporated in England. This company continued operating these mines till 1956 when key were taken over by the Karnataka.

BGML was incorprated in 1972 to take over and operate these mines. There are three working mines *viz.,*

(*i*) Mysore Mine

(*ii*) Nundi Drug Mine

(*iii*) Chamption Reef Mine

Besides this, BGML is also exploiting Yeppamana Mine Project in Andhra Pradesh. Mining is created out in Kolar Gold Fields under extremely difficult conditions. Mining has reached a depth of over 3,200 metres at Kolar Gold Fields involving problems of heat and ground control.

Due to depth of mining and depletion of Gold Reserves, mining operations of BGML are uneconomic. Exploration for development of new shallow mines is being actively pursued. Further, taking advantage of skilled manpower, technical expertise and available infrastructure and diversification plants have been prepared to cover areas of mine construction and manufacture of mining machinery.

Project and Contracts division of BGML was established in 1973 for mine construction work and has already executed a large number of shaft sinking and mine development jobs. It has ambitious programmes in this field to meet the requirement of mining industry in the country during 1990s.

BGML has four central workshops, which besides catering the maintenance requirements of their own mines, produce a variety of mining equipment for the market. It is planning to strengthen manufacturing activities with regard to traditional items as well as to diversity into new lines of products.

7. Bharat Aluminium Company Limited

Bharat Aluminium Company Limited (BALCO), the first unit in Public sector for production of Aluminium, was incorporated in November, 1965, for setting up an integrated Alumina/aluminium Complex at Korba in Bilaspur District of Madhya Pradesh based on Bauxite Deposits in Amarkantak/Phutka-pahar Area. The plant has an installed capacity of two lakh tonnes per annum and was commissioned in 1973. The smelter was commissioned in phase, corresponding to availability of electric power from Madhya Pradesh Electricity Board. The final phase was commissioned in September, 1984, which brought the installed capacity of one lakh per annum.

A 270 mW captive thermal power station was commissioned in 1987-88 for facilitating operations of Korba complex by reducing dependence on Madhya Pradesh Power Supply Board. Amarkantak and Phutka-Pahar Bauxite Deposits are nearing the end of economic working life. Till suitable alternative captive source for steady supply for bauxite are established, arrangements are being made to obtain Bauxite from Panchpatmali Mine NALCO and some private mine operators in Madhya Pradesh.

8. National Aluminium Company Limited

The National Aluminum Company Limited (NALCO) is the biggest integrated bauxite/alumina/aluminium project in Asia which is based on extensive Bauxite Deposits in Orissa on East Coast of India. This company was incorporated in 7 January 1981, to exploit these deposits. The projects includes 24 lakh tonnes per year Bauxite Mine at Penchapatmali (Koraput), eight lakh tonnes per annual Alumina Plant at Damanjodi (Koraput), 2,18,000 tonnes per annual Aluminum Smeltre at Angul (Dhenkanal) and port facilities at Vishakhapatnam (Andhra Pradesh) for export of Alumina and import of caustic soda.

M/s. Aluminium Pechiney of France supplied technical know how and basic engineering package. Engineers India Limited has done detailed engineering, construction, supervision, procurement assistance and overall monitoring of the project. Trial production was started in 1987-88 was the first years of commercial production when over 60 per cent of the rated capacity was achieved and this increased to 87.66 per cent in 1989-90.

NALCO entered export market of Alumina in January 1988 and aluminium metal in September 1988. Foreign exchange earnings through alumina and aluminium exports in 1989-90 were about Rs. 412 crores.

9. Minerals Exploration Corporation Limited

Mineral Exploration Corporation Limited (MECL) was registered in 1972 to undertake detailed mineral exploration for assessing mineral reserves in the Country. Besides, the corporation is engaged in mine construction, geographical work at dam sites and drilling and construction of tubewells. The corporation, with its headquaters at Nagpur, carries out detailed mineral exploration in behalf of the Government of the Public and Private Sector enterprises and organizations, state governments, *etc.* on contractual basis. It plays the role of a premier exploring agency in the country. Since its inception in 1972, the company has explored places to the tune of tonnes of different mineral/ores comprising coal, bauxite, base metals, gold, iron ore, limestone, etc.

Note: Courstesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

NATIONS WATER DEVELOPMENT AGENCY

The Agency was estiblished in 1982 to carry-out studies and investigations of possible storage reservoir sites and inter-connecting links in order to establish feasibility of proposals under the 'National Perspective Plan' which comprises of two components *viz*. Himalayan River Development and Peninsular Rivers Development. Detailed studies about quantum of which is surplus in various Peninsular Rivers and which can be transferred to other Basins in the region after meeting reasonable needs of the Basin States as well as, feasibility reports of various components of schemes relating to Peninsular Rivers Development are being prepared. Studies are expected to be completed by the end of the eighth plan. Simultaneously, the National Water Development Authority will also start carrying-out studies for Himalayan Rivers Development during the eighth plan period.

PUBLIC SECTOR UNDERTAKINGS

(i) Water and Power Consultancy Services (India) Limited

The Water and Power Consultancy Services (India) Limited was set up in June, 1969 to project and channelise India Expertise in power and water resources development and their utilization. It offers consultancy services in all aspects of Water Resources Development including downstream aspects, ground water, supply and treatment, inland waterways and navigation, hydrographic surveys, etc.

(ii) National Project Construction Limited

The National Projects Construction Corporation Limited, which was earlier under the Department of Power, was brought under the Administrative Control of the Ministry of Water Resources in September, 1989.

The corporation was set-up in January venture of the central and state governments to undertake execution of heavy construction engineering works of all types. Over the years, the National Project Construction Corporation Limited have evolved into a professionally managed organization functioning on commercial lines and has successfully completed a number of project of national importance. The corporation has gathered rich expertise and is now capable of undertaking construction of Large Super Thermal Power Stations, Hydro-Electric Power Projects, dams, bridges, tunnels, canals and other allied civil works and industrial structures.

National Water Board

A National Water Board was constituted by the Ministry of Water Resource in September, 1990, under the Chairmanship of Secretary, water resources, to consider and review the progress made on issues connected with the development of water resources as well as implementation of the National Water Policy and report the same of the National Water Resources Council. The first meeting of the National Water Board was held on 27 December 1990 at New Delhi. The progress on implementation of the National Water Policy was reviewed. The proposed programme of actions on the 'different clauses' of the National Water Policy for 1991-92 was also discussed. It was inter-alia decided in the meeting to set-up Three Sub-Committees of the Board to prepare policy papers on:

(*i*) Setting-up of the River Basin Organization in the Country;

(*ii*) National Rehabilitation and Resettlement Policy;

(*iii*) The Water Information System.

These Sub-Committees have since been set-up.

Water Resources Day

The Water Resources Day is organized all over the Country since 1986 in April in order to make the people more conscious about problems associated with the management of water, a limited precious resource. As a result of the increasing encouraging response from the Central/state Government and other voluntary agencies concerned, the Water Resources Day was orgainsed at about 503 centres of the country during 1990. The theme for National Debate was "Water for future."

The Water Resources Day was celebrated at 800 places all over the country during April-May 1991 by mobilizing the support of various state governments and other Agencies including Local Offices. In view of the over-all increasing demand for water linked with the increasing population pressure, the Theme for the forthcoming Water Resources Day was selected as "Water Conservation."

Note: Courtesy Research and References Division Ministry of Information and Broadcasting Govt. of India.

FROM PROBLEM: CAUSES AND SUGGESTIONS

At present not only India but the whole world is facing the food problem.

Main Causes of Food Problem: Main causes of food problem are as under:

1. Quantitative aspect of food problem

(*a*) *Increasing Population*: Though food production has increased all over the world as well as in India, yet due to over growth of population our needs also have increased for greater than the production.

(*b*) Secondary, man off and on suffers from the draughts and floods. This is the reason why the prices of food grains are shooting up.

Per capita net availability of food grains went up to a level of 496 grams per day in 1989 as compared to that of 395 grams in early fitfties. In 1990, it has been provisionally estimated at 476 grams per day. In terms of gross fertilizers consumption, Indra ranks fourth in the World after USA, USSR and China. The country has the largest in the World under Pulse Crops. In the field of cotton, India is the first one to evolve a cotton hybrid. The country has made a major breakthrough in Prawn Seed Production and Post Culture Technology.

Compound growth rate in agriculture production during the period 1949-50 to 1988-89 was 2.63 per cent per annum. Production of foodgrains increased significant from 549.2 lakh tonnes in 1949-50 to 1706.3 lakh tones in 1989-90. Cropping pattern is more diversified and cultivation of commercial crops has received new impetus in line with domestic demands and export requirements.

During Post Green Revolution period *i.e.* 1967-68 to 1988-89, growth rate in agriculture production was assessed at around 2.64 per cent annum. Production of foodgrains during this period from 950.5 lakh tones to 1699.2 lakh tones. Cropping pattern has undergone perceptible changes and non-traditional crops like summer moong, soya-bean, summer groundnut, sunflower etc., are gradually gaining importance. In order to utilize scares resources optimally, a short duration third crop is also being raised in some areas utilizing residual moisture available from post-kharif and post-rabi cultivation.

The index of agriculture production, which registered an increase of 21.0 per cent in 1988-89 over the previous year showed further increase of 1.6 per cent in 1989-90 due to primary increase recorded in the production of cotton, jute and mesta, sugarcane and other commercial crop. The index of foodgrains during 1989-90 however, registered a marginal increase of 0.4 per cent cover the previous years level of 182.5. It was anticipated that the foodgrains production during 1990-91 would reach an another record level, the third year in succession. Production of all lukseed crios except groundnut, cotton, surgance, jute and mesta was also bright.

Inspite of an increase in production is failed to cope with the rapid and formidable increasing in population.

2. Qualitative aspects of food problem

If we view from nutritional view point, we find that foodgrains have the storages. If every person is given balanced diet, nutritious food must have per day per person 3000 calories but in India it is about 200 calories while Canada has 3060, America has 3090, U.K. has 3290 and Japan has 2280.

The qualitative aspects of the poor's food are more pitiable. In this way, Indians do not even get appropriate nutritious elements. An average Indian is able to take only carbohydrates, as he depends on ill-nutritious grains. From his meals protective food like milk, fish egg, fruits and vegetables are absent.

The following reasons are responsible for unbalanced diet:

(*i*) Less production of protective food.

(*ii*) Low capacity for the purpose of nutritious articles.

(*iii*) Refraining from meat, fish and eggs due to religious causes.

(*iv*) Unawareness of balanced diet.

However, our government has become conscious of improving the nutritious status of the people. A number of nutritious interventions have been made in recent years by different sectors of the Government, which have direct and indirect impact on the nutritious status of the people. The nutritious programmes of the department of food are directed towards improving the nutritious status of the people through a combination of measures such as,

(*i*) Nutritious education and training.

(*ii*) Development and production of nutritious foods.

(*iii*) Fortification and enrichment of food.

Nutritious education has become one of the important activities of the department for more than three decades. Thirty Four Mobile Food and Nutrition Extension Units (MEUs) equipped with mobile van, audio- visual equipments and technical trained personnel have been set up the Department of Food in different parts of the country to impart nutrition education in rural, urban and tribal areas. These units organise live demonstrations supported by lecture-cum-discussions, films and slide shows and exhibitions on various aspects of food, nutritions and health in collaboration with the state governments, educational institutions and voluntary orgainsations. The Department of Food also has Thirty Three Food and Nutrition Extensions (FNECs) in different Parts of Country for imparting education and training in home-scale preservation of fruits and vegetables and nutrition mainly to the housewives and providing progressing facilities for fruits and vegetables for domestic consumption.

Realizing the importance of integrated to nutrition, the Department of Food is implementing an Integrated Nutrition Education Scheme Department with a view to equip the grass-root level works of the concerned sectors with simple knowledge in food, nutrition and health so that these messages are conveyed to the community by all field functionaries during the course of their respective duties. Intensive training is imparted to grass-root level workers and their supervisors belonging to different sectors implementing nutrition, health and welfare progrmmes by MEUs and FNECs by orgainising Integrated Nutrition Education Camps at the block level and orientation training Nutrition Education Camps at the block level orientation training courses at State Level Training Institutes or Home Science Colleges respectively.

A Nation Nutritious Week is celebrated in the Country from 1-7 September every year with a view to create nutritional awareness among the people. This Department has taken up action programmes for the development and production of low-cost proceed nutritious food for use in supplementary feeding, programme and meeting the requirements of vulnerable sections of the population. These foods are Miltone (a nutritious milk beverage), Energy Foods, Ready-to-Eat Extruded Food and Weaning Foods. It has also taken up schemes for fortification of milk with Vatamin ‘A’ and Salt with Iron. The Milk Fortification Scheme is in operation through 45 dairies in the Country covering 16 states and two union territories. The analysis of fruit and vegetable products under the regulation of quality control of this product for domestic consumption as well as export has also been entrusted to the department and is carried out at Four Laboratories at Delhi, Bombay, Calcutta and Madras.

Note: Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

3. Distribution aspect of Food Problem

Distribution of foodgrain is far from being satisfactory. It is essential that the available foodgrains in the country should be distributed to public at fair-price and appropriate time. But the policy adopted by the Government for food procurement, price control ends in fiasco due to lack of initiative, hoarding and Black-marketing by traders is the next problem. It is worth mentioning that our Government has taken up proper measures in this direction. The Public distribution System has become one of the basic features in the Governments Policy. Its role as an anti-inflationary measure has also been recognized. The system is designised. The system is designed to help both the producers and the consumers, as procurement is linked to purchase and support prices and distribution is made at as more of less uniform prices throughout. The system has also helped to provide a nutritious diet at a low-budget to the common man. Moreover, this system has acted as an effective establishing factor in India's Social Life by providing a steady supply of essential commodities at reasonable prices.

Pressured on the Public Distribution System continued, during the year due to higher prices of essential commodities in the open market. Total allocations of Rice and Wheat (including under PD, JRY Nutritional programme, etc.) during 1990-91 and 95.47 lakh tones respectively as against 85.26 and 93.09 lakh tones respectively in the previous year.

With a view to control sugar prices and ensure its availability as reasonability at reasonable rates to consumers, the Government took a number of measures including increase of Sugar (both free sale Levy Sugar) from 9.32 lakh tones in August, 1990 to 10.07 lakh tones per month in September on October, 1990.

In view of increased demand and reduction in the production of Indigenous Edible Oils due to delayed rainfall in Gujarat, total allocations of imported Edible Oils during 1990 were at the level of 6.52 lakh tones as against 3.91 lakh tones in the corresponding period in 1989, showing an increase of 66.5 per cent. The lifting by state/Uts against the allocation during 1990 was 5.21 as against 3.27 during 1989.

The Public Distribution System continued to be a major component of our strategy for growth with social justice. The Centre, states and union territories have a joint responsibility in making this system a success. The working of this system is periodically reviewed in consolation with state government and corrective measures taken. At the Centre, an Advisory Council functions to review its working from time to time. In the states/Uts Consumer Advisor Committee at District, Block and Taluka Levels oversee the working of the Fair Price Shops. The network of Fair Price Shops has been expanding over the years and in the last five years their number increased from 3.02 lakh (March, 1984) to 3.61 lakh (March, 1990). Special emphasis is being laid in opening of Fair Price Shops in remote, far-flung and inaccessible areas, particularly covering tribal population. With a view to ensuring that the essential commodities reach the farthest corners in hilly and inaccessible areas, the Government continued to provide financial assistance to states/Uts enabling them to purchase mobile vans. Such assistance was worth Rs. 144.50 lakh for purchase of 58 vans in 1990-91.

Government procures and supplies six essential commodities, *viz.,* rice, Wheat Sugar, Imported Edible Oils, Kerosene and Soft Coke. States/Uts are free to include any other commodity of mass consumption by arranging for its procurement on their own. Some states have arranged supplies of Pulses, Vanaspati, Soaps, cycle types and tubes, torch cells *etc.* through Fair Price Shops.

4. Economic aspect of food problem

The price of foodgrains is soaring high while income has no proportionate increase. Hence poor people are unable to avail two meals a day. Some illustrations are as under:

(*i*) *Cereals*

Prince of Cereals, particularly Rice and Wheat, rose sharply towards the end of the third quarter of 1990-91. In additional to increased allocations of these commodities through the Public Distribution System, the Food Corporation of India was permitted to sell 15 lakh tones of Wheat to roller flour mills, traders, Government Agencies and other users at the rate of Rs 320 per quintal in Northern and Rs 330 per quintal in the Southern Parts of the country. The procurement price of Paddy (common variety) rose from Rs 185 per quintal in 1989-90 Rs 205 per quintal in 1990-91 and of Wheat from Rs 183 quintal for 1989-90 to Rs 215 quintal in 1990-91.

(*ii*) *Pulses*

In the wake of decline in the Production of Pulses in 1989-90 to 126. 1 lakh tones from 138.5 tonnes in 1988-89, the prince of Pulses during 1990-91 period increased by 14.5 per cent. In order to bridge the gap between demand-supply equilibrium, NAFED has been authorized to import pulses under OGL Scheme. Under this scheme, NAFED registered contracts for a total quantity of 97.7 lakh during 1990-91. As an incentive to production, the Minimum Support Prices of Pulses have been increased substantially *i.e.* Rs. 325 per quintal for 1989-90 to Rs 421 per quintal for 1990-91 in case of Gram and Rs. 425 per quintal for 1989-90 to Rs. 180 per quintal for 1990-91 in the case of Arhar, Moong and Urad.

(*iii*) *Edible Oils*

Production of Oilseeds suffered a set-back during 1989-90.During this period the production declined to 167.3 lakh tones from 178.9 lakh tones in 1988-90. As a result of this decline, coupled with increased demand, the prices of Edible Oils rose by 30.1 per cent during 1990-91. The Government has taken a number of steps to check the run-away increase in the prices of Edible Oils. This includes exemption of Excise Duty on Refined Rapeseed/Mustard seed Oil, reduction in the stock limits of Edible Oils with wholesalers and retailers and withdrawal of permission for use of 20 per cent Expellor Mustard/Rapeseed Oil in the manufacture of Vanaspati for ensuring increased availability of these oils during the lean period/festival season. To increase the available position of Edible Oils in the open market, the imports have been stepped-up from 3.73 lakh tones in the oil-years 1988-89 lakh tones in oil year 1989-90. The Minimum Support Prices of Oilseeds were stepped-up as an incentive to Oilseed Gravers.

In the Case of Groundnut, the Minimum Support Price was increased from Rs. 500 per quintal for 1989-90 to Rs. per quintal for 1990-91 and for Mustard Seed from Rs. 460 per quintal to Rs. 575 per quintal.

(*iv*) *Cement*

During the financial year 1990-91, the Wholesale Prince Index of Cement showed and increase to sharp increase in demand, lower growth rate of production, inadequate supply of Coal, hike in railway freight charges, *etc.* The government took proper remedial steps.

Several factors contribution to the increase in prices. These included Budgetary Levies, Hike in Petroleum cumulative effect of high liquidity, High Budgetary deficit, fall in the production of some key commodities like Pulses, Oilseeds, *etc* substantial hike in minimum procurement/support prices of important agriculture commodities, *etc*., and the situation being further aggravated by the Gulf Crisis.

The Government took several steps to contain the rising price spiral of essential commodities. Allocation of foodgrains (Rice and Wheat) through the Public Distribution System was increased from 1.55 lakh tones in January 1991 to 1.81 lakh tones in March 1990.

State Governments and UT administrations were asked to step up enforcement activities against hoarders, black-marketers and other antisocial elements. During the period from January, 1990 to March, 1991, a total number of 1,24,885 raids were made, 5,900 persons were arrested 4,557 persons were prosecuted and goods worth Rs. 1956.65 lakh were confiscated under the Essential Commodities Act.

Note: Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

CAUSES OF FOOD GRAIN PROBLEMS

The causes of foodgrain problems can be understood under three heads-long term; mid-term and short-term.

(a) Long-Term Causes

The long term causes of food problem are as under:

(*1*) *Population growth*

Instant imbalance in supply and demand of foodgrains is consequent to the enhanced population pressure on the quantity of foodgrains.

(*2*) *Decrease in agriculture output*

For various reasons, agriculture output is decreasing day to day.

(*3*) *Decrease in Productivity*

Due to the afforestation, land abrasion; insufficient manures, defective agricultural methods defective land tenures have led to decrease in productivity of land. Although new agricultural policy increased the main crops by times, yet compared to other countries, it is even less.

(*4*) *Insistence of commercial agricultural*

With the growth of importance to agriculture for commercial purposes, to earn immediate profit production of foodgrains is discouraged.

(*5*) *Natural Calamities*

At times, the natural calamities like floods, crops instead of nutritious foodgrains as the former has richer growth. Consequently there is scarcity of foodgrains.

(b) Mid-term Causes

(*1*) *Position of 1947*

With the independence in 1947, the country was sub-divided into Pakistan and India. The areas with rich agricultural produce went to Pakistan. This led to food crisis in India.

(*2*) *Defective Food Distribution*

Food crisis is chiefly due to defective food distribution. Traders and consumers store in lot when they see that production is less. Hence, crops available in market decrease and prices soar.

(*3*) *Fall in Purchasing Capacity*

Dearness has increased while income of the people has not risen. Thus to purchase foodgrains people lack the purchasing capacity.

(*4*) *Limited Jurisdiction of Reserve Bank*

Reserve Bank has extensive power to control the credit policy of commercial banks, which prevent the traders from improper collection of foodgrains. However, it has no control over the indigenous bankers and sahukars. Hence its policy ends in failure.

(c) Short-Term Causes

This classification includes such causes which provoke the crisis through imbalance in supply and demand of foodgrains during a year.

Some causes are as under:

(*1*) *Increase in Consumption Level*

The progress of India people, on account of various reasons, has increased average income which has led to increase the consumption level. Increase in demand results in decrease in foodgrains.

(*2*) *Deficit in Production*

Untimely rains and under rains during the year bring less production.

(*3*) *Anti- Social Activities*

Anti-social activities of traders like brokerage, hoarding and black-marketing result in artificial shortage of foodgrains.

(*4*) *Transportation*

Rise in the price of diesel and other lubricants as well as risks involved in transportation also result in shortage of foodgrains now and then.

CHANGE AGRICULTURE AND OVERGRAZING

(1) Jhum Cultivation

In North-East India (Meghalaya), non-mechanized farming system called 'Jhum' cultivation has been practised since long. They cut a clearing in a forest during the dry months, trees are felled, allowed to dry and then burnt. The fire kills weeds, seeds and insects and provides the mineral rich ash. With the onset of rains, the farmer plants a crop. The grain is harvested and the rest of the plant is burnt. When this system is practiced for 2 or 3 years, the soil fertility progressively decreases as there is less of ash every year (as compared to the amount in the first year when the trees were burnt). When it is no longer profitable to cultivate that part, the farmer moves on to another forest and repeats the same cycle.

(2) Overgrazing

Effects of over-grazing are well known on soil loss. Increasing number of livestock and migrating grazers have contributed to degradation of forests and the consequent devastation. The most accessible forest areas are heavily grazed. For instance, (*a*) There are nearly 1200 thousand sheep and goats in alpine areas of U.P.

(*b*) Besides nearly 25,000 migration graziers visit the area.

(*c*) There are also about 5 to 7,000 buffaloes owned by Gujaras.

It is estimated that in absence of suitable checks, growing forestry stock will decrease from 13.79m^3/head in 1981 in 2001; and reduction in annual availability of grass will be from 3.60t/cattle unit in 1981 to 0.90t/cattle unit in 2001. Existing forests may thus not be able to meet out wood and fodder requirements of mankind and livestock respectively.

They Menace

(1) The annual loss of soil nutrients in this way is of the order of 5.37 million tones of NPK valued at about Rs. 700 crores.

(2) Besides, the expenses of soil removal, which gets silted in irrigation tanks, reservoirs, sea and riverbeds, are also quite high.

(3) Overgrazing is a major hazard afflicting pastures, forests and mountains.

(4) There are huge semi-arid zones in India used for grazing. But grazing destroys the little covers and enhances wind and erosion.

Suggestions

(1) There must be development crops for arid regions. For example, there are some plants, which yield hydrocarbons (substitute for oil), and grow well in arid conditions. These include jojaba, a plant that yields a sap like diesel oil and milkweed.

(2) The Jidhpur Arid Zone Rea Institute is already experimenting with such varieties.

(3) In overgrazed areas there should be grown fodder trees like Ku-babul, which in irrigated condition gives enough green fodder per acre to maintain six cows.

(4) Most villages should be asked to grow such plants instead of grass on panchyyati pastures.

(5) Goats and sheep should be kept in enclosures and fed with tree fodder, through which many more calories will be converted into meat and wool. These animals waste huge quantities of calories roaming on pastures. Ku-babul can supply the high quality feed.

MODERN AGRICULTURE: EFFECTS OF

With a view to feed rapidly increasing new mouths and to cope with the necessity of providing sufficient food to the people, various techniques and methods have been applied in the field of agriculture.

(1) Agriculture Census

The Department of Agriculture and Cooperation has been conducting agriculture census in each of the plan period since 1970-71. Census in 1970-71 and 1980-81 were organized as part of the World Agricultural Census Programmes sponsored by the Food and Agriculture Organisation of United Nations. They were conducted on a complete enumeration basis in most States/Uts. The other two census with agriculture years 1976-77 and 1985-86 as reference period were conducted on a census-cum sample basis to reduce burden tin collection and processing of primary as also to keep costs low.

The agriculture Census seeks to collect information on distribution of holding an area operated along with its related characteristics such as tenancy and terms of leasing, land use and cropping pattern, irrigation and sources of irrigation *etc* by different six classes. Data is utilized for formulation of Poverty Alleviation Programmes in general and uplifts of Small and Marginal Farmers in particular. Skewness in distribution of land holdings and pattern of tenancy are also extremely useful for the Department of Rural Development for certain programmes.

(2) Agricultural Research and Education

The Department of Agriculture Research and Education Raise More darker which was set up in 1973 in the Ministry of Agriculture is responsible for coordinating research and educational activities in agriculture, animal Husbandry and fisheries. Besides, it helps to bring about inter-departmental and inter-institutional with the National and International Agencies engages in the same and allied fields. The Department provides Government support, service and linkage to Indian Council of Agricultural Research (ICAR).

(3) Indian Council of Agriculture Research

The Indian Council of Agricultural Research (ICAR) is a registered society and is the apex body responsible for promoting, conducting and co-ordinating research education and primary extension education in the fields of agriculture, animals science, fisheries and the allied sectors in the country.

The Council is directly involved in undertaking research through its 46 Central Institutes including Four Nation Bureaus, 20 National Research Centres and Nine Project Directorates on Fundamental and Applied Aspects of Individual Crops, commodities and disciplines which have direct relevance to Agriculture Animal Husbandry, Fisheries and Allied Sectors. In addition the ICAR also operates 71 All India Coordinated Research Projects, which are multi-locational and multi-disciplinary in nature on important commodities, and research has proved its efficacy and utility over the last successive plan period as an effective instrument to tackle the diverse problems characteristic of India Agriculture.

The educational programmes at the National Level are by the large being conducted through 26, Agriculture Universities located in various important states. Four of the ICAR's Institutes *viz* Indian Agriculture Research Institute, New Delhi, Indian Karnal and Central Institute of Fishery Education, Bombay, also perform educational functional and offer Post Graduated, Bombay Programmes in the capacity of well-recognised Deemed University and award degrees. The ICAR is also supporting the educational programmes of the State Agriculture Universities by providing developmental grants to these universities.

The ICAR is also conducting first-line demonstration for the transfer of improved technology to the extension/state functionaries and the village-level workers as well as to selected farmers. The council has been operating projects like National Demonstrations, Operational Research Projects and Lab-to-Land Programmes at 301 Centres in the country including 45 centres for upliftment of Scheduled Castes and Scheduled Tribes. A network of 109 Krishi Vigyan Kendras has also been established for imparting on-farm training in various aspect of agriculture. Animal Husbandry, Fisheries and allied areas for youth, farm-men and women and other categories of rural workers. These programmes also have a degree up-support in the form of Trainers Training Centres for providing an up-to-date knowledge of farm-worthy advancement made in research.

Attempted are being made to make Agriculture more science-based and industry-linked. Biotechnology, Gentic Engineering, Photosynthesis, Tissue Culture, Bio-insecticides and Pheromones are the merging area of research to promote growth of agriculture productivity. Accordingly, the ICAR has established. Three Nation Research Centres in Biotechnology in agriculture, animal health and animal production at Three National Institutes. It involves Biological Nitrogen Fixation, Plant Cell and Tissue Culture, Molecular Biology and Biochemistry of monoclonal antibodies and hybridomes for cheaper and more effective Immunodiagnostic and Immunoprophylactic Agents and Multiple Ovulation, Embryo Transfer Technology, Genetic Manipulation and Cryo-Preservation. The following priorities and thrust areas in respect of Agriculture Research and Educational have been identified which are based on the present need to make agriculture knowledge intensive using also frontier technologies to accelerate the Research and Development output in critical areas, developing appropriate rural technologies for farm women, research in agricultural, economic and policy planning and creating genetic enhancement centers and technology blending centures *etc.:*

(*a*) Conservation and planned exploitation of Germ-plasm Resources.

(*b*) Enhancing productivity through evolution of new high-yielding Hybrides/varities/starins with tolerance to biotic and abiotic stresses.

(*c*) Development of Intergrated Pest Management Practices to optimize plant protection.

(*d*) Bredder Seed Production;

(*e*) Research on Export Oriented Commodities;

(*f*) Diversification of agriculture with emphasis on Agro-forestry, livestock and fishers;

(*g*) Development and refinement of Dry Farming Technology.

(*h*) Improving Nutrient Management System.

(*i*) Inventory of Natural Resources.

(*j*) Energy Management in Agriculture.

(*k*) Post-harvest Technology and Engineering with emphasis on on-farm storage.

(*l*) Forestering excellence in research and educational programmes.

(*m*) Tansfer of Technology an Improving Information and Communication Systems,

(*n*) Human Resources Development.

Crops Science

Research Advances in Crops Sciences including crop protection techniques have given the National confidence to produce foodgrains to meet not only present requirement but to achieve the target of 2250-2500 lakh tones to foodgrains set for the ensuing year. During the year, the emphasis was given on attaining higher crop productivity and sustainability of crop yield for which effort were made to provide adequate infrastructure and redeployment of scientific strength to provide major thrust to the priority areas. New varieties of Rice-(Pusa-Basmati-1, Kasturi, Nalini, Amulya, Prana, Aditya, Govind); Wheat Varun, Hybrid

DHM 105) were released having desirable traits like high productivity and tolerance to various biotic and abiotic stresses. High-priority given to develop better production and protection for Pulses and Oilseeds in view of the urgent need to increase their production in the country. Many highyieling-improved varities were developed. The important ones are: Pigeonpea Hybrid, ICPH-8; Chick-pea Varities, Pushja 256 (wide adaptability with bold seeds) and PBG-1 (tolerant to ascochyta blight), Mungbean Varities PDD 54 (early maturing), Pusa 105 (Powdery mildew resistant) and Mothbean Varity Moth-880 for rained conditions. The importance development of Malviya Rajmah-15 is another landmark for increasing total production of Pulses in the Country.

Research efforts on-coarse grains like pearl Milled and Small Millets has led to development of several high-yielding varities and hybrids. The extra short duration (about 70 days) Pear Millet Hybrid HHB67, Resistant to Downy Mildew was released for Semi-arid Areas of Western Rajasthan, Kutch, Haryana and commercial cultivation. Variety VL-149 of Finger Millet maturing in about 1900-105 days having multiple resistances to pests and diseases was identified for release. Two hybrids and two varieties of Sweet Sorghum for Sugar and Syrup Production and Two Barley Varieties, which will go a long way in stabilizing, yield of these crops.

There was record production of 114 lakh bales of cotton and India is now in a position of exporting cotton, yarn and texitiles cultivation of Cotton Hybrids. Recently, Two Desi Hybrids and a Hybrid with Cytoplasmic Base were released for cultivation. Research efforts have been intensified for developing Short-duration Hybrids for North Indian Conditions. Similarly, record production of (2,242) lakh tones of Sugarcanes was obtained using improved varities and practicing better Crop Management Recommendations. New thrust has been given on quality seed in adaptive research for further increasing production and productivity of Sugarcanes. High-yielding varities and production technology for all types of Tobacco have been developed and efforts are being made to develop varities possessing Low Nicotine and Tar Contents.

Production of quality seed is a vital link in the spread of new varities and, hence, this programme was given a very high-priority by executing National Seed Project. Phase III of this project has been taken up for accelerating the development of High Quality Breeder Seed.

Conservation of Valuable Plant Genetic Resources is vital for the success of Crop Improvement Programme. National Bureau of Plant Genetic Resource established in 1976 is acting as a nodal Institute for the important activities related to collection, conservation and exchange of Germ plasm. Lately over 2400 Germ-plasm accessions were added to over one lakh accessions already conserved in the Gene Bank for long-term conservation. To further strengthen the research efforts on conservation has been launched at NBPGR, New Delhi.

Sustainability and environmental quality have been the major considerations for Developing Crop Protection Programmes. Major thrust was given in promotion of Integrated Pest Management (IPM) concept in all major crops. This included biology control of crops pests and diseases; mass multiplication and development of appropriate systems for dissemination of biological gents and use of novel methods such as insect growth regulators, Pheromones, Kairmones, etc. Development of mass multiplication and field release technologies for many natural irritants like Chrysopa and Trichogramma were developed and popularized. The Integrated Pest Management (IPM) recommendations, which were based on sound ecological principles, have been developed for Major Crops such as Cotton, Sugarcane, Pulses and Oilseeds. The IPM recommendations for different Agro-ecological Zones and Cropping Systems for Pests like Holiothis were chalked-out and widely populatised. Water Hyacinth and Water Fern, the two serious Weed Pests, have been controlled, another Dreaded Weed, is also being checked in Karnataka with the help of beetle feeing on it. The Italian Honey Bee is extremely popular in Punjab, Harayana and Himachal Pradesh among the apiarists due to its High-Honey Yielding Potential. This Bee was successfully introduced in Bihar also where One Point Five to two times increase in honey-yield was obtained over the Indian Bee.

IMPROVEMENT IN AGRICULTURE

The effects of modern agriculture can be summarised as under:

(1) Horticulture

The scientific cultivation of Horticultural Crops and Plantation Crops has helped to increase both production and productivity. In fruits, a production level of 265 lakh tones has been reached largely due to superior vegetatively propahated planning material, regular bearing Hybrids of Mango, high-yielding varieties of Grapes, Papaya, Pomegranate, banana, Ber, Aonal, Lime and Kinnow Mandarin, *etc* better crop production technology and Pest and disease control measures.

The vegetable Production has reached 495.3 lakh tones from an area of 45-lakh hectare due to 106 improved high-yielding varieties including F1 hybrids in 17 vegetable crops evolved so far. A few of these tare resistant to diseases and pets. Similarly, the Potato Production has reached 140 lakh tones as a result of 14 newly evolved disease resistant varieties growing in different parts of the country, use of Virus Free Seeds being produced through advanced techniques and improved production technologies. Introduction of 'True Potato Seeds' has been done successfully to reduce the over-all cost of Potato Production.

Release of 18 improved high-yielding varieties in six other Tuber Crops like Cassava, Sweet Potato, Yam etc. have improved prospects of higher production of these crops for food and industrial purpose.

(2) Agriculture

Availability of Edible Oils including Vanaspati has increased significantly. The country has been able to sustain and improve availability of basis consumption articles and has, thus, raised the standard of living.

(3) Land Utilisation

Land utilization statistics are available for 92.7 per cent of total geographical area of 3287.3 lakh hectares. According to land use statistical available from states, area under forests has increased from 404.8-lakh hectare in 1950-51 to 667.3 lakh hectares during the same period. Broad cropping pattern indicates that though foodgrains have preponderance in gross cropped area as compared to non-foodgrains, their relative share came down from 76.7 per cent during 1950-51 per cent during 1986-87.

(4) Seeds

India has transformed itself from a subsistence economy and food importing country to one, which is self-sufficient in foodgrains. Recognizing seed as the primary input for increasing agriculture production, the Central Government established the National Seeds Corporation (NSC) in 1963 and the State Farms Corporation of India (SFCI) in 1969 to encourage the production and distribution of certified seeds of various crops. Thirteen State Seed Corporations have also been established to supply improved seeds to farmers.

(5) Quality Control

The Seeds Act was passed by Parliament in 1966 to ensure that farmers get good quality seeds. There is a Central Seed Testing Laboratory and 90 State Seed Testing Laboratories functioning in various states/union territories. There are also 19 seeds certification agencies. New varieties of seeds are notified by the Central Seed Committee. About 1775 new varieties have been notified so far. This has been possible due to the collection efforts of research scientists, seeds technologists, progressive farmers and administrators involved in agricultural development.

(6) Breeder Seeds

Production of Breeder Seeds is organized by the Indian Council of Agriculture Research (ICAR) through the concerned breeders and scientists on receipt of indents from the state governments. The National Seeds Corporation (NSC) and State Farms Corporation of India (SFCI) also produce Breeder Seed.

(7) High-Yielding Variety programme

This High-Yielding Variety programme was started in 1966-67 as a major plank of agriculture strategy for increase strategy of increasing production of foodgrains in the country.

The main objectives of the programmes for increasing food grains production during the Seventh Plan inter-alia included the following:

(*i*) Achieving self-sufficiency if food grains with the complete elimination of imports;

(*ii*) Imparting greater stability of foodgrains production;

(*iii*) Acceleration of growth rate in production of pulses and coarse grains, and

(*iv*) Protection of the interest both of farmers and consumers through price support and better distribution measures.

High-yielding variety programmes is supported by the Cental sector Scheme of:

(*i*) Mini-kit programmes of Rice, Wheat, Jowar, Bajra, Maize and Ragi,

(*ii*) Maize demonstrations in tribal/backward areas,

(*iii*) State-level training of extension workers.

Mini-kit Demonstration Programmes aims at popularizing newly released varieties and getting the newly evolved varieties tested under field conditions. For this, all large number of seed mini-kit containing 0.25 kg. 5 kg seeds are distributed at a nominal cost to farmers.

The objectives of Maize and Millers Demonstrations in backward and tribal areas is to increase the adopting of latest Maize and Millets Protection Technology, bring about an increase in the per unit are production of Maize and Millets and improve the economic condition of the backward and tribal farmers.

(8) Dryland/Rainfed Farming

About 990 lakh hectare in the country is rainfed accounting for 70 per cent of the net sown area of 1410.6 lakh hectare crops grown and cropping practices followed in these areas entirely depend upon the rainfall which is often erratic and unpredictable. Bulk of the crops like Rice, Jowar, Bajra, Other Millets, Pulses, Oilseeds and Cotton are grown in this area under rainfed conditions. Farmers in these areas, particularly, small and Marginal farmers, are still practicing subsistence farming and are not in the vertex of vicious circle. Wide fluctuations in production in these areas is therefore of crucial importance.

The Government has given high-priority for the development of Dryland Areas and accorded the importance for utilization of potential of these areas for:

(*i*) Realising the projected requirement of about 240 M.T. of annual food production and to smooth out fluctuation in an annual production.

(*ii*) Reducing regional disparities between irrigated and vast rainfed areas;

(*iii*) Restoring ecological balance by 'greening' rainfed areas through appropriate mixture of trees, shrubs and grasses and

(*iv*) Generating employment for rural masses and reducing large-scale migration from rural area to already congested cities in towns. Holistic approach for Integrated Farming Systems Development on Watershed Basis in rainfed areas would be the main pursuit of the development activities.

(9) Himalayan Watershed Management Project in Uttar Pradesh

This Himalayan Watershed Management Project in Uttar Pradesh was launched in 1983 with the assistance of the World Bank. The main objective of this project is to minimize further deterioration of the Himalayan Ecosystem caused by depletion of forests cover, over-grazing, bad land use and careless road construction. The project is spread over 3.12 lakh hectare in Two Watersheds namely; Nayar in Garhwal and Panar in Kumaon Regions of Uttar Pradesh with a total cost of US$ 660 lakh and World Bank Loan US$ 462 lakh.

Note: Courtesy Research and Reference Division Ministry of Information and Broadcasting Govt. of India.

FERTILIZER PROBLEM

Fertilizer is very essential for increasing productivity in agriculture. It has been estimated that about 70 per cent of growth in agriculture can be attributed to increased fertilizers application. Increase in yearly consumption of fertilizers would thus be a good indication of the country's progress in agriculture.

Total consumption of fertilizers went up from 69,000 tonnes of nutrients in 1950-51 to estimated level of 115.68 lakh tones during 1989-90. During 1990-91, the consumption of fertilizers was around 126 lakh tones.

Soil Tests

Soil-testing is an important tool to advise farmers on judicious, balanced and efficient use of fertilizers for economic returns. There are 461 soil-testing laboratories with analysis capacity of 64.75-lakh-soil sample per annum. It is intended to expand the soils, twenty-five sets of Atomic Absorption Spectro Photometers had been provided to the state governments under the India-United Kingdom Bilateral Programme. Besides, the state government/ agriculture universities have installed a number of such equipments.

Balanced and Integrated use of Fertilizers and Organic Manures

Appreciable progress has been made in crop production by the increased use of 'NPK Fertilizers'. However, lately the intensification of agriculture coupled with the use of his analysis chemical fertilizers has resulted in soil micronutrient deficiencies in large areas. To ensure optimum benefit from 'NPK Fertilizers', it is necessary that they are applied on the basis of soil-testing results and, where necessary, in combination with micronutrients farmers are being encouraged through extension training to do this. Organic Manures are essential for maintaining proper soil health. The Country has a potential of 650 million of rural and 160 lakh tones of Urban Compost. Presently, the potential is not fully utilized.

Fertilizers Quality Control

Quality, price and trade in fertilizers are regulated so that farmers get good quality fertilizers at the right time and at reasonable prices. The Government has issued the Fertilizers (Control) Order, 1985, under the Essential Commodities Act, 1955. This order sampling analysis and provision for appointment of enforcement agencies for regulating the trade and distribution of fertilizers. There are 43 fertilizers Quality Control and Training Institute at Faridabad with its One Central Fertilizers Quality Control and Madras. Total analyzing capacity of these laboratories in the Country is 87,400 fertilizers samples per annum. The institute organizes training programmes for state enforcement officers, state fertilizers analysts and for foreigner's developing countries. Besides, training courses for fertilizers dealers are also organized in collaboration with the state governments and the fertilizers industry.

Development of Bio-Fertilizers

Decreasing non-renewable petroleum reserves all over the World and increasing cost of chemical fertilizers have necessitated search, for alternative renewable sources to meet the increasing demand, for chemical fertilizers, Emphasis is being laid on integrated nutrient supply through combined use of fertilizers, organic manures and bio-fertilizers. Scientists have proved that bio-fertilizers are an effective, cheap and renewable supplement to chemical fertilizers. Rhizobium inoculants have been found to be effective for pulses, Legume Fodder, Legume Oilseeds like Soyabean, Groundnut and Blue Green Algae (BGA) for lowland Paddy.

Considering the prospect of bio-fertilizers, the government is implementing the National Project on Development and Use of Bio-fertilizers with a view to produce, distribute and promote bio-fertilizers used by organizing training and demonstration programmes and also quality testing of bio-fertilizers. Under the scheme, one National Centre at Ghaziabad in Uttar Pradesh and Six Regional Centres Bangalore (Karnataka), Bhubaneshwar (Orissa), Hissar (Haryana), Imphal (Manipur), Jabalpur (M.P.) and Nagpur (Maharasthra) have been established. The anticipated production from these Centres during 1990-91 is 85 tonnes of Rhizobium Inocculant. In addition to production, these Centres have “Culture Collection Bank” with a good number of effective and promising starting. Quality-testing for bio-fertilizers have also been taken up at these centers. During 1988-89, Sixty Blue Green Algae (BGA) Centres have produced 110 tonnes and during 1989-90, it was 200 tonnes. It is expected that during 1990-91 also the production will be maintained at the same level.

Fertilizers and Pollution

Some of the fertilizers have washed off the lands through irrigation, rainfall and drainage, into rivers and streams. There they can seriously disturb the aquatic ecosystem. Depletion of dissolved oxygen caused by excessive algae growths can bring disaste or death to fish and other aquatic biota. Excessive and indiscriminate application of inorganic fertilizers often leads to accumulation of nitrates in water. When such waters are drunk by living beings, these nitrates are reduced to the toxic nitrites by intestinal bacteria. Nitrites can cause a serious disease known as nethnohlobinemia. The disease can inflict serious damage to respiratory and vascular systems and may even cause suffocation.

The indiscriminate and excessive use of fertilizers can have serious and adverse ecological consequences, especially in aquatic ecosystems and ground water resources. The world’s ecosystems form a sort of continuous and interlinked network. As such, the materials lost by one ecosystem may spell a gain for its neighbours. Hence fertilizers when applied in excess, leach from crop fields into water bodies, affecting the down-stream aquatic life.

Beneficial Affects of Fertilizers

Known beneficial effects of fertilizers use in ecosystems include the following:

(1) Increase in food production,

(2) Improvement of soils in temperature areas,

(3) Checking of soil erosion

(4) Conservation of soil and water;

(5) Enhancement in water and efficiency of crops.

Adverse Effects of Fertilizers

Some adverse effects of fertilizers used are as under:

(1) Changes in mobility status of nutrients in soils.

(2) Deterioratory of water resources caused by eutrophication.

(3) Stimulation of weed growth in crop fields.

(4) Disturbance in the ionic balance and equilibrium in soils, often leading to high acidity, nutritional imbalance, shortages of certain trace elements, and molybdenum or selenium toxicity.

(5) The Excessive applications of nitrogenous fertilizers to soils can lead to its accumulation to such a stage that the plants begin to absorb excess amounts and even then some of the excess amounts present in the soil get leaked off through the soil into groundwater or into streams and springs.

PESTICIDES: ENVIRONMENTAL PROBLEM

Use of Pesticides

Until 1940's the following chemicals were used to control pests:

(1) Elements fungicides (S, Cu, Hg, organomercury) against fungal diseases.

(2) Copper sulphate, sodium aresenite and ferrous sulphate against weeds.

(3) Nature insecticides *e.g.* pyrethrum and nicotine, against beetles and aphids.

(4) Tar oil, petroleum, etc*., against and red spider mite eggs.*

(5) Lead arsenate against caterpillars.

Even these chemicals were sparingly used. The applications to cereals used to be confined to seed treatment with organomercury to kill-borne pathogens.

The organochlorine insecticides and herbicides became quite widespread in the mid and late 1950s and a large variety of these dangerous compounds were being used in the 1960s in USA, UK, and other developed countries. The British Govt. approved over 150 chemicals for use as pesticides/herbicides by 1970.

THE HAZARDOUS METHODS OF PESTICIDE APPLICATION

The main method of pesticide application on a large scale is the 'Aerial Drift Spray". It is a highly inefficient and wasteful, capital-intensive technique. A close study shows its nature:

(1) More than 40 per cent of applied pesticide is normally out of the target area.

(2) 15 per cent is out of the target crops.

(3) 40 per cent near the target insect.

(4) 75 per cent is not in contact with it.

(5) It is estimated that the insect through contact, inhalation and ignition absorbs less than one of the total applied pesticide.

(6) Only about 0.3 per cent of the applied insecticides appear to be absorbed by aphids on bean contours and 0.02 per cent by myriads on cocoa. The wasteful use is magnified by the practice followed by farmers who apply pesticide according to the pre-set schedules prepared by manufacturers. Indeed the actual use of pesticides by many advanced country farmers may safely be cut by 30 to 50 per cent with no adverse effect on crop production in case pesticides are applied only when necessary and in relation to specific pests.

The following are some general properties of pesticides or their residues:

(1) They often strike the intended pests as well as several off.

(2) Many of them continue to persist and cannot be disposed off.

(3) They may cause unintended effects like resistance, faunal displacement and other population changes.

(4) They may be carried to places fare removed from the points of application or origin.

(5) Their concentration and magnification in biological systems may lead to certain unexpected or untoward result.

PROBLEMS CREATED BY THE PESTICIDES APPLICATION

Pesticides widely distributed by natural means but they tend to retain much of their biocidal activity for fairly long periods. On account of the use of different kinds of poisonous agriculture chemicals the whole biosphere is being increasingly poisoned and polluted. Many of these chemicals and pesticides are known to persist for long periods in the environment. Their concentration builds up geometrically as they are transferred to different stages of the food web.

Harms caused by the use of pesticides are as under:

(1) Harm to Fish

Serious cases of fish mortality have occurred following the leaching of poisonous biocides from agricultural fields to nearby rivers or streams after rainfall. Great concern was shown on a case of large-scale fish kill in the lower Mississippi river in U.S.A. wherein five million fish died. Careful investigation indicated that the fish had died due to dumping of Endrin-rich agriculture wastes and runoff into a tributary of the Mississippi River the Memphis.

The widespread use of DDT as an insecticide has also aroused considerable concern in recent years. As a result, some countries have already legally banned its use.

(2) Harm Caused by the Herbicides

Residues of various weedicides and insecticides often accumulate in agricultural soils rapidly. Insecticides are designed to kill insects. As such they may not be toxic to plants. On the contrary to it, some herbicides differ from insecticides in killing both desirable species as well as the intended target. They may adversely affect such soils microbes as nitroes fixing blue-green algae and bacteria. This, in turn, may impair the growth and production of higher plants.

(3) Damage to the Extent of Complete Destruction of Vegetation

The impact of some chemical wastes as phenols, metals etc. applied to soil may go to the extent of complete destruction of vegetation and also soil sterilization.

Table 2.7

Relative Distribution of Aldrin & D1-2 Ethylhexyl Phythalate (Dehp) in a Model Ecosystem (Condensed from Metcalf, 1974)

	Concentration (ppm equivalents) in				
	Water	**Algae**	**Snail**	**Mosquito**	**Fish**
ALDRIN					
Aldrin	0.00005	1.95	2.23		0.157
Dieldrin	0.0047	16.88	52.4	1.1	28.0
Polar metabolites	0.004	0.015	0.097		0.004
Unknown	0.0004	0.585	2.05		0.612
Value					3140

(Contd.)

DEHP					
Dehp	0.00034	18.32	7.30	36.61	0.044
Phthalic anhydride	0.0036	0.18	5.77		0.113
Phthalic acid	0.00077	0.094	2.72		0.018
Polar metabolites	0.00016	0.1555	1.218		0.010
Ecological magnification		53890	24480	107670	130

Source: Metcalf R.L.A laboratory model ecosystem for evaluating the chemical and biological behaviours of radiolabelled micropollution. IAEA Wien ST/PUB/348. pp, 49-63 (1974).

(4) Findings of the Researches

Extensive researches in the USA found widespread distribution of DDT residues through food grains in several lakes. Residues were detected in shallow and deep-water mud samples, crustaceans, whitefish, duck ring-billed and herring gulls and other fauna. Both DDT and Dieldrin are found passing from mother off spring through the placenta in mice and certain other animals, possible including man.

(5) Adverse Consequence of Pesticides like DDT

Most pesticides tend to accentuate the problems of both production and pollution instead of containing them. The consequence of pesticides is almost invariably adverse and harmful. In the Ninteenth century, the ladybird beetle was brought from Australia to California to control a scale insect pest of oranges. It is reported that the beetle successfully kept the pest under check for more than five decades until about 1946 when DDT began to be used in the citrus orchards. The beetle was susceptible to DDT and hence its population declined. However, a subsequent withdrawal of DDT again restored the natural balance of biological control within a few years.

In fact, DDT is one of the most effective pesticides known. This is the reason why it was banned in the USA in 1972. its remarked insecticidal properties were first discovered in 1939. it became a ubiquitous contaminant of fish, penguins, birds and human being. Hence a popular public movement started in the USA that asked the Government to protect the public from the general toxification of the environment by DDT and persistent poisons.

(6) Harm to Human Beings

Human beings are exposed to pesticides mainly through the intake of food and war but also by inhaling contaminated air. Several pesticides are teratogenic, mutagenic, or carcinogenic.

(7) Harm to Bees

Bees vitally aid the pollination of several plants. Pesticides have adversely affected some honey bees and other useful insects whose populations have declined. According to Pimental, annual agriculture losses due to poor pollination from pesticides can be as high as US$ 4000 million in the USA.

(8) Damage to Crops

(i) Sometimes crops are damaged by pesticide applications, *e.g*. application of improper dosage under unfavourable conditions.

(ii) Herbicides that drift from a treated crop to a nearby crop also cause serious environmental problems. Persistent herbicides also can injure crops planted in rotation.

(9) Harm Caused to Fishery and Wildlife

Drifting or leaching pesticides drain into nearly water bodies causes fishery and wildlife losses. Wild birds and mammals exposed to pesticides suffer by death from direct exposure to high doses and reduced survival growth and reproduction from exposure to subtle dosages.

(10) Harmful Effect on Decomposers

Pesticides have harmful effects on insects, earthworms, invertebrates, protozoa, and microbes found in soils, especially the decomposers. It is reported that human pesticide poisonings, reeducation in insects and mites, and honeybee poisonings account for about 70 per cent of the calculated socio-environmental costs for pesticides in the USA.

(11) Development of Secondary Pests

The use of pesticides kills natural enemies and creates such problems as the development of secondary pests *eg.* Red spider mites. Resurgence of primary pests can also occur. To illustrate, caterpillars of the small cabbage white butterfly in Brussels sprouts reappeared after DDT has killed their natural enemies. Resistance to pesticides is a cause for serious concern. Other hazards include those to the operator or worker who sprays pesticide, those to the consumer of the crop and those to wildlife.

(12) Elimination of Birds

Some species of Eagles and top carnivors are known to be eliminated by DDT because contaminated adults failed to lay viable eggs. Populations of peregrine falcons and some pelicans have disappeard from some areas from some areas where excessive use of DDT interfered with the bird's ability to transport calcium to growing eggs, leading to marked thinning of the eggs shells. Such weak eggs fail to reach the hatching stage. It is discovered that in ringdoves, DDT greatly reduced the activity of carbonic anhydrase. This enzyme is critical in providing calcium for eggshell growth. When the pesticide inhibits this enzyme, eggshell grows thinner.

(13) Growth of New Pests

Artificial introduction of pesticides in the environment upsets natural biological controls. This is the reason why new pests are created in this way because their natural predators, which previously checked their populations, are eliminated. In this way mites have become a pest as a consequence of the emergence of the pesticide industry. Indiscriminate and excessive use of DDT killed some insect predictors of these mites, enabling the mites to multiply to pest status.

(14) Effect on Algae

Some of the pesticides inhibit division in aquatic algae. They may decrease their rates of photosynthesis. In this way they almost produce changes in the species composition and/or diversity of algal communities. The algae-grazing animals are more affected by the level of blooms.

(15) Flora And Fauna

Pesticides have adverse effects on the flora and fauna of soils. Effects on mycorrhizal fungi or decomposer bacteria in forests would almost certainly alter plant community structure in forests. Some soil animals consume plant debris and contribute to soil fertility. Use of insecticides changes the populations of some of these animals. It leads to reduction in soil fertility especially in woodlands.

IMPROVEMENTS BROUGHT IN LAND RESOURCES

It is estimated that in our country there has been a slight increase in the net sown area. About 23 million ha have been added over three decades. This is about 47.7% of total area. Another 1.3% of the land is under fruit trees. Nearly 5% of the land falls under fallow land. This land is cultivated once in every 2-3 years. In this way on an average nearly 51% of the total area, is cultivated every year. Efforts are made to restore the fertility of fallow land by use of fertilizer and new technology. In view of the rapidly increasing population pressure on land, meagre pastureland is left. Generally for self-contained economy and proper eco-balance at least one-third of the total land area must be under forest and natural vegetation. But in our country it is as low as 19.3%. As shown by satellities only about 46 million ha is under real forest. As such it is essential for us to increase our area under forests.

Integrated Land Use Planning

Although land is an important component of the life support system in our country, it has been overused and even abused over the centuries. In 1972 Mrs. Indira Gandhi said, “We can no longer afford to neglect our most important natural resource. This is not simply an environmental problem but one which is basic to the future of our country.” In a predominantly agricultural country like India land becomes more important. Due to exploding population, soil is being used increasingly. It poses a great threat to its productivity because careless use of soil leads to adverse results as under:

(1) Damage to soil,

(2) Reduction in quality and quantity of woodland, grassland, cropland,

(3) Soil erosion,

(4) Degradation of watersheds and catchments;

(5) Deforestation and desertification.

At present land is under stress due to sprawl in agriculture, industry and urbanization.

India has one of the lowest men: land ratio-hardly 0.48ha/per capita. It is essential to develop a strategy to cure past damage and to save the country from future damage to land. This can be achieved by using following means:

(1) Preparation of accurate land use data through remote sensing etc.

(2) By a time bound nation-wide survey programme of micro-level land use planning giving short and long-term scenatious.

(3) Preparation of land use classes.

(4) Review all existing legislations and updating them.

(5) Preparation of management plans for land amelioration. It is incumbent upon as to adopt a dynamic land-use policy. Our Government is not unaware of this all. Headed by the Prime Minister, the Government has constituted an apex body called the National Land use and Wastelands Development Council (NLUWDC). At the second level two boards were set up in 1985 as under:

    (1) First National land use and Conservation Board (NLICB) (Ministry of Agriculture);

    (2) Second National Wastelands Development Board (NWDB) (Ministry of Rural development).

Their working is as under:

(i) Wastelands Development

Wastelands are those pieces of land which for one reason or the other like the life sustaining potential. Besides earlier existing wastelands increasing misuse of land resources through shortsighted development policies have resulted into wastelands. Nearly half of the land area of the country is lying as wasteland. Degraded, mined and other wasteland should not be left as it is. Instead it should be reclaimed and put to some productive use.

(a) Degraded Land

In view of the incessantly increasing population in India more land is needed for agriculture and forestry. Good land is shrinking both in quantity and quality. The various reasons responsible are-unexpected demands besides soil erosion, desertification, waterlogging, salinity, alkali soil and toxic effects of agrochemicals and industrial effluents.

It is essential to reclaim and develop degraded land such as ravines, gulies waterlogged, alkaline, saline and riverine lands, lateritic soils, land infested with unwanted shrubs and bushes, stony and gravelly land etc.

(b) Mined Areas

It is opined that in our-country most mining work has been unscientific with no environmental protection. As a result, large tracts have lost productivity. Besides water and air pollution there is despoliation of land and deforestation. Mined areas should be reclaimed for agriculture, forestry, fisheries and recreation through standard methods of reclamation. A number of mining operations are going on affecting forest and cultivated land areas mainly in U.P. Bihar, M.P., Orissa and Andhra Pradesh. Urbanisation and allied processes like large-scale use of land for townships, communication, excavation and transport affected the socio-economy and ecology of these areas. Consequently, Ecological problems have developed in coal mine areas in Ranchi, Hazaribagh (Bihar), Bina Project (U.P.) and Singrauli complex at Gorbi (U.P.) and Jayanto (M.P.) Ranchi several hundred of sq. km. of land has become wasteland. In Singrauli complex forests and hillocks are damaged by the construction of high power transmission lines, Roads and rail tracks. Besides, establishment of cement factories, super thermal power stations around coalmines have resulted into environmental degradation to a great extent.

Successful results are at hand. At present two successful cases of reclamation of mined areas in India are as under:

(1) Neyvely Lignite Corporation Ltd., in Tamil Nadu and

(2) Stone Quarries of Sayaji Iron work in Gujarat.

It is essential to revise the Mines and Minerals (Regulations and development) Act, 1957 (MMRD Act) to bring in it the environmental concerns.

(ii) National Wastelands Development Board

The Board was founded in 1985 to formulate action plans to arrest land degradation and deforestation. The board is entrusted with the following function:

(1) Regeneration of degraded forest areas and

(2) Reclamation of ravines, user lands, arid tracts, mine spoils etc.

In the initial four years the Wastelands Development Programme laid emphasis on tree planting. In 1989-90 the programme was suitably restructured.

At present the Board is performing the following functions:

(1) To check land degradation,

(2) To bring wastelands into sustainable use,

(3) To increase biomass availability,

(4) To restore ecological balance.

The functioning of the Board during the last seven years has demonstrated that it is possible collectively to meet the challenge of regenerating India's wastelands.

The Ministry of Environment and Forests initially selected five districts in the country for going to the ground and drawing up action plans for reforestation and amendment of degraded land there.

Success is achieved in the preparation of maps on 146 districts in the country representing every state for identifying the wastelands and plantations. The five districts chosen were Almora (U.P.) Purulia (W. Bengal), Bellary (Karnatak), Durgapur (Rajasthan) and Sundargarh (Orissa).

In 1992 the NWDB was merged with the Ministry of Rural Development and a new Department of Wasteland Development was established under a Minister of State.

Non-government organization (NGOS):-Several NGOS have also been putting endeavours in the direction of wastelands management. Some are as under:

(1) The Indian Farmers Fertilizer Cooperative Ltd. (IFFCI) is providing funds for schemes of wasteland development in Udaipur and other areas of Rajasthan. "IFFCO Farm Forestry Project" has been taken up by IFFCO in ten states to cover a total of 50,000 hectare of wasteland.

(2) Ramakrishna Mission Ashram, Bihar, insisting upon afforestation in tribal areas.

(3) Forestry project of Chandmura, W.Bengal, insisting upon regeneration of degraded land through social forestry as people's involvement.

(4) Comprehensive Social Service Society, Andhra Pradesh insisting upon afforestation by women's involvement.

(5) Brukhy 'O' Jeever Bandho Parishads, Orissa, insisting upon environmental conservation.

(6) Magra Mewar Vikas Sanstha, Rajasthan, insisting upon ecological restoration.

(7) Kerala Sastra Sahitya Parishad, Kerala, for mobilising people's power by rousing awakening in them.

(8) People Nurseries Scheme and Tree Grower's Co-operative besides National Dairy Development Board are helping in wasteland management.

(9) A great number of registered non-profit organizations, are registered with the societies, Cooperatives, companies, trusts etc. and Recognised schools. Colleges and universities that are financially supported by Govt. of India. For the purpose have undertaken the wasteland management programmes.

Some programmes aiming wasteland management are as under:

(1) Green Haryana Programme,

(2) Green Delhi Campaign,

(3) Green Rajasthan Programme,

(4) Smriti Vans etc.

(5) Eco-Task Forces in different states.

(6) A national fund for afforestation and Wastelands Development is set up. Donors to this fund are eligible for 100% income tax exemption.

LAND DEGRADATION AND MAN INDUCED LAND SLIDES

Land Degradation

Soil is no less than our mother as it is indispensable for our survival. It is formed over long periods of time. But man is degrading it with his misdeeds. Many of our once-fertile soils have already been converted to agriculturally unfit alkaline or saline land or marshlands. It is estimated that there is more than 25 million hectares of such barren lands throughout the world.

Our soil constitutes a biogeochemical shell around land and shallow waters. It is a product of the interactions of living matter with rocks. It profoundly affects the growth of living organism (especially plants) however; in turn it is influenced by the activities of the latter.

Reasons for Land Degradation

Various factors have led to Land Degradation. Some of them are as under:

1. Rapid increase in industrialization, urbanization and other activities or civilized man have exercised a tremendous impact on the soils and on other components of the biosphere.

2. Unplanned destruction of forests and forest litter has brought about serious changes both in land and water.
3. The washing off of fine soil particles from deforested areas has caused great soil erosion.
4. Soil erosion has resulted in a great increase in run-off, pollution turbidity and mineralization in rivers and extensive silting in water reservoirs,

MAN INDUCED LAND SLIDE

Forests are important regulators of ecosystems. They exert significant effects on the water budget and the hydrological cycle.

In areas of heavy rainfall, the tree crowns and other forest plants intercept a large fraction of the rain. Some of the water reaching the forest floor penetrates into the soil through the litter and the loose soil surface, and there is little surface run-off. The seeped water reaches the streams and rivers only after some period of time. This time lag is and important device to regulate the water discharge into rivers. It is in this way, that flooding is prevented or minimized. Thus, in dry periods also the forest soil continues to feed the streams and rivers.

Destruction of forest changes the above situation immediately. The hydrological cycle is disrupted and the water level of the rivers cannot be properly regulated. This causes flooding during the raining season. Simultaneously, in dry period, the rivers tend to dry up, affecting irrigation and power generation. In deforested areas, erosion of soil occurs fairly briskly, especially on steep slopes. This removes the fertile top soil and also loads the rivers with much suspended matter. Deforestation thus greatly increases the quantity of detritus in many tropical rivers.

Large-scale forest destruction often produces grave climatic consequences, especially desertification and aridity. These result from reduction of evaporation as the tree canopies no longer intercept rain water, and also because rapid run-off of precipitation occurs in the absence of the forest cover.

Some erosion of soil results from the deforestation as seen in the Himalayas. Erosion in the Himalayan ranges is caused both by natural climatic influences ranging from tropical to arctic, and by man-made causes. Forest cover greatly reduces erosion of the fast increasing population pressure; the Himalayas are being deprived gradually of their forests. Bare, unprotected soil cannot store large quantities of water. The soil are compacted by heavy rain and then washed away. The results are as under:

(1) The rivers are flooded during rainy season,

(2) Springs dry up during the dry season in some localities,

(3) Rivers meander in the plains at the foothills,

(4) Large amounts of gravel and sedimentary material tend to accumulate.

In view of the nutrients depletion, modern agricultural practices seek to counter the above processes of soil destruction by advocating increased use and application of chemical fertilizers, However, this practice is not a healthy one. It is an ecologically dangerous practice. Instead there is necessity of preventive and remedial measures as under:

(1) Recourse to contour and strip farming,

(2) A network of forest plantations in clumps and rows,

(3) A regular sowing of grass in crop rotations,

(4) The preferential use of organic, rather than inorganic manures,

(5) The use of organic manure as it tends to preserve the quality of soil and also their humus content.

At present, soil scientists are trying to solve problem of safeguarding soils from exogenous chemical substances, mineral fertilizers, pesticides, etc. heavy doses of the wrong kind of inorganic fertilizer have often resulted in creating excessive acidity or alkalinity in the soil.

Besides the indiscriminate use of pesticides and fungicides has caused adverse effects on soils in addition to their well-known effects on the activities of soil microbes, flora and fauna. Various kinds of air pollutants and noxious gases also have a harmful effect on soils.

Suggestions

It should be kept in mind that the soil is a living community of micro organisms-algae, fungi, protozoa and metazoan. It contains many inorganic and organic substances which are products of weathering and decay of organic matter. Microbes normally oxidize these substances to inorganic oxides, However, when some organic compounds reach oxygen-defi ient ground water may remain incompletely oxidized and add to pollution.

At present, so many countries of Africa lying along the south of the Sahara desert are suffering the severe effects of prolonged drought caused by rain failure or inadequacy. It is also discovered that the desert is advancing southwards by several kilometers each year. Local inhabitants plant millet in tiny plots of topsoil fenced in with straw matting to avoid the sand; they water the wilting shoots by bringing cupfuls of the precious and scarce water, often from long distance. Despite such frugality, however, the resource could be better managed.

Two Evil Practices

(1) A practice which leads to resource squandering and wastage, is to set bush fires to drive out and exterminate desert rats. Such practices are harmful and result in great impoverishment of the top soil.

(2) Another similar practice is to chop sown the scarce tree wealth for firewood and to let cattle eat up Acacia branches

It should be, kept in mind that Acacia and other similar plants are very useful since they help check the advance of desert by the following processes:-

(1) By breaking the winds,

(2) By humus formation,

(3) By binding soil by means of deep penetrating roots,

(4) By trapping the scarce rainwater.

It should be remembered that by controlling excessive destruction of grazing of trees and planting many more trees or bushes much of the land could be successfully conserved and reclaimed in due course of time.

SOIL EROSION: MEANING, FACTORS

The top layer of the soil is the vital component as it includes all the nutrients required by plants. Hence the top layer of soil is, called to be the feeding zone of plants. This fertile top soil is most valuable natural resource. It usually lies at most places at a depth of 15-20 cm. over the face of the land. Soil is not a dead inert matter of minerals. Instead healthy soil is indeed alive and dynamic consisting of microorganisms as bacteria, fungi, algae, protozoa, worms and insects.

The soil erosion is not a new thing. It is a natural process and is as old as the earth itself, yet today soil erosion problems far exceed natural formation of soil. It should be kept in mind that it takes approximately 500 to 1000 years for an inch of the top layer to build up. But in several ways this fertile, topsoil is lost and wasted. This loss of top soil or disturbance of the soil structure is given the name soil erosion. Some views on soil erosion are as under:

(1) Odum (1966) included soil erosion as a part of soil pollution,

(2) Rama Rao (1962) called soil erosion as creeping death of the soil.

Nature of the Problem

The problem of soil erosion is throughout the world. In U.S.A. over 77 million acres of land has become seriously eroded. It is reported that after the rain begins the cream of soil is skimmed off with every spell of showers.

The gravity of the problem of soil erosion may become evident from the face that of all potentially arable land, only about 44 per cent is under cultivation. The rest i.e. 56 per cent is unsuitable for farming due to inherent soil problems and man induced problems. Only about 2.5 million sq. km. Arable land is irrigated at great cost and with many side effects. Massive irrigation is harmful to fertility due to salinisation. Thus, in a short time, approximately 600 million hectares of potential farmland will be lost to soil erosion, salinisation, and waterlogging. By that time the world population will reach 8 billion. Even if another 300 million hectares of the land, which is at present, lying unused is brought under farming, the net result will be that the area of farmland per person will dwindle from 0.31 to 0.15 hectares.

It is observed that soil loss is maximum in region with high population densities. Continuous cultivation of same crop also adds to soil loss. At present the rate of soil erosion is over 2500 million tones per year i.e. over half a ton of soil every man, woman and child on the planet. Certainly we cannot afford such a loss. Soil erosion can be called one of the most difficult problems which the present day world is facing particularly in country as ours. The Indian subcontinent is faced with severe silting problems in Bhakra, Rihand and other multipurpose dams. It is estimated that the life of Bhakra dam is reduced by 250 years due to lack of proper attention towards silt prevention at Govind Sagar Lake, the main reservoir of the dam. It is quite formidable to think that owing to alarming rate at which silt is accumulating, it may not last for more than 150 years although it was designed originally to last for 400 years). The Border Road organization while constructing roads along the Sutlej also failed to take adequate steps to prevent debris and soil from entering the river. The Spiti River discharges a considerable amount of silt in the Sutlej. In the absence of any vegetation in Spiti valley, soil erosion is inevitable and the rocks from nude mountains crumble under the flow of water. In the eastern hills of Nepal about 38 per cent of the land area has fields on the topsoil whereof has been washed away depriving it of its fertility.

On making a comparative study of the sediment loads from major rivers of the world it is seen that yellow River in China carried 1.6 billion tons of soil to ocean each year. At the same time, the Ganges carries nearly 1.5 billion tons and Mississippi, the largest river of the USA carries only about 0.36 billion tons into the Gulf of Mexico. The startling point is that both the Ganges and the Mississippi have almost same discharge (Fig. 2.5).

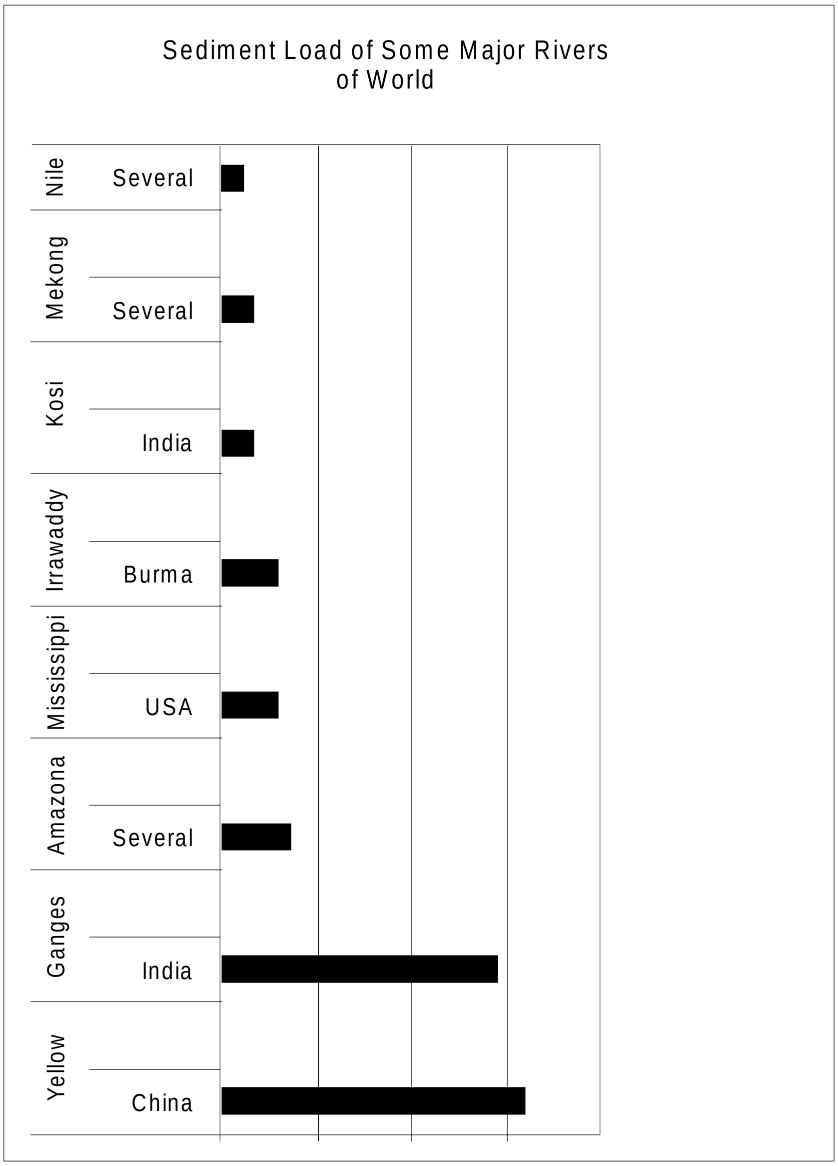


Fig. 2.5

Table 2.8 : Sediment load of some major rivers (Brown and Wolf, 1984)

River	Country	Annual sediment load (Million metric tons)
Yellow	China	1,600
Ganges	India	1,455
Amazon	Several	363
Mississippi	USA	300
Irrawaddy	Burma	299
Kosi	India	172
Mekong	Several	170
Nile	Several	111

Table 2.9 : Estimates of excessive erosion of top soil from world cropland (Brown and Wolf, 1984)

Country	Total cropland (Million acres)	Excessive loss (Million tons)
USA	421	1700
USSR	620	2500
India	346	4700
China	245	4300
Total	1632	13200
Rest of World	1506	3138
Grand total	12200	25400

It is evident from the table that the loss of cropland soil is maximum in India as it is 18.5% of the total soil loss at global level. The situation is grave because India has only 2.4% of the land area of the world. In USSR it is 9.80% whereas in USA only 6.70% (Fig. 2.6).

Kinds of Soil Erosion

There are various types of soil erosion. However, on the basis of the rate at which soil loss takes place, there are two main types of soil erosion:

(1) Normal or geologic erosion

This type of soil erosion occurs under normal natural conditions by itself without any interference of man. It is a very slow process, and equilibrium between loss and build up is lost, only when there is some major disturbance by a foreign agent.

(2) Accelerated soil erosion

This type of removal of soil is very rapid and never keeps pace with the soil formation. This is generally caused by an interference of an agency like man and other animals.

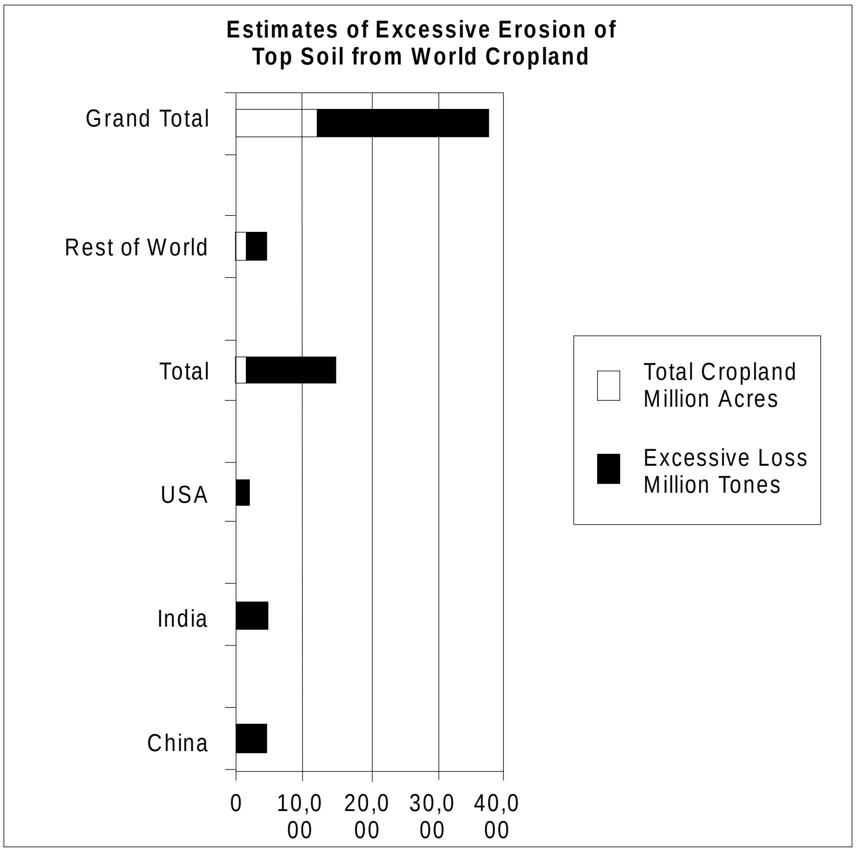


Fig. 2.6

Agents of Soil Erosion

The various agents that bring about soil erosion are as under:-

Water Erosion

Water removes the soil by falling on as rain drops, a well as by its surface flow action, It may be of three types:

(i) Sheet erosion

Here the removed soil is like a thin covering from large area. This sheet is more or less uniform.

(ii) Rill erosion

If sheet erosion occurs with full force, the run off water moves rapidly over the soil surface. It cuts well-defined finger-shaped groove like structures, It appears as thin channels or streams. These are known as rill erosions.

(iii) Gully erosion

This results due to the convergence of several rills or thin channels formed during rill erosion towards the steep slope. When they join together, they form wider channels of water, known as gullies. In case of further rains these gullies may become still wider and deeper.

Wind Erosion

Soil erosion by wind is common in dry (arid) regions Two characteristics of such region are:

(*a*) The soil is chiefly sandy

(*b*) The vegetation is very poor or even absent.

In India erosion by wind affects approximately 50 million hectares of land, most of which is in Rajasthan. The wind erosion also is triggered by the destruction of natural vegetation cover of land by overfelling and overgrazing. When the top soil is laid bare to the fury of strong gales it begins to be blown off in the form of dust storm and sand storm. The high velocity winds blow away the soil particles. This may be of the following types:

(a) Saltation

Saltation takes place in the arid regions where:

(1) Rainfall is low,

(2) Drainages is poor,

(3) High temperatures prevail,

(4) Water evaporates quickly leaving behind the salts.

The salts are normally chlorides, sulphates, carbonates and nitrates of potassium, magnesium and sodium, and chlorides and nitrates of calcium. The major portion of such salty soil is carried by wind in the form of small leaps. These leaps are created by direct pressure of wind on small particles of soil.

(b) Suspension

The wind throws away smallest soil particles into air, these particles move as fine dust with the wind. By this way soils are transported to long distances.

(c) Surface creep

The heavier particles of soil which the wind cannot easily throw up are pushed or spread along the surface by wind.

Landslides or slip erosion

The hydraulic pressure which is caused by heavy rains, increases the weight of the rocks at cliffs. As a result they come under the gravitational force and finally slip or fall off. Sometimes the whole hillock may slide down.

Stream bank erosion

The rivers during floods splash their water against the banks. In this way the water cuts through them. Particularly at curves, water strikes with great speed and the bank caves in alongside. This type of erosion is also known as riparian erosion.

FRIGHTENING POSITION OF SOIL EROSION IN INDIA

According to the Tiwari Committee, of the total land of 304 million hectares of India, about 175 million hectares are exposed to serious environmental threat. This area is suffering from degradation of various kinds. The main causes are water and wind erosion besides water logging. Water and wind erosion alone has affected 150 million hectares of fertile land. Our entire cultivated area is only 160 million hectares. In this way, it becomes clear that our degraded land is more than all our arable land put together.

It is evident from the report of NCEPC that India was losing more than 6,000 million tones of top soil per year in 1972 which in terms of major nutrients-N.P.K. alone represented an annual loss of Rs. 700 crore. Today the loss is many times more. It is our duty to identify the areas of maximum concern, and the means to check damage in these areas.

SOME EFFECTS OF SOIL EROSION

Every year in India, water erosion alone takes away more than 6,000 tonnes of top soil, containing more than Rs. 1000 crores worth of nuitrients. Its evil effects are as under:

1. This erosion causes the rapid siltation of tanks and reservoirs.
2. Silt is choking our estuaries and harbours.
3. Eroded soil is deposited on riverbeds, raising their levels and leading to devastating floods, which cause Rs. 2,000 crores of damage each year.
4. The land area prone to floods has doubled from 20 million hectares in 1971 to 40 million ha. In 1980.
5. Denuded land cannot soak up water like wooded land, so and increasing amount of rainwater is thus running waste into the sea, causing silting and flooding in the process.

As a result there is much less water stored in underground aquifers, which are vital to maintain river flower in the dry season and provide water for tubewell irrigation.

Position in Kerala

Rains have been eroding Kerala coast. During monsoon there occurs extensive damage due to sea erosion. The worst affected areas are as under:

(1) Poonthura, Panathura and Kotaqpuram in Trivandrum Distt.

(2) Edava, Thanni and Eravipuram in Quilon Distt.

(3) Thikkunnapuzha, Arattupuzha, Punnapra, Thumboli, Anthakara Azhi and Palithodu in Aleppey Distt.

(4) Kannamali, Puthenthodu, Cheria, Kadavu and Nayarambalam in Ernakulum Distt. And

(5) Kadapuram, Eriyad, Perinjanam, Kaipamangalam and Engandiyoor in Trichur Distt.

DESERTIFICATION: MEANING CONCEPT CAUSES

Meaning of Desertification: Desertification can be defined as a process of degradations of the environment, that usually is a product of climate and human activity and involves the spread of extension of desert-like conditions in a hitherto fertile area.

In this way Desertification process is leading to desert formation, It may be either due to a natural phenomenon linked to climatic change or due to abusive land use. However, the improper land use practices besides soil erosion greatly lead to climatic change. Removal of vegetal cover brings about marked changes in the local climate of the area. In this way deforestation and overgrazing etc. bring about changes in rainfall, temperature, wind velocity etc. These lead to desertification of the area. Desertification often starts as patchy destruction of productive land. In margins of the zones that are not humid, increased dust particles in atmosphere lead to desertification and drought. In case droughts continue to occur over a series of years, even the humid zones are in danger of getting progressively drier. As the forest diminishes, there is steady rise in the atmospheric temperature and the threat of desertification becomes imminent.

Causes of Desertification

(1) Man Made

Most of the vegetation in arid and semi-arid regions is threatened with man-made desertification, a result of excessive, indiscriminate, and archaic land-use practices.

(2) Forest Grazing

Forest grazing is the most serious cause of desertification in arid and semi-arid areas.

(3) Shifting cultivation

Shifting cultivation is likewise important in the humid tropics and N.E. Himalayas.

(4) Increasing Population

Increasing population pressure has greatly accentuated the adverse impacts of the above causes.

Position of Desertification

Desertification used to be an issue of considerable concern during the 1970s and 1980. However, much credence is now not given to the theory of deserts advancing and swallowing up adjacent savanna landscapes. According to UNEP (1984), in 1983 it was estimated that 17 per cent of the world's arid, semi-arid and sub-humid regions had suffered some loss of productivity land degradation resulting from removal of the vegetation cover is a serious problem throughtout the world's savannas. Loss of biodiversity is also a serious problem in savannas. In areas of high domestic grazing pressure, loss of animal biodiversity is aggravated by a reduction in the number of forage plants available for wildlife.

Concept of Desertification

Desertification is usually defined as an irreversible change in a land resource. Losses are considered irreversible if recovery would take more than a decade. There forms of desertification can be identified.

1. Loss of economic potential to produce goods and services of direct human-use value;
2. Loss of ecological functions necessary to maintain ecosystem processes;
3. Loss of biodiversity at the ecosystem, species, or genetic level.

According to Nelson (1988):

4. A permanent national land monitoring systems is needed to identify emerging and difficult-to-reverse forms of degradation.

5. Research should focus on management technology and the present socio-economic systems.
6. Policy proposals must take into account complexity and local variability.
7. In the absence of any global or regional solutions to most savanna and arid land degradation problems, progress will depend upon small pilot projects, community experimentation and within-country expertise.
8. It is clear from the failure and high cost of conventional projects that more progress is likely through attention to enabling incentives that promote spontaneous response across the entire community. The main policy areas are land tenure, taxation and marketing.
9. Many successful strategies will consist of a strong spatial dimension and involve movement across national and ecological boundaries.

Monitoring and assessment are vital for the development of an action programme to stop the process of desertification. A unified mapping methodology is a prerequisite for this purpose.

Causes of Desertification

Main causes of desertification are as under:

(1) The population explosion in man and livestock

It has led to enhanced requirement of timber and fuelwood. Besides, increasing number of livestock causes degradation of forests and the consequent devastation. It is observed that the most accessible forest areas are heavily grazed. For instance, there are nearly 1200 thousand sheep and goats in Alpine areas of U.P. Besides is there visit about 25,000 migratory graziers. In addition there are about 5-7,000 buffaloes owned by Gujarat. In absence of suitable checks growing in forestry stock was expected to decrease from 13.79 m^3/ head in 1981 to 2.60m^3/ head in 2001; It is estimated that reduction in annual availability of grass will be from 2.60 t/cattle unit in 1981 to 0.90t/cattle unit in 2001.

(2) Shifting Agriculture

The increase in shifting (jhum) cultivation in North East and Orissa has also laid large forest tracts bare. There has been shortening of jhum cycle to six years only (in some districts, even 2.3 years only), It provides not enough time for natural repair of damaged ecoststemk.

(3) Revenue Generation

Maximum has been extracted from the trees by Govt. and private owners. In the face of agriculturalisation, urbanization and industrialization, preservation of forests could be given a very low priority. During 1951 to 1976 India lost about 4.2 million hectors of forests for such activities.

(4) Road Construction

The construction of hill roads (about 30,000 km long) is a major cause of deforestation. Road construction caused desertification in the following way:

(1) It affected the stability of hill slopes,

(2) It damaged the protective vegetation over both above and below roads,

(3) It resulted in debris covering forests vegetation, orchards and agriculture fields,

(4) It blocked natural drainage,

(5) It polluted streams;

(6) It delayed vehicular traffic,

(7) It caused damage to human life and property.

(5) Industries and Mining

These have a serious impact in forest areas. Large areas have been clear-felled and laid barren consequent to open cast mining of iron ore, mica, coal, manganese, limestone etc.

Environmental impact of mining includes loss of production for the following reasons:

(1) The forests, agriculture turned into pastures,

(2) The loss of top soil,

(3) The surface water pollution,

(4) The lowering of ground water table,

(5) Ore transport hazards such as damage to vegetation, soil drainage, water quality and property, sediment production and discharge, fire hazards and air pollution.

(6) Development Projects

There are hasty approaches to formulation of developmental projects particularly hydro-electric besides those on tourism, road building and mining.

(7) Commercial Demand

In comparison of commercial demand supply fell short and led to decimation of forests, particularly the wood. Consequently there has been unlimited exploitation of timber for commercial use.

(8) Over grazing

The goat is considered to be the most serious agent of forest grazing. The goat has been aptly called "the razor of forests" (Maydell, 1980). In the topics and subtopics, the stock of goats is above 300 million. Destruction primarily affects the shrub and tree vegetation where goats prevent regeneration and damage established plant. When the vegetation cover is destroyed, it leads to soil erosion and irreversible destruction of ecosystem.

Goats are particularly destructive to trees and shrubs because they eat virtually all parts of forest plants including young shoots, twigs, fruits and bark. In the thickly vegetated moist forests, goat grazing does not cause serious damage, but in the arid zones where vegetation is already sparse, the goats become a serious menace.

There occur different types of desertification in various continents and ecosystems. Two main objectives for mapping desertification have been identified as under:

(1) To assist decision-makers to understand the various dimensions of desertification,

(2) To assist scientists to make the best choice in selecting strategies for desertification control, to reduce the impact of land degradation. Mapping and landscape dynamics simulation in arid regions prone to desertification is also being undertaken.

Desert Development Programme:- The objectives of the programme include controlling the process of desertification, mitigate the effects of drought in desert areas, restoration of ecological balance in affected areas and raising productivity of land, water, livestock and human resources in these areas. The objectives are sought to be achieved through activities such as afforestation with special emphasis on sand dune stabilization, shelterbelt plantation and grassland development, soil and moisture conservation and water resources development. The programme covers 131 blocks of 21 districts in five states. It also covers cold arid areas of Jammu and Kashmir and Himachal Pradesh. The area covered under this programme is about 3.62 lakh sq. km. and the population in the area covered is about 150 lakh. This programme is implemented with 100 per cent Central Financial Assistance. In 1989-90, allocations were made at the rate of Rs. 24 lakhs per 1000 sq. km., the ceiling per district hence will be Rs. 500 lakh. For cold desert areas, a lumpsum provision is made, the rate being Rs. 100 lakh per district per year for Himachal Pradesh and Rs. 150 lakh per district per year for Jammu and Kashmir.

Since its inception, Rs. 291.33 crore was spent under the programme. During the Seventh Plan Period, Rs. 194.04 crore has been spent under this programme.

INDIVIDUAL'S ROLE IN CONSERVATION OF NATURAL RESOURCES

Meaning of Conservation

Conservation broadly means sound land or water use planning. It is concerned with the maintenance of natural systems and with their moderate, systematic, planned and regulated utilization and exploitation for the long-term benefit of mankind.

Conservation has been defined as "As management of the benefit of all life including humankind of the biosphere so that it may yield sustainable benefit to the present generation which maintaining its potential to meet the needs and aspirations of the future generations."

Need for Conservation

As expanding human population resulted into expanding needs of man, man started utilizing natural resources at a much larger scale with scientific progress and technological development. Continuous increase in population caused and increasing demand for resources. It created a situation when the non-renewable resources are likely to come to an end after some time. In fact, we would be using all those resources, which are, in real sense, the property future generation. As such, there must be some sort of balance between the population growth and the utilization of natural resources.

It is apparent to all of us that, the non-availability of resources leads to their prices-rise which has an adverse affect on the economics of countries. During 1980s the world experienced a state of imbalance between the growth rates of food production and economic development suffered setbacks. We are facing contrary positions.

In some areas, there is not enough water for agriculture and industry. On the country to it in other areas there are problems of waterlogging due to over-irrigation. In some countries much of underground water is being utilized for food grain production. It is resulting in lowering of water table in northern China.

As a consequence of increasing tampering of nature by man, natural reserves are greatly dwindling and are becoming the main sanctuaries for wild plants and animals. It has been proposed that adequate examples of all-important and representative biospheres be protected and conserved. A worldwide network of such protected ecosystems is extremely important for ecological research pertinent to national use and conservation of the biosphere.

Objectives of conservation

(1) To maintain essential ecological processes and life support system;

(2) To preserve biological dividers;

(3) To ensure that any utilization of species and ecosystems is sutainable.

Categories of Conservation

There are two categories of conservation as under:

(1) In Situ Conservation

This is the conservation of genetic resources through their maintenanced within natural or even human-made ecosystems in which they occur. It includes a system of protected areas of different categories, managed with different objectives to bring benefit to the society. For example National parks, Sociometries, Nature Reserves, Natural Monuments, Cultural Landscapes, Biosphere Reserve etc. Evidently in situ conservation is not practicable for domesticates.

(2) Ex Situ Conservation

This is conservation outside habitats by perpetuating sample population in genetic resource centers, zoos, botanical gardens, culture collections etc. or in the form of gene pools and gamete storage for fish; germplasm banks for seeds, pollen, semen, ova, cells etc. Plants are more readily maintained than animals. In this kind of conservation vital role is played by seed banks, botanical gardens, pollen storage, tissue culture and genetic engineering.

Under Ministries of Environment and Forests, Agriculture, and Science and Technology a large number of institutions are involved in conservation and utilization of natural resources. Between them, they are dealing with in situ conservation including sphere reserves, national parks. Wildlife sanctuaries and ex situ conservation such as field gene banks, seed and other banks, and utilization involving gene and drug prospecting respectively.

Individuals Role in Conservation of Natural Resources

An individual can play his role in the conservation of natural resources as under:

1. Soil Conservation

An individual can play a vital role in conservation of soil. Main principles of soil conservation are as under:

(1) To Protect soil from impact of raindrops.

(2) To Slow down the water movement if it flowed along the slope.

(3) To slow down the water from moving down the slope in narrow path.

(4) To encourage more water to enter the soil.

(5) To increase the size of soil particle.

(6) To reduce the wind velocity near the ground by growing vegetation cover, ridging the land etc.,

(7) To grow the strips of stubble or the vegetation cover which might catch and hold the moving particles of soil.

Keeping in view the above said principles an individual may adopt several methods to prevent the loss of soil during its erosion.

Methods of Conservation

Various methods of soil conservation may be broadly arranged into the following types:

(1) Biological Methods

Conservation achieved by the use of plan vegetation cover the following:

(*i*) *Agronomic Practices*: In areas with normal farming, where vegetation itself is used for soil protection.

(ii) Dry Farming: In areas with low and moderate rainfall, where normal farming is not possible.

(iii) Agrostological Methods : In areas which are suitable for successful growth of grasses used as soil binders to check soil erosion.

(2) Mechanical Methods

Conservation achieved by supplementing the biological methods with a view to increase the time of concentration of water, to reduce the velocity of water, or afford protection against damage due to run off:

(i) Basin Listing: To construct small basins along the contours.

(ii) Contour Terracing: To construct small basins along the slope to intercept and divert the runoff water.

(3) Other Methods

Conservation achieved by purely mechanical method including construction as under:-

(i) Gully Control: Formation or widening of gullies.

(ii) Stream Bank Protection : To grow vegetation alongside construction of drains stone pitching etc.

(iii) Afforestation: To check the velocity of wind by tree plantation (windbreads).

2. Less exploitation of Resources

We must bear in mind that resource exploitation and pollution are two faces of the same coin since exploitation of resources in one place can become environmental degradation either in the same place or in a remote area. We are aware of the adverse effects on the ocean harvest, which are often caused by man's activities on land. Thus, biocides and persistent inorganic pesticdes, which are used to increase crop yields on land, lead to decrease the yields of fish and other proteins from the oceans. Increasing use of biocides for boosting carbohydrate yields on land is likely to lead to such high increase in their concentration in the oceans as to significantly reduce its productivity.

3. Control over Population Increase

We should aim at striving for an optimum instead of maximum, sutainable population size on Earth, and to arrive at the optimum figure after due consideration of the complex environmental problems. The optimum size permits long-term persistence of the population in equilibrium with its environment. The optimum represents that stage when any further addition of more members would result in deterioration of the quality of like of those already present.

4. To Make An Integrated and Holistic Approach in Tackling Environmental Problem

Environmental strategies and programmes must be based on a thorough analysis of technical and economic factors as well as of social and political dimensions of the environmental problem. Such an approach includes an analysis of balance of political forces besides issues of livelihood for disadvantaged groups.

5. Increase in the Plant Cover

The plant cover is essential for the maintenance of the soil in a balanced and healthy state. Over-exploitation of forests and deforestation practices lead to soil erosion with the topsoil washing down the stream. It results in the ruin of soil fertility. We are annually losing millions of tons of nitrogen, phosphorus and potassium through soil erosion. Nearly 5,000 million tons of soil are being annually lost by water erosion, and the loss of valuable nutrients in this way often reaches colossal proportions. It is estimated that thousands of acres of arable soil are also being rendered unfit for farming due to salinity and alkalinity problems. Here it may be mentioned that the Green Revolution has further generated some newer problems of soil fertility depletion, mineral nutrient imbalances, agricultural residues, etc. In some parts of Punjab for instance, paddy straw of the high-yielding rice variety IR-8 is found responsible for the deterioration in health of cattle because of its abnormally high content of certain mineral salts.

6. Proper Use of Water

Agricultural use of soil is linked with the use of water which is required for irrigation. Much progress has been achieved in the large-scale storage of water in Dams and Reservoirs for agricultural use and for generation of hydroelectric power, but economy in its use is paid no heed. We must remember that policies directed toward the maximum economic yield from a fixed amount of water will result in maximum conservation and also that planning for the maximum use of water ought to be correlated with planning for the optimum use of land resources.

7. Proper Irrigation for Soil Conservation

The land resources of India have been increasingly degraded. Excessive unplanned canal irrigation without proper drainage and water management has resulted in seepage, water logging and salinity. Seven million hectares are already affected and another ten million are threatened. About 150 million hectare area suffers from wind and water erosion. This results in the loss of valuable topsoil. Rising water tables is also responsible for increasing salinization of farm lands. Soil erosion causes premature silting up on many reservoirs and tanks.

8. Proper Use of Wood

Our country is gifted with a fairly considerable potentiality for increasing the supply of such renewable resources as forests and forest products that could substitute for some of the scarce non-renewable resources. As such, it is advisable to substitute wood and wood products for the non-renewable fuel and energy sources, as has been commonly practiced in villages since times immemorial. Wood has certain advantages as fuel. As compared to coal, its sulphur content and ash content are very low. The ash which is left, can be used as a fertilizer. Wood and vegetable fibres might also some day furnish us certain primary organic chemicals. In our country and other tropical countries wood residues may profitably be converted into liquid and gaseous fuels. This can relieve, to some extent the problem of scarcity of large-scale exploitable oil and coal resources, which are non-renewable ones.

9. Substitution of Biomass for Petroleum Product

Biomass conversion has unique advantages over other commonly used energy technologies. Unlike petroleum or coal, biomass resources are renewable. Conversion of municipal and industrial wastes into useful fuels will serve two purposes as with it:

(*i*) The energy supplies are increased, and

(*ii*) The environment is cleaned up.

Biomass is amenable to genetic manipulations and is flexible through crop switching. Biomass encompasses wood chips, sawdust, maize stalks, other vegetable matter, municipal and organic wastes.

10. Fuel Alcohol from Biomass

Ethanol and methanol can be used as fuels or may be blended with petrol and used in a spark type internal combustion engine. These alcohols can be produced from biomass and agricultural residues, etc.

11. Use of Solar Energy

Solar thermal systems are the best developed and simplest of the solar technologies. It is proved that Solar energy can be gainfully conserved by suitable architectural designs that gainfully exploit the site and building materials to turn a building into a solar collector. In Active solar thermal systems the basic unit is the solar collector- a panel commonly made of aluminium, glass, plastic and copper. When fitted to a roof, these panels absorb direct sunlight and transfer heat to a fluid that passes through the collector. The fluid flows through pipes into the building where it is used to heat water or warm the rooms. The solar cell is a device that converts sunlight directly into electricity. Photovoltaics (solar cells) generate an electromotive force in a material as a result of its absorbing ionizing radiation.

Solar cells have already proved their usefullness in the space exploration programme. Solar cells successfully developed at the Bhabha Atomic Research Centre in Trombay, Bombay, have been tested in the satellite Bhaskara. They have successfully met part of the power requirement aboard.

EQUITABLE USE OF RESOURCES FOR SUSTAINABLE TO LIFE STYLE

Introduction

Man has a great responsibility to render equitable use of resources capable of inducing significant alternations in the environment either intentionally or inadvertently. He is capable of altering the basic functioning of the atmosphere, hydrosphere, lithosphere and the whole biosphere. The most essential basic attribute of most environments is that they are muti-dimensional systems of complex relationships in a continuing state of change. It is also generally recognized that the loss of life caused by such calamities as floods, droughts, cyclones and earthquakes, is largely due to the quality of natural environments as well as mankind's misdeeds.

Cragg (1970) has highlighted the link between conservation and quality of human environment. Cragg advocates a study of the biogeochemical cycles disturbed by man. He has pointed out many hazards arising from the recent marked increases in the CO2 content of the atmosphere and similar decreases in oxygen level of natural water bodies. He has warned against the present evil practices. If precautions were not observed in time, the earth would not remain inhabitable.

Cragg has listed the following basic arguments for conservation:

(*a*) Maintenance and perpetuation of environmental quality

(*b*) Aesthetic considerations;

(*c*) Food production;

(*d*) Preservation of gene pools and germplasms;

(*e*) Ecological diversity.

Methods for Equitable Use of Resources

The following methods may be suggested:

1. Equitable Use of Soil

It is due to our misdeeds that many of our once-fertile soils have been converted to agriculturally unfit alkaline or saline lands or marshlands. More than 25 million hectares of such barren lands are now estimated to be distributed throughout the world.

Soil constitutes a biogeochemical shell around land and shallow waters. Recent increases in the pace of industrialization, urbanization and other activities of of civilized man have exerted a tremendous impact not only on the soils but also on other components of the biosphere. Unplanned destruction of forests and forest litter has brought about serious changes both in land and water. The washing-off of fine soil particles from deforested areas has caused considerable soil erosion. There has also been a great increase in run-off, pollution, turbidity and mineralization in rivers and extensive silting in water reservoirs. It is essential to take a recourse to contour and strip farming, a network of forest plantations in clumps and rows, a regular sowing of grass in crop rotations, the preferential use of organic, rather than inorganic, manures, etc. The use of organic manure is especially desirable since it tends to preserve the quality of soil and also their humus content.

Steps should be taken to safeguard soils from exogenous chemical substances, mineral fertilizers, pesticides, etc. Heavy doses of the wrong kind of inorganic fertilizer have often resulted in creating excessive acidity or alkalinity in the soil, and the indiscriminate use of pesticides and fungicides has caused adverse effects on soil. Efforts should be made to restore the fertility of the fallow lands by use of fertilizers and new technology. The forested land in India is below the scientific norm. Normally for self-contained and proper eco-balance, at least, one-third or the total land area must be under forest and natural vegetation. In India it is as low as 19.3%. We must increase our area under forests.

A part of the land not in use is classified as wasteland. This includes the arid, rocky and sandy deserts. Much of the land is being used in cities and towns as residential land. Cities and towns must grow vertically rather than horizontally now. The land is also needed for industry, commerce, transport and recreation. Since total land is a fixed asset, we must make efforts for integrated land use planning. Land is an important component of the life support system. Mrs. Indira Gandhi in 1972 said, "We can no longer afford to neglect our most important natural resource. This is not simply an environmental problem but one which is basic to the future of our country." In a predominantly agricultural country like ours, land comes first.

For proper planning we need authentic figures agreed upon by the concerned departments viz agriculture, forestry, revenue records etc. using modern method as remote sensing. It is observed that good agricultural land is going to industrial estates and for urban development. Thus valuable cropland is lost to agriculture forever. This is not in national interest. The best land use planning has been done by Japan, being hard pressed for land. A strategy must be developed to cure past damage and to save the country from future damage to land. A strategy must be developed to cure past damage and to save the country from future damage to land. This can be achieved by following the methods mentioned as under:

(*i*) To prepare accurate land use data through remote sensing,

(*ii*) A time bound nation wide survey programme of micro-level land use planning giving short and long-term scenarios,

(*iii*) To prepare land use classes,

(*iv*) To review all existing legislations and to update them and

(*v*) Management plans for land amelioration are to be prepared. This would lead to a dynamic land-use policy.

2. Proper Management of Water Resources

Water is an integral part of land/soil productivity base. Its misuse can cause soil degradation and soil erosion. Water management is necessary for crop yields and other activities. Primary channel flow originates in upper catchments and these watersheds are very important for future.

3. Watershed Management

In India floods bring much havoc causing loss of life and property each year. Due to floods, the plains have become silted with mud and sand, thus affecting the cultivable land areas. Extinction of civilisation in some coastal areas is mainly due to such natural calamites as flood. Flood damage cost the country Rs. 21 crore in 1951, which increased to Rs. 1,130 crore in 1977. the worst suffering states are Assam, Bihar, Orissa, U.P. and West Bengal. Through modern technology and scientific knowledge steps are to be taken. There is need of a proper understanding of the ecosystem so that changes could be forecast well in time. Thus management of rainfall and resultant runoff, which is essential, can be best based on a natural unit called watershed. A watershed is an area bounded by the divide line of water flow. Thus it may be drainage basin or stream. The Himalayas are one of the most critical watersheds in the world. The cast hydroelectric power potential can be harnessed from Himalayan watersheds if proper control measures are taken. They are inclusive of soil and land use survey, soil conservation in catchments of River Valley Projects and flood prone rivers, afforestation or social forestry programmes, Drought Prone Area Development Programmes and Desert Development and Control of Shifting Cultivation.

4. Afforestation

Top priority should be given to the forestry. Forests occupy central position in nature. They restore ecological balance of all ecosystems (including desert), maintain biological diversity, act as catchments for soil and water conservation, prevent floods and safeguard future of tribals. We should develop massive afforestation programmes of indigenous and exotic fast growing species for production and protection forestry on suitable land including wasteland. A massive social forestry programme is needed to meet demands of local people for fuel, fodder, timber etc. the two major goals for forestry are:

(*i*) Supply of goods and services to people and industry by a well thought out plan of production,

(*ii*) Long term ecological security through conservation of forests cover and its restoration.

The areas where our water regimes are located i.e. Himalayas and Western and Eastern ghats together with catchment areas; National Parks; Sanctuaries, Sacred Groves; Biosphere Reserves and all ecologically fragile areas should be protected from fuel-starved villagers and fodder-starved cattle. For this, public support must be generated in order to fulfil the real goal of eco-development. Such awareness will be very helpful for supply of goods and services to meet the local villager's needs. One very good example of public support is the Chipko Movement of Bishnoi Women in U.P. We, have only about 14% forest cover, and thus need to plant nearly 70 million hectares of additional land. This can be done by:

(*i*) Intensive plantations,

(*ii*) Production/captive plantations.

These are explained as under:

(I) *Intensive plantations:* Intensive plantation is planting all the available land from villagers' fields, to community land, to road/rail sides every available space. Indigenous and/or exotic species can be used for plantations that remove pressure on natural forests. Social/participative/agro-forestry programmes are included in this category.

(II) *Production/Captive plantations:* Plantations are to be done on fallow land not being used for agriculture; mostly on free grazing lands. A part of such plantations may be used to generate fodder for cattle. Moreover short rotations of indigenous or exotic species are to be preferred over long duration sal or teak.

The productivity in USA could be enhanced by:

(*i*) Proper manipulation of silvicultural and nutritional requirements that is use of fertilizers, irrigation, bacterial and mycorrhizal inoculations,

(*ii*) Disease and pest management,

(*iii*) Weed control,

(*iv*) Advanced techniques in forest tree breeding for superior genetic strains,

(*v*) Judicious use of tissue culture methods.

Social forestry: This forestry, is for private land. There are two main objectives of social forestry:

(*i*) Use of public and common land to produce in a decentralized way firewood, fodder and small timber for the local poor men and also to manage soil and water conservation,

(*ii*) To relieve pressure on conservation forests. This programme is in fact for poor.

Agroforestry: Agroforestry is a system of land use where woody perennials are deliberately used on the same land management units as annual agricultural crops and/or animals, either sequentially or simultaneously, with the aim of obtaining greater outputs on a sustained basis. "Here land is used for agriculture, forestry and animal husbandry. Depending upon the situation we may also have a mix of three basic elements i.e., agriculture, forestry and animal husbandry.

There should be massive afforestation arm/agroforestry programmes. Every village/town/city must be able to meet firewood, fodder and small timber needs by growing trees and shrubs in the land available in a cooperative system.

5. Proper Management of Drinking Water

This Resource (water) is renewable. However, it is subject to abuse and misuse. Infact, most of our water problems, are not those of quantity or even necessarily of quality, but are rather caused by our way of thinking and attitudes. If man learns to live with man on a cooperative basis, the water problem, like many other ecological problems, could be solved. The replenishable ground water resources in India are sufficient to provide assured irrigation to 40 million hectares. The present level of development is estimated at 25 million hectares, i.e. about 40 per cent of the total irrigation potential created in the country.

Drinking water becomes more significant in a developing country because it serves as a source of micronutrients that are so essential for good health. Deficiency or excess of the essential trace elements can cause disorders. Drinking water is an important source of intake of trace elements.

QUESTIONS

1. What is meant by Natural Resources? Explain Renewable and Non-renewable Natural resources.
2. Discuss the use and importance of Forest Resources in India.
3. Describe the main causes that are responsible for over consumption of forest.
4. Define Deforestation. What are the chief effects of Deforestation?
5. Give an account of the effects of timber extraction, mining dams on forests and tribal people.
6. Write a note on Water resources.

   Describe the main resources of water.

   Discuss the use and over-utilization of surface and ground water.
7. Discuss the measures adopted to regulate the utilization of surface water and check its over-utilization.
8. Discuss the measures adopted to regulate the utilization of underground water and check it over-utilization.

CHAPTER 3

Environmental Science : Ecosystem

INTRODUCTION

No life exists in a vacuum. Materials and forces which constitutes its environment and from which it must derive its needs surround every living organism. Thus, for its survival, a plant, an animal, or a microbe cannot remain completely aloof in a shell. Instead, it requires from its environment a supply of energy, a supply of materials, and a removal of waste products.

For various basic requirements, each living organism has to depend and also to interact with different nonliving or abiotic and living or biotic components or the environment.

1. Abiotic

The abiotic environmental components include basic inorganic elements and compounds such as water and carbon dioxide, calcium and oxygen, carbonates and phosphates besides such physical factors as soil, rainfall, temperature, moisture, winds, currents, and solar radiation with its concomitants of light and heat.

2. Biotic

The biotic environmental factors comprise plants, animals, and microbes; They interact in a fundamentally energy-dependent fashion. In the words of Helena Curtis "The scientific study of the interactions of organisms with their physical environment and with each other, is called ecology". According to Herreid II "It mainly concerns with the directive influences of abiotic and biotic environmental factors over the growth, distribution behaviour and survival of organisms.

Ecology Defined

(1) Ernst Haeckel (1866) defined ecology "as the body of knowledge concerning the economy of nature-the investigation of the total relations of animal to its inorganic and organic environment.

(2) Frederick Clements (1916) considered ecology to be "the science of community.

(3) British ecologist Charles Elton (1927) defined ecology as "the scientific natural history concerned with the sociology and economics of animals."

(4) Taylor (1936) defines ecology as "the science of the relations of all organisms to all their environments."

(5) Taylor (1936) defined ecology as "the science of the relations of all organisms to all their environments."

(6) Allee (1949), considered ecology as "the science of inter-relations batwing living organisms and their environment, including both the physical and biotic environments, and emphasizing inter-species as well as intra-species relations.

(7) G.L. Clarke (1954) defined ecology as "the study of inter-relations of plants and animals with their environment which may include the influences of other plants and animals present as well as those of the physical features."

(8) Woodbury (1955) regarded ecology as "the science which in investigates organisms in relation to their environment: a philosophy in which the world of life is interpreted in terms of natural processes.

(9) A. Macfadyen (1957) defined ecology as " a science, which concerns itself with the inter-relationships of living organisms, plants and animals, and their environments."

(10) S.C. Kendeigh (1961, 1974) defined ecology as "the study of animals and plants in their relation to each other and to their environment." Certain modern ecologists have provided somewhat broader definitions of ecology.

(11) M.E. Clark (1973) considers ecology as "a study of ecosystems of the totality of the reciprocal interactions between living organisms and their physical surroundings.

(12) Pinaka (1973) defined ecology as "the scientific study of the relationships of loving organisms with each other and with their environments." He adds that "it is the science of biological interactions among individuals, populations, and communities; and it is also the science of ecosystems-the inter-relations of biotic communities with their non-living environments.

(13) R.L. Smith (1977), considers ecology as "a multidisciplinary science which deals with the organism and its place to live and which focuses on the ecosystems."

ECO-SYSTEM

At present ecological studies are made at Eco-system level. At this level the units of study are quite large. This approach has the view that living organisms and their non-living environment are inseparably interrelated and interact with each other. A.G. Tansley (in 1935) defined the Eco-system as 'the system resulting from the integrations of all the loving and non-living actors of the environment'. Thus he regarded the Eco-systems as including not only the organism complex but also the whole complex of physical factors forming the environment.

HISTORICAL BACKGROUND

The idea of Eco-system is quite an old one. We find in literature some such parallel terms as (*i*) biocoenosis (Karl Mobius, 1977), (*ii*) microcosm (S.A. Forbes, 1887), (*iii*) Geobiocoenosis (V.V. Doduchaev, 1846-1903); G.F. Morozov; see Sukachev, 1944), (*iv*) hlocoen (Frienderichs, 1930), (*v*) biosystem (Thienemann, 1939), (*vi*) bioenert body (Vernadsky, 1994), and ecosom etc. use for such ecological systems.

The terms ecosystems is most preferred, where 'eco' implies the environment, and 'system' implies an interacting, inter-dependent complex.

In this way, it can be said that 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 (*i.e.* exchange of materials between living and non-living components) within the system, is known as an ecological system or eco-system.

Eco-system may be visualized as 3-dimensional cutouts from the ecosphere. All primary and secondary producers composing the ecosystem are its essential elements. The unique feature of eco-systems is the maintenance of their chemical state and of their environment.

Thus an eco-system is an integrated unit, consisting of interacting plants and animals whose survival depends upon the maintenance of abiotic *i.e.* physicochemical environment and gradients such as moisture, wind and solar radiation with its concomitants of light and heat, as well as biotic structures and functions. The integrated unit may or may not be isolated but it must have definable limits within which there are integrated functions. The physiologists study various functions in individual plants or animals, but the ecologists study them at the eco-system level. A real ecologist endeavors for maintaining holistic or eco-system perspective of the process being studied by him.

ASPECTS OF ECO-SYSTEM

The eco-system can be defined as any spatial or organizational unit including living organisms and non-living substances interacting to produce an exchange of materials between the living and non-living parts. The eco-system can be studied from either structural or functional aspects.

1. Structural Aspect

The structural aspects of ecosystem include a description of the arrangement, types and numbers of species and their life histories, along with a description of the physical features of the environment.

2. Functional

The functional aspects of the ecosystem include the flow of energy and the cycling of nutrients.

Habitat

The non-living part of the eco-system includes different kinds of habitats such as air, water and land, and a variety of abiotic factors. Habitat can be defined as the natural abode or locality of an animal, plant or person. It includes all features of the environment in a given locality. For example, water is used as habitat by aquatic organisms and it comprises three major categories-marine, brackish and freshwater habitats. Each of these categories may be subdivided into smaller unit, such a freshwater habitat may exist as a large lake, a pond, a puddle, a river or a stream.

The land is used as a habitat for numerous terrestrial organisms. It includes many major categories of landmasses, which are called biomes. Biomes are distinct large areas of earth inclusive of flora and fauna, *e.g.* deserts, prairie, tropical forests, *etc.* Soil is also used as a habitat by a variety of microbes, plants and animals.

Abiotic Factors

Among the main abiotic factors of the ecosystem are included the follwing:

(1) The climatic factors as solar radiation, temperature, wind, water currents, rainfall.

(2) The physical factors as light, fire, pressure, geomagnetism,

(3) Chemical factors as acidity, salinity and the availability of inorganic nutrients needed by plants.

Biotic or Biological Factors

The biological (biotic) factors of ecosystem include all the living organisms-plants, animals, bacteria and viruses. Each kind of living organism found in an ecosystem is given the name a species. A species includes individuals which have the following features:

(1) They are genetically alike.

(2) They are capable of freely inter-breeding and producing fertile offsprings.

Relationships

In an ecosystem, there exist various relationships between species. The relationship may be as under:

(1) Effects

Two species may have any of the following kind of effects:

(*i*) They may have a negative effect upon one another (competition).

(*ii*) They may have a neutral effect (neutralism).

(*iii*) They may have beneficial effect (protoco-operation and mutualism).

(2) Other kinds of Relationship

The species may aggregate, or separate, or show a random relationship to one another.

Population

A population is a group of inter-acting individuals, usually of the same species, in a definable space. In this way we can speak of population of deer on an island, and the population of fishes in a pond. A balance between two aspects determines the size of a population of any given species:

(*i*) Its reproductive potential,

(*ii*) Its environmental resistance.

In this way population size is determined by the relative number of organisms added to or removed from the group as under:

(i) Addition

Recruitment into the population is a function of birth rate and immigration rate.

(ii) Removal

Loss from the population is a function of death rate and emigration.

Factors Regulating Population

Following factors does population regulation:

(*i*) Physical attributes of the environment (*e.g.* climate),

(*ii*) Food (quantity and quality),

(*iii*) Disease (host-parasite relationships).

(*iv*) Predation,

(*v*) Competition (inter-specific and intra-specific).

An ecosystem contains numerous populations of different species of plants, animals and microbes; all of them interact with one another as a community and with the physical environment as well. A community or biotic community, thus, consists of the population of plants and animals living together in a particular place.

Division of Ecosystem

The ecosystem can be divided, from the energetic view point into three types of organisms: producers, consumers, and reducers. These can be explained as under:

(1) Producer

Photosynthetic algae, plants and bacteria are the producers of the ecosystem; all other organisms depend upon them directly or indirectly for food.

(2) Consumers

Consumers are herbivorous, carnivorous, and omnivorous animals; they eat the organic matter produced by other organisms.

(3) Reducers

Reducers are heterotrophic organisms like animals; they are fungi and bacterial that decompose dead organic matter.

FOOD CHAINS OF FOOD WEB

Species are related by their feeding behaviour in food chains or food webs. There are two basic types of food chains as under-

(*i*) The consumer food chain includes the sequence of energy flow from producer+herbivore+carnivore+reducer;

(*ii*) The detritus food chain pypasses the consumers, going from producer+reducer.

Basic Theme of Ecosystems

(1) Relationship

The first and foremost theme of an ecosystem in that everything is somehow or other related to everything else, the relationships include interlocking functioning of organisms among themselves besides with their environment. Biocoenosis and bioecocoenois are roughly equivalent to community and ecosystem respectively. Biotopes are the physical environment in which such communities exist. According to Lamotte (1969), it is this network of multiple interactions that permits us to define the ecosystem completely. Many ecologists regard Interdependence as the first basic theme of ecology. Ecosystem includes interacting and interdependent components that are open and linked to each other.

(2) Limitation

The second basis theme is Limitation which means that limits are ubiquitous and that no individual or species goes on growing indefinitely. Various species control and limit their own growth in response to overcrowding or other environmental signals and the total numbers keep pace with the resources available.

(3) Complexity

Complexity is a third characteristic of any eco-system. The three-dimensional interactions of the various constituent elements of an ecosystem are highly complex and often beyond the comprehension on the human brain.

GENERAL CHARACTERISTICS OF AN ECO-SYSTEM

According to Smith following are the general characteristics of eco-system.

(1) The ecosystem is a major structural and functional unit of ecology.

(2) The structure of an eco-system is related to its species diversity; as such the more complex ecosystem has high species diversity.

(3) The relative amount of energy required to maintain an ecosystem depends on its structure. The more complex the structure, the lesser the energy it requires to maintain itself.

(4) The function of the ecosystem is related to energy flow in material cycling through and within the system.

(5) Ecosystems mature by passing from less complex to more complex states. Early stages of such succession have an excess of potential energy. Later (mature) stages have less energy accumulation.

(6) Both the environment and the energy fixation in any given ecosystem are limited. They cannot be exceeded in any way without causing serious undesirable effect.

(7) Alterations in the environments represent selective pressures upon the population to which it must adjust. Organisms, which fail to adjust to the changed environment, must vanish.

To conclude the eco-system is an integrated unit or zone of variable size, it comprises vegetation, fauna, microbes and the environment. Most ecosystems process a well-defined soil, climate, flora and fauna and their own potential for adaptation, change and tolerance. The functioning of any ecosystem involves a series of cycles. These cycles are driven by energy flow, the energy being the solar energy.

STRUCTURE OF ECO-SYSTEMS

Meaning of Structure

By structure of an eco-system we mean as under.

(*i*) The composition of biological community including species, numbers, biomass, life history and distribution in space *etc.*

(*ii*) The quantity and distribution of the non-living materials, such as nutrients, water *etc.*

(*iii*) Structure of an ecosystem the range, or gradient of conditions of existence, such as temperature.

Natural And Function of Structure of Eco-system

The structure of an ecosystem is in fact, a description of the species of organisms that are present, including information on their life histories, population and distribution in space. It guides us to know who's who in the ecosystem. It also includes descriptive information on the non-living features of ecosystem give us information about the range of climatic conditions that prevail in the area. From structural point of view all ecosystems consist of following two basic components:

1. Abiotic Substances (Non-Living Components)

The Abiotic substances include basic inorganic and organic compounds of the environment or habitat of the organism.

(a) Inorganic Components: The inorganic components of an ecosystem are as undercarbon dioxide, water, nitrogen, calcium, and phosphate. All of these are involved in matter cycles (biogeochemical cycles).

(b) Organic Components: The organic components of an ecosystem are proteins, carbohydrates; lipids and amino acids, all of these are synthesized by the biota (flora and fauna) of an ecosystem and are reached to ecosystem as their wastes, dead remains, *etc.*

(c) The climate, temperature, light, soil etc., are othe rabiotic components of the eco-system.

(3) ***Biotic Substances (Living Components):*** This is indeed the trophic structure of any ecosystem, where living organisms are distinguished on the basis of their nutritional relationships. From this trophic (nutritional) standpoint, an ecosystem has two components:

(a) Autotrophic Component of Producers

These are the components in which fixation of light energy use of simple inorganic substances and build up of complex substance predominate.

(*i*) The component is constituted mainly by green plants, including photosynthetic bacteria.

(*ii*) To some lesser extent, chemosynthetic microbes also contribute to the build up of organic matter.

(*iii*) Members of the autotrophic component are known as eco-system producers because they capture energy from non-organic sources, especially light, and store some of the energy in the form of chemical bonds, for the later use.

(*iv*) Algae of various types are the most important producers of aquatic eco-systems, although in estuaries and marshes, grasses may be important as producers.

(*v*) Terrestrial ecosystems have trees, herbs, grasses, and mosses that contribute with varying importance to the production of the eco-systems.

(b) Heterotrophic Component or Consumers

These are the components in which utilization; rearrangement and decomposition of complex materials predominate. The organisms involved are known as consumers, as they consume autotrophic organisms like bacterial and algae for their nutrition, the amount of energy that the producers capture, sets the limit on the availability of energy for the ecosystem. Thus, when a green plant captures a certain amount of energy from sunlight, it is said to produce the energy for the ecosystem. The consumers are further categorized as:

(i) Macroconsumers

Marcoconsumers are the consumers, which in a order as they occur in a food chain are, herbivores, carnivores (or omnivores).

(*a*) Herbivores are also known as primary consumers.

(*b*) Secondary and tertiary consumers, if preset, are carnivores of omnivores. They all phagotrophs that include mainly animals that ingest other organic and particulate organic matter.

(ii) Microconsumers

These are popularly known as decomposers. They are saprotrophs (=osmotrophs) they include mainly bacteria, actinomycetes and fungi. They breakdown complex compounds of dead or living protoplasm, they absorb some of the decomposition or breakdown products. Besides, they release inorganic nutrients in environment, making them available again to autotrophs.

The biotic component of any ecosystem may be thought of as the functional kingdom of nature. The reason is, they are based on the type of nutrition and the energy source used. The trophic structure of an ecosystem is one kind of producer consumer arrangement, where each “food” level is known as trophic level.

Standing Corp

The amount of living material in different trophic levels or in a component population is known as the standing corp. This term applies to both, plants as well as animals. The standing crop may be expressed in terms

(*i*) Number of organisms per unit area,

(*ii*) Biomass *i.e.*organism mass in unit area, we can measure it as living weight, dry weight, ash-free dry weight of carbon weight, or calories or any other convenient unit suitable.

Decomposers

In the absence of decomposers, no ecosystem could function long. In their absence, dead organisms would pile up without rotting, as would waste products, It would not be long before and an essential element, phosphorus, for example, would be first in short supply and then gone altogether, the reason is the dead corpses littering the landscape would be hoarding the entire supply. The decomposers tear apart organisms and in their metabolic processes release to the environment atoms and molecules that can be reused again by autotrophic point of view. Instead they are important from the material (nutrient) point of view. Energy cannot be recycled, but matter can be. Hence it is necessary to feed Energy into ecosystem to keep up with the dissipation of heat or the increase in entrophy. Matter must be recycled again and again by an ecological process called biogeochemical cycle.

An Illustration

The Structure of ecosystem can be illustrated as under with the help of ponds example.

1. Abiotic Part

The abiotic or non-living parts of a freshwater pond include the follwing:

(*i*) Water,

(*ii*) Dissolved oxygen,

(*iii*) Carbon Dioxide,

(*iv*) Inorganic salts such as phosphates, nitrates and chlorides of sodium, potassium, and calcium

(*v*) A multitude of organic compounds such as amino acids, humic acids, *etc.* according to the functions of the organisms, *i.e.*, their contribution towards keeping the ecosystem operating as a stable, interacting whole.

(a) Produces

In a freshwater pond there are two types of producers,

(i) First are the larger plants growing along the shore or floating in shallow, water,

(ii) Second are the microscopic floating plants, most of which are algae,

These tiny plants are collectively referred to as phytoplankton. They are usually not visible. They are visible only when they are present in great abundance and given the water a greenish tinge. Phytoplanktons are more significant as food producers for the freshwater pond ecosystem than are the more readily visible plants.

(b) Consumers

Among the macro consumers or phagotrophas of pond ecosystems include insects and insect larvae, Crustaces, fish and perhaps some freshwater clams.

(*i*) ***Primary Consumers:*** Primary consumers such as zooplankton (animal plankton) are found near the surface of water. Likewise benthos (bottom forms) are the plant eaters (herbivores).

(*ii*) ***Secondary consumers:*** The secondary consumers are the carnivores that eat the primary consumers. There might be some tertiary consumers that eat the carnivores (secondary consumers).

Saprotrophs

The ecosystem is completed by saprotrophs or decomposer organisms such as bacteria, flagellage protozoans and fungi, They break down the organic compounds of cells from dead producer and consumer organisms in any of these ways-

(*i*) Into small organic molecules, which they utilize themselves, or

(*ii*) Inorganic substances that can be used as raw materials by green plants.

ECOLOGICAL PYRAMIDS

The main characteristic of each type of Ecosystem in Trophic structure, *i.e.* the interaction of food chain and the size metabolism relationship between the linearly arranged various biotic components of an ecosystem. We can show the trophic structure and function at successive trophic levels, as under:-

Producers $\longrightarrow$ Herbivores $\longrightarrow$ Carnivores

It may be known by means of ecological pyramids. In this pyramid the first or producer level constitutes the base of the pyramid. The successive levels, the three make the apex. Ecological pyramids are of three general types as under:

(*i*) **Pyramid of numbers:** It shows the number of individual organisms at each level,

(*ii*) **Pyramid of energy:** It shows the rate of energy flow and/or productivity at successive trophic levels.

(*iii*) **Pyramid of energy:** It shows the rate of energy flow and/or productivity at successive trophic levels.

The first two pyramids

That is the pyramid of numbers and biomass may be upright or inverted. It depends upon the nature of the food chain in the particular ecosystem, However, the pyramids of energy are always upright.

A brief description of these pyramids is as under:

1. Pyramids of numbers

The pyramids of numbers show the relationship between producers, herbivores and carnivores at successive trophic levels in terms or their numbers.

(*i*) In a grassland the producers, which are mainly grasses, are always maximum in number.

(*ii*) This number shows a decrease towards apex, the reason is obvious, number than the grasses.

(*iii*) The secondary consumers, snakes and lizards are less in number than the rabbits and mice.

(*iv*) In the top (tertiary) consumers hawks or other birds, are least in number.

In this way the pyramid becomes upright. In a pond ecosystem, also the pyramid is upright as under:

(*i*) The producers, which are mainly the phyto-planktons as algae, bacteria etc. are maximum in number;

(*ii*) The herbivores, which are smaller fish; rotifers *etc* are less in number than the producers;

(*iii*) The secondary consumers (carnivores), such as small fish which eat up each other, water beetles *etc.* are less in number than the herbivores;

(*iv*) Finally, the top (tertiary) consumers, the bigger fish are least in number.

However, the case is not so in a forest eco-system. There the pyramid of numbers is somewhat different in shape:—

(*i*) Producer, here the producers, are mainly large-sized trees, they are less in number, and form the base of the pyramid.

(*ii*) The herbivores, which are the fruit-eating birds, elephants, deer *etc.* are more in number than the producers.

(*iii*) Thereafter there is a gradual decrease in the number of successive carnivores.

In this way the pyramid is made again upright. However, in a parasites food chain the pyramids are inverted. This is for the reason that a single plant may support the growth of many herbivores. In its turn, each herbivore may provide nutrition to several parasites, which support many hyperparasites. Consequently from the producer towards consumers, there is a reverse position. In other words the number of organisms gradually shows an increase, making the pyramid inverted in shape.

2. Pyramids of biomass

The pyramids of biomass are comparatively more fundamentalism; as the reason is they instead of geometric factor; show the quantitative relationships of the standing crops. The pyramids of biomass in different types of ecosystem may be compared as under:

In grassland and forest there is generally a gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. In this way, the pyramids are upright. However, in a pond the producers are small organisms, their biomass is least, and this value gradually shows an increase towards the apex of the pyramid and the pyramids are made inverted in shape.

3. Pyramid of energy

The energy pyramid gives the best picture of overall nature of the ecosystem. Here, number and weight of organisms at any level depends on the rate at which food is being produced. If we compare the pyramid of energy with the pyramids of numbers and biomass, which are pictures of the standing situations (organisms present at any moment), the pyramid of energy is a picture of the rates of passage of food mass through the food chain. It is always upright in shape.

FUNCTION OF AN ECO-SYSTEM

For a fuller understanding of ecosystems a fuller understanding of their functions besides their structures is essential. The function of ecosystems includes, the process how an eco-system works or operates in normal condition.

From the operational viewpoint, the living and non-living components of ecosystem are interwoven into the fabric of nature. Hence their separation from each other becomes practically very much difficult. The producers, green plants, fix radiant energy and with the help of minerals (C, O, N, P, L, Ca, Mg, Zn, Fe *etc.*) taken from their soil and aerial environment (nutrient pool) they build up complex prefer to call the green plants as converters or transducers because in their opinion the terms 'producer' form an energy viewpoint which is somewhat misleading. They contend that green plants produce carbohydrates and not energy and since they convert or transducer radiant energy into chemical form, they must be better called the converters or transducers. However, the term' producer' is so widely used that it is preferred to retain it as such.

While considering the function of an ecosystem, we describe the flow of energy and the cycling of nutrients. In other words, we are interested in things like how much sunlight plants trap in a year, how much plant material is eaten by herbivores, and how many herbivores carnivores eat.

Functions of Eco-system

The functions of Ecosystem are as under:

1. Transformation of Solar Energy into Food Energy

The solar radiation is major source of energy in the ecosystem. It is the basic input of energy entering the ecosystem. The green plants receive it. And is converted into heat energy. It is lost from the ecosystem to the atmosphere through plant communities. It is only a small proportion of radiant solar energy that is used by plant to make food through the process of photosynthesis. Green plants transform a part of solar energy into food energy or chemical energy. The green plants to develop their tissues use this energy. It is stored in the primary producers at the bottom of trophic levels. The chemical energy, which is stored at rapid level one, becomes the source of energy to the herbivorous animals at *trophic level two* of the food chain. Some portion energy is lost from *trophic level one* through respiration and some portion is transfereed to plant-eating animals at *trophic level two.*

2. The Circulation of elements through Energy Flow

It is seen that in the various biotic components of the ecosystem the energy flow is the main driving force of nutrient circulation. The organic and inorganic substances are moved reversibly through various closed system of cycles in the biosphere, atmosphere, hydrosphere and lithosphere. This activity is done in such a way that total mass of these substances remains almost the same and is always available to biotic communities.

3. The Conversion of Elements into Inorganic Flow

The organic elements of plants and animals are released in the under mentioned ways:

(*i*) Decomposition of leaf falls from the plants dead plants and animals by decomposers and their conversion into soluble inorganic form.

(*ii*) Burning of vegetation by lighting, accidental forest fire or deliberate action of man. When burnt, the portions of organic matter are released to the atmosphere and these again fall down, under the impact of precipitation, on the ground. Then they become soluble inorganic form of element to join soil storage, some portions in the form of ashes are decomposed by bacterial activities.

(*iii*) The waste materials released by animals are decomposed by bacteria. They find their way in soluble inorganic form to soil storage.

4. The Growth and Development of Plants

In the biogeochemical cycles are included the uptake of nutrients of inorganic elements by the plants through their roots. The nutrients are derived from the soil where these inorganic elements are stored. The decomposition of leaves, plants and animals and their conversion into soluble inorganic form are stored into soil contributing to the growth and development of plants. Decompositions are converged into some elements. These elements are easily used in development of plant tissues and plant growth by biochemical processes, mainly photosynthesis.

5. Productivity of ecosystem

The productivity of an ecosystem refers to the rate of production i.e. the amount of organic matter, which is accumulated in any unit time. Productivity is of the following types:

(1) **Primary productivity:** It is associated with the producers which are autotrophic, Most of these are photosynthetic, Thus, they are, to a much lesser extent the chemosynthetic micro organisms. These are the green plants, higher saprophytes as well as lower forms, the phytoplankton's and some photosynthetic bacteria. We can define Primary productivity as "the rate at which radiant energy is stored by photosynthetic and chemosynthetic activity of producers." Primary productivity is further distinguished as:

Gross primary productivity: Gross Primary Productivity is the rate of storage of organic matter in plant tissues in excess of the respiratory utilization by plants during the measurement period. This is, thus, the rate of increases of biomass. In this way, net primary productivity refers to balance between gross photosynthesis and respiration and other plant losses as death *etc.*

(2) **Secondary productivity:** These are the rates of energy storage at consumers level. Since consumers only utilize food materials (already produced) in their respiration, simply covering the food matters to different tissues by an overall process. The secondary productivity is not divided into 'gross' and 'net' amount.

(3) **Net Productivity:** Net productivity refers to the rate of storage of organic matter not used by the heterotrophs (consumer) i.e. equivalent to net primary production minus consumption by the heterotrophs during the unit period. It is thus the rate of increase of biomass of the primary producers, which has been left over by the consumers.

(4) Stability of Ecosystem: The stability of ecosystems refers to the balance between production and consumption of each element in the ecosystem. In other words, balance between input and output of energy and normal functioning of different biogeochemical cycles and stable conditions of equilibrium as under:-

(*i*) **The Equilibrium Model:** The equilibrium model states that an ecosystem, always tends towards stability. As soon as the community of an ecosystem is disturbed due to external environmental change, it quickly returns to original state where as.

(*ii*) **The non-equilibrium model:** The non-equilibrium model states that an ecosystem stability is rarely attained because disturbances caused by frequent external environmental change do not allow to develop ordered state of species assemblages in an ecosystem.

DECOMPOSERS

In this world all living organisms require a constant supply of nutrients for growth. The death and decomposition of plants and animals, with release of nutrients constitutes an essential link in the maintenance of nutrient cycles. When an organism dies, an initial period of rapid leaching takes place and populations of macromolecules. The dead organism is disintegrated beyond recognition. Enzymic action breaks down the disintegrating parts of the litter. Animals invade and either eat the rapidly recolonized by micro- organisms, and the litter biomass decreases. It becomes simpler in structure and chemical composition.

Process of Decomposition

The process of decomposition involves three interrelated components, *viz.*

(*i*) Leaching (*ii*) Catabolism, (*iii*) Comminution.

1. Leaching

Leaching is a physical phenomenon operating soon-after litter fall. Soluble matter is removed from detritus by the action of water. Sometime over 20% of the total nitrogen content of litter maybe leached off.

2. Catabolism

The process in a plant or animal by which living tissue is changed into waste products.

3. Comminution

Comminution to make small to reduce to power or minute particles. Comminution means the reduction in particle size of detritus. During the course of feeding, the decomposer animals community detritus physically. And utilize the energy and nutrients for their own growth (secondary production). In due course, the decomposers themselves die and contribute to the detritus.

Function of Decomposition

The two major functions of decomposition within ecosystems are as under:-

(1) The mineralization of essential elements,

(2) The formation of soil organic matter to inorganic form.

The formation of soil organic matter in nature is a slow process. The decomposition of any piece of plant detritus may take hundreds of years to complete. However, some residues of decomposition within this period do contribute to the formation of soil organic matter.

Community of Decomposer Organisms

The community of decomposer organisms includes several bacteria, fungi, protests and invertebrates. The different species in such a community function in an integrated manner. For example, a fungus decomposes plant litter and is eaten by an animal. Upon death, bacteria decompose the animal, and protozoa may eat the bacteria.

Fungi and bacteria are the principal organisms that break down organic matter. Certain protozoa, nematodes, annelids and arthopods strongly influence their functioning (*i.e.* of fungi and bacteria) due to their feeling activities. Microarthopod fauna, comprising mainly of oribatid mites besides other mites and collembolans, are abundant in most forest, grassland and desert ecosystem.

Most of these micro-arthropods are predominantly fungal-feeders. They can do as under:

(1) They can decompose substrata.

(2) They can decrease substrata's mass by leaching soluble intercellular components.

(3) They can do so by oxidation.

(4) They can physically cut in into smaller fragments.

Increased mineralization of nitrogen, phosphorus and potassium has been reported to be mediated by microarhropods in several studies.

In the same way, the interactions of micro-arthropods with soil fungi are also quite important in nutrient cycling. Studies of this aspect are made in mycorrhizal fungi and themicro-arthropods which feed upon these fungi:

(1) It is found that Mycorrhizal pump massive amounts of nutrients form detritus and represent a sizable nutrient reservoir themselves.

(2) The orbited mites and other micro-arthropods feed on myocardial fungi they act like herbivorous pests, and can alter nutrient relations/cycling in terrestrial ecosystems.

Table 3.1 : Chief Decomposer Organisms

Division/Class	Orders	Common Names
Eubacteria	Myxobacterales Cytophagales Spirochaetales Actinomycetales	Fruiting bacteria Gliding bacteria Spirochaetes Actinomycetes
Cyanobacteria		Blue green algae
Myxomycota		Slime moulds
Mastigomycotina		Chytrids, zoosporic fungi, water moulds
Zygomycotina	Mucorales Eutomophjthorales Zoopagales	Pin moulds Entomogenous fungi Nematode-trapping fungi
Ascomycotina	(Several)	Yeasts, cup fungi, flask fungi
Basidiomycotina	(Several)	Ruts, smuts, mushrooms, Toadstools, bracket fungi, Puffballs etc.
Deuteromycotina Protozoa		Imperfect fungi, puffballs, Pycnidial fungi, etc. Ciliates, amoebas, Flagellates, etc.
Rotifera		Rotifers
Nematoda	Tricladida Metanemertini	Flatworms Ribbonworms
Annelida		Earthworms, leeches
Mollusca	Pulmonata	Slugs, snails Copepods, amphipods, Isopods, decapods
Arthropods, Diplopoda		Millipedes
Arthropods, Chilopods		Centipedes
Arthropods, Insects	(Several)	Termites, beetles, flies, Moths, ants, grasshoppers, Cockroaches etc.
Arthropods, Arachnida	(Several)	Scorpions, sun spiders, Mites, spiders

DECOMPOSERS WITH VARYING RELATIONS

Some decomposer organism's cannot be assigned a rigid or fixed position in the food web. Their trophic relations can vary from time to time.

1. **Nectroph:** Some decomposers are nectrophs. They cause rapid death of the food source because they have a short-term exploitation of living organism. Nectrophs include may plant parasitic microbes as well as some herbivores, predators, and microtrophs (organisms which feed on living bacteria and fungi.)
2. **Biotrophs:** On the other hand biotopes resort to a long-term exploitation of their living food resource. For example, root-feeding nematodes and aphids, obligate plant parasites, *e.g.,* and mycorhizae and root nodules, *etc.*
3. **Saprotophs:** The apostrophes utilize food already dead, and most of the decomposers belong to this category.

Decomposers occupying different trophic levels

There are some such organisms causing decompositions as can occupy various trophic levels under different conditions. For instance the root parasites like Fusarium and Thizoctonia are necrotrophs, which often show a saprotrophic tendency. In the same way, the predators (foxes and kites) sometime behave as saprotrophs. Biotrophs sometime act as necrotrophs or as saprotrophs.

Soul Invertebrates And Termites

There are some soil invertebrates *e.g.* earthworms and collembolans distribute organic matter throughout the soil whereas others *e.g.* termites and ants, concentrate it at localized sites around or near the royal chamber or in mounds. The following table shows the estimated activities of major groups of soil animals.

Table 3.2 : Soil Animals' Activites

Group (m-2)	**Density Respiratory quotient**	**R/Q efficiency**	**Production products**	**Excretory**	**C/N ratio**
Protozoa	0.1-x1000	0.31-0.71	0.34-0.40	Urea ammonia	5
Nematodes	3.9-0-6x106	04.41-0.96	0.04-0.13 aminoacids	Urea ammonia	7.5-12
Annelids (eartworms)	0.650		<0.07	Urea	
Molluscs	0-8500	0.82		Ammonia. urea, Amino acids	
Arthropods					
Collembola	700-40,00				
Ants, termiter	1000-10,000			Uric acid urates	

ENERGY-ITS FLOW IN ECOSYSTEM

Energy-Defined

Energy can be defined as the capacity to do work, whether that work be on a gross scale as raising mountains and moving air masses over continents, or on a small scale such as transmitting a nerve impulse from one cell to another.

Kinds of Energy

There are two kinds of energy, potential and kinetic. They can be explained as under:-

1. Potential Energy

Potential energy is energy at rest. It is capable and available for work.

2. Kinetic Energy

Kinetic energy is due to motion, and results in work. Work that results from the expenditure of energy can be of two kinds:

(1) It can store energy (as potential energy).

(2) It can order matter without storing energy.

3. Laws of Thermodynamics

The expenditure and storage of energy is described by two laws of thermodynamics:-

(*i*) **Law of conservation of energy:** The law of conservation of energy states that energy is neither created nor destroyed. It may change forms, pass from one place to another, or act upon matter in various ways. In this process no gain or loss in total energy occurs. Energy is simply transferred from one form or place to another.

Two Reactions

There may be either of the two reactions:

1. Exothermic Reaction

When wood is burnt the potential energy present in the molecules of wood equals the kinetic energy released, and heat is evolved to the surroundings. This is an exothermic reaction.

2. Endothermic Reaction

In an endothermic reaction, energy from the surrounding may be paid into a reaction. For example, in photosynthesis, the molecules of the products store more energy than the reactants. The extra energy is acquired from the sunlight yet there is no gain or loss in total energy.

(*ii*) Law of Decrease in Energy: The second law of thermodynamics states that on the transformation of from one kind to another, there is an increase in entropy and a decrease in the amount of useful energy. In this way, when coal in burned in a boiler to produce steam, some of the energy creates steam that performs work, but part of the energy is dispersed as heat to the surrounding air.

Three Sources of Energy

Three sources of energy account for all the work of the ecosystem. These sources are gravitation. Internal forces within the earth and solar radiation. The last one is significant for ecosystem. The solar radiation, which originates from sun is the source of energy for life and is what sets the ecosystem, besides other natural system.

Energy Flow

Due to unidirectional flow of energy, the behaviour of energy in ecosystem is called Energy Flow. From the energetics point of view, energy flow is explained as under:

(*i*) The efficiency of the producers in absorption and conversion of solar energy.

(*ii*) The use of the above said converted chemical form of energy by the consumers.

(*iii*) The total input of energy in form of food and its efficiency of assimilation.

(*iv*) The loss caused through respiration, heat, excretion etc.

(*v*) The gross, net production.

Single Channel Energy Model

Lindemann (1942) was the first to propose the community energetics approach or the trophic-dynamic model) to ecology, which enables an investigator to compare the relative rates at which different kinds concerning energy flow through forest ecosystems by the application of this kind of approach, e.g. by comparing ratios of leaf fall to litter deposition on the forest floor. His conclusion was that the rates of leaf production are higher and those of litter accumulation lower, in the tropics than at higher latitudes.

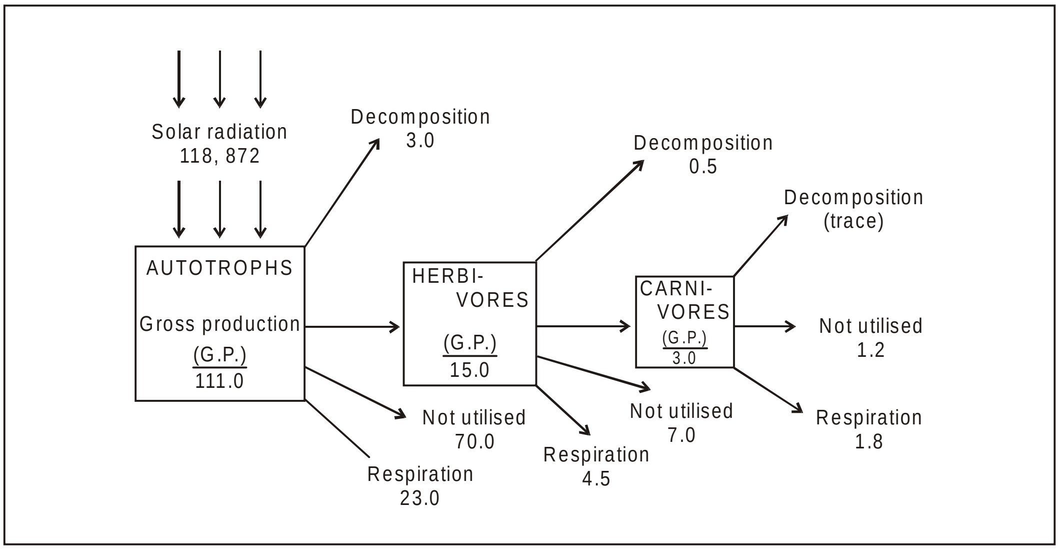


Fig. 3.2 Single channel energy model.

The following conclusion can be drawn from the above figure:

(1) Out of the total incoming solar radiation (118,872 g cal/cm^2 /yr), 118,761 gcal/cm^2/yr remain unutilized. In this way, the gross production (net production plus respiration) by autotrophs comes to be 111 gcal/cm^2/yr with an efficiency of energy capture of 0.10 per sent.

(2) Again 21 per cent of this energy, or 23 gcal/cm^2/yr (show on the bottom as respiration) is consumed in metabolic reactions of autotrophs for their growth, development, maintenance and reproduction.

(3) 15 gcl/cm^2/yr are consumed by herbivores that graze of feed on autographs-this figure amounts to 17 per cent of net autotroph production.

(4) Decomposition is 3 gcal/cm^2/yr which amount to be 3, 4 per cent of net production.

(5) The remainder of the plant material, 70 gcal/cm^2/yr of 79.5 per cent production, is not utilised. It becomes part of the accumulating sediments. Apparently much more energy is available for herbivory than is consumed.

We may conclude the following conclusions

(1) Various pathways of loss are equivalent to and account for total energy capture of the autotrophs *i.e.* gross production.

(2) The three upper 'fates' *i.e.* decomposition, herbivory and not utilized collectively are equivalent to net production.

(3) Of the total energy which is incorporated at the herbivory level, *i.e.* 15/ gcal/cm2yr, 30 percent of 4.5 gcal/cm^2/yr is used in metabolic reactions.

(4) In this way more energy is lost via respiration by herbivores (30 percent) than by autotrophs (21 percent),

(5) Considerble energy is available for the carnivores, namely 10.5 gcal/cm^2/yr or 70-per cent. It is not entirely utilized, merely 3.0 gcal/cm^2/or 28.6 per cent of net production passes to the carnivores. This utilization of resources is evidently more efficient than the one, which occurs at autotroph-herbivore transfer level.

(6) At the carnivore level the consumption in metabolic activity is about percent of the carnivores energy intake.

(7) The remainder becomes part of the un-utilized sediments;

(1) There is Noe-way Street along which energy moves (unidirectional flow of energy.

  (*a*) The energy that is captured by the autotrophs does not revert back to solar input.

  (*b*) The energy which passes does not pass back to the autotrophs. It moves progressively through the various trophic levels. As such, it is no longer available to the previous level. Since there is one-way flow of energy, the system would collapse in case the primary source, the sun, were cut off.

(2) Secondly, progressive decrease in energy level is seen at each trophic level. This decrease is accounted as under:

  (*i*) By the energy dissipated as heat in metabolic activities.

  (*ii*) Measured here as respiration coupled with unutilized energy.

Below is a figure after Epodum (1963).

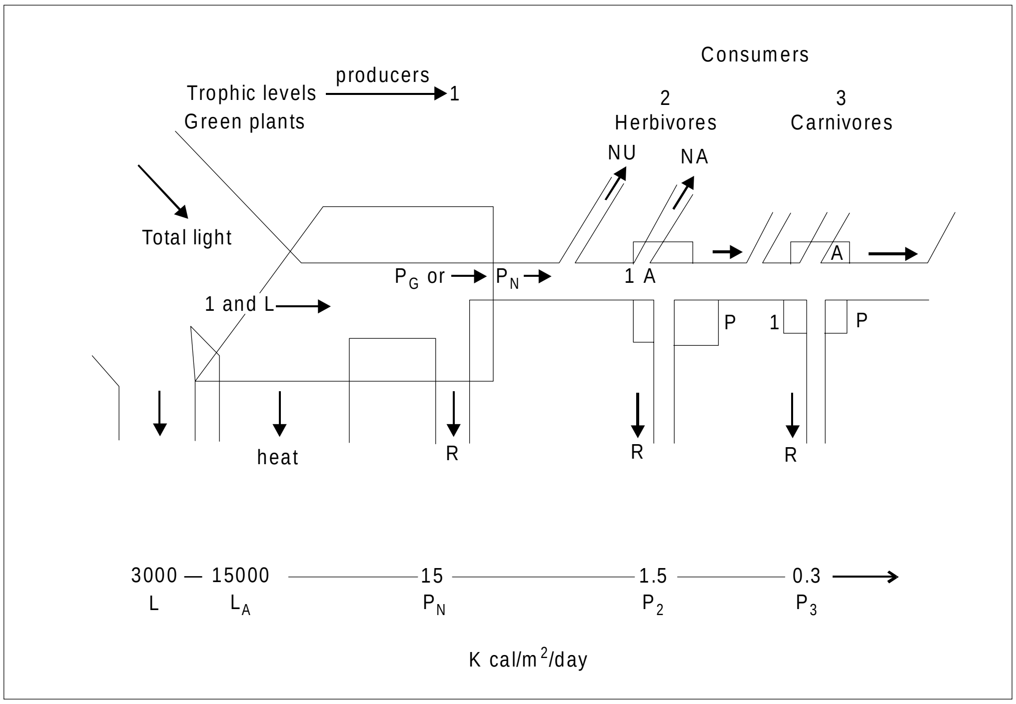


Fig. 3.2 Energy flow diagram

This is a simplified energy flow diagram

(1) The diagram depicts three trophic levels. Boxes numbered 1, 2, 3 in a leaner food chain exhibit these.

(2) L. shows total energy input (3000).

(3) LA shows light absorbed by plant cover (1500).

(4) P.G. shows gross Primary production.

(5) A shows total assimilation.

(6) Pn shows net primary production.

(7) P shows secondary (consumer) production.

(8) Nu shows energy not used (stored or exported).

(9) NA shows energy not assimilated by consumers (egested).

(10) R shows respiration.

Some more elucidation of the figure is as under:

(1) The 'boxes' represent the trophic levels

(2) The 'pipes' depict the energy flow in and out of each level.

Energy inflows balance outflows

The first law of thermodynamics requires it. The energy transfer is accompanied by dispersion of energy into unavailable heat (*i.e.* respiration). The second law requires it.

It is very simplified energy flow model of three trophic levels

Apparently the energy flows is greatly reduced at each successive trophic level from producers to herbivores and then to carnivores. It is reflected that at each transfer of energy from one level to another, major part of energy is lost as heat or other form. The energy flow is reduced successively. We may consider it in either term as under:

(1) In terms of total flow (*i.e.* total energy input and total assimilation).

(2) In terms of secondary production and respiration components.

In this way of the 3,000 Kcal of total light, which falls upon the green plants, approximately 50 per cent (1500 Kcal) is absorbed. Only 1 per cent (15 Kcal) of it is converted at first trophic level. Thus net primary production comes to be at 15 Kcal. Secondary productivity (P2 and P3 in the diagram) is about 10 percent at successive consumer trophic levels in other words at the levels of herbivores and the carnivores. However, efficiency may be sometimes higher as 20 per cent, at the carnivore level as shown (or P3=0.3 Kcal) in the diagram.

It may be concluded from the above studies as under:

(1) There is a successive reduction in energy flow at successive trophic levels. Thus shorter the food chain, greater would be the available food energy. The reason is with an increase in the length of food chain, there is a corresponding more loss of energy.

(2) With a reduction in energy flow (shown as ‘pipes’ in the diagram) at each successive trophic level, there is also a corresponding decrease in standing crop or biomass (shown as ‘boxes’ in the diagram). However, it does not mean that there exists any correlation between the biomass and energy. Indeed energy as taken here represents rate functions or production rates. The relationships between biomass and content are not fixed. They may differ according to the situations. For example, one gram of an algae (lesser biomass) may be equal to many grams (more biomass) of a forest tree leaves as the rate of production of the algae is higher than that of tree leaves.

Y-shaped energy flow model-Two channel energy flow model

Following the example of Lindeman, several authors described energy flow modes for different kinds of ecosystems. Two illustrations are here:

(1) Teal (1957) prepared an energy flow diagram of Root Spring in U.S.A.

(2) H.T. Odum (1957) prepared energy flow model for Silver Springs, Florida, U.S.A.

(3) 30, 810 Kcal/m2 y remained for net production.

In model given by Teal (1957) for Root Springs, most of the energy rich material eaten by heterotrophs entered the systems as plant debris. On the other hand in the model given by H.T. Odum (1957) for Silver Spring, most of the heterotroph’s food in food chain was produced by green with in some systems heterotrophs consume living plants while in others they feel on dead plant parts (detritus).

(1) In Root Springs, the chain began with dead plant parts.

(2) In Silver Springs the chain began with live plant parts.

On the basis of the studies E.P. Odum pointed out that in nature there are present two basic food chains in any system:

(1) The grazing food chain beginning with green plant base going to herbivores and then to carnivores, and

(2) The detritus food chain beginning with dead organic matter acted by microbes, then passing to detritivores and their consumers (predators).

The figure given below present one of the first published energy flow models as pioneered by H.T. Odum in 1956.

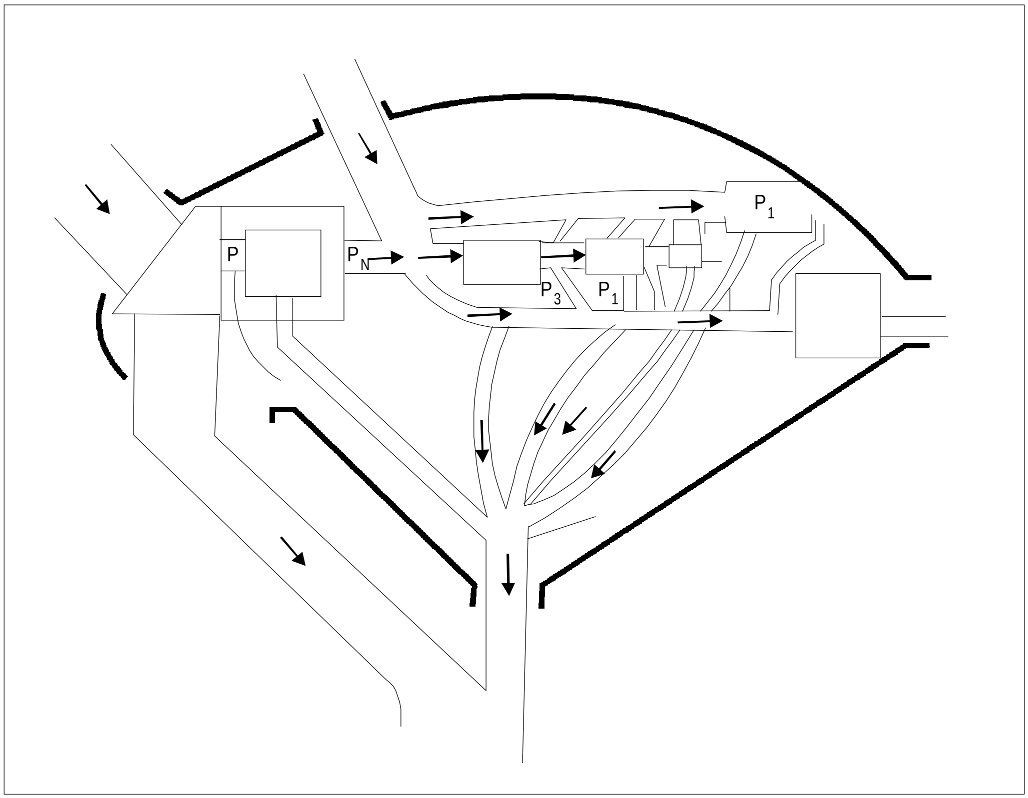


Fig. 3.3 First Energy Flow Model (1956)

The above figure illustrates energy flow in a community with a large import and smaller export of organic matter.

P indicates gross primary production; P_N indicates net primary production. P_2. P_2...............P_5 indicate secondary production at the shown levels.

Gross Primary production GPP = Total photosynthetic C fixation Autotrophic Respiration, RA = GPP-NPP

Net primary Production, NPP-RA

Heterotrophic Respiration, RH = respiration of consumers and decomposers.

Ecosystem Production, NEP = GPP-RE

The three major steps in energy flow correspond to:—

(*a*) Exploitation efficiency,

(*b*) Assimilation efficiency,

(*c*) Net production efficiency.

The product of the assimilation net production efficiencies gives gross production efficiency *i.e.* by the fraction of the eaten material eventually transformed into consumer biomass. The whole food web may be taken to be the product of the gross production efficiency and the exploitation efficiency. The various kinds of energetic efficiencies can be defined as under:

Exploitation efficiency	=	Ingestion of food/prey production.
Assimilation efficiency	=	Assimilation/ingestion;
Net production efficiency	=	Production/assimilation.
Ecological efficiency	=	Exploitation efficiency × Assimilation efficiency × Net production efficiency;
	=	Consumer production/prey production;
	=	Production/ingestion.
Gross production	=	Production/ingestion.

In animals, rate of production appears to depend on body mass. Per unit body mass, small animals are found more productive than big animals. Again invertebrates are less productive than mammals. Molluscs, annelids, isopods, and insects are invertebrates of intermediates size between copepods and echinoids.

Some conclusions regarding energy flow in the ecosystem are as under:

There is no quantitative relationship between the production of a certain trophic level and the production of the next lower trophic level (both in calorific terms) except for the very high or very low values of the former. This applies to the "phytoplankton-filter feeders" and as well as "filtrators-invertebrate predators" trophic links in the plankton food chain.

The utilization of primary production in pelagic zone often depends on the nature of dominant species of producers and consumers. In a system containing phyto-planktonic algae-macroconsumers effective utilization occurs mostly via grazing. In the case of larger algae and smaller consumers, primary production is mainly utilized via bacterial detritus medium.

The energy transfer efficiency from the filtrator's trophic level to their invertebrate predators is often higher than from phytoplankton to filtrators.

ECOLOGICAL SUCCESSION-MEANING AND TYPES

Meaning of Succession

Biotic communities are not static. Instead they change through time. This change can be understood on several levels. The simplest level is the growth, interaction and death of individual organisms as they pass through their life cycles, affected by the cycles of seasons and other natural phenomena. Some other levels of community change act over longer time spans and that account for much larger changes in community composition and structure. These include ecological succession and community evolution.

It is evident from the above said that the term succession denotes a sequence of changes in the species composition of a community, which is generally associated with a sequence of changes in its structural and functional properties. The term is generally used for temporal sequence (in terms of years, decades or centuries) of vegetation on a site; although only short term changes can be observed directly and the long term ones are inferred from spatial sequences.

The changes associated with succession are usually progressive or directional. This fact enables one to predict which species are likely to replace other in the course of a succession. Sucession tends to continue until the species combinations best suited to the regional climate and the particular site are established.

Historical Background

The basic idea of succession was in the beginning forwarded by Anon Kerner (1863) in his book "Plant Life of the Danube Basin" during the description of the regeneration of a swamp forest. The term ecological succession was first of all used by Hult (1885) in the study of communities of Southern Sweden. H.C. Cowles held that communities are not static but dynamic. This changed understanding be visualized as an orderly, directional and predictable phenomenon. It was added that succession is autogenic *i.e.* regulated by biotic interactions within the community. The central foundation of the classical theory was that early communities alter the environment to their detriment and favour later successional communities. It was revealed by the later studies that allogenesis was perhaps more common and dominant than autogenesis; allogenesis means the control of community dynamics by factors originating outside the community boundaries.

The succession of animals on these dunes was studied by 'Shelford (1913). Later on, Olson (1958) restudies the ecosystem development on these dunes and has given us an updated information about it. Federick Clements (1907-1936) elaborates the principles and theory of succession. He proposed the monoclimax hypotesis of succession. During the later years certain other hypotheses were proposed by various ecologists to explain the nature of climax communities: for example, polyclimx hypothesis by Braun-Blanquet (1932) and Tansley (1939): climax pattern hypothesis by Whittaker (1953), Mac intosh (1958) and Sellack (1960): and stored energy theory of information theory by Fosberg (1965, 1967) and Odum (1969).

Odum (1969) defined succession in terms of 3 parameters, viz.:

(1) Succession is an orderly process of reasonable directional and fairly predictable community development;

(2) Succession results from modification of the physical environment by a community, i.e. succession is largely community controlled.

(3) Succession culminates in a stabilized ecosystem in which maximum biomass and symbiotic function between organisms are maintained per unit of available energy flow. Whittaker (1975), held that through the course of succession community production, height and mass, species-diversity, relative stability, and soil depth and differentiation generally all tend to increase. The culminating point of succession is a climax community of relatively stable species composition and steady-state function, It is adapted to its habitat. It is permanent in its habitat if it is not disturbed.

Illustrations

Ecological succession can be explained with the help of illustrations as under: -

1. Lake

When a lake fills with silt it changes gradually from a deep to a shallow lake of pond, then to a marsh, and beyond this, in some cases, to a dry-land forest.

2. Crop field

When a crop field is deserted or a forest is severely burned over, it is just like a plot of bare ground and a series of plant communities grow up there and replace on another - firest annual weeds, then perennial weeds and grasses, then shrubs, and trees-until a forest ends the development.

In this way, ecological succession is an orderly and progressive replacement of one community by another until a relatively stable community, called the climax community, occupies the area.

(1) In the first example the principal cause of the change in the community was physical process-the filling in of the lake with silt.

(2) In the second example, a principal cause was the growth of plants on an existing soil.

Development

Ecological succession develops as under:

1. Pioneers

The first organisms to become established in an ecosystem undergoing succession are called pioneers; the stable community that ends the succession is termed the climax community.

2. Sere

The whole series of communities which are involved in the ecological succession at a given area. For example, from grass to shrub to forest, and which terminates in a final stable climax community, is called as sere.

3. Seral stage

Each of the changes that take place is a seral stage.

4. Community

Each seral stage is a community, although temporary, with its own characteristics. It may remain for a very short time or for many years.

Classification of Seres

Seres are sometimes classified according to the predominant force that is bringing them about. These forces are biotic, climatic, physiographic, and geologic. Their resultant seres are commonly called bioseres, cliseres, eoseres and geoseres.

Types of Succession

The succession may be of the following two types:

1. Primary Succession

Primary Succession is the process of species colonization and replacement in which the environment is initially virtually free of life. In the other words the process starts with base rose or sand dune or river delta or glacial debris and it ends when climax is reached. The sere involved in primary succession is called presere.

2. Secondary Succession

Secondary succession is the process of change that occurs after an ecosystem is disrupted but not totally obliterated. In this situation, organic matter and some organisms from the original community will remain; thus the successional process does not start from scratch. As a result, secondary succession is more rapid than primary. It is seen in areas burned by fire or cut by farmers for cultivation. The sere involved in secondary succession is called subsere.

Types of Succession

The primary and secondary successions may be of three types. The classification is on the basis of the moisture contents:

(a) Hydrach of Hydrosere

The succession when starts in the aquatic environment such as ponds, lakes, streams, swamps, bogs, *etc.* is called hydrach or hydrosere.

(b) Mesarch

The succession when begins in and area, where adequate moisture is present, is called mesarch.

(c) Xerach or Exerosere

The succession when starts in xeric or dry habitat having minimum amounts of moisture, such as dry deserts, rocks, etc. is called xerach. A temporary community in an ecological succession on dry as sterile habitat is called xerosere. It may be of three types as under:-

(1) Iithosere-succession initiating on sand;

(2) Psammosere-succession initiating on sand;

(3) Halosere-succession starting on saline water or soil.

Autogenic Community

Autogenic community is the succession progressing entirely as a result of interactions of the organisms and their environment (*i.e.* "driving force" is internal to the community) for example succession on sand dunes.

Allegonic Community

Allegonic community is the succession moving under the influence of external factors, as input of nutrients, succession in a small pond or bog.

Autotrophic And Heterotrophic Succession

Sometimes, succession is classified as autotrophic and heterotrophic on the basis of community metabolism:

(1) Autotrophic succession is characterized by early and continued dominance of autotrophic organisms like green plants. It begins in a predominantly inorganic environment. In it the energy flow is maintained indefinitely.

(2) Heterotrophic succession is characterized by early dominance of heterotrophs, such as bacteria, actinomycetes, fungi and animals. This sort of succession begins in a predominantly organic environment and there is a progressive decline in the energy content.

Serule

The miniature succession of micro-organic environment and different types of fungi on the fallen logs of the decaying wood, tree bark, etc. is called serule.

Drury and Nisbet (1973) classified succession into three main types:

(*a*) Category I includes many classical types of secondary succession and some primary successions. It involves temporal sequences on one site with climate and physiography mostly remaining stable.

(*b*) Category II includes many primary successions (especially those in ponds and lakes) and a few secondary successions. In this, temporal sequences on site with the local environment changes under the influence of such external factors as climate, erosion, drainage, nutrient inputs, etc.

(*c*) Category III includes those changes, which take place over long (geological) time scale, and cover spatial sequences on adjacent sites.

Common attributes of Ecological Succession

Some Common attributes of ecological succession are as under:

Table 3.3 Ecosystem Attributes

Ecosystem attributes	**Development Stage**	**Mature Stages**
Community Energetics Gross production/community respiration	More or less than 1	About 1 (or approaches 1)
Gross production/standing crop biomass	High	Low
Biomass supported/unit energy flow	Low	High
Net community production (yield)	High	Low
Food Chains	Mainly grazing; detrital web like	Predominantly linear
B. Community Structure		
Total organic matter	Less	More
Inorganic nutrients	Extrabiotic	Intrabiotic
Species diversity	Low	High
Biochemical diversity	Low	High
Spatial heterogeneity and stratification	Poor	Well-organized

(Contd.)

C. Life History		
Niche specialization	Broad	Narrow
Organism size	Small	Big
Life Cycle	Simple & short	Complex, Long
D. Nutrient Cycling		
Mineral cycles	Open	Closed
Nutrients exchange rate	Rapid	Slow
Role of detritus in nutrient regeneration		
E. Selection		
Growth	For rapid growth "I" selection	Mainly for feedback control (k-selection
	Quantity	Quality
F. Overall Homeostasis		
Internal symbiosis	Undeveloped	Developed
Nutrient conservation	Poor	Good
Stability (resistance to external perturbations	Poor	Good
Entropy	High	Low

SUCCESSION: GENERAL PROCESS, CLIMAX

General Process

The process of succession being with a bare area or nudation formed by several reasons, such as volcanic eruption, landslide, following sequential steps.

1. Nudation

The process of succession begins with a bare area or nudation formed by several reasons, such as volcanic eruption, Landslide, flooding, erosion, deposite, fire, disease, or other catastrophic agency. Man also may be reason of formation of new lifeless bare areas for example, walls, stone quarrying, burning, digging, flooding large land areas under reservoirs, etc.

2. Invasion

The invasion means the arrival of the reproductive bodies or propagules of various organisms and their settlement in the new or bare area. Plants are the first invaders (pioneers) in any area the animals depend on them for food. The invasion includes the following three steps:

(*a*) **Dispersal or migration:** The seeds, spores or other propagules of the species reach the bare area through air, water or animals.

(*b*) **Ecesis:** Ecesis is the successful establishment of migrated plant species into the new area. It includes germination of seeds or propagules, growth of seedlings and starting of reproduction by adult plants.

(*c*) **Aggregation:** In this stage, the successful immigrant individuals of a species increase their number by reproduction and aggregate in large population in the area. As a result individuals of the species come close to one another.

QUESTIONS

1. Explain the concept of an ecosystem with their structure and function.

2. Write the procedures of ecosystem in your own words.

3. Draw an energy flow in the ecosystem.

4. What is Ecological Succession, and food chain ? Explain in your own words.

5. Write short notes on:

(*a*) Ecological pyramids,

(*b*) Types and characteristics,

(*c*) Structure and functions of ecosystems.

CHAPTER

4 Environmental Science : Biodiversity and Conservation

INTRODUCTION

Today most of us live in a socially and technologically evolved society where our exploitive potential and knowledge of nature has increased academically. The problem is that our contact with it has diminished morally. It may have diminished to such an extent as to be dangerous to us and to the nature itself. Biodiversity is the vast array of all the species of plants, animals, insects and the microorganisms inhabiting the earth either in the aquatic or the terrestrial habitats. The human civilization depends directly or indirectly upon this biodiversity for their very basic needs of survival–food, fodder, fuel, fertilizer, timber, liquor, rubber, leather, medicines and several raw materials. This diversity's the condition for the long-term sustainability of the environment, continuity of life on earth and the maintenance of its integrity.

Although our understanding of the earth's organisms–its biological resources- is still imperfect, there is no doubt that the abundance and diversity of living organisms provide many benefits and make our world a beautiful and interesting place to live. Biodiversity is generally described in terms of its 3 fundamental and hierarchically related levels of biological organisms. These are-

Genetic diversity

It includes the genetic variations within species, both among geographically separated populations and among individuals within single population.

Species diversity

It includes full range of species from micro organisms to giants and mammoth varieties of plants and animals, *e.g.* single celled viruses and bacteria etc. and multi-cellular plants, animals and fungi.

Ecosystems diversity

It studies variation in the biological communities in which species Jive, exist and interact.

Because genes are parts of species, and the species make up ecosystems- the concept of biodiversity reflects an interrelationship among its three components. Biodiversity is distributed uniformly across the globe. It is substantially greater in some areas than in the others. Generally, species diversity increases from the poles towards the tropics- for instance, among the terrestrial systems, the tropical moist forests, which cover only 57% of the earth's land area, possess as much as over 50% of the world's species.

LOSS OF BIODIVERSITY

Biodiversity is diminished or destroyed in a number of ways either by natural changes or by human disruption. The loss of even a single species is considered as a tragedy as each form of life is a natural storehouse of irreplaceable substances the genetic materials (Ehrlich & Ehrlich, 1982). As species become extinct, the fine balance of nature is disturbed to great extent. The loss of even a single species can alter a food chain/food web, i.e. ecosystem disruption, and upset the delicate balance between one species that preys upon another.

Natural Causes

Species arise through processes of mutation, isolation, and natural selection. Evolution can proceed gradually over millions of years or may occur in large jumps when new organisms migrate into an area or when environmental conditions change rapidly. In a sense, species that are replaced by their descendants are not completely lost. The much larger modern horse, for instance, has replaced the tiny Hypohippus, but most of its genes probably still survive in its distant offspring.

Human-Caused Extinction

Man has a long history of dependence on biological resource hence depletion of resources is obvious. It has never been the pursuit of mankind to completely destroy other species, but in a variety of ways through ignorance or carelessness, we have reduced biological abundance and driven species into extinction. Man as a hunter in Stone Age may have been responsible for the extermination of the "Mega fauna" of both America and Eurasia during the Pleistocene era. Climatic change may have been partially or primarily responsible. Vast usage of bones in Europe and Siberia provide enough evidence that our ancestors have hunted upon animals mercilessly. The loss of species and ecosystems extracts a high price. The water, the air, fertile soils and productive seas as a common resource are all products of healthy biological systems. The scale of human impact on the global biodiversity is huge. It is considered that man has disturbed his own life support system. Tropical forest areas or the world suffer a great loss, which are disappearing at the rate of 17 million hectares (17 sq. kms.) every year (UNEP report, 1992).

The estimation from the fossil record suggests that the average life of a species is about 4 million years. According to an estimate, if there are about 10 million species a year at a moderate estimate, we are now likely to lose around 50,000 species a year over the next decades. According to the IUCN Red Data Book, the following is a broad list of threatened animals:

Table 4.1: List of Threatened Animals

Animal group	No. of species
Mammals	507
Birds	1,029
Reptiles	169
Amphibians	57
Fish	713
Insects	1,083
Molluscs	409
Corals and sponges	154
Annelid worms	139
Crustaceans	126

In a large number of southern countries the seeds of biodiversity destructions were laid during the colonial era. In India, for instance, large-scale commercial forestry started in British colonial times speeded up the rate of forest exploitation for fodder, meat, milk and coffee demand. Deforestation and biodiversity destruction to sustain life after independence by our more recent ancestors added fuel to the fire. Our mental capabilities do not allow us to accept the growing changing demand of time. We still experience a lot of dependence on forest products especially for fuel wood. However, government has provided substitutes of solar driven appliances for cooking and lighting. Still it has failed to decrease pressure on wood resources.

Table 4.2. Direct and Indirect Impact of Humans on Biological Resources

Direct impact	Indirect impact
Hunting and food Gathering	Habitat destruction
Fishing	Exotic species Introductions
Trade in Animal Products	Diseases
Harvesting wild plants	Pollution
Pet and scientific trade	Genetic assimilation
Predator and pest control	

1. Measuring Biodiversity

Diversity can be defined as the number of species found in a community. Hence, biodiversity refers to the species richness of an area. Algorithms of biodiversity have been developed to connote species diversity at different geographical scales as follows:

Alpha Diversity

It indicates the number of species in a single community. The index can be used to compare the number of species in different ecosystem type.

Beta Diversity

It indicates the degree to which species composition changes along an environmental gradient.

Gamma Diversity

It indicates the rate at which additional species are encountered as geographical replacements within a habitat type in different localities.

2. Rio-geographic Classification of India

India has been classified into ten bio geographic zones by the Wildlife Institute of India under the Government's Bio-geographic Project Table 3.

Table 4.3: Bio-geographic Zones of India

S.No.	Bio-geographic Zones	Distribution
1.	Trans- Himalaya	Ladakh Mountains, Tibetan plateau.
2.	Himalaya	North-Western, Central, Western and Eastern Himalayas
3.	Desert	Thar, Kachchh
4.	Semi-arid	Punjab plains
5.	Arid	Gujarat, Rajputana
6.	Deccan Peninsula	Central Highlands, Chhota Nagpur, Eastern Highlands, Central Plateau, Deccan south
7.	Gangetic Plain	Upper and lower Gangetic plain
8.	Coast	West coast, East coast
9.	North-East	Brahmputra valley, North east hills
10.	Island	Andamans and Nicobar Group of Islands, Lakshwadeep

3. The Value of Biodiversity

Ecosystems and species provide an enormous range of goods and other services - immediate as well as long term, material as well as spiritual and psychological - which are vital to our well being. The values of the earth's biological resources can broadly be classified into-

Direct Values

Consumptive and productive uses.

Food Resources: Grains, vegetables, fruits, nuts, condiments, tea-coffee, tobacco, liquor, oil from plant resources; and meat, fish, egg, milk (and milk products), honey, etc. from animal resources.

Other Resources: Medicine, fuel, timber, household accessories, fodder, fiber, fertilizer, wool, leather, paint, resin, wax, thatch. Ornamental plants, rubber, creams, silk, feathers, decorative items, etc.

Indirect Values

Non-consumptive uses and options for the future.

1. Carbon fixing through photosynthesis, which provides the support system for species.
2. Pollination, gene flow, etc.
3. Maintaining water cycles, recharging ground water, protecting watersheds.
4. Buffering from climatic extreme conditions such as flood and drought;
5. Soil production and protection from erosion;
6. Maintaining essential nutrient cycles, e.g. carbon, nitrogen, and oxygen and others.
7. Absorbing and decomposing pollutants, organic wastes, pesticides, air and water pollutants;
8. Regulating climate at both macro and micro levels;
9. Preserving recreational, aesthetic, socio-cultural, scientific, educational, ethical and historical values of natural environments.

(*i*) *Consumptive Use.* Man is mostly dependent on plant and animal resources for his' dietary requirements. A major share of our food comes from domesticated crops and animals. Still we derive major of food from wild species. A large section of human population is dependent on food, which we gather from seas, and oceans that is harvested from free roaming wild organisms. Seafood is rich in minerals and vitamins and contains up to 60 percent of the protein. Unfortunately, deforestation, hunting and clearing of forests, grazing and expansion of agricultural lands removes potentially valuable food species and the wild ancestors of our domestic crops.

(*ii*) *Productive Use.* Trade and commerce industry is very largely dependent on forests. Besides, timber, firewood, paper pulp, and other wood products, we get many valuable commercial products from forests. Herbs of medicinal value. Rattan, cane, sisal, rubber, pectins, resins, gums, tannins, vegetable oils, waxes, and essential oils are among the products gathered in the wild form forest areas. Like Himalayan forests serve as a storehouse of medicinal herbs, which are presently being used to cure many diseases. Many wild species e.g. milkweeds, etc. are also being investigated as a source of rubber, alkaloids, and other valuable organic chemicals.

(*iii*) *Medicine.* Many medicinal and aromatic plants are being exploited in the wild to tap their potential for different ailment cure in the field of drug extraction e.g. *Hippophae rhamnoides*, *Ephedra Kerardiana*. *Dactylorrahiza hatageria* etc. Besides, they are being cultured in plantations and protected in wild to encourage in-situ and ex-situ conservation viz. Valley of flowers, Rohtang in Kullu, Lahu & Spiti Valley. Animal products are also sources of drugs, analgesics pharmaceuticals, antibiotics, heart regulators, anticancer and ant parasite drugs, blood pressure regulators, anticoagulants, enzymes, and hormones.

(*iv*) *Ecological Benefits*. Man cannot have control over nature in the wild. It can only put "pressure on resources and pollute environment. Then what makes environment act as a self-replenishing system with respect to resource generation and self-cleanliness. To answer this comes into picture the role of biological communities. The processes of soil formation, waste disposal, air and water purification, nutrient cycling, solar energy absorption, and management of biogeochemical and hydrological are all beyond the scope of man's control. Non-domestic plants, animals, and microbes do this favor to mankind by maintaining ecological processes at no cost. These also serve as a library of gene pool. Wild species of plants and animals exercise control over disease-carrying organisms and in suppressing pests. Food chain explains how nature keep a control over population of organisms wherein organisms of small size and larger in number are consumed by organisms large in size and smaller in number to next higher tropic level. Hence, preservation of natural areas and conservation of wild species should be encouraged and practiced to restore the biological wealth.

(*v*) *Aesthetic Use*. Wild species of plants and animals have always appealed man's psyche. Human society has evolved from his early habitat in the forests, which abounds in flora and fauna. Till date his instinct to observe nature in the wild calls him from socially and culturally an evolved society, as tourist from far and wide places. Thousands of tourists visit national park, sanctuaries and forests throughout the country and especially in mountainous areas. A glance of temperate grasslands perhaps the most beautiful landscape pleases and comforts man. All domestic plants have evolved from wild ancestors and food gathering is no longer a necessity for man but still thousands enjoy hunting, fishing and other adventurous outdoor activities that involve wild species. Such environment and playful exercise gives man an opportunity to renew his pioneer skills, and be at mental ease after leading a hectic day in today's life. Man enjoys his surrounding by decorating it with images of wild animals and plants.

(*vi*) *Cultural Benefits*. A particular species or community of organisms may have emotional value for a group of people who feel that their identity is inextricably linked to the natural components of the environment that shaped their culture. This may be expressed as a religious value, or it may be a psychological need for access to wildlife. In either case, we often place a high value on the preservation of certain wild species.

(*vii*) *Option Values*. This refers to the use of various species for the benefit of mankind, sometime in future. The hunt for various species under the scope of biotechnology. is already underway for finding solutions to various environmental problems. The environmental issues being addressed to be: pollution as a major problem, ways to fight various disease viz., cancer, diabetes etc., AIDS and others.

4. Biodiversity at Global, National and Local levels

1.Global Initiatives for Biodiversity Assessment

The initiative for biodiversity assessment was taken long back in 1991 with the UNEP Biodiversity Country Studies Project (consisting of bilateral and Global Environmental Facility funded studies in developing countries) implemented in cooperation with donor countries and UNDP. The preparation of it dates back to 1987. Nineteen studies have been completed and several more are in the process of completion. The approach from gene to ecosystem was initiated as a Research Agenda for Biodiversity, IUBS/SCOPE/ UNESCO, Paris (Sol brig, 1991). The agreed text of the Convention on Biological Diversity was adopted by 101 governments in Nairobi in May 1992, signed by 159 governments and the European Union at the United Nations Conference on Environment and Development (UNCED) held at Rio de Janeiro in June 1992. At present 174 governments is party to this convention. Apart from this Global Biodiversity Strategy (1992), Global biodiversity; Status of the Earth's Living Resources (1992), Caring for the Earth; A Strategy for Sustainable Living (1991), Global Marine Biological Diversity: A Strategy for Building Conservation into Decision Making (1993), Norway/UNEP Expert Conference on Biodiversity (1993) and From Genes to Ecosystems: A Research Agenda for Biodiversity (1991) are the milestones on the international biodiversity initiatives. Many more nations are engaged in developing their own National Biodiversity Strategies. Global Biodiversity Assessment (UNEP, 1995) estimates the total number of animal and plant species to be between 13 and 14 million. It further records that so far only 1.75 million species have been described and studied. Ecosystem diversity has not been even reasonably explored as yet. Hence, there seems to be wide gap of knowledge at global, regional and local levels.

Till recent past biodiversity conservation was thought to be limited to saving genes, species and habitats but the implementation revolutionary policies and more awareness has led to the emergence of a framework based upon saving biodiversity, studying and most importantly using it sustainable. Reforms in the field of forestry, agriculture, technology, international trade agreement and watershed management is required. Biodiversity is directly or indirectly related to masses (researchers, government agencies, non-government agencies and private sectors) 'at all levels of development. Since we depend upon biodiversity our various activities can be linked to its usage and conservation. Therefore, trade, economics, population, land tenure, intellectual property rights and resource consumption & waste are all related to biodiversity conservation. Hence, its sustainable use can be promoted through information, ethics, knowledge and awareness.

2. Levels of Action

Need for biodiversity conservation is realized by all nations of the world because their lies common interest of masses. Most of the resources do not belong to an individual, a nation or a continent. They are simply global. Each and every member on the earth has equal right over it. To limit the loss of biodiversity globally 4 major steps have been realized important at national, regional and local levels.

(i) Global Environment Facility (GEF)

World bank, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP) established the GEF in 1900 on a three-year pilot basis. The GEF is expected to commit $ 400 million for the biodiversity conservation issue.

(ii) International Biodiversity Strategy Programme (IBSP)

World Resources Institute (WRI), World Conservation Union (WCU), UNEP together with more than 40 Governmental and non-Governmental organizations have prepared the framework to drastically reduce the loss of biodiversity. This would serve mankind on a more sustainable basis.

(iii) Convention on Biological Diversity (COBD)

Under the aegis of UNEP, more than 100 nations gathered during Earth Summit at Brazil. This was accomplished to workout a legal framework for—

- Governing international financial support for biodiversity conservation,
- The identification of international conservation priorities and
- Technology transfer for conservation and use of biodiversity.

(iv) Agenda 21

Developed through a series of inter-Governmental preparatory meetings with input from a variety of non-Governmental processes including the Biodiversity Strategy Programme—AGENDA 21 provides a plan of action on a number of issues including biodiversity.

INDIA AS A MEGA-DIVERSITY NATION

Lying at the junction of Agro-tropical, Euro-Asian and the Indo-Malayan biogeography realms, India is a country of vast biodiversity in the world and quite a significant one all over the globe. In fact, it is among the twelve "Mega diversity" countries in the world. India is also a "Vavilov" centre of high crop genetic diversity–so named after the Russian agro botanist N.I. Vavilov who identified about eight such centres around the world in the 1950s.

India, a mega-biodiversity country, while following the path of development, has been sensitive to the needs of conservation. India's strategies for conservation and sustainable utilization of biodiversity in the past aimed at providing special status and protection to biodiversity rich areas by declaring them as national parks. Wildlife sanctuaries, biosphere reserves, ecologically fragile and sensitive areas. It has helped in reducing pressure from reserve forests by alternative measures of fuel wood and fodder need satisfaction. by a forestation of degraded areas and wastelands, creation of ex-suit conservation facilities such as gene banks and eco-development. The challenges before India are not only to sustain the efforts of the past but also further add to these efforts by involving people in the mission.

BIODIVERSITY ASSESSMENT: INITIATIVES IN INDIA

In a most recent attempt to map biogeographically regions, Rodgers and Pan war (1988) attempted to define the biogeographically regions of India. The sub-continent has ten biogeographically zones viz., Trans-Himalayan, Himalayan, Indian desert, Semi-Arid, Western Ghats, Deccan Peninsula, Gangetic Plains, North East India, Islands and Coasts and not yet defined zones for aquatic (freshwater and marine) ecosystems have been mapped. The Wildlife Institute of India has converted these regions on Survey of India digital database.

India is rich in endemic flora and fauna. According to an estimate (Anon., 1983) about 30 per cent plant species are endemic to India. Areas rich in endemism are North Eastern India, the Western Ghats and the North Western Himalayas. A small pocket of -local endemism is also reported from Eastern Ghats (MacKinnon and MacKinnon, 1986). The Project on Study, Survey and Conservation of Elidangered Plants (POSSCEF) has estimated that about 3000-4000 plant species are under different degrees of threat (Nayar & Shastri, 1987). Recently, Ministry of Environment and Forests, Government of India has launched a project viz., National Biodiversity Strategy and Action Plan (NBSAP) which envisages the assessment and stock taking of biodiversity related information at various levels, including distribution of endemic and endangered species and site-specific threats. Key features of this project include emphasis on decentralized planning and use of interdisciplinary working groups to involve all sectors concerned with biodiversity conservation.

Table 4.4: Wild Animal Diversity in India

S.No.	Class	World	India	% (Age) Endemism
1.	Mammals	4,231	372	8
2.	Birds	8; 400	1,175	4
3.	Reptiles	5,375	399	33
4.	Amphibian	2,000	181	62
5.	Fishes	23,400	1,693	—
6.	Insects	8,00,000	60,000	—
7.	Molluscs	1,00,000	5,000	—

Source: Wildlife Institute of India WII, (1993).

Table 4.5: Wild Plants Diversity in India

S.No.	Flora	World	India	% of Endemism
1.	Angiosperm	2,50,000	15,000	6
2.	Gymnosperm	—	64	—
3.	Pteridophytes	—	1,022	—
4.	Bryophytes	—	2,584	—
5.	Algae	—	2,500	—
6.	Fungi	-—	23,000	—
7.	Bacteria	—	850	—
8.	Lichens	—	1,600	—

Source: Biodiversity in India, R.R. Rao (NBRI) Lucknow, 1984.

HOTSPOTS OF BIODIVERSITY

Areas with rich biodiversity and exhibiting high levels of endemism, which are under immediate threat of species extinction and habitat destruction, are recognized on priority basis worldwide for conservation practices and are known as hot spots. 12 hot spots identified world over represent 14% of world's plant species in only 0.2% of its -total land surface. 12 mega diversity nations (Mexico, Columbia, Brazil, Peru, Ecuador, Madagascar, Indonesia. Malaysia. India, China and Australia) contain 60-70 % of the world's biodiversity. Out of the total hot spots worldwide two lies in India. These are represented by North-eastern Himalayas (Khasi jaintia hills and the lower Himalayan slopes embracing areas of Arunachal Pradesh, Assam, Meghalaya, Nagaland and Tripura) and Western Ghats region in the south. These fall under heavy rainfall zones.

The rain forests of the Western Ghats and the eastern Himalayas consist of very dense and lofty trees with a multitude of species occurring in the same area. Hundreds of species of trees can be identified in a hectare of land besides mosses, ferns, epiphytes, orchids, lianas and vines, herbs shrubs and fungi that make up this. region the most diverse habitat. Giant trees stretch up towards the sun. Buttress roots, anchored within the soil, support the smooth straight trunks, which rise 30 mts. or more before branching out. The spreading crowns effectively block outmost of the light from the light from the ground beneath. *Dipterocarpus* sp. predominates in these forests and this type of vegetation is often called Dipterocarpus forests.

1. North-east Himalayas

From the dense evergreen and semi-evergreen vegetation of the foothills in the Eastern. Himalaya, the character of vegetation changes at altitudes of 1525 m to 1830 m. Qaks, magnolias, laurels and birches covered with moss and ferns replace the sal, silk-cotton trees and giant bamboos of the foothills. At about 2745 m to 3660 m one enters the coniferous forest of pine, fir yew and junipers. There is undergrowth of scrubby Rhododendrons and dwarfs bamboos. Due to high humidity and much higher rainfall, lichens, mosses, orchids and other epiphytes cover the tree trunks. The animal life in the temperate region is different from the western Himalaya and is characterized by the presence of Indo Chinese fauna. The red panda, hog badgers, ferret badgers, crestless porcupines are typical species of this area. Three kinds of goat antelopes also occur in the eastern Himalaya and are relatives of the European chamois. Goral is a smaller goat antelope found throughout the tract on rugged grassy slopes and on rocky grounds near the conifers forests.

2. Western Ghats

The Western Ghats and the central belt lying to the west of it, is a region of very high rainfall and is characterized by evergreen vegetation, its flora and fauna being a kin to the evergreen rain forest of north-eastern India. Among the macaques the lion tailed (*Macaca silenus*) is one of the world's most endangered primates, surviving in the evergreen forests of the Western Ghats of south India, its total population is estimated to be about 800 only. In the *langur* group, the nilgiri 'Iangur' (Presbvtis johni) is a multihabitat species occurring in addition to the shoals, in the temperate evergreen forests above 1700 m altitude in the Western Ghats. A number of climbing animals have evolved gliding mechanisms and are particularly characteristic of these forests. Among these are the flying squirrels. The other characteristic species of the Western Ghats are the Nilgiri mongoose, the stripnecked mongoose, the malabar civet and the spiny mouse.

The flora and fauna of these evergreen regions have not been fully explored. Being a store house of a large variety of plants and animals, these forests represent one of the richest gene pool resources of flora and fauna in the country. Though a large number of such forests have not been destroyed for various plantation crops like rubber, cocoa, coffee etc., whatever virgin forests remain have to be specially protected as in the Silent Valley of Kerala or the rich orchid belt of the north-eastern Himalayas in Arunachal Pradesh and Sikkim.

THREATS TO BIODIVERSITY

The biggest reason for the current increase in extinctions is habitat loss. Destruction of tropical forests, coral reefs, estuaries. Marshes, and other biologically rich ecosystems threaten to eliminate thousands or even millions of species in a human-caused mass extinction that could rival those of geologic history. By destroying habitat, we eliminate not only prominent species but also many obscure ones of which we may not even be aware. Over harvesting of food species is probably the most obvious way in which humans directly destroy biological resources. There are many, historic examples of human disturbances of natural systems. Once-fertile areas have become deserts because of unsound forestry, grazing, and agricultural practices. Technology nm" makes it possible for us to destroy vast areas even faster than in the past. Undoubtedly the greatest current losses in terms of biological diversity and unique species occur when tropical moist forests are disrupted.

1. Main Causes of Threat to Species

It is well known now that several plant species have become extinct due to certain natural phenomena, such as land upheavals, volcanic eruptions, glaciations, protracted periods of rain or drought, spreading of desert lands, forest fires and eutrophication in the geological past. While such natural processes in the past had no doubt led to the extinction of flora, the resulting new environmental conditions had also resulted in the evolution and speciation of new flora and migration of floral elements.

But, in recent times man with his anthropogenic associates and other factors or practices such as fire or 'slash and burn' for shifting cultivation (also called as 'jhum' or 'podu' cultivation in India), grazing by cattle and by several other mechanical means, has suddenly accelerated disastrous condition in natural ecosystems. Besides, commercial exploitation of entire plants, roots, rhizomes, tubers bulbs seeds and fruits has been the prime cause of depletion of more important wild economic plants throughout the world for lucrative financial gains, in the trade which flourishes both by legal and illegal means *Rauvolfia serpentina*, *Coptis teeta*, *Dioscorea* sp. and *Podophylum hexandrum* serve as good examples.

(i) Habitat Destruction

Deforestation has been one of the major causes for the depletion of wildlife. With the increase in human population and the growing need for resources, forests were cleared or for agricultural operations, for human habitation and for grazing their livestock. Technological advance and human progress had a direct bearing on the exploitation of natural resources. Forest trees were cut to yield timber for building houses, for making furniture and for collecting wood as fuel. Industries made a heavy demand on forest resources such as wood for paper- making, exploitation of gums and resins, mining. of forestland for mineral ores, building materials, etc.

Habitat destruction thus has an adverse impact on wildlife as it leads to the loss of an environment, which provides them food and breeding grounds or nesting sites to facilitate rearing of their young ones. Wild animals are left with no alternative but to adapt, migrate or perish. Widespread habitat loss all over the country has diminished the population of many species, making them rare-and endangered. In our race for progress and prosperity we have disturbed the delicate balance of Nature.

(ii) Hunting and Poaching

Uncontrolled hunting of wildlife for pleasure, food, furs. Skins, horns, tusks, etc. pose a serious threat to the survival of wildlife. In India, the Cheetah was hunted to extinction. The illegal trade in animal skins has been responsible for the destruction of a large number of tigers, leopards, deer, fishing cat, crocodiles and snakes, as well as birds with beautiful plumage. Elephants were hunted for ivory. The rhinoceros was killed for its horns because of the superstitious belief that it contained aphrodisiac properties. There are laws in the country to prevent such illegal trade, but unscrupulous elements, traders and exporters often violate these. Added to this is the practice of trade in exotic mammals, birds and reptiles and use of wild animals in biomedical research.

(iii) Pollution

Pollution of air, water and soil due to various industrial activities not only affect our health, but the health and well being of animal population also. Industrial effluents one reaching water bodies adversely affect aquatic life. Pesticides like DDT and Dieldrin are very harmful. These have a major effect particularly sea birds and their eggs. Oil pollution is another serious problem affecting the seas through leakage from cargo ships or accidents.

Besides there are other numerous factors that affect wildlife population, which are mostly anthropogenic. Introduction of exotic species, unhealthy agricultural practices, diseases introduced by domesticated animals, silting of rivers, floods and droughts are a few to name some. These all have somehow contributed to the process of endangering animal species.

2. Man and Wildlife Conflict

Man by virtue of his nature is destructive and self-centred despite the fact that he is known as social animal. Until he realizes the need of time no rules and regulations may help. The exploitation of forests and wildlife or rare species for commercial purposes should be stopped. A good tiger skin is worth more than five thousand rupees. The tusks of an elephant and the skin of big cats also fetch a good prize. The horns of rhinoceros carry a highly fancy prize. This high market value has lead to unlimited slaughter of these animals.

ENDANGERED AND ENDEMIC SPECIES OF INDIA

The Forest administration in India is more than 100 years old. Efforts to identify plant species as a part of wildlife and to recognize the importance for providing special protection to endangered plant species have so far been negligible. The extinction of certain attractive animals stimulated efforts to protect fauna, but no special heed was given to flora. The word 'Wildlife' had till recently been considered synonymous with animal life and consequently, conservations and naturalists have their attention only to conservation of animal species.

It was only in the year 1968 at an International Conference (UNESCO 1968) that the problem of conservation of flora and fauna was appreciated and several recommendations were made urging the International Biological Programme (IBP), .the International Union for Conservation of Nature and Natural resources (IUCN) and various international and national organizations to initiate studies in to the problems involved, particularly the problem of protecting and preserving wild fauna and flora in their natural habitat/ecosystems establishing nature reserves.

Later at the 10th General Meeting of the IUCN, the Survival Service Commission reviewed the status of endangered species of plants and their habitats. The recent promulgations of the United States Endangered Species Act (1973), the UK Wild Creatures and Wild Plants Act. (I975), development of international conventions on conservations (Wetlands Convention) and the setting up of Biological Records Centre of the Nature

Conservancy, UK, and threatened plants, orchids, cycads tree wide awakening of the need for the conservations, preservation and protection of floras of the world.

According to the Volume 5 of Red Data Book on angiosperms started by the Survival Service Commission of the IUCN in the year 1970 (Melville, 1970), it is estimated that out of the total of three lakes (0.3 million) species of plants in the world, over 20,000 were in the category of either endangered or vulnerable and threatened with extinction by the year 2000 A.D.The following categories of rare species have been recognized by the IUCN, mainly based on (*i*) present distribution, (*ii*) decline in number of time, (*iii*) abundance and quality of natural habitats, and (*iv*) biology and potential value of the species.

Endangered (E)

Species in danger of extinction and whose survival is unlikely if the casual factors continue operating, included are species whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

Vulnerable (V)

Species believed likely to move into the endangered category in the near future if the casual factors continue operating. Included are species, of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental, disturbance species with populations that have been seriously depleted and whose ultimate security is not yet assured; and species with populations that are still abundant but are under threat from serious adverse factors throughout their range.

Rare (R)

Species with, small world populations that are not at present endangered or vulnerable, but are at risk. These species are usually localized within restricted geographical areas or habitats or thinly scattered over a more extensive range.

Threatened (T)

Threatened is used in the conservation context for species which are in one of the categoriser Endangered, Vulnerable and Rare. Some species are marked as threatened where it is known that they are Endangered, Vulnerable or Rare, but there is known that they are Endangered, Vulnerable or Rare, but there is not enough information to say which of these three categories is appropriate.

Out of Danger (O)

Species formerly included in one of the above categories, but which are now considered relatively secure because effective conservation measures have been taken or the previous threat to their survival has been removed.

Indeterminate (I)

Species that are suspected of belonging to one of the first three categories, but for which insufficient information is currently available.

1. Endemic Species of India

India has a very rich element of endemics in its flora. According to Chatterjee (1940) Indian subcontinent has about 61.5 percent to endemic flora with about 7,000 endemic species and 134 endemic genera. Of these the Himalayas and the Khasi Hills account for about 3,000 and Deccan peninsula for about 2,000 endemic species. These figures speak eloquently of the great need for protecting the endemics. This can be done effectively by carefully analyzing the floristic composition of the various phytogeographical units of Indian flora and by selecting suitable natural forests in these units and preserving them as 'Biosphere Reserves'.

Sapria himalayana, Uvaria Inroad, Alcimandra cathcartii Magnolia gustavii, M pealiana, Pachylarnax pleiocarpa, Nepenthes khasiana, Dicentra royler several species of *Primula* and *Rhododendron* and the Lady's Slipperorchids. P. *aphiopodilum insigne*, P. *hirsutissimum*, P. *faireenum*, P. *spicerianum* and P. *venusturm*, are some of the noteworthy endemics of the Himalayas and Khasi Hills. *Antiaris taxicaria*, *Campanual cytinoides*, *Pedicularis perroter* and the some species of the Podostemaceae are endemic to Western ghats/the Nilgiri Hills in South India.

2. Endangered Flora and Fauna of India

Some plants and animals have already become extinct and there are many facing danger of extinction. The basic reasons of extinction of wildlife are as follows:

(1) Destruction of their natural habitats due to expanding agriculture, urbanization and industrialization.

(2) Overgrazing by domestic animals that convert the area into deserts.

(3) Poaching for meat, skin, fur, ivory, rhino horns etc.

(4) Export of some species.

The Botanical Survey of India (BSI) could so far complete survey of plant resources. in only about 3/5th of the country. As per the targets set, BSI should have complete survey of the remaining 2/5th of the country by 1998. It is planned to publish National Flora of the country in 24 volumes by 2000 A.D.

The Zoological Survey of India (ZSI) could so far survey only about 1/3 of the country, and is planned to complete the survey of the 75% of the remaining 2/3rd area of the country by 2000 A.D. Sixty-two volumes of Fauna of India are to be brought out by 2000. Data regarding all endangered plant and animal species of the country are also not complete. It was set that data regarding all endangered plant species will be inventoried by 1992, for which BSI had been restructured. In its Annual Report (1987-88); D.O. En. Has reported to publish Vol. I of Red Data Book of Indian plants covering 235 species. Red Data Book of Indian Plants Vol. II containing about 200 rare and endangered species is completed and printed (D.O. En. Annual Report, I988-89). The status survey of Endangered animal species is being done and is claimed to be completed and Red Data Book compiled by 1995.

According to the Red Data Book of IUCN (International Union for Conservation of Nature and Natural Resources), more than 1000 creatures are threatened with extinction, some very soon, some within a decade or so. Among these facing most immediate danger are, all species of rhinoceros particularly the Indian variety the Royal Bengal, and Siberian Tigers, the Mexican grizzly bear, the red wolf, the mountain gorilla; the Arabian oryx and the Asiatic lion.

Indian Endangered Flora

In India, nearly 450-plant species have been identified as endangered, threatened or rare. A list of some such species in different parts of the country is given below (this may not be a complete list).

Table 4.6. List of Some Endangered, Threatened or Rare Species

S.No.	Species	Family
Himalayas and Eastern India		
1.	*Abies delavayi*	Pinaceae
2	*Acanthephippium sylhetense*	Orchidaceae
3.	*Aconitum deinorrhzum*	Ranunculaceae
4.	*Adinandra griffithii*	Theaceae
5.	*Aglaia perviridis*	Meliaceae
6.	*Amblyanthus multiflorus*	Myrsinanceae
7.	*Anacolosa ilicoides*	Oleaceae
8.	*Anoectolchilus sikkimensis*	Orchidaceae
9.	*Angopteris eracta*	Angiopteridaceae
10.	*Aphyllorchis Montana*	Orchidaceae
11.	*Arachnanthe cathcartii*	Orchidaceae
12.	*A. clarkei*	Orchidaceae
13.	*Artemisia*	Asteraceae
14.	*Astragalus strobiliferus*	Papilionaceae
15.	*Camellia caduca*	Theaceae
16.	*Cyathea gigontean*	Cyatheaceae
17.	*C. elegans*	Orchidaceae
18.	*Dendrobium densiflorum*	Orchidaceae
19.	*Dioscorea deltoidea*	Dioscoreaceae
20.	*D. ruflesiana*	Asclepiadacea
21.	*Gentiana Kurroo*	Gentianaceae
22.	*Lespedeza elegans*	Papilionaceae
23.	*Nardostachys grandiflora*	Valerianaceae
24.	*Nepenthes khasiana*	Nepenthaceae
25.	*Osmynda regalis*	Osmundaceae
26.	*Picea brachytyla*	Pinaceae
27.	*Rauvolfia serpentina*	Apocynaceae
28.	*Rhododendron arizelum*	Ericaceae
29.	*Saussurea bracteata*	Asteraceae
30.	*S. lappa*	Asteraceae
31.	*Zanthoxylum scandens*	Rutaceae

Rajasthan and Gujarat		
32.	*Commiphora wightii*	Burseraceae
33.	*Helichrysum cutchicum*	Asteraceae
34.	*Hyphaene dichotoma*	Arecaceae
35.	*Meconopsis betonicifolia*	Papaveraceae
Gangetic plain		
36.	*Aldrovanda vesiculosa*	Droseraceae
Peninsular India		
37.	*Anemia tomentosa*	Schizaeaceae
38.	*Ceropegia fantastica*	Asclepiadaceae
39.	*Cycas beddomei*	Cycadaceae
40.	*Lobelia nicotionaefolia*	Lobeliaceae
41.	*Piper barberi*	Piperaceae
42.	*Pterospermum obtusifolium*	Sterculiaceae
Andaman and Nicobar Islands		
43.	*Depterocarpus kerrii*	Dipterocarpaceae
44.	*Hippocratea nicobarica*	Hippocrateaceae
45.	*Lagerstroemia hypoleuca*	Lythraceae
46.	*Myristica andamanica*	Myristicaceae
47.	*Podocarpus neriifolius*	Podocarpaceae
48.	*Uvaria nicobarica*	Annonaceae

Indian Endangered Fauna

Some of the animal species listed below has been identified as endangered ones. This may not be a complete list. The chici's species are:

Table 4.7 : List of Animals Species

Mammals	**Four-horned antelope**	**Bengal florican**
Lion-tailed macaque	Indian bison	Nicobar pigeon
Nilgirilangur	Wild yask	Wreathed hornbill
Indian wolf	Gangetic dophin	**Reptiles**
Red fox	Baleen whales	Turtle
Himalayan Brown bear	Marinedolphines	Tortoise
Red panda	**Birds**	Terrapin
Indian Lion	Geese	Green sea turtle
Leopard	Black eagle	Tortoise shell turtle
One-horned rhinoceros	Bamboo partridge	Esturine crocodile

Indian wild ass	Mountain quail	Marsh crocodile
Andaman wild pig	Chir pheasant	Monitor lizards
Kashmir	stag Peacock pheasant	Indian python
Swamp deer	Indian peafowl	**Amphibia**
Alpine musk deer	Blacknecked crane	Viviparous toad
Blackbuck	Masked finfoot	Indian salamander
Chinkara	Houbra bustard	

CONSERVATION OF BIODIVERSITY

The hope for conservation of natural biodiversity however rests on preservation of selected ecosystems and representative areas of different vegetation types in the country. as well as on saving some of the extinction-prone species. The number of endangered species of plants and animals is on the rise, which has prompted government and non-governmental organizations to take certain steps in this direction. Forestry and wildlife were primarily under the control of state governments but later on looking to the gravity of the situation a separate Ministry of Environment and Forests was established.

The aims and objectives of wildlife management in India includes the following

(i) Protection of natural habitats
(ii) Maintenance of a viable number of species
(iii) Establishment of biosphere reserves
(iv) Protection through legislation

Some of the non-government organizations working in this direction are

(i) Bombay Natural History Society
(ii) Wildlife Preservation Society of India, Dehradun.
(iii) World Wide Fund for Nature India (WWF)

Laws Governing Biodiversity Conservation in India

(i) The Madras Wild Elephant Preservation Act, 1873.
(ii) All India Elephant Preservation Act, 1879.
(iii) The Indian Fisheries Act, 1897.
(iv) Wild Birds and Wild Animals Protection Act, 1912.
(v) The Indian Forest Act, 1927.
(vi) Bengal Rhinoceros Act, 1932.
(vii) Haily National Park Act.. 1936.
(viii) Bombay Wild, Animals and Wild Birds Protection Act, 1951.
(ix) Assam Rhinoceros Protection Act, 1954.
(x) The Cruelty Against Animals Act, 1960.
(xi) The Wildlife (Protection) Act, 1972.

(xii) The Forest (Conservation) Act, 1980.

(xiii) Wildlife (Protection) Amendment Act; 1991.

Conservation of Forests and National Ecosystems Act, 1994.

IN-SITU AND EX-SITU CONSERVATION OF BIODIVERSITY

The goal of biodiversity conservation can be attained in a number of ways. The concept of gene banks regulates all these methods.

In-situ conservation

It can be defined as the conservation of plants and animals in their native ecosystem (natural habitats) or even man made ecosystem, where they naturally occur.

This type of conservation is applicable to wild flora and fauna as conservation is achieved through protection of populations in their natural ecosystems. The concept of protected areas falls under this category e.g. National Parks, Sanctuaries and Biosphere reserves etc.

Ex-situ conservation

It can he defined as the conservation of plants and animals away from their natural habitats, which includes collection of samples of genetic diversity and their treatment in the laboratory, where they are cultured.

The concept of 'gene banks' has primarily become the talk for *ex-situ* conservation as it is important for conservation of agricultural crops and forestry based afforestation programmes. Genetic resource centres fall under this category and include botanical gardens, zoos etc.

INSTITUTIONS FOR "EX-SITU" CONSERVATION OF BIODIVERSITY

(*a*) National Bureau of Plant Genetic Resources (NBPGR)

The set up was established in 1976 by the Indian Council of Agricultural Research (ICAR) New Delhi for "Ex-Situ" conservation of plant genetic resources for agri-horticultural and agri-silvicultural activities. Built- in long term cold storage (Gene Banks) have been installed in New Delhi to conserve genetic resources at low temperature of 20°C. At present, NBPGR holds about 48.5 thousand accessions of diverse species of economically important plants (Khanna & Singh 1987). A number of scientific organizations dealing with storage of genetic material of various crop plants have been established in India after independence. They are "Rice Research Institute", Cuttack, "Potato Research Institute", Shimla & "Indian Institute of Horticultural Research", Bangalore.

(*b*) National Bureau of Animal Genetic Resources (NBAGR)

It was established in the 1980's in Kamal, Punjab: for preservation of germless of improved varieties of cattle's-cows, buffaloes, goats, sheep, camels and oxen and their various breeds found in different parts of India. Other organizations for "*ex-situ*" conservation of animal germplasm are "National Bureau of Fish Genetic Resources". Lucknow and Wildlife

Research Institute of India, Dehradun. At WRI a "gene bank" of all wild and domesticated animals of India is coming up.

Protected areas of India for "In-Situ" Conservation of Biodiversity:

Three types of protected areas-

(*i*) Wildlife Sanctuaries;

(*ii*) National Park;

(*iii*) Biosphere Reserves were created in India for "*In-Situ*" conservation of biodiversity.

As on 31 March, 1994 there were 421 Wildlife Sanctuaries, 75 National Park, 14 Biosphere Reserved in India covering about 4% of total geographical area. In-situ conservation of wildlife is a comprehensive system of protected areas. There are different categories of protected areas, which are managed with different objectives for bringing benefits to the society. The major protected areas include: (*i*) National Parks, (*ii*) Sanctuaries, (*iii*) Biosphere Reserves etc. These areas vary considerably in size, design, purpose and effectiveness of management.

Table 4.8. Distribution between National Park, Sanctuary and Biosphere Reserve

S.No.	National Park	Sanctuary	Biosphere Reserve
1.	Associated to the habitat of wild animal species like rhino, tiger, lion etc.	These are species oriented as pitcher plant, Great Indian Bustard.	Takes into consideration the entire ecosystem.
2.	The size range is 0.04-3162 sq.km.	Size range is 0.61-7818 sq. km.	Size range over 5670 sq. km.
3.	Boundaries marked by legislation	Boundaries not sacrosanct	Boundaries marked by legislation
4.	Disturbance only limited to buffer zone	Limited disturbance	Disturbance only limited to buffer zone.
5.	Tourism allowed	Tourism allowed	Tourism generally not allowed
6.	Scientific management is lacking	Scientific management is lacking	Scientifically managed
7.	No attention is paid to gene pool conservation	No attention is paid to gene pool conservation	Attention is paid

(i) National Park

According to the Indian Board for Wild Life (IBWL), "a National Park is an area dedicated by statute for all time to conserve the scenery, natural and historical objects, to conserve the wild life there in and to provide for enjoyment of the same in such manner and by such means, that will leave them unimpaired for the enjoyment of future generations with such modification as local conditions may demand".

The history of National parks in India begins in 1936 when the Hailey (now Corbett) national parks of United Provinces (now Uttar Pradesh) was created. The area is declared for the protection and preservation for all time of wild animal life and wild vegetation for the benefit and advantage and enjoyment of the general public. In this area hunting of fauna or collection of flora is prohibited except under the direction of park authority.

Table 4.9. Wildlife Reserves in Different Status

State	Wildlife Reserve
Andhra Pradesh	Kawal, Pocharam, Neelapattu
Arunachal Pradesh	Namidapha
Assam	Kaziranga, Manas
Bihar	Hazaribarh, Belta
Goa	Mollen
Gujarat	Gir, Wild Ass, Nal Sarovar
Haryana	Sultanapur lake
Himachal Pradesh	Gobin-sagar
Jammu & Kashmir	Dachingam
Karanataka	Bandipur, Nagarhole
Kerala	Periyar, Neyyar
Madhya Pradesh	Kanha
Maharashtra	Pench, Nawegaon, Dhakna-Kolkaz
Manipur	Keibul
Meghalaya	Balapakrani
Mizoram	Dampa
Nagaland	Intangki
Orissa	Simplipal, Chilka lake
Punjab	Abohar
Rajasthan	Ranthambore, Ghana
Sikkim	Kanchenjunga
Tamil Nadu	Guindy, Mundumalai, Annamalai
Uttar Pradesh	Corbett, Dudwa
West Bengal	Mahanandi, Jaldapara, Deer Parks, Sunderban

(ii) Sanctuary

The Indian Board for Wild Life has defined a sanctuary as, 'An area where killing, hunting, shooting or capturing of any species of bird or animal is prohibited except by or under the control of highest authority in the department responsible for the management of the sanctuary and whose boundaries and character should be sacrosanct as far as possible. By June 1992 India had 416 sanctuaries. The Board has further clarified the position by stating that while the management of sanctuaries does not involve suspension or restriction of normal forest operation, it is desirable to aside a completely sacrosanct area within a sanctuary to be known as 'Abhyaranya'. It has also indicated that sanctuaries should be made accessible to the public.

In India sanctuary is usually created by an order or gazette notification of State government. So the weakness of a sanctuary is that it can be desanctuarized merely by another order or gazette notification of a State government because it is not safeguarded by any proper legislation. The idea behind a wild life sanctuary and a national park is same, i.e., maximum protection, preservation and conservation of wild animals. But the fundamental difference between the two is that a sanctuary is created by order of a competent authority, who may be the chief conservator of forest: or minister of a State, while a national park can be harmed, abolished or changed only by the legislation of a State. There are, title status and degree of permanency and protection is much higher in a national park than in a sanctuary. In a wild life sanctuary private ownership rights may continue and forestry usages also may continue so long as wild life conservation is not adversely affected. However, in a national park all private ownership rights are extinguished and all forestry and other usages are prohibited. Every national park should have the minimum requisites of fauna, flora and scenery etc. There should be sufficient means of management and protection in a sanctuary to be upgraded as national park.

(iii) Biosphere Reserves

Biosphere Reserves have been described as undisturbed natural areas for scientific study as well as areas in which conditions of disturbance are under control. These serve as the centres for ecological research and habitat protection, The "Biosphere consists of two main zones as:

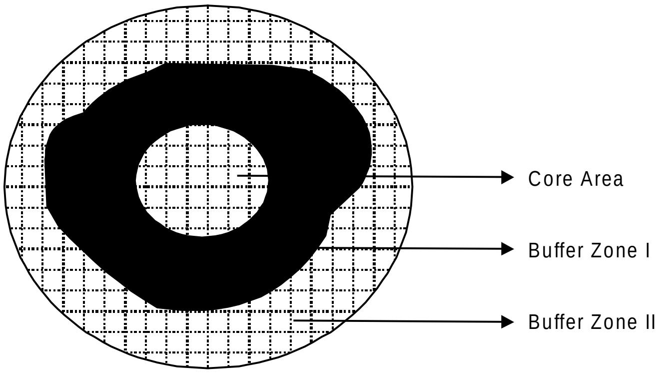


Figure 4.1: Diagrammatic representation of a typical biosphere reserve.

UNESCO launched biosphere Reserve National Programme in 1971 under its Main and Biosphere Programme (MAB). The main objectives of the programme are as follows:

- Conserve biological diversity
- Safeguard genetic diversity
- Provide areas for basic and applied research
- Opportunity for Environmental Science and training
- Promote international cooperation
- Promote management of biotic resources.

In January 1989, 274 biosphere reserves had been established in 74 countries out of which 14 proposed sites found place in India. These are as follows:

Table 4.10. Biosphere Reserves in India

S.No.	Biosphere Reserve	State
1.	Nilgiris	Tamil Nadu, Kerala and Karanataka
2.	Namdapha	Arunachal Pradesh
3.	Nanda Devi, Uttarakhand	Uttar Pradesh
4.	(Valley of flowers)	Uttar Pradesh
5.	Andamans	Andamans & Nicobar
6.	Gulf of Mannar	Tamil Nadu
7.	Kaziranga	Assam
8.	Sunderbans	West Bengal
9.	Thar desert	Rajasthan
10.	Manas	Assam
11.	Kanha	Madhya Padesh
12.	Nokrek	Meghalaya
13.	Little Rann of Kutch	Gujrat
14.	Great Nicobar Island	Andamans & Nicobar

The country falls under 2 realms and 12 biogeographical provinces as under:

Ladakh, Himalayas, Highlands, Malabar, Bengal, Indus-Ganga, Assam-Burma. Coromondal Deccan, Thar Desert, Lakshdweep, Andaman, Nicobar Islands.

Position in India

India's Department of Environment functions as the nodal agency for United National Environment Programme (UNEP), the South Asia Cooperation Environment Programme (SACEP) and the International Union for Conservation of Nature and Natural Resource (IUCN). India has been actively participating in the various sessions of UNEP with a view to ensure that programmes are more relevant to the developing countries.

The South Asia Cooperative Environment Programme has recently set up the inter-governmental organization with Afghanistan, Bangladesh, Bhutan, India, Maldives, Pakistan, Sri Lanka and Iran as its members. At the 1981 ministerial level meeting, areas were identified for implementation. India was assigned the focal point responsibilities in the areas of Environment Education, Environmental Legislation and Wild Life Management. At the 1983 Government Meeting of SACEP number of projects have been identified for implementation in the area of Energy, Environmental Science, Legislation and Environmental Impact Assessment. India has a number of on-going Bilateral Programmes with both developed and developing countries.

The Constitutional directives (Art. 48 and 51-A) and development policy have provided a strong base for enactment of legislative measures as required for environmental protection.

There are several laws enacted from time to time, which are directly related to environmental protection. Among them more recent ones are the Insecticides Act, 1968, Wildlife Protection Act 1972, Water (Prevention and Control of Pollution) Act 1974, Water Pollution Act 1977, Forest Conservation Act 1980 and the Air (Prevention and Control of Pollution) Act, 1981.

The Endangered Species Act

Passage of the U.S. Endangered Species Act of 1973 and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1976 represented a powerful new approach to wildlife protection. Endangered species are those considered in imminent danger of extinction, while threatened species are those that have declined significantly in total numbers and maybe on the verge of extinction in certain localities. Valuable species are naturally rare or have been depleted by human activities to a level that puts them at risk. Bald eagles, grey wolves, brown (or grizzly) bears, sea otters, and a number of native orchids and other rare plants are considered either vulnerable or threatened.

Convention on International Trade in Endangered Species (CITES)

The 1975 Conventional International Trade in Endangered Species (CITES) was a significant step towards worldwide protection of endangered flora and fauna. It regulated trade in living specimens and products derived from listed species. India is a signatory to this convention. The signatory countries unanimously agreed upon:

(*i*) That wild flora and fauna in their natural habitat is irreplaceable.

(*ii*) That the nations are aware of the ever-growing value of wild flora and fauna from aesthetic; scientific, cultural and recreational viewpoint.

(*iii*) That people of all nations hold a collective responsibility of the protection of flora and fauna.

(*iv*) That international cooperation is a must to prevent trade in endangered species of plants and animals.

Special Projects

Project Tiger

A fast decline of the tiger population lead to the set up of a special task force in 1970 by the Indian Board for Wildlife to prepare an action plan to conserve the tiger population in India. As a result 'Project Tiger' was launched on 1 April 1973 with the following objectives:

- To maintain a viable population of tigers for scientific, cultural and ecological values.
- To preserve areas rich in biodiversity as a national heritage for the education and enjoyment.

In 1973-74 nine Tiger Reserves were established to promote elimination of all forms of human exploitation and disturbance from the core zones.

Gir Lion Project

The Asiatic lion is now confined to the Gir Forest of Gujarat. The sanctuary harbored nearly 200 of them. The great reduction in the number was due to the increased threat from overgrazing, depletion of prey species, etc. The Asiatic lion was in danger of being wiped out either due to starvation, epidemics or human interference. In 1972 the State government prepared a scheme for the management of the Gir Lion Sanctuary with proper guidelines for conservation. The Centre provided assistance for the protection and improvement of the habitat.

Himalayan Musk Deer Project

The musk deer (*Moschus moschiferus*) which was once found throughout the Himalayan tract has terribly suffered due to its musk been used in the preparation of perfumes and medicine. Secondly the habitat destruction brought about a sharp decline in their population. A conservation project was therefore launched at the Kedarnath sanctuary in U.P.

Crocodile Breeding Project

The three varieties of crocodile population viz., gharial (*cavialis gangeticus*), the mugger (*Crocodylus palusstris*) and the salt-water crocodile (*Crocodylus porosus*) witnessed a sharp decline by the early 1970s. With the assistance of the UNDP, the Government of India launched a crocodile breeding and management project. The project was initially launched in Orissa in the year 1975. The project scheme was subsequently extended to U.P., Rajasthan, W.B., T.N., A.P., Gujarat. Kerala, M.P., Maharashtra, Andamans, Assam, Bihar and Nagaland. As a result the population of all the three species has considerably increased.

Project Elephant

The Project Elephant was launched with a view to protect and conserve the elephant population of the country. Project Elephant aimed at restoring degraded habitats of elephants. Creation of migration corridors, elimination of human interference and establishment of a data base on the migration and population dynamics of elephants e.g. elephant habitat restoration work was done in Rajaji National Park.

QUESTIONS

1. Write the Definition of the Biogeographically Classification of India in 300 words.
2. Write the Value of Biodiversity in the concept of Global.
3. What do you understand by the India as a Mega? Explain in your own words.
4. What is Diversity Nation?
5. Write short notes on Conservation of Biodiversity in India in 500 words.

CHAPTER

5

Environmental Science : Pollution and its Factors

INTRODUCTION

Pollution may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or man-made. The agents that pollute are called pollutants.

Pollutants

Pollutants are by-products of man's action. The important pollutants are summarised below:

- **Deposited matter—**Soot, smoke, tar or dust and domestic wastes.
- **Gases—**CO, nitrogen oxides, sulphur oxides, halogens (chlorine, bromine and iodine).
- **Metals—**Lead, zinc, iron and chromium.
- **Industrial pollutants—**Benzene, ether, acetic acid etc., and cyanide compounds.
- **Agriculture pollutants—**Pesticides, herbicides, fungicides and fertilizers.
- **Photochemical pollutants—**Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.
- **Radiation pollutants—**Radioactive substances and radioactive fall-outs of the nuclear test.

Classification of Pollutants

On the basis of natural disposal, pollutants are of two types:

(i) Non-degradable pollutants

These are the pollutants, which degrade at a very slow pace by the natural biological processes. These are inorganic compounds such as salts (chlorides), metallic oxides waste producing materials and materials like, aluminium cans, mercuric salts and even DDT. These continue to accumulate in the environment.

(ii) Biodegradable pollutants

These include domestic sewage that easily decomposes under natural processes and can be rapidly decomposed by natural/ artificial methods. These cause serious problems when accumulated in large amounts as the pace of deposition exceeds the pace of decomposition of disposal.

On the basis of the form in which they persist after their release into the environment, pollutants can be categorized under two types:

(*i*) **Primary pollutants :** These include those substances, which are emitted directly from some identifiable sources. This include-

(*a*) *Sulphur compounds:* SO_2, SO_3, H_2S produced by the oxidation of fuel.

(*b*) *Carbon compounds:* Oxides of carbon ($CO+CO_2$) and hydrocarbons.

(*c*) *Nitrogen compounds:* NO_2 and NH_3.

(*d*) *Halogen compounds:* Hydrogen fluoride (HF) and hydrochloric acid (HCl).

(*e*) *Particles of different size and substances:* These are found suspended in air. The fine particles below the diameter of 100u are more abundant and include particles of metals, carbon, tar, pollen, fungi, bacteria, silicates and others.

(*ii*) **Secondary pollutants.** The secondary pollutants are produced by the combination of primary emitted pollutants. in the atmosphere. In bright sunlight, a photochemical reaction occurs between nitrogen oxides; oxygen and waste hydrocarbons from gasoline that forms peroxyacetyle nitrate (PAN) and ozone (O_3), Both of them are toxic components of smog and cause smarting eyes and lung damage.

(*iii*) **Smog.** The fog deposited with smoke and chemical fumes forms a dark and thick covering, the smog. Smog is very common in almost all the industrial areas as the smog is trapped for many days by the stagnant air. It is harmful both for animals and plants.

AIR POLLUTION

The WHO defines **air pollution** as the presence of materials in the air in such concentration which are harmful to man and his environment. A number of ingredients find their way in the air and these are mostly gases, which rapidly spread over wide areas.

SOURCES OF AIR POLLUTION

Various sources of air pollution are fossil fuels, industries, agricultural activities, wars, natural causes arid emissions from vehicles.

(i) Burning Fossil Fuels

Burning of wood, charcoal and other fossil fuels causes air pollution by the release of carbon dioxide (CO_2), carbon sulphur dioxide etc. Petroleum consists mainly of hydrocarbons, sulphur and nitrogen.

(ii) Emissions from Automobiles

Vehicles are mainly responsible for more than 80% of total air pollution. The major pollutants released from automobiles, locomotives, aircraft etc., include CO, unburnt hydrocarbons and nitrogen oxide.

(iii) Industries

Paper and pulpfactories, petroleum refineries, fertilizer plants, and steel industries, thermal power plants are the main sources of air pollution. They add various harmful gases like CO, SO_3, NO, Hydrocarbons etc., to the atmosphere. Textile factories release cotton dust into the air. Cities experiencing this type of pollution are Kanpur, Surat and Ahmedabad. The pesticide and insecticide industries are posing serious threat to the environment. Food processing industries and tanneries emit offensive odors. Release of poisonous gases from accidents also poses serious threats. e.g. Bhopal Gas Tragedy in which methyl isocynate (MIC) gas leakage killed several people. In Tokyo, about 34 tones of carbon particles mixed with other suspended particles settle per square kilometer every day.

(iv) Agricultural Activities

Spraying of insecticides and weedicides also cause air pollution. These, when inhaled create severe problems to both animals and man.

(v) Wars

Various forms of explosives used in war pollute the air by releasing poisonous gases. This greatly disturbs the ecology of the area. Nuclear explosions pollute air by radioactive rays. The effects of nuclear explosions on Hiroshima and Nagasaki are well-known examples.

(vi) Natural Causes

Gas emissions from active volcanoes, marsh gas, spores of fungi and pollens are the natural causes of air pollution.

COMMON AIR POLLUTANTS

Air pollutants are of two main types ~gaseous and particulate. Oxides of carbon. Nitrogen and sulphur are gaseous pollutants. Particulate pollutants may be solid or liquid particles, larger particles settle down quickly viz., sand and water droplets whereas small dust particles remain suspended in air for a long time. These are added into the atmosphere by the processes of blasting, drilling, crushing, grinding and mixing.

(i) Carbon Dioxide

CO_2 content of air has increased by 20% during the last century. CO_2 causes nausea and headache. It's increase in the air may cause green house effect, rise in the atmospheric temperature. This may melt the polar ice resulting in rise in level of oceans and flooding of coastal regions.

(ii) Carbon Monoxide

It is a very poisonous gas and is produced by incomplete combustion of fuel. If inhaled. it combines with hemoglobin and reduces its oxygen-carrying capacity. This leads to laziness, reduced vision and death.

(iii) Oxides of Nitrogen

These include NO and NO_2, which are released by automobiles and chemical industries as waste gases and also by burning of materials. These are harmful and lower the oxygen carrying capacity of blood.

(iv) Oxides of Sulphur

SO_2 and SO_3 are produced by burning of coal and petroleum and are harmful to buildings, clothing, plants and animals. High concentration of SO_2 causes chlorosis (yellowing of leaves), plasmolysis, damage to mucous membrane and metabolic inhibition. SO_2 and SO_3 react with water to form Sulphuric and sulphurous acids. These may precipitate as rain or snow producing acid rain or acid precipitation.

(v) Photochemical Oxidants

Formed by the photochemical reactions between primary pollutants, viz. oxides of nitrogen and hydrocarbons. Nitrogen oxides in the presence of sunlight react with unburnt hydrocarbons to form peroxyacyl nitrate (PAN), Ozone, aldehydes and some other complex organic compounds in the air.

(vi) Hydrocarbons

These are unburnt discharges from incomplete combustion of fuel in automobiles. These form PAN with nitrogen oxides, which is highly toxic.

(vii) Particulate Matter

Industries and automobiles release fine solid and liquid particles into the air. Fly ash and soot from burning of coal, metal dust containing lead, chromium, nickel, cadmium, zinc and mercury from metallurgical processes; cotton dust from textile mills; and pesticides sprayed on crops are examples of particulate pollutants in the air. These are injurious to respiratory tract.

(viii) Aerosols

Aerosols are chemicals released in the air in vapour form. These include fluorocarbon (carbon compound having fluorine) present in emissions from the Jet aeroplanes. Aerosols deplete the ozone layer. Thinning of ozone layer results in more harmful ultraviolet rays reaching the earth, which are harmful to skin, and can lead to skin cancer also.

(ix) Radioactive Substances

These are released by nuclear explosions and explosives. These are extremely harmful for health.

(x) Fluorides

Rocks, soils and. minerals containing fluorides release an extremely toxic gas called hydrogen fluoride on heating. This gas is highly injurious to livestock and cattle.

POLLUTION IN INDIA

India supports a large network of factories and industries. These factories are generally localized in eight or ten large industrial centres. These are also a great source of air as well water pollution. To be on a safer side delocalisation of industries is the need of the time. This would lead to an even distribution of pollutants and faster degeneration of pollutants. The major pollutants coming out from these industries are -

(i) Industrial Pollutants. The common air pollutants from industries are SO_2, CO, CO_2, H_2S and hydrocarbons together with dust, smoke and grit. These are produced by the burning of coal and petroleum and by the combustion of lignite at thermal power stations. The chemical industries release HCl, chlorine, nitrogen oxide and oxides of copper, zinc, lead and arsenic.

The fertilizer factories at Gorakhpur and Ahmedabad; the steel industries at Bhilai, Rourkela, Jamshedpur and Durgapur pollute the air with above-said gases.

(ii) Automobile Exhausts. Automobiles run by petrol and diesel produce CO, nitrogen oxides and hydrocarbons. Hundreds and thousands tons of hydrocarbons and CO are emitted into air daily. Metropolitan cities harbour lakhs and crores of automobiles. Every gallon of petrol consumed by automobiles produces 3 pounds of carbon monoxide and 15 pounds. of nitrogen oxide.

(iii) Ionizing Radiations from Radioactive Substances. Ionizing radiations include alpha, beta particles and the gamma rays etc. These are produced by atomic explosions and testing of atomic weapons.

Effects of Air Pollution

Effect on Plants

(*i*) SO_2 causes chlorosis and also results in the death of cells and tissues.

(*ii*) Fluorides and PAN damage leafy vegetables such as lettuce and spinach.

(*iii*) Oxides of nitrogen and fluorides reduce crop yield.

(*iv*) Smog bleaches and blaze foliage of important leafy plants.

(*v*) Hydrocarbons cause premature yellowing, fall of leave and flower buds, discoloration and curling of sepals and petals.

(*vi*) Smoke and dust cover the leaf surface and reduce photosynthetic capacity of plants.

(*vii*) Ozone damages cereals, fruits, and cotton crop.

Effect on Man

The effect of pollutants on animals and man are as follows-

(*i*) Ozone causes dryness of mucous membranes, changes eye vision, causes headache, pulmonary congestion and oedema.

(*ii*) Ozone has been reported to produce chromosomal aberrations.

(*iii*) SO_2 causes drying of mouth, scratchy throat, smarting eyes and disorders of respiratory tract.

(*iv*) SO_3, CO and NO_2 diffuse into blood stream and reduce oxygen transport. CO damages cardiovascular system. Hydrocarbons and other pollutants act, as carcinogens and lead to different cancers.

(*v*) Cotton dust leads to respiratory disorders *e.g.* bronchitis and asthma.

(*vi*) Smoking of tobacco causes cancerous growth in lungs.

Change in Climate

CO_2 content of air is increasing due to deforestation and combustion of fuel. This increase is affecting the composition and balance of gases in the atmosphere. Increase in CO_2 concentration may increase the atmospheric temperature, producing green house effect A rise of global temperature by more than 2-3 degrees may melt glaciers and polar ice. This would lead to a rise in ocean level and consequent flooding and submergence of coastal areas. Rainfall pattern may also change, affecting agricultural output in various regions of' the world. Aerosols deplete the ozone layer in the stratosphere. Thinning of ozone layer would permit more of the harmful ultraviolet rays to reach the earth. This may cause, sunburn, blindness and inactivation of proteins, RNA, DNA and plant pigments.

Aesthetic Loss

Dust and smoke spoils the beauty of nature. Especially the mountain environments, which serve as a great attraction for tourists. Foul odours emitted by industries, automobiles, dirty drains and garbage heaps in cities are a great nuisance.

Control of Air Pollution

Following measures have been suggested to control air pollution-

(*i*) Some gases, which are more soluble in a particular liquid than air, for example, ammonia in water, can be separated by dissolving in it

(*ii*) Particles larger than 50 mm are separated in gravity settling tanks. Using cyclone collectors or electrostatic precipitators separates fine particles.

(*iii*) The height of chimneys should .be increased to the highest possible level to reduce pollution at the ground level.

(*iv*) SO_2 pollution can be controlled by extracting sulphur from the fuel before use.

(*v*) Pollution control laws should be enforced strictly.

(*vi*) Trees should be planted on the roadside, riverbanks, parks and' open places as they keep the environment fresh.

(*vii*) Population growth, which is the main cause of pollution should be checked.

(*viii*) Nuclear explosions should be restricted.

Water Pollution

Water is extremely essential for life, this common fact is known to all. It is required to meet our basic needs in day to day life viz., cooking, drinking, bathing, disposal of sewage, irrigation, generating electricity in power plants, cooling and manufacturing different products in industries and the disposal of industrial wastes. During all these processes the undesirable substances are added to the water resources to a great extent. This alters the basic chemistry of water in rivers and streams.

Sources of Water Pollution

(*i*) *Domestic sewage*

This includes household's wastes like food wastes, synthetic detergents used for washing clothes and cleaning bathrooms and latrines and water based paints.

(*ii) Industrial effluents*

The industrial wastes are discharged in the adjoining rivers and streams through flush lines of factories. The textiles, sugar and fertilizers factories, oil refineries, drugs manufacture, rubber, and rayon fibers, the paper industries and the chemical factories all produce Chemical pollution.

(*iii) Agricultural source*

Increased use of fertilizers has become essential for high yielding crop plants. Excess of nitrates used as fertilizers seep into ground water is carried into lakes and pond. On entering the drinking water supply system these create several health problems.

(*iv) Pesticides*

These include insecticides, fungicides, nematicides, rodenticides, herbicides and soil fumigants. These contain chlorinated hydrocarbons, organophosphates, metallic salts, carbonates, acetic acid derivatives etc. many pesticides are non-degradable. They pass through the food chains and accumulate in fatty tissues thus causing several health hazards.

(*v) Thermal pollution*

Power plants and nuclear power stations are the main sources of thermal pollution of water where water is used for cooling and becomes hot. The hot water on entering the main water body raises its temperature, which kills fishes and other aquatic animals and increases the rate of respiration in aquatic plants.

(*vi) Pathogenic organisms*

Sewage and domestic waste from houses introduces pathogenic organisms viz., protozoa, worms-eggs and bacteria into water. This contaminated water if consumed causes jaundice, typhoid, dysentery, cholera, tuberculosis etc.

(*vii) Mineral oils*

Oil from oil spills and washings of automobiles finds way into river water through sewers.

(*viii) Underground water pollution*

Underground water particularly in cities and industrial areas is no more pure and safe. The sources of underground water pollution are sewage, seepage, pits, industrial effluents, septic tanks, fertilizers and pesticides, garbage etc.

(*ix) Marine water pollution*

River and stream network sources of water ultimately end up ocean and seas. Thus, these acts as the sink of all natural and man-made water based pollutants. The main sources of oceanic pollution are discharges of oil, greases, petroleum products, detergents, sewage and garbage including radioactive wastes.

Effect of Water Pollutants

The main effects of water pollutants are:

1. Compounds of mercury, arsenic and lead are poisonous and chemically harmful as they even affect water treatment plants e.g. organic sulphur compounds interfere with nitrification.

2. Mercury when dissolved in water is absorbed by aquatic plants and enters the food chain. Lead impairs metabolism and brings about congenital deformities, anaemia etc.
3. Cadmium damages kidneys and liver.
4. Inorganic nitrates and phosphates promote growth of oxygen-consuming algae, which result in the death of fishes and other aquatic animals.
5. Presence of dyes and compounds in the discharged water changes the colour of water.
6. Soap, detergents and, alkalis result in foam formation.
7. Industrial effluents containing iron, free chlorine, phenol, manganese, oils, hydrocarbons, ammonia, algae and microorganisms impair the taste and odours of water.
8. The nitrates and phosphates dissolved in water accelerate the growth of microorganisms, which consume much of the dissolved oxygen depriving fish and other aquatic life (Eutrophication).
9. Biomagnifications is the increase of toxic materials at each tropic level of a food chain.

For example, DDT after reaching a water system is absorbed by the microorganisms on which smaller fishes feed. From them, DDT reaches the carnivorous animals. Since bigger fishes consume more food, large amounts of DDT accumulates in their body.

CONTROL OF WATER POLLUTION

(*i*) Separate ponds and tanks to be used for cattle and animals.

(*ii*) Use of pesticides, insecticides and fertilizers should be done judiciously. Rapid biodegradable substitutes for pesticides should be employed.

(*iii*) In towns where sewage facilities are not available, septic tanks should be made in the houses.

(*iv*) Rivers and lakes should not be used for bathing or washing as it contaminates water.

(*v*) Domestic sewage and industrial wastes should be treated before discharging them into drains.

Treatment of waste Water

Domestic sewage and industrial wastes should be properly treated before these are drained in the mainstream water. Treatment involves the following two steps:

(*i*) *Sewage treatment*

It involves following steps:

Primary treatment. It involves physical processing of sedimentation, flotation and filtration where sewage water is passed through screens to remove larger particles and then through grinding mechanism to reduce the larger particles to smaller size. The sewage is finally passed through settling tanks to remove suspended impurities.

Secondary treatment. Sewage obtained after primary treatment is sent to aeration tank where it is mixed with air and sludge laden with bacteria and algae. The algae provide oxygen to the bacteria and decompose organic matter into simple compounds. Chlorination is finally done to remove bacteria.

Tertiary treatment. In the third and last step water is passed through ion exchangers to remove dissolved salts.

(*ii*) *Treatment of industrial effluents*

Treatment of industrial effluents involves neutralization of acids and bases, removal of toxic compounds, coagulation of colloidal impurities, precipitation of metallic compounds and reducing the temperature of effluents to decrease thermal pollution.

SOIL POLLUTION

Soil Pollution

Like water and air, soil is also equally important for living organisms. It supports plants on which. all other living organisms depend. The process of soil formation is so slow that the soil may be regarded as a non-renewable source. Therefore, the study and control of soil pollution is important. Any substance that reduces soil productivity is called **soil pollutant.**

Sources of Soil Pollution

There are several materials, which adversely affect physical, chemical and biological properties of the soil and thus reduce its productivity. These are

1. Chemicals present in industrial waste.
2. Pesticides and insecticides that are sprayed on crops. .
3. Fertilizers and manures that are added to the soil to increase the crop yield.

Effect of Soil Pollutants

Chemicals and pesticides affect the structure and fertility of soil by killing the soil microorganisms. Pesticides are absorbed by the plants and then transferred to other organism. Hence, they affected food chains and food webs. Excretory products of livestock and human beings used as manure pollute the soil besides giving high yield. The faulty sanitation and unhygienic practices of the people add to the soil pollution. Pathogens present in the wastes and excreta contaminate the soil and vegetable crops causing diseases in man and domesticated animals.

Types of Soil Pollution

It is of the following types-

(*i) Positive soil pollution*

Reduction in the productivity of soil due to the addition of undesirable substances like pesticides, herbicides, fertilisers, etc. is called positive pollution. These pollutants have cumulative effect and kill the soil organisms.

(ii) Negative soil pollution

It is caused by the removal 01 useful components from soil by erosion, deforestation and improper methods of agriculture.

Salination of Soil

Increase in the concentration of soluble salts is called **salination**. This adversely affects the quality and productivity of soil. It takes place in two ways: accumulation of salts dissolved in irrigation water on the soil surface due to intensive farming and poor drainage, and deposition of salts as white crust during summer months drawn by capillary action from the lower surface to the top surface.

Control of Soil Pollution

Various measure to control soil pollution are-

1. Transfer stations for bulk shifting of refuse should be constructed in cities and big towns.
2. Pneumatic pipes should be laid for collecting and disposing wastes.
3. Materials like paper, glass and plastics can be recycled.
4. Metals should be recovered from scrap and disposed materials.
5. Use of chemical fertilizers should be reduced by the use of bio fertilizers and manures.
6. Use of pesticides can be reduced by adopting biological control of pests.
7. Use of cattle dung and agricultural wastes in biogas plants should be encouraged.
8. Deforestation can check soil erosion to a great extent.

Land Degradation

Besides pollution, land and soil face several other problems. Removal of topsoil is called soil erosion. Soil erosion factors are water, wind, ocean, waves and glaciers, felling of trees, overgrazing by cattle, over-cropping etc. Erosion occurs both in wet and dry regions. It leads to floods.

Soil Erosion in India

Soil erosion is a worldwide phenomenon, but it is especially high in Central Africa, China, India, Nepal, Australia, Spain, USA and USSR. India loses about 40,000 hectares of land every year as an effect of wind and water erosion. Damage to the topsoil is 18.5% of the total world's loss. This is due to overgrazing by livestock. The population of livestock in India is the highest in the world. Overgrazing damages the topsoil, which reduces soil fertility.

(i) Deforestation of overgrazing

Over-grazing is the main cause of soil erosion in India. Roots of grasses act as binding material and keep the soil intact, which upon grazing are destroyed.

(ii) Desertification

Loss of soil productivity by erosion of top soil results in the formation of deserts. Deserts are spreading in all continents. Desertification takes place by shifting of sand dunes by wind and .over-grazing. That desert in India is spreading at the rate of 12,000 hectares of land every year.

(*iii) Shifting cultivation*

Tribal communities follow the practice of cutting down trees and setting them on fire and then raising the crops on the resulting ash. This is called *Jhuming* in northeastern India. It is harmful if the Jhuming cycles are longer than ten years but short cycles destroy forests and cause soil erosion. e.g. Asia and Africa. .

(*iv) Developmental activities*

Large areas of fertile and productive croplands, woodlands and grasslands are lost to various developmental activities such as rapid urbanization, building of airports, industries, railways, roads, mining and construction of dams.

Control of Land Degradation

Following ways can control Land degradation

1. Restoration of forests and grass cover can help in prevention of soil erosion and floods.
2. By replacing shifting cultivation with crop rotation, mixed cropping or plantation cropping. Providing adequate drainage to irrigated and flood-prone lands can prevent salinity.
3. Desertification can be controlled by spread of appropriate plant species and by raising trees as wind breaks.

Noise Pollution

Noise can be defined as unwanted/unpleasant sound. So noise pollution is unwanted sound dumped into the atmosphere without regard to the adverse effects it may have. In our country urbanization and industrialization have become twin problems. Cities and towns have sprouted up where industries are concentrated. Lack of town' planning had led to residential, commercial and industrial areas being mixed up. Houses, schools and hospitals are situated near industries. All the boons of industrialization and civilization such as motors, horns, heavy and light machinery, work and movement, blaring radios, supersonic aeroplanes have become disturbing and irritant. Our ears can hear ordinary conversation between 30-60 decibels. Modern conversation has a noise value of 60 decibels. A decibel value greater than 80 decibels causes noise pollution. Noise becomes troublesome above 140 decibels.

Effect of Noise Pollution

1. Constant noise affects a man physically and mentally. Physical effects include blood vessels to contract, skin to become pale, muscles to constrict and rise in blood pressure leading to tension and nervousness.
2. High intensity sound emitted by industrial plants, bottling machines, supersonic aircrafts, when continued for long periods of time not only disturbs but also permanently damages hearing.
3. Offices, industries and crowded places where constant noise prevails can produce temper tantrums, headaches, fatigue and nausea. .

4. Loud and sudden noise affect the brain. Intermittent noise leads higher incidence of psychiatric illness and also a danger to health of pregnant mothers and small infants.
5. Noise has harmful effects on nonliving materials too, *e.g.* cracks develop under the stress of explosive sound.

Control of Noise Pollution

Following methods can control noise pollution:

1. Limited use of loudspeakers and amplifiers.
2. Excursing control over noise producing vehicles.
3. Industrial workers should be provided with ear plugs.
4. Delocalisation of noisy industries far away from dwelling units.
5. Within a radius of 10 miles of airport, no buildings or factories should be allowed.
6. Plants and trees should be planted all around the hospitals, libraries and schools and colleges.
7. Personal protection against noise can be taken by using, cotton plugs in the ear.

Radiation

The radiations from the atomic blasts cause several health hazards. The radiations carry high energy and remove electrons from atoms and attach them to other atoms producing positive and negative ion pairs. Hence, they are known as ionizing radiations. The ionization property of these radiations proves to be highly injurious to the protoplasm. The ionizing radiations of ecological concern are classified as follows:

Corpuscular Radiations

These consist of streams of atomic or subatomic particles, which transfer their energy to the matter they strike.

(*i) Alpha particles*

These particles are large and travel few centimeters in the air. These cause large amount of local ionization.

(*ii) Beta particles*

These are small particles characterized by having high velocities. They can travel a few meters in space. These are capable of entering into the tissues for few centimeters.

Since alpha and beta particles have low penetration power they can produce harmful effects only when absorbed, ingested or deposited in or near living tissues.

(*iii) Electromagnetic radiations*

Electromagnetic radiations include waves of shorter wavelengths. These are capable of traveling long distances and can readily penetrate the living tissue. These include gamma rays. These can penetrate and produce effect even without being taken inside.

Other Types of Radiations

Besides radioactive radiations, some other radiations are also present in the atmosphere.

(*i) Neutrons*

These are large uncharged particles, which do not cause radiation by themselves, but they produce radioactivity in non-radioactive materials through which they pass.

(*ii) X-rays*

These are electromagnetic waves very similar to gamma rays, but originate from the outer electron shell of radioactive substances, which are not dispersed in nature.

(*iii) Cosmic rays*

These are radiations from the outer space, which contain alpha and beta particles together with gamma rays.

Sources of Radiations

The radiations are produced from the radioactive elements, which are known as radionuclides or radioactive isotopes, e.g. Uranium. Radium, Thorium, and Carbon-14. These contribute to background radiation. But isotopes of certain metabolically important elements like Carbon-14, Cobalt-60, Calcium 45, Iodine-131, Phosphorus-32, etc. are not ecologically harmful but are used as tracers. The third category of radionuclides comprises of fission products of uranium and certain other elements. These are cesium, strontium, and plutonium etc.

Biological Effects of Radiation

The effects of radiation have revealed that acute doses are found to be deleterious and may kill the organisms, whereas the increase in radiation in biological environment leads to different kinds of mutations. The effects of Cobalt-60 or Cesium-137 gamma radiations have now been studied on communities and on ecosystems at different places. The research concludes that Irradiations eliminate varieties in species. The sensitivity of cells, tissues and organisms to radiation varies. The cells with larger chromosomes are more sensitive. Herbaceous communities and early stages of succession are resistant than the mature forest.

Nuclear Fall Outs or Radioactive Fall Outs

The atomic blasts not only produce the local ionizing radiations at that time but the radioisotopes produced as a result of explosion enter the atmosphere and continue to fallout gradually over broad geographic areas for a very long time. These are known as nuclear fallout or radioactive fallout. These are dangerous for life as they also produce ionizing radiations.

Biological Effects of Fall outs

The fallout of radionuclides combines with various metals and dust and from colloidal suspension combines with organic compounds to form complexes. The smaller particles of radionuclides adhere tightly to the leaves of plants and produce radiation damage to leaf tissue besides entering the tissues also. Through grazing animals these enter the food chain directly at the primary consumers level. Radionuclides, which combine with organic substances, enter the food chain through producer tropic level. Therefore, the radionuclides fall out manages to enter the body of all living organisms. Radioactive Strontium-90 poses a health hazard in human beings and other higher vertebrates. It continues to deposit in the bones and causes bone cancer and leukemia. Radioactive Cesium-137 is known to cause irreversible genetic changes in different organisms. The fallout radiations do cause changes in the genetic constitution of organisms, resulting in gene mutations and chromosomal aberrations. Their considerable, doses may kill, cripple and alter the animals and plants in the areas.

Control of Radiation Pollution

Following measures can help in controlling the radioactive pollution:

(*i*) Workers in nuclear plants should be provided with nuclear gadgets and safety measures against accidents.

(*ii*) Leakage of radioactive elements from nuclear reactors, laboratories, transport, careless handling and use of radioactive fuels should be checked.

(*iii*) Level of radiation pollution should be monitored regularly in risk areas.

(*iv*) Disposal of radioactive wastes deserves special attention.

Case studies

Hiroshima and Nagasaki Episode

The tale of Hiroshima and Nagasaki is a painful experience. It is for the first time that an atomic bomb has been exploded over human population. The incident took place on August 6,1945 at 8:15 a.m. The bomb with an approximate temperature of around 100 million 0°C was exploded on a fine morning in Hiroshima (Japan). The temperature of the city hiked like anything, almost like an oven. After three days, Nagasaki too suffered the ravages of a nuclear attack. More than 1,00,000 people were reported to die just after the event took place. Since radiations from nuclear elements remain active even after, the generations to follow up also suffered from various diseases. Even the babies in the mother's womb were affected and a few perished. Blindness, deafness, skin diseases and cancers, distortion of bones and other parts became the fortune of human civilization.

Chernobyl Accident

This incident took place in Ukraine on April 26, 1986. There was a Chernobyl nuclear power plant in Ukraine after which the event has been named. Approximately four million people had been reported to suffer from the accident. The accident contaminated neighboring environment up to several kilometers. The sites were evacuated and resettlement was done for the affected people. The radiations released affected ground water and surface waters, affecting large areas of Europe. 131 Iodine and 137 Cesium are the most dangerous amongst the 20-odd radioactive elements released during Chernobyl disaster. As per the Soviet Health Ministry, 31-persons died shortly after the disaster. Of the 276,614 people who worked for rehabilitation and cleaning operations, a total of 1065 died by the end of 1990.

Marine Pollution

All river drainages end up in the seas. On the way to sea, rivers carry large amounts of sewage, garbage, and agricultural discharge, biocides, including heavy metals. Besides this discharge of oils and petroleum products and dumping of radionuclides waste into sea also cause marine pollution. Huge quantity of plastic is being added to sea and oceans. Over 50 million lb plastic packing material is being dumped in sea of commercial fleets. Many marine birds ingest plastic that causes gastro-intestinal disorders. The chemical principle in

PCBs causes more damage as thinning of eggshell and tissue damage of egg. Radionuclide waste in sea includes Sr-90, Cs-137, Pu-239, and And Pu-240.

The pollutants in sea may become dispersed by turbulence and ocean currents and finally becomes a part of food chain. Bioaccumulation in food chain may result into loss of species diversity. The pollution in Baltic sea along the coast of Finland, took place largely from sewage and effluents from wood industries. This pollution effect brought changes. in species diversity in the bottom fauna. In less polluted water there was rich species diversity, which tended to decrease with increasing pollution load. In heavily polluted areas, macroscopic benthic animals were absent, but chirognomy larvae occurred at the bottom. In marine water the most serious pollutant is oil. Spill of oil or petroleum products due to accidents/ deliberate discharge of oil polluted waste brings about pollution. About 285 million gallons of oil are spilled each year into ocean, mostly from transport tankers. Oil pollution causes damage to marine fauna and flora including algae, fish, birds, and invertebrates. About 50,000 to 2,50,000 birds are killed every year by oil. The oil is soaked in feathers, displacing the air and thus interferes with buoyancy and maintenance of body temperature. Hydrocarbons and benzpyrene accumulate in food chain and consumption of fish by man may cause cancer. Detergents used to clean up the spill are also harmful to marine life.

Thermal Pollution

The increase in water temperature by industrial units such as steel and iron factories, electric powerhouses and atomic power plants may be called as thermal pollution. Some of the industries generate their own power supply where water is used to cool the generators. This hot water is released into the main stream, causing a warming trend of surface waters. If the drainage is poorly flushed, a permanent increase in the temperature may result.

Many organisms are killed instantly by the hot water resulting into a high mortality. It may bring other disturbance in the ecosystem. The eggs of fish may hatch early or fail to hatch at all. It may change the diurnal and seasonal behaviour and metabolic responses of organisms" It may lead to unplanned migration of aquatic animals. Macrophysics population may also be changed. As temperature is an important limiting factor, serious changes may be brought about even by a slight increase in temperature in a population. Heat stress (5-1 one above the normal growing temperature of organism) induces expression of specific gene families called heat shock genes, which lead to the synthesis of a new set of proteins called heat shock proteins. Heat shock proteins have been found in every organism from unicellular prokaryotes to multicultural organisms including Homo sapiens. Heat Shock Proteins synthesis lead to acquired thermo tolerance, i.e. the ability of an organism to withstand a normally lethal temperature. Thermo tolerant genotypes show adaptations at various levels of organization besides showing qualitative and quantitative differences in heat shock proteins as compared to the thermo sensitive genotypes.

Solid Waste Management

Environmental problems also include solid waste disposal. At all levels of development human beings produce domestic wastes. These comprises of kitchen wastes, ashes from fires, broken utensils and worn-out clothing. The industrial revolution leads to the concentration of people in urban areas with very high population density. This resulted in addition of new sources of wastes from shops, institutions and factories. In developed countries services for the regular removal of domestic and trade wastes have been in operation for last many years.

Many changes have taken place in our society. The character of the wastes has altered with rising living standards, changes in retail distribution methods and fuel technology. Grave environmental concerns have come up with rise in construction of new buildings, supermarkets, and industrial wastes of many kinds. In the industrialized countries, therefore, basic health and environmental problems have been solved in the storage and collection of solid wastes, although major problems remain in regard to resource recovery and disposal. The technology of wastes handling is now highly developed. The substantial sectors of industry are engaged in the production of equipment with regard to removal of wastes. Many institutions give technical training and support. However developing nations like India are facing the problems of urbanization with high population densities. The developing countries are aware of the importance of avoiding the environmental pollution. The quality of urban environment is a matter of growing concern and the importance of solid wastes management is increasingly being recognized.

Sources and Characteristics

Solid wastes generally refer to describe non-liquid waste materials arising from domestic, trade, commercial, industrial, agriculture and mining activities and from the public services. Disposal of sludge's (liquid waste) of some kind fall within the scope of solid waste management. These arise primarily from industrial sources and from sewage treatment plants. Solid wastes comprise countless different materials; dust, food wastes, packaging in the form of paper, metals, plastics or glass, discarded clothing and furnishing, garden wastes and hazardous and radioactive wastes. The method and capacity of storage, the correct type of collection vehicle, the optimum size of crew and the frequency of collection depend mainly on volume and density. Just as solid wastes comprise a vast number of materials, they arise from a multitude of separate sources as well as many kilometers of streets upon which solid wastes accumulate. Thus, the four main aspects of solid wastes management are: (*i*) storage at or near the point of generation, (*ii*) collection, (*iii*) street cleansing, (*iv*) disposal.

The main constituents of solid wastes are similar throughout the world, but the proportions vary widely. As personal income rises, paper increases, kitchen wastes decline, metals and glass increase, total weight generated rises and the density of the wastes declines. Clearly, the amount of work involved in refuse collection depends upon the weight and volume of wastes generated and the number of collection points from which the wastes have to be removed.

Health and environmental implications

Improper handling of solid wastes results in increased potential risks to health and to the environment both. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from skin contact with wastes. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. More serious, however, and often unrecognized, is the transfer of pollution to water, which occurs when the leach ate from a refuse dump enters surface water or wastes, either in the open air, or in plants that lack effective treatment facilities for the gaseous effluents. Traffic accidents can result from wastes accumulated and dispersed on to streets and roads. They have caused death and injury to people in the surrounding areas. There also persists the specific danger of the concentration of heavy metals in the food chain. These metals can be taken up by the plants growing on land on which sludge has been deposited, creating risks to the animals which graze and the humans who consume these animals.

Economic implications

Labour and transport absorb the major part of the operating cost of solid wastes management services. The level of mechanization that should be adopted for solid wastes management systems relates directly to the cost of labour, as compared to that of plant and energy. There is not much variation, worldwide, in energy or mechanical plant costs, but there is wide variation in the range of labour costs. Thus, there are no universally applicable solid wastes management systems. Every country must evolve indigenous technology based on the quantity and character of the wastes, the level of national wealth, wage rates, equipment, manufacturing capacity, energy costs etc. It is necessary to deploy a complete set of technical skills, which derive from several professional disciplines. These include civil and mechanical engineering, chemical engineering, transport organization, land use planning and economics.

Refuse Collection

A refuse collection service requires vehicles and labour. For their efficient development, three components are basic:

(1) Travel to and from the work area,

(2) The collection process, and

(3) The delivery process.

The use of large, widely spaced communal storage sites is usually a failure because the demand placed on the householder goes beyond his willingness to cooperate. Communal storage points should, therefore, be at frequent intervals, Madras and Bangalore provide fixed concrete containers. They are fairly successful because they place reasonable and acceptable duty on the residents, thus very little domestic waste is thrown in the street.

In another system of block collection, a collection vehicle travels a regular route at prescribed intervals, usually every two days or every three days, and it stops at every street intersection, where a bell is rung. At this signal the residents of all the streets leading from that intersection bring their wastes containers to the vehicle and hand them to the crew to be emptied. A crew of one or two men is adequate in number, as they do not need to leave the vehicle.

Sanitary Landfill Disposal

Land disposal (burying of wastes) is the only approved method of disposal, which is performed at a single site. Incineration, composting, and salvage are either a form of refuse handling or processing. They are not complete methods of disposal, and they require disposal of residue. Sanitary landfill can be defined as the use of solid wastes for land-reclamation, a typical example being the restoration, by filling to the original level of man made surface dereliction such as a disused surface, mineral excavation. Solid wastes may also be used to improve natural features by raising the level of low-lying land to enable it to be used or cultivation or industrial development. Thus, sanitary land filling has two essential features, which differentiate it from crude dumping:

(*i*) Only sites that will be improved not degraded, by a change of level are selected.

(*ii*) Simple engineering techniques are used to control the manner in which the wastes are deposited, so that dangers to public health and the environment are avoided.

Unfortunately most of the world's wastes are disposed off by uncontrolled dumping which blights the land for any future use and causes serious risks of water pollution and vector breeding. Very few cities operate sanitary land filling to standards, which totally control health and environmental dangers; most of those that do are in the industrialized countries.

Control of Hazards

(*i*) Control over pathogens is dependent upon a rigorous policy of covering the wastes soon after deposit. This serves both to isolate the wastes and to retain the heat, which is quickly generated during aerobic decomposition.

(*ii*) The main source of insects will be the eggs of flies. Which have been deposited in the wastes before they arrive at the site. Most of these will be buried deep in the wastes and will succumb to the temperature increase.

(*iii*) Fire at a sanitary landfill can arise from innumerable causes, hot ashes in a vehicle delivering wastes: a cigarette thrown by a worker; the sun's ray though a fragment of glass on the surface. With some kinds of wastes the consequence of fire may be very serious and underground fires have been known that ultimately caused the collapse of the surface into voids caused by the fire.

(*iv*) The pollution of static water, ditches, river or the sea occurs when a sanitary landfill adjoins a body of water. The normal source of the leach ate causing this pollution is rain falling on the surface.

Incineration

Open burning, barrel burning, and other related uncontrolled forms of burning have a long history of use. Many liquid wastes and pathological wastes are best disposed of by incineration. Originally, solid waste incineration was practiced to reduce the quantity of refuse or disposal. After it was proven that heat could destroy most pathogens, incinerators were used in hospitals for destruction of pathological wastes. With few exceptions, incinerators are not "good neighbors," and the environmental nuisances of dust. Noise and air pollution have provoked communities to an anti-incinerator philosophy. To overcome this negative community feeling is going to require that incineration prove its worth and that imagination be used in the design of future units. Incineration of solid wastes yields the highest percent of volume reduction except for Pyrolysis. Unlike a sanitary landfill, incineration of solid wastes can be performed on the premises of apartments, supermarkets, departments' stores, and similar establishments.

Composting

Composting involves the biological stabilization of solid matter either under aerobic or anaerobic conditions. The end product of composing is an organic material, which could have beneficial value as a soil conditioner or plant mulch. In addition to producing a modified solid waste material, which can be useful in land reclamation, composting does yield a volume reduction of solid waste by about 40-60% of the compost able fraction *pyrolysis*

Pyrolysis is a thermal process where oxidation of the organic fraction is not allowed to occur. Instead, the organic matter is evolved from the refuse with heat, leaving an ash consisting mostly of carbon and any inorganic matter, e.g. metal and glass are not removed before Pyrolysis. Some of the gases, which have been volatized, are condensed while the remainder is burned to supply the heat (energy) needed to pyrolyze the material. Since oxidation is prevented, the Pyrolysis process must be performed in an atmosphere of argon, helium or nitrogen.

Role of an Individual in Prevention of Pollution

Which are the most viable, efficient and economical ways to eliminate pollution problems? We very often see people blaming public and government sectors to control pollution through controlling market mechanisms and government blaming people to avoid and check pollution. Who would control whom? Many ecologists and environmental scientists believe in that pollution problems can be overcome by using market mechanisms to reduce pollution rather than rigid rules and regulations. However, on the other hand man should identify and gear up his own potential to curb down pollution. Man could achieve this by identifying his own role at individual level in prevention of pollution. This is possible through environmental awareness, education and enlightenment.

Ways and means by which pollution problems can be greatly reduced at individual level are:

1. Masses at personal level should determine to consume optimum level of resources, which would lead a comfortable life. Because excessive resource consumption is in someway related to pollution problems and hazards (natural and anthropogenic both).
2. Waste disposal at personal level should be optimally reduced as waste destruction by any means causes pollution.
3. Maintenance of vehicles should remain proper as to avoid introduction of harmful gases and other pollutants in to the atmosphere.
4. Generators and other household gadgets that add to pollution of environment should be kept well maintained.
5. Use of chemical fertilizers should be limited as to avoid water pollution e.g. DDT
6. Timely disposal of waste to prevent decomposition of household refuge as to check foul odours and spread of disease by insects, flies and other pathogenic bacteria.
7. Industrialists should check for proper disposal of treated water from factory units as to avoid thermal pollution of water bodies. They should also deploy a water treatment plant to prevent the flow of hazardous material.
8. Service centres of vehicles should minimize the disposal of organic solvents into the main drains.
9. Music lovers should listen and operate their music systems at optimum levels as to avoid noise pollution.

Disaster Management

Loss of life and property due to natural disasters like tropical cyclones, floods, droughts, tornadoes, earthquakes, volcanic eruptions etc, is very large. Fortunately warning facilities are available today and by mitigation measures, loss of lives and properties can be minimized. National Meteorological Services of the world to provide warnings to the public for some of the weather related natural disasters. It is not possible to forecast a long period ahead precisely when and where a dangerous natural phenomenon will take place. While natural disasters cannot be prevented, taking proper long-term and short-term disaster mitigation measures can minimize the loss of life and property.

Some common disasters known to occur in our country are as under:

Floods

Floods are defined as a relatively high flow of water discharged from river and stream network, which sets the riverbank margins to overflow and lead to the inundation of low land areas surrounding the riverbed. It is essentially a physical phenomenon. Floods arise from abnormally heavy rains, dam failures, snow melts, river blockages. Flood disasters rank second only to droughts in the total number of people affected worldwide.

Types of Floods

Floods can be classified into three categories as under:

(*i) River floods*

Rivers get charged due to heavy rains over large catchments areas or by melting of snow or sometimes both especially in the mountainous tracts. The floods take place in river systems with tributaries that may drain into large geographic areas and encompass many independent river basins. Amount of flooding depends on moisture in the soil, vegetation cover, and depth of snow and size of catchments basin.

(*ii) Coastal floods*

Coastal flooding is associated with tropical cyclones/ harsh winds arising at the ocean surface. Coastal floods are often aggravated by wind induced storm surges along the coastline. Sea and ocean ‘water floods the inland coasts affecting kilometers of tracts. Ocean tides, storm surges or tsunamis play a definite role. Prolonged and indefinite rains in the rainy season marked from June-September results in extreme flood in coastal river basins.

(*iii) Flash floods*

These floods occur within six’ hours of the beginning of rainfall and; are characterized with rising clouds, thunderstorms and tropical cyclones. These result from runoff from a torrential downpour, particularly if the catchments slope is unable to absorb and hold a significant part of water. Other causes of flash floods include dam failure, sudden break up of glaciers etc. These offer potential threats in the areas where the terrain is steep, surface runoff is high, water flows through canyons and where severe rainstorms are likely.

General Characteristics of Floods

1. Man made structures and forest vegetation exhibits different levels of tolerance towards effects of floods.

2. Intensity of damage is governed by the time interval of standing floodwaters.
3. High velocity of running water may uproot or weaken foundations of buildings.
4. Rate of rise and discharge of a river is important as a basis for flood control.
5. Frequency of occurrence estimated over a length of period would determine the kind of activities the flood plain should be put to.
6. Generally the rainy season is characterized by the floods during which agricultural economy suffers a huge loss.

Effects of Floods

1. Rising water, erosion and the force damages the residential and commercial building. They are dangerous for villages lying in the coastal areas as it sweeps away everything, which comes into its path. In mountainous areas it is the chief cause of landslides.
2. Fisherman, local people, cattle, animals and vegetation suffer a great loss of life and property. Most of the deaths are reported to be from drowning.
3. Fresh water supplies by all sources are nearly destroyed and contaminated hence the areas falling under its impact bear a great risk of suffering from water borne diseases.
4. The destruction of food and fodder crops result in acute food shortage.
5. Floods also make soil infertile, as the topsoil is lost due to erosional activity.
6. Floods are also known to preserve, wetlands and recharge ground water.

Flood Control

1. Depth and width of the riverbed could be increased as its capacity to carry larger loads increases manifold and thus reduce the area of the flood plain.
2. A network of canals can be established from the river systems, which generally leads to floods. This would also benefit the agricultural economy/ section. Care must be taken in the design and construction because of the possible environmental impact and necessary safety features.
3. Reservoirs should be made for storing floodwater and releasing them at manageable rates. This would require careful engineering. Dams, and reservoirs would further lead to generation of resources.
4. Newly constructed residential as well commercial buildings should have foundations, which are strong enough to respond to flood conditions.
5. Rivers and streambeds should be stabilized with stone, masonry or vegetation at the banks. This should strictly be followed where rivers pass through cities, specially near bridges.

Post Disaster Requirements

The initial response to flooding authorities/community should include:

Search and Rescue operations,	water provision,
Medical assistance, Disaster	epidemiological surveillance assessment, food and and temporary shelter.

The secondary response should include:

Reconstruction of houses, Creation of employment, Assistance to farmers, Distribution of farm equipment and tools, supply of animals, and assist with recovery of small business and fisheries.

Flood Problem In India

The nature of flood problem varies from one river system to another. Two great river systems are discussed below considering the flood problems in India:

Brahmputra River

The main problem of flooding in the northeastern region arises from the Brahmaputra river and its tributaries. The river in monsoon season overflows its banks and causes a great damage to life and property both. Several times it has affected Kaziranga wildlife sanctuary where rhinoceros population died due to rising floods. In recent years, the erosion along the banks of the Brahmputra has assumed serious proportions. The rivers also carry considerable amount of silt and have a tendency to change its course.

Ganga River System

In this region the northern tributaries of the Ganga, namely the Rapti, the Sharada, the Ghaghra and the Gandak cause extensive flooding along their banks. Drainage congestion is confined to the northwestern parts of U.P., Meerut, Mathura and Agra suffers the most. Bihar suffers a considerable amount of damage due to the flooding of the Burhi Gandak, the Baghirati, the Kamla Balan, the Kosi and the Mahananda. In addition to the crop submergence the area experiences traffic dislocation also. In the Bengal region Baghirati, the Ajoy and the Damodar cause extensive flooding. Here the tidal effect of Bay of Bengal also plays a role in flooding. In Delhi and Haryana it is the Yamuna, the biggest tributary of the Ganga, which causes a marginal amount of flooding. Most of these flooding regions suffer from inadequate channel capacity as well as regulation of river water flow in these channels.

Earthquakes and Seismology

An earthquake is a major demonstration of the power of the tectonic forces caused by endogenetic thermal conditions of the interior of the earth. An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking buildings apart and causing gaping fissures to open in the ground. The Richter scale devised by Charles F. Richter in 1935 measures the magnitude or intensity of energy released by an earthquake. Good Friday Earthquake of March 27, 1964 in Alaska (USA) measuring 8.4 to 8.6 on Richter scale is among the greatest earthquakes of the world ever recorded.

The science that studies the behaviour and patterns of seismic waves is called seismology. The place of origin of an earthquake is called focus, which is always hidden inside the earth, but its depth varies from place to place. The place of the origin of an earthquake is called 'focus' which is always hidden inside the earth. The deepest earthquake may have its focus at a depth of even 700 km below the ground surface. Major Himalayan earthquakes, such as the Bihar-Nepal earth quake of August 2, 1988, have their focus around 20-30 km deep. The place on the ground surface, which is perpendicular to the buried 'focus' or 'hypocenter', recording the seismic waves for the first time is called 'epicenter'. The waves generated by an earthquake are called 'seismic waves' which are recorded by an instrument called seismograph. The lines joining the places of equal intensity of seismic waves on the maps are called is oseismallines.

Causes of Earthquakes

Earthquakes are caused mainly due to disequilibria in any part of the crust of the earth. A number of causes have been assigned to cause disequilibria in the earth's crust such as volcanic eruptions, faulting and folding, gaseous expansion and contraction inside the earth, hydrostatic pressure of man-made water bodies like reservoirs and lakes, and plate movements.

(1) Vulcan City

Volcanic activity is considered to be one of the major causes of earthquakes. Vulcan city and seismic events are so intimately related to each other that they become cause and effect for each other. Earthquakes follow each volcanic eruption and many of the severe earthquakes cause volcanic eruptions. The explosive violent gases during the process of Vulcan city try to escape upward and hence they push the crystal surface from below with great force and thus is' caused severe earth tremors of high magnitude.

(2) Faulting and Elastic Rebound Theory

The horizontal and vertical movements caused by end genetic forces result in the formation of faults and folds which in turn cause isocratic disequilibria in the crystal rocks which ultimately causes earthquakes of varying magnitudes depending on the nature and magnitude of dislocation of rock blocks caused by faulting and folding. The 1950 earthquake of Assam was believed to have been caused due to disequilibria in crystal rocks;

(3) Hydrostatic Pressure and Anthropogenic Causes

Certain human activities such as pumping of ground water and oil, deep underground mining, blasting of rocks by dynamites for constructional purposes, nuclear explosion, storage of huge volume of water in big reservoirs etc. also cause earth tremors of serious consequences. The introduction of additional load through the construction of large dams and impounding of enormous volume of water in big reservoirs behind the dams cause disequilibria of adjusted rocks below the reservoirs.

(4) Plate Tectonic Theory

The earth is composed of solid and moving plates having either continental crust or oceanic crust or even both continental oceanic crusts. The earth's crust consists of 6 major plates (Eurasian plate, American plate, African plate, Indian plate, Pacific plate and Antarctic plate) and 20 minor plates. These plates are constantly moving in relation to each other due to thermal convective currents originating deep within the earth. All sorts of disequilibria are caused due to different types of plate motions and consequently earthquakes of varying magnitudes are caused.

CLASSIFICATION OF EARTHQUAKES

Each earthquake differs from the other and thus it becomes difficult to classify all the earthquakes into certain categories.

(1) Classification on the Basis of Causative Factors

(A) Natural Earthquakes are those, which are caused by natural processes i.e. due to end genetic forces. These are further divided into four subcategories.

(*i*) **Volcanic Earthquakes** are caused due to volcanic eruptions of explosive and fissure types and are confined to volcanic areas. Severe earthquake caused by violent explosions of Etna volcano in 1968.

(*ii*) **Tectonic Earthquakes** are caused due to dislocation of rock blocks during faulting activity. Such earthquake is very severe and disastrous i.e. 1906 earthquake of California (USA).

(*iii*) **Isostatic Earthquakes** are triggered due to sudden disturbance in the Isostatic balance at regional scale due to imbalance in the geological processes.

(*iv*) **Plutonic Earthquakes** are in fact, deep focus earthquakes, which occur at greater depths.

(B) Anthropogenic Earthquakes are caused by human activities such as pumping of water and mineral oil from underground aquifers. and oil reserves respectively, deep underground mining, blasting of rocks by dynamites for constructional purposes *e.g.* Koyna earthquake of Maharashtra of 1967 due to Koyna reservoir etc.

(2) Classification on the basis of Focus

On the basis of the depths of their foci these have been divided into 3 types.

(*i*) **Moderate Earthquake:** Foci are located at the depths between 0-50 km.

(*ii*) **Intermediate Earthquake:** Foci at the depths between 50-250 km.

(*iii*) **Deep Focus Earthquake:** Foci at the depths between 250-700 km.

Classification on the basis of Human casualties

(*i*) **Moderately Hazardous Earthquakes:** If deaths of human range below 50,000 due to seismic tremors e.g. Tabas earthquake of Iran 1978 A.D. (death toll 25,000).

(*ii*) **Highly Hazardous Earthquakes:** If deaths of human range between 51,000-1,00,000 due to seismic tremors e.g. in 1935, Quetta, Baluchistan, (death toll 60,000).

(*iii*) **Most Hazardous Earthquakes:** If deaths of human casualties are above 1,00,000 mark e.g., in 1976 Tang-Shan, China (death toll 7,50,000).

World Distribution of Earthquakes

Earthquakes are, in fact associated with the weaker and are statically distributed areas of the world. Most of the world earthquakes occur in the zones of young folded mountains, the zones of faulting and fracturing, the junction of continental and oceanic margins, the zones of active volcanoes and along the different plate boundaries. The world map of the distribution of earthquakes prepared by seismologists show the occurrence of earthquakes along the following belts.

(*i*) **Circum-Pacific Belt:** surrounding the Pacific Ocean.

(*ii*) **Mid-Continental Belt:** representing epicenters located along the Alpine-Himalayan Chains of Eurasia and northern Africa and epicenters of East African Fault zones.

(*iii*) **Mid Atlantic Belt:** representing the earthquakes located along the mid-Atlantic Ridge-and its offshoots.

Effects of Earthquake hazardous

Earthquakes and their hazards are determined on the basis of the magnitude of seismic intensity as determined by Richter scale but are decided in the basis of quantum of damages done by a specific earthquake to human lives and property.

(i) Landslides

Weaker landmasses and tectonically sensitive land margins cause landslides and debris falls, which damage settlements and transport systems on the lower slope segments.

(ii) Damage to Life and property

Structures such as buildings, roads, rails, factories, dams, bridges suffer a huge damage thus causing a heavy loss of human life and property both. The vibrations of earthquakes last longer and the amplitudes of seismic waves are greater artificially in filled and leveled depressions, swamp deposits etc. than in the structures of consolidated materials and bedrocks. Two major earthquakes of Bihar-Nepal border in 1934 and 1988 explain the impact of earthquake disasters on human structures and human lives. The damage caused by the Bihar earthquake of 15 January 1934, measuring 8.4 on Richter scale, include 10,700 human deaths, landslides and slumping in an area of 250 km length and 60 km width, ruptures and faults in the ground surface etc.

(iii) Damages to Government Infrastructure

Cities and towns are worst affected due to large concentration of human population, commercial complexes and residential areas. Due to collapse of large buildings there is greater loss of life and property. Due to collapse of buildings ground water pipes are bent and damaged thus water supply is disrupted, electric and telephone poles are uprooted and there is total disruption of power and communication. Other side effects are collapsed sewer system causing epidemics, roadblocks etc.

(iv) Fire Hazard

Earthquakes strongly shake the buildings and thus strong oscillations cause severe fires in houses, mines and factories because of overturning of cooking gas cylinders, contact of live electric wires, churning of blast furnaces, displacement of other electric and fire-related appliances.

(v) Landmass Deformation

Severe earth tremors and resultant, vibrations caused by severe earthquakes result in the deformation of ground surface because of crusts and troughs in the ground surface and faulting activity.

(vi) Flash Floods

Strong seismic events result in the damages of dams and cause severe flash floods. Severe floods are also caused because of blocking of water flow of rivers due to rock blocks and debris produced by severe tremors on the hill slopes facing the river valleys.

(vii) Tsunamis

The seismic waves, caused by the earthquakes traveling through seawater, generate high sea waves and cause great loss of life and property. Since the pacific Ocean is girdled by the earthquakes and volcanoes tsunamis are more common in the pacific with a minimum frequency of 2 tsunamis per year.

A CASE STUDY

U.P. Earthquake of 1991

A severe earthquake occurred in Garhwal region of Uttar Pradesh on 20th Oct. 1991. Intensive tremors were felt at 2.53 a.m., which lasted for about 45 seconds. The magnitude of earthquake was measured 6.6 on Richter scale and its epicenter was at Angola, a place near Uttarkashi, Mild tremors are a regular feature of the area. The worst affected areas have been in the district of Uttarkashi, Tehri Garhwal and Chamoli while it also caused sizeable damage in the districts of Dehradun, Pauri Garhwal and Nainital. The roads and bridges are the chief means of communication in hill region, which underwent heavy damage. The economy of such places is based on tourism to a great extent, which suffered a great set back. The overhead drinking tanks and pipelines had developed cracks. Sources of drinking water had been damaged. The earthquake caused intensive damage to the building of various government departments, Forest, Home, Finance and Rural Development.

Cyclones

Cyclones are the centers of low pressure surrounded by closed isobars having increasing pressure outward and closed air circulation from outside towards the central low pressure in such a way that air blows inward in anticlockwise on northern hemisphere and clockwise in southern hemisphere. They range in shape from circular, elliptical to V shape. From locational viewpoint cyclones are classified into two principal types e.g. i) extra-tropical cyclones/temperate cyclones ii) tropical cyclones.

(I) Temperate Cyclones

Temperate cyclones are atmospheric disturbances having low pressure in the centers produced in the middle latitudes characterized by converging and rising air, cloudiness and precipitation. They are formed in the regions extending between 350- 65" latitudes in both hemispheres due to convergence of two contrasting air masses e.g. After their formation temperate cyclones move in easterly direction under the influence of westerly winds and control the weather conditions in the middle latitudes.

(i) Shape, Size and Speed

Temperate cyclones are of different shapes e.g. circular, semi-circular, elliptical, elongated or V, but all of them are characterized by low pressure in their centres and closed isobars. The pressure difference between the centre and periphery is about 10-35 mb. It means that pressure increases from the centre towards outer margin. Average large diameter of an ideal cyclone is about t 900 km while short diameter measures t 000 km. The temperate cyclones move eastward under the influence of westerly winds with average velocity of 32 km per hour in summer and 48 km per hour in winters.

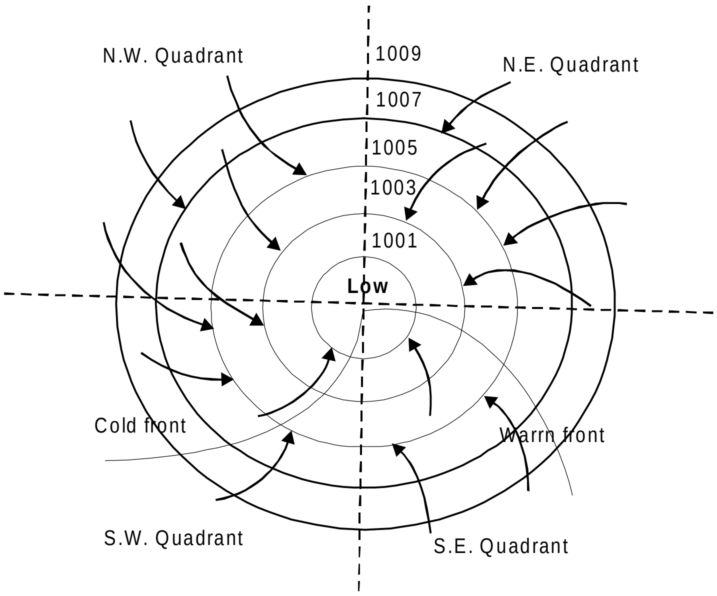


Figure 5.1: A generalized temperate cyclone in northern hemisphere.

(ii) Wind Systems

Since there is low pressure in the centre of temperate cyclone and air pressure increases outward and hence winds blow from the periphery towards the centre but these winds do not reach the centre straight rather they cut the isobars at the angle of 20° to 400 due to friction and Coriolis force and thus wind direction becomes anticlockwise in the northern hemisphere and clockwise in the southern hemisphere. Since temperate cyclones are formed due to convergence of two contrasting air masses and hence it is natural that there are variations in the nature and direction of winds in different parts of the cyclones.

(iii) Temperature

Different temperatures are noted in different parts of temperate cyclones because of their origin due to convergence of two thermally contrasting air masses. The southern part of cyclone records higher temperature because of the dominance of warm air while the north-eastern, northern and north-western parts record low temperature because of the dominance of cold polar air mass. The western part records lowest temperature.

(iv) Source Regions and Tracks of Movement

The areas frequented by temperate cyclones mostly lie in the middle and high latitudes extending between 350-650 latitudes in both the hemispheres. These cyclones move, on an average, in easterly direction. (1) Cyclones after originating in the north Pacific off the north-east and eastern coasts of Asia move in easterly and north-easterly direction towards the Gulf of Alaska and ultimately merge with Aleutian Lows from where they follow southerly direction and reach as far south as southern California. The cyclones moving inland dissipate and are occluded at the windward western slopes of the Rocky Mountains.

(v) Origin of Temperate Cyclones

Though the formation and development of temperate cyclones is a quick process but it passes through a series of successive stages. The period of a cyclone from its inception (cyclogenesis) to its termination (proteolysis or occlusion) is called the 'life cycle of cyclone'; which is completed through six successive stages.

(*a*) **The first stage** involves the convergence of two air masses of contrasting physical properties and directions. Initially, the air mass (warm and cold) move parallel to each other and a stationary front is formed. This is called initial stage.

(*b*) **The second stage** is also called as 'incipient stage', during which the warm and cold air masses penetrate into the territories of each other and thus a wave-like front is formed.

(*c*) **Third stage:** This is the mature stage when the cyclone is fully developed and isobars become almost circular.

(*d*) **Fourth stage:** Warm sector is narrowed in extent due to the advancement of cold front than warm front, as cold front comes nearer to warm front.

(*e*) **Fifth stage:** Starts with the occlusion of cyclone when the advancing cold front finally overtakes the warm front and an occluded front is formed.

(*f*) **Sixth stage:** Warm sector completely disappears, occluded front is eliminated and ultimately cyclone dies' out.

(II) Tropical Cyclones

(*i*) *General Characteristics*

Cyclones developed in the regions lying between the tropics of Capricorn and Cancer are called Tropical Cyclones which are not regular and uniform like extra tropical or temperate cyclones. There are numerous forms of these cyclones, which vary considerably in shape, size, velocity and weather conditions. The weather conditions of low latitudes mainly rainfall regimes are largely controlled by Tropical Cyclones.

(*a*) Size of tropical cyclones varies considerably. On an average their diameters range between 80 km and 300 km.

(*b*) Weak cyclones move at the speed of about 32 km per hour while hurricanes attain the velocity of 180 km per hour or more.

(*c*) Tropical cyclones become more vigorous over the oceans but become weak and feeble while moving over land areas. This is why these cyclones affect only the coastal areas e.g. Tamil Nadu, Orissa and West Bengal coasts of India.

(*d*) The centre of the cyclone is characterized by extremely low pressure.

(*e*) Tropical cyclones are not characterized by temperature variations in their different parts because they do not have different fronts.

(*f*) There are no different rainfall cells hence each part of the cyclones yields rainfall.

(*g*) Tropical cyclones are not always mobile. Normally, they move from east to west under the influence of trade winds

(*h*) Tropical cyclones are confined to a particular period of the year (summer season).

(*ii*) *Types of Tropical Cyclones*

Generally they are divided into 4 major types:

(*a*) Tropical disturbances or easterly waves

(*b*) Tropical depressions

(*c*) Tropical storms

(*d*) Hurricanes or typhoons

(iii) Origin of Tropical Cyclones

On an average, tropical cyclones are formed due to development of low pressure of thermal origin. They develop when the following requirements are fulfilled:

(*a*) There should be continuous supply of abundant warm and moist air. Tropical cyclones originate over warm oceans having surface temperature of 27°C.

(*b*) Higher value of Coriolis force is required for the origin of these cyclones.

(*c*) They are associated with inter-tropical convergence (lTC), which extends from 50 -300N latitudes during summer season.

(*d*) There should be anti-cyclonic circulation at the height of 9000 to 15000 m above the surface disturbance.

(iv) Distribution of Tropical Cyclones

There are 6 major regions of the tropical cyclones e.g. (1) West Indies, Gulf of Mexico, and Caribbean Sea. (2) Western North Pacific Ocean including Philippines, Islands, China Sea, and Japanese Islands. (3) Arabian Sea and Bay of Bengal. (4) Eastern Pacific coastal region off Mexico and Central America. (5) South Indian Ocean of Madagascar (Malagasi), and (6) Western South Pacific Ocean, in the region of Samoa and Fiji Island and the east and north coasts of Australia.

(v) Environmental Impact of Tropical Cyclones

Tropical cyclones are very severe disastrous natural hazards which inflict heavy loss to human lives and property in terms of destruction of buildings, transport systems, water and power supply systems, disruption of communication system, destruction of standing agricultural crops, domestic and wild animals, natural vegetation, private and public institutions etc. Through damages caused by high velocity winds, floods and storm surges.

ANTICYCLONES

General Characteristics

Surrounded by circular isobars anticyclone is such a wind system which has highest air pressure at the centre and lowest at the outer margin and winds blow from the centre outward in clockwise direction in the northern hemisphere and anticlockwise in the southern hemisphere fig.13. Thus, anticyclones are high-pressure systems and more common in the subtropical high pressure belts but are practically absent in the equatorial regions. Anticyclones were classified into (*i*) **warm anticyclones**, and (*ii*) **cold anticyclones** by Hanzilk in 1909.

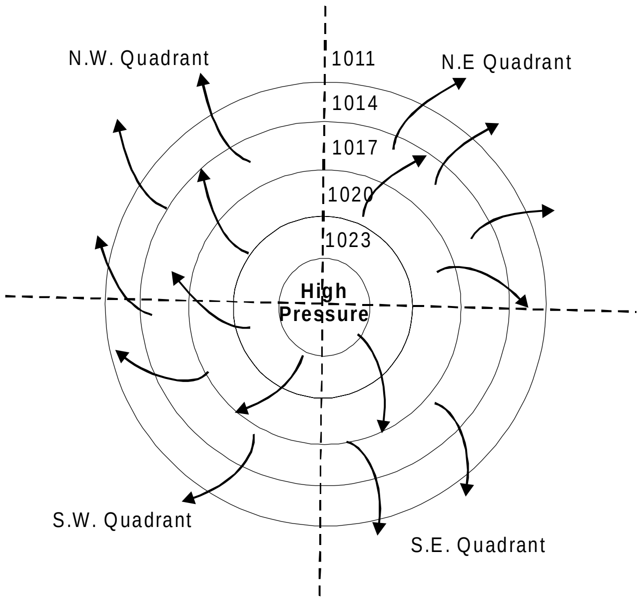


Figure 5.2: Generalized representation of air pressure and wind system in an anticyclone.

They are characterized by the following properties.

(1) They are usually circular in shape. The difference of pressure between the centre and periphery of anticyclone ranges between 10-20 mb.

(2) They are much larger in size and area than temperate cyclones.

(3) Anticyclones follow cyclones. They move very sluggishly. The average velocity of anticyclones is 30-50 km per hour.

(4) Winds descend from above at the centre and thus weather becomes clear and rain less because the descending winds cause atmospheric stability.

(5) Temperature in anticyclones depends on weather, nature of air mass and humidity in the air.

(6) Anticyclones do not have fronts.

1. Wind Systems and Temperature

Wind system is not fully developed in anticyclones because of weak pressure gradient. On an average, wind circulation is of divergent system wherein winds spread in all directions from high-pressure centre to low-pressure periphery. The winds are very much sluggish in the rear portion in comparison to the front portion. The centre is characterized by light breeze.

These arise due to the descent of either polar cold air mass or warm tropical air mass. Cold anticyclones are associated with extremely low temperature and they cause cold waves during winter season but when they come in summer season, weather becomes pleasant.

2. Shapes and Size

Anticyclones are generally of circular shape but are very large in size. They become so large in size that their diameters become 9,000 km.

3. Weather Conditions

Generally, anticyclones are rainless and sky is free of clouds because of the fact that descending air in the centre of anticyclone is warmed up at dry adiabatic rate due to subsidence. This causes rise in temperature, which reduces normal lapse rate of temperature, with the result the stability of air increases resulting into marked increase in the aridity of air. This is why anticyclones are indicative of dry weather.

4. Landslides

Among physiographic units, the two northern units of the Greater Himalayas (7500-8500m), and the Inner Himalayas (Trans-Himalayan zone), an intervening system of high plateau and valleys lying between the two great mountain ranges, are considered along with middle mountains, the traditional centres of population. The upper northern section of these middle mountains remains largely' under upper montane forest (2900-4000 m), below which is the belt of intensive agriculture. Lithology is highly varied, including sedimentary, metamorphism, and granites. However, there are extensive areas of phyllites and schists; these are deeply weathered and the prevailing steep slopes render them highly susceptible to erosion and slope failure (mostly through landslides). Presently, according to gross yet reliable estimate, the landslides occupy about 1% of land surface in only five central districts of Himachal Pradesh. They have a total volume of more than 2.2 x 106 m^3 and a mean age of 6.5 years. This helps to evaluate the denudation rate, which is about 12 mm/year (all erosive processes). Landslides have about 2.5-mm/ year denudation rates. One of the main causes of landslides is road construction.

Suggestions

Various studies indicate that for each linear kilometer of mountain road, 10 small to medium landslides occur. Prior to the 1962 border war with China, the Himalayan section in India was in most parts accessible only on foot. The shock of the Chinese military presence, the three India-Pakistan wars of 1947, 1965, and 1971, the continued border tensions (especially along the Kashmir ceasefire line), and several other problems led to accelerated construction of up to 10,000 km of highways and connecting roads. The poor alignment and ill-considered design are causing a total soil loss of 0.199 t of sediment per linear meter of road per annum. Valdiya (1973) indicated that during the construction phase an average kilometer of road requires the removal of 40,000-80,000 m^3 of debris. These enormous volumes are dumped on the roadsides and damage ecologically fragile slopes by depriving them of natural vegetation and at times destroy the terraces.

QUESTIONS

1. Write the definition of pollution in your own words and also explain the causes of pollution.
2. Explain the types of pollution. Write the precautions to minimize the pollutions (air, water, social, marine, noise).
3. What is social water management? Explain.
4. Explain the role of an individual in prevention of pollution and how it is possible?
5. How we can conduct the pollution case study in a particular area and also explain the disaster management?

CHAPTER 6

Environmental Science : Social Issues

Introduction

The term sustainable was development and introduced by the World Commission on Environment and Development (The Brundtland Commission), in its seminal report of 1987, Our Common Future. The concept has terrifically worked out in creating public awareness for sustaining the planet with better management. The sustainable development has been defined as "meeting the need of the present generation without compromising the needs of future generation". The concept precisely emphasizes upon using the earth resources judiciously and compensating for it in some sense e.g. if cut few trees to support our lives, we should also implant some new ones at some site. This would result in. maintaining the earths fine balance between resource consumption and resource generation.

In understanding this concept we very often encounter two terms- sustainable and development. These are summarized below as:

Sustainable

The literal meaning of sustainability is "that can be maintained" or "keep goal continuously". In ecological sense it refers to "conservation of ecological balance by avoiding depletion of natural resources". Hence, we can understand it as something, which has got to do with longevity (long life) of a resource, commodity, species, ecosystem, earth etc.

Development

The literal meaning of development is "the act or instance of growth/advancement". So the growth can be of many types viz., growth of education, growth of industry, growth of population, growth of forests and many other. But what type of growth are we addressing to? Here we are addressing to one of the most sensitive issue of growing concern 'about improving the well-being of human beings. This could be achieved only through compromising with some of our comforts and luxuries. The generation of comforts and luxuries brings environment under great pressure. The Nations economic growth should not stand upon the fragile foundation of earth's resources. Mahatma Gandhi a great social scientist, rightly pointed out that, “The earth provides enough to satisfy everyone’s need, but not everyone’s greed”.

In the context of economical and technical development the world always had been better today than yesteryears and will always be better tomorrow than today. But the condition of environment will always be poorer than before. Hence, the concept of sustainable development raises certain questions for the present generations to answer. What is our present? Are we happy with our present? Prospective changes of the magnitude described above raises fundamental questions about the kind of world we will bequeath to our children and about the nature and goals of development. The present in which we live is important as it shapes our future. Nothing much can be done to recover the damages imposed on nature in the past. But if we shape our surroundings based on environmental ethics and economically exploit our present environment we would lend a healthier tomorrow to our children. As we have examined some environmental issues in the previous chapters, we would commonly agree that human population growth, loss of biodiversity, habitat destruction, ozone depletion, global climate change, pollution (air, water, noise etc.) and limited food & energy supply are environmental concerns of global scale. In the past two decades a great deal of work from researchers, ecologists, environmental scientists, social scientists, geographers and demographers have build up a very clear picture of what our tomorrow would be like: Some initiatives have been taken up both at government and non-government level. Still promising environmental concern at individual level is far lacking beyond sustainable needs.

Although population growth continues to expand at an unsustainable pace but still certain countries have achieved a demographic transition to zero population growth. However, positive signs from developing nations are still absent. We have achieved breakthroughs in renewable energy sources, agro-forestry schemes and better pollution control advancements. Increased man awareness, resourcefulness and enterprise will help eliminate poverty and resource wastage and will make our environment a much better place to live in. Until environmental concerns do not find space in our heart we would never be able to delicately handle our surroundings when we are at home or public. We should recognize things at personal and collective grounds to protect nature and to create a sustainable environment.

Urban Problems Related to Energy

Big cities and towns have always influenced education, religion, commerce, communication and politics, which have in turn influenced culture and society in various proportions. Initially only a very limited section of the society lived in cities and towns while the chief occupation of major population had been fishing, hunting, agriculture and cattle rearing. However’ Industrial Revolution lead to expansion of cities and town both in size and power. In developing nations, especially a large segment of society from villages moved to cities for occupational support (occupational migration). This exactly was the cause of rapid expansion of cities’ and formation of metropolitans like Delhi, Bombay, Chennai, Bangalore, Calcutta and others. This ultimately brought into picture the concept of urbanization and industrializations, which provided many benefits to society, especially to the rich, but also introduced some evils in it. Here evils referred to were the increasing demand on energy resources; whose consumption in turn lead to multitude problems of pollution, resource shortage, diseases and waste disposal. Some of the major urban problems related to energy are as under:

(*i*) *Electricity*

Electricity from various sources is a major requirement of expanding cities, towns and villages. Each and every activity of mans life is now someway related to electricity consumption. Housing gadgets like mixer-grinder, T.V., computer, music systems, geysers, fans, lights, A.C.s, microwave, water lifting pump, warm blowers, coolers, etc. form the essential components of a house. This all together has led to an electricity energy crunch.

It is well known that some part of electricity is lost in transmission and greater part is stolen. The remainder is simply not enough to support the majority of people in the city and that's why the problem of electricity in cities is on the rise. The buildings are empowering the cities like anything but nowhere we see dams, supplying electrical units, increasing in number at the same pace. Therefore, what majority of the cities face today is a usual cut of electricity for a minimum of 6-8 hrs. This makes today's urban life handicapped. Resourceful enjoy the resource benefit from the rising generator and inverter culture, which in turn put pressure on resources and lead to pollution problems.

(*ii*) *Fossil fuels (petroleum, natural gas and coal)*

Fossil fuels have always been under a great threat from times immemorial. In the absence of technological advancements these have served mankind for several years. In this quest for energy the coal reserves have suffered a lot. With rise in technical know how man started generating power from nuclear sources, hydroelectric power, wind power etc. But still these contribute a little. We still depend on thermal power a lot.

(*a*) *Petrol and Diesel:* Transport and communication has brought the petroleum reserves of the world under a great threat. The rise in number of vehicle per year is immense. To understand the gravity of the problem a glance of metropolitan roads and lanes is enough. Even the roads and lanes of big cities, small cities and towns are loaded with two wheelers.

(*b*) *Natural Gas:* The common usage of natural gas is in the form of Liquid Petroleum Gas (LPG). There is a terrific rise in the usage of LPG driven household commodities with the expanding population. Earlier the LPG usage was only limited to kitchen for cooking. The advent of technology introduced a numerous household items making its use like gas geysers, gas heaters, gas fans, gas lanterns etc. In a way it is serving as a substitute of electricity, which is other reason for increasing pressure on oil wells/reserves.

(*c*) *Coal:* The world population has extracted and used coal reserves thinking as if it is a never-ending commodity/resource. It has served Sustainable Development,

— Urban Problems,

— Water Conservation and Management,

— Resettlement and Rehabilitation of People,

— Environmental Ethics,

— Global Warning,

— Environment Protection Act,

— Issues involved in Enforcement of Environment Legislation, Millions throughout the ages. Earlier it was primarily used to support kitchens. People also utilized it for heating stoves/ heaters in colder regions of the world. Later, its usage in the railways became the chief cause of its rapid exhaustion. Coal reserves are a limited source of energy now. It should be used judiciously and economically.

(*iii) Fuel wood*

Fuel wood being used for the ignition of fire is chiefly responsible for the destruction of impoverished forestlands. Though fuel wood collection to support family daily chores is allowed in certain parts of the forest generally the outskirts but the greed and dearth compels women to penetrate deep into the forest. Generally the big cities are characterised by the absence of forestland at the fringes. But whatever degraded forest is available serve as a source of fuel wood even in and around urban centres e.g. Dehradun is a well developed city, but in its fringes we can still see women and children carrying loads of fuel wood.

Water Conservation

We could save as much as half of the water we now use for domestic purposes without great sacrifice or serious changes in our lifestyles. Simple steps, such as taking shorter showers, stopping leaks, and washing cars, dishes, and clothes as efficiently as possible, can go a long way toward forestalling the water shortages that many authorities predict. Isn't it better to adapt to more conservative uses now when we have a choice than to be forced to do it by scarcity in the future?

Rain Water Harvesting

Water is commonly taken for granted as nature's gift. Often it is used wastefully in agriculture, but industry and people pollute and poison available water supplies at an alarming rate. Water problems arise from increasing demands generated by rapid population growth; urbanization, industrialization and irrigation for additional food production. In many areas excessive pumping of groundwater not only brings down water quality, but also depletes it this affects' sustainability. The 'capacity of irrigation tanks numbering about five lakh in the country is shrinking due to situation and encroachment. Scarcity is noticed even in high rainfall areas like Cherrapunji (Assam), Western Ghats and Kerala. This is due to improper management and poor conservation of rainwater.

India's water potential is substantial but the scarcity is felt everywhere even for drinking. This is because the country's water policy and management is not very specific and implementation is poor. Total rain in the country is about 400 M hm (million hectare meters). The runoff in the rivers is estimated at 186 M ha. Further the utilizable groundwater is calculated as 40 M hm. However, the utilizable quantity is about 110-115 M hm (70 M hm from surface and 40 M hm from groundwater). To meet the relentless increase in demand for water for various purposes and to achieve the goal of optimal use and to get the maximum benefits, it is necessary to make water resource development holistic through a comprehensive integrated river basin planning and management. This can be done only if a wide range of disciplines are involved. Wastage of water due to leakage in pipes and unattended repairs results in about 30-40 per cent water resource lost.

The landscape watershed units can be effectively subdivided into discrete hydrological units. Since the watersheds are spatially laid from ridge to valley, they most efficiently conserve land and water resources and help secure water availability throughout the growing season. The land area of the watershed drains into a common point. Hence, the drainage water can be easily stored in above -ground storage structures for recycling during droughts or for growing an additional crop. Rain fed agriculture research and development has been dominated by the concept of high yields for decades. It arose from the scientific principles developed for the 'green revolution' high input, high-output technologies. Fatigue and cracks are now developing in the green revolution areas. For rain fed agriculture, an area-based development through watershed management provides an excellent framework for sustaining semi-arid tropical ecologies. Also the landscape watershed units focus on the maintenance of managed biodiversity through diversified cropping systems. It is significant to note that a broad range of baseline information on watershed-based soil and water conservation technologies already exists. A study commissioned by the National Institute of Agricultural Extension Management, Hyderabad, showed that if the watershed technology is to succeed it must be specific to natural endowments of the location; it must be built on indigenous knowledge; it should be based on people's participation; it must be equitable in sharing of costs and benefits, and village-based institutions must be put-in-place right from inception of the project.

Watershed Management

It was suggested that, rather than allowing residential, commercial, or industrial development on flood plains, these areas should be reserved for water storage, aquifer recharge, wildlife habitat, and agriculture. Sound farming and forestry practices can reduce runoff. Retaining crop residue on fields reduces flooding, and minimizing. Ploughing and forest cutting on steep slopes protects watersheds. Wetlands conservation preserves natural water storage capacity and aquifer recharge zones. A river fed by marshes and wet meadows tend to run consistently clear and steady rather than in violent floods.

A series of small dams on tributary streams can hold backwater before it becomes a great flood. Ponds formed by these dams provide useful wildlife habitat and stock-watering facilities. They also catch soil where it could be returned to the fields. Small dams can be built with simple equipment and local labour; eliminating the need for massive construction projects and huge dams. Watershed-based frame for rain fed agriculture provides uncommon opportunities for achieving sustainable food and nutritional security. It is time that the watershed development agenda is considered a programme for-the masses.

Resettlement and Rehabilitation of People

"Land for land" is a better policy than cash settlement. Even in implementing this policy, the land is not given in the command area in most cases, forestland is either cleared on waste fallow land given without any provision for developing the land or for the supply of necessary inputs; a village is broken up and families dispersed; villagers are usually left to buy private land, take loans from the government, which puts poor villagers at a disadvantage- land prices in neighboring villages shoot up steeply if the government takes up resettlement; the villagers are resettled in distant places, sometimes in a totally alien environment and culture, thus creating insurmountable adjustment problems. Oustees from Pong dam in Himachal Pradesh were settled in Anupgarh in Rajasthan, bordering on Pakistan. The people were generally left to fend for themselves. Arrangements for drinking water, dispensaries, schools, village roads or drainage of the rehabilitation sites are only completed years later. In the case of the Ukai Dam in Gujarat, resettlement work was undertaken by the 'Ukai Nav Nirman Samity. Even so, out of a total of 18,500 affected families, only 3500 families could be resettled.

People who could previously barely manage to survive in their traditional environment are uprooted as a result. The objectives of rehabilitation should be:

1. The people displaced should get an appropriate share in the fruits of development.
2. Creating new settlements with their own environment should rehabilitate them.
3. Removal of poverty should also be an objective of the rehabilitation policy and therefore some land to all.
4. Oustees (even the landless) should be given assurance of employment.
5. While dealing with tribal one should also keep in mind the following five principles of tribal-development accepted during Jawaharlal Nehru's era as 'tribal panchsheel.'
6. Tribal should develop along the lines of their own genius and we should avoid imposing anything on them.
7. We should try to encourage their own traditional arts and culture in every way.
8. Resettlement should be in the neighborhood of their own environment. If resettlement is not possible in the command area, top priority should be given to the development of irrigation facilities and supply of basic inputs for agriculture; drinking water, wells, grazing grounds for cattle schools for the children, primary health care units and other amenities should be arranged.
9. In partly affected village, villagers should be given the option of shifting out with others with the same compensation as available to evacuees.
10. Training facilities should be set up to upgrade the skills of affected people and reservation in jobs should be made for the willing adults among the evacuees.
11. Special attention should be given to the rehabilitation of artisans and village crafts people.
12. Villagers should be taken into confidence at every stage or implementation and they should be educated, through open meetings and discussion about the legalities of the Land Acquisition Act and other rehabilitation provisions.
13. The aid of voluntary agencies planning and implementation programme.

Rehabilitation Problem

Involuntary displacement of human population is always traumatic. Irrespective of the causes leading to such migrations the degree of suffering experienced by such people simply cannot be quantified in money values, and even in words it can be described only inadequately. But, unfortunately, ousting of people likely to be submerged under irrigation or hydel power dams is a classic case where hardships are imposed on people in spite of the 'pro-people' laws and policies proclaimed by the Government. Below is a critique of the Tehri Dam Rehabilitation.

Compensatory Land

The project authorities commenced the Scheme by allocating 2767 acre of land in the Dehra Dun area, which was already reeling under severe pressure from tourism, limestone quarrying and urban expansion.

Rehabilitation should be collective

In the villages, almost each' family depends on the other. The social and moral obligations towards each other bind them into one cohesive whole. The authorities are rehabilitating individual families and not the village as a whole.

Monetary Compensation

Mere payment of cash is not rehabilitation. Moreover, the amount of cash paid as compensation is insufficient to buy land in other places because of the high rates. The oustees being basically farmers lack the business acumen needed to set up a viable commercial alternative. Since they are not accustomed to having such large sums (relative to their usually small incomes) in a lump sum, they are ignorant as to how they should spend it.

Mismanagement

The project authorities estimated the total affected population in 1981 as 46,000. Using the Census Office figures, the total number affected for 1981 is act 70,000.

Lack of Public Relations

The majority of populace to be displaced consists of *advises,* tribal, scheduled castes that have a unique lifestyle. The traumatic experience of shifting to new areas and new occupations involving drastic changes in their lifestyle weighs heavily on these people. The absence of any public relation efforts has further aggravated the situation.

Housing compensation: It is necessary to highlight a major flaw in the procedure for fixed immovable property like houses, well, barns fence, cattle-stalls, etc. The present procedure evaluates the "current worth" or "value after depreciation" for determining the amount of compensation. This concept is faulty. He should be paid an amount for his house etc., equivalent to the cost of reconstructing a dwelling place equal to the plinth area lost under submergence. This amount (*i.e.*, replacement cost) will obviously be more than the "current worth" of his old dwelling.

Environmental Ethics

The Earth is unique among all the planets in our solar system. It is endowed with plentiful resources. Man's greed to raise his standard of living compels him control and tap natural resources. Many. rivers throughout the world have been "controlled" to provide power, irrigation, and navigation for the people at the expense of the natural world. If such gifts of nature are not tapped for resource generation, many people think it to be wastage of resources. The capitalists want to use the forests for timber production and not doing so is closely linked to economical hardships. Removing the trees would destroy something that took hundreds of years to develop and may never be replaced. Efforts to manage the interactions between people and their environment are an age-old practice. At one time, pollution was a local, temporary event, but today, pollution problems have crossed international borders and have become global. The seminars over chemical and radioactive waste disposal witness the increasingly international nature of pollution.

Ethical issues dealing with the environment are no different from other kinds of problems. The concept of an environmental ethics could encompass differing principles and beliefs. Ethics is one branch of philosophy, which fundamentally attempts to define what is right, and what is wrong, regardless of cultural differences. Environmental ethics are formulated on the basis that human beings are also a part of nature and nature has many interdependent components. In any natural ecosystem, the well being of the individual and of each species is linked to the well being of the entire community. In a world increasingly without environmental borders, nations, like individuals, should have a fundamental ethical responsibility to respect nature and to care for the Earth, protecting its life-support systems, biodiversity, and beauty, caring for the needs of other countries and future generations. Environmental ethicists argue that to consider environmental protection as a "right" of the planet is a natural extension of concepts of human rights.

Although there are many different attitudes about the environment. Three types of the ethics are identified as (*a*) the development ethic, (*b*) the preservation ethic, and (c) the conservation ethic. Each of these ethical positions has its own appropriate code of conduct against which ecological mortality may be measured.

The **development ethic** is based 011 actions. Development in any sector is inevitable. . But the development should not crop up at the cost of environmental failure. This philosophy is strengthened by the idea that, "if it can be done, it should be done."

The **preservation ethic** considers nature special in itself. Some preservationists have an almost religious outlook regarding nature. They believe that nature is beautiful place to live in and it should be maintained for feeding, breeding, enjoyment and peace. On the other hand scientific outlook argue that the human species depends on and has much to learn from nature. Rare and endangered species and ecosystems, as well as the more common ones, must be preserved because of their known or assumed long-range, practical utility.

The third environmental ethic is referred to as the **conservation ethic**, It recognizes the desirability of decent living standards, but it works towards a balance of resource use and resource availability.

Economic growth and **resource exploitation** are attitudes shared by developing societies. As a society, we continue to consume natural resources as if the supplies were never ending. All of this is reflected in our increasingly unstable relationship with the environment, which grows out of our tendency to take from the "common good" without regard for the future.

Industrial Environmental Ethics

Industries are harmful to the health of environment and hence at large are considered as nuisance. When raw materials are processed, some waste is inevitable e.g. paper industry leads to a lot of wastage and pollution of water. It is usually not possible to completely control the dispersal of all by-products of a manufacturing process. Also, some of the waste material may simply be useless. Ethics are involved, however, when an industrialist compromise upon the quality of a product or waste disposal to maximize profit. It is cheaper to dump wastes into a river than to install a wastewater treatment facility. At its core, environmental justice means fairness. It speaks to the impartiality that should guide the application of laws designed to protect the health of human beings and the productivity of ecological systems on which all human activity, economic activity included, depends.

Environmental Ethics at Individual level

As human populations and economic activity continue to grow, we are facing a number of environmental problems that threaten not only human health and the productivity of ecosystems, but in some cases the very habitability of the globe. We have to recognize that each of us is individually responsible for the quality of the environment we live in and that our personal actions affect environmental quality, for better or worse. Our environmental ethics must begin to express itself not only in national laws, but also in subtle but profound changes in the ways we all live our daily lives. It appears that many individuals want the environment cleaned up, but they do not want to make major life-style changes to make that happen.

Global Environmental Ethics

This new sense of urgency and common cause about the environment is leading to unprecedented cooperation in some areas. Ecological degradation in any nation almost inevitably impinges on the quality of life in others. For years, acid rain has been a major irritant in relations between the United States and Canada.

Conclusion

Will the nations of the world be able to put aside their political differences to work towards a global environmental course of action? Out of that international conference was born the U.N. Environment Programme a separate department of the United Nations that deals with environmental issues. Through organizations such as this nations can work together to solve common environmental problems. Deep ecologists, on the other hand, see humankind itself as the main problem. They believe that the earth is a complex organism with its own needs, metabolism; and immune system and that humankind's relationship with the earth is increasingly parasitic. In the book Deep Ecology: Living Nature. As If Nature Mattered, proponents Bill Devall and George Sessions, clearly state their principles: (1) Humans have no right to reduce the richness and diversity of life except to satisfy vital needs: (2) the quality of human life and culture is compatible with a substantial decrease in the human population; and (3) the flourishing of non-human life requires such a decrease.

To secure for current and future generations a safe and healthy environment, a sound and prosperous economy should aim at:

1. Ensure that citizens today and tomorrow have the clean air water, and land essential to sustaining human health and the environment.
2. Protect and enhance, the quality of water resources and promote the wise and efficient use of water.
3. Maintain and enhance the health and diversity of the wildlife and planets.
4. Develop an environmentally literate society.

Climate Change

Introduction

The recent interest in global warming and sustainable development has become a global talk. The most important global environmental topics as chosen by a panel of about 12 world experts were as follows: human population growth, bio-diversity and conservation, climate change, forest decline, hazardous wastes, land degradation, human pathogens, urban environment, work environment and resource depletion. Man is as closely related to nature as he is to himself, because he is a part of it. An outright dependence on nature has been a striking feature of man's progress through the centuries of his struggle.

Climate has from the very beginning regulated man in practically every aspect of life and has played a very important role in the development of civilizations all around the world. Man's impact on climate began 5000 to 9000 years ago, as he was able to alter the environment by burning and felling forest and tilling the earth. The most extensive change wrought by man prior to our own times was the gradual conversion of most of the temperate forest zone to crops that is an artificial steppe or savanna. Thus until the industrial revolution and probably until the present century, man had little effect on the climate except on a very local scale.

Presently global warming has emerged as one of the most important environmental issues ever to confront humanity. This concern arises from the fact that our everyday activities may be leading to changes in the earth's atmosphere that have the potential: to significantly alter the planet's heat and radiation balance, and thereby lead to a warmer climate in the next century and thereafter. International efforts to address this problem have been on for the last decade, with the Earth Summit at Rio in 1992 as an important launching point and the Conference of Parties in Buenos Aires. In 1998 as the most recent step. Although India as a developing country does not have any commitments or responsibilities at present for reducing the emissions of greenhouse gases such as carbon dioxide (CO_2) that lead to global warming, pressure is increasing on India and other large, rapidly developing countries such as China and Brazil to adopt a more pro-active role.

What is Climate Change?

Climate change is a newcomer to the international political and environmental agenda, having emerged as a major policy issue only in the late 1980s and thereafter. It has emerged since the 19th century that CO_2 in the atmosphere is a 'greenhouse gas', that is, its presence in the atmosphere helps to retain the incoming heat energy from the sun, thereby increasing the earth's surface temperature. Of course, CO_2 is only one of several such greenhouse gases in the atmosphere. Others include methane, nitrous oxide and water vapour. However, CO_2 is the most important greenhouse gas that is being affected by human activities. CO_2 is generated by a multitude of processes. Since the Industrial Revolution, when our usage of fossil fuels increased dramatically, the contribution of CO_2 from human activities has grown large enough to constitute a significant perturbation of the natural carbon cycle.

The concentration of CO_2 in the Earth's atmosphere was about 280 parts per million by volume (ppmv) in 1750, before the Industrial Revolution began. By 1994 it was 358 ppmv and rising by about 1.5 ppnw per year. If emissions continue at the 1994 rate, the concentration will be around 500 ppmv, nearly double the pre-industrial level, by the end of the 21st century.

Rising Concentrations

The effect is that the atmosphere retains more of the Sun's heat, warming the Earth's surface. While the pattern of future warming is very much open to debate, it is indisputable that the surface of the Earth has warmed, on average, 0.3 to 0.6 °C since the late 19th century when reliable temperature measurements began. Under the existing scenarios of economic growth and development leading to greenhouse gas emissions, on a worldwide average, temperatures would rise by 1 to 3.5 °C by the year 2100, and global mean sea level by about 15 to 95 cm. It is likely that changes of this magnitude and rapidity could pose severe problems for many natural and managed ecosystems. Indeed, for many low-lying and deltaic areas and small islands, a sea level rise of one meter could threaten complete Joss of land and extinction of habitation.

Extreme Weather Events

In addition, most of the ill effects of climate change are linked to extreme weather events, such as hot or cold spells of temperature, or wet or dry spells of rainfall, or cyclones and floods. Predictions of the nature and distributions of such events in a changed climate are even more uncertain- to the extent that virtually no authoritative predictions exist at all. While there are costs as well as benefits associated with climate change, the scientific consensus is clearly that the overall effects are likely to pose a significant burden on the global community. Unlike many other environmental issues, such as local air or water pollution, or even stratospheric ozone depletion caused by chlorofluorocarbons (CFCs), global warming poses special challenges due to the spatial and temporal extent of the problem covering the globe and with decades to centuries time scales.

Analysis and assessment of just what steps needed to be taken to limit greenhouse gas emissions. This process resulted in the negotiation' of a protocol, the final details of which were completed at the third meeting of the Conference of the Parties to the Framework Convention held December 1-12, 1997, in Kyoto, Japan. The Kyoto Protocol to the United Nations Framework Convention on Climate Change commits industrialized nations to specific, legally binding emission reduction targets for six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, per-fluorinated compounds and sulphur hex fluoride.

First, although India does not currently have any obligations under the Convention to reduce its greenhouse gas emissions. It is important for us to develop a clear understanding of our emission inventory. We also need to document and analyze our efforts in areas such as renewable energy, wasteland development and a forestation - all of which contribute towards either reducing CO_2 emissions or increasing CO_2 removal from the atmosphere. Considering that these efforts may often be undertaken for a variety of reasons not directly related to global warming, but yet has benefits as far as climate change is concerned, we may be able to leverage such efforts in the international context. The Research community could contribute substantially in this regard. We need to significantly improve our ability to plan and adapt to extreme events such as floods, droughts, cyclones and other meteorological hazards. Any robustness that we build into the system in this regard will always stand us in good stead no matter what climate change actually transpires.

Global Warming and the Greenhouse Effect

In the late 1900's researchers realized that the world may be getting warmer. The last two decades of the 1900's witnessed some warm and cool years. However, not enough evidences were available to support the theory of global warming. But this a well-known fact that accumulation of several green house gases can lead to a rise in temperature (global warming). If a global warming phenomenon sets in this would result in major changes in world's climate. The increase in temperature might lead melting of snow on poles, which would terrifically add, to ocean waters. Hence the level of seas, and oceans would rise, this would largely affect the coastal areas. These would submerge under coastal Waters due to expansion of seas and oceans. Besides the Temperate climate pattern would shift northward and present temperate regions would become hot & dry.

The Greenhouse Effect is a natural phenomenon that plays a central role, in determining the earth's climate. The hot surface of the sun radiates heat and light energy. Several gases in the atmosphere are transparent to light but absorb infrared radiation. These allow sunlight to pass through the atmosphere and be absorbed by the earth's surface. This energy ,is again radiated as heat energy, which is absorbed by the gases. As the effect is similar in nature to what happens in a' botanical greenhouse (the glass panes allows the light energy to enter inside but diminishes the loss of heat), these gases are called greenhouse gases and the resultant warming from their increase is called the greenhouse effect. Anthropogenic activities add to the phenomenon accelerating greenhouse gas building process. Global increase of greenhouse gases in the atmosphere viz., carbon dioxide, nitrous oxide, methane and chlorofluorocarbons are now well documented. In addition to all these changes, troposphere and stratospheric chemistry are being modified due to the addition of these gases as well as emission of carbon monoxide, nitrogen oxides and other compound. The United State Environmental Protection Agency, Office of Policy, Planning and Evaluation in 1989 have documented the increase of the different green house gases.

Table 6.1: Major Green House Gases Contributing to Global Warming

Sl.No.	Gas	Contribution to global warming
1.	Carbon dioxide	57
2.	Chlorofluorocarbons	25
3.	Methane	12
4.	Nitrous oxide	6

The concentration of carbon dioxide into the atmosphere has increased by 25% since the industrial revolution. Carbon dioxide is increasing at a rate of about 0.4% per year and is responsible for about half of the current increases in the greenhouse effect. The concentration of methane has more than doubled during the last three centuries. Agricultural sources particularly rice cultivation and animal husbandry has probably been the most significant contributors to historical increase in concentrations. But there is the potential for rapid growth in emissions from landfills, coal seems, permafrost, natural gas explorations and pipeline leakage, and biomass burning associated with forest clearings in the future.

The concentrations of nitrous oxide have increased by 5-10% since pre-industrial times. The cause of this increase is highly uncertain, but it has been understood that the use of nitrogenous fertilizer, land clearing biomass burning and fossil fuel combustion have all contributed. Nitrous oxide is currently increasing at a rate of about 0.25% per year, which represents and imbalance between sources and sinks of about 30%. CFC's were introduced into the atmosphere for the first time during the century; the most common species are CFC-12 and CFC-II. Of major concern because of their potential to deplete stratospheric ozone, the CFCs also represent about 15% of the current increases in the greenhouse effect.

The chemistry of the atmosphere is changing due to emission of carbon monoxide, nitrogen oxides, and volatile organic compounds, among other species, in addition to the changes in the greenhouse gases already described. This alters the amount and distribution of ozone and the oxidizing power of the atmosphere. which changes the lifetimes of methane and other greenhouse gases. Changes in global ozone are quite uncertain, and may have contributed to an increase or decrease in the warming commitment during the last decade.

Acid Rain

Although the phenomenon of "acid rain" (more correctly acid deposition) was identified in Manchester, England, as long ago as 1852, and described more thoroughly in 1872, modern scientific research has been going on only since the mid-1950s. Public concern about the problem began in the late 1960s. Acid rain is an environmental hazard that is transponder in nature. Northeastern America, North Western Europe and India are facing an acute problem of acid rain. Acid rain has affected certain rivers, lakes, streams and forests in United Kingdom (UK), United States of America (USA), Germany and many other countries.

Acid rain literally means 'the presence of excessive acids in rain waters'. Acid precipitation is a mixture of strong mineral acids sulphuric acid (H_2SO_4), nitric acid (HNO_3) and in some locations, hydrochloric acid (HCl). It usually has a ph of less than 5.6, the value of distilled water in equilibrium with atmospheric carbon dioxide.

Acid in the Rain Water's

Acid rain problem is a result of anthropogenic activities. Most acids come from cars, homes, industries and power stations but some share is contributed by natural sources such as volcanoes, swamps and planktons. The acid problem is basically associated with the transport and subsequent deposition of oxides of sulphur, nitrogen and their oxidative products. These are produced by combustion of fossil fuels, power plants, automobile exhausts and domestic fires etc.

Formation of Acid Rain

Acid rain is one of the form of acid deposition which can either be wet or dry, acid rain, snow, dew, fog, frost and mist are the wet form of deposition, while dust particles containing sulphate and nitrates which settle on ground is called dry deposition.

Wet Acid Rain

Coal, fuel wood or petroleum products have sulphur and nitrogen. These elements, when burnt in atmospheric oxygen,' are converted into their respective oxides (SO_2 and NO_3), which are highly soluble in water. By anthropogenic and by natural sources, oxides of sulphur and nitrogen enter the atmosphere.

Reactions

Reaction with Sulphur

$$S + O_2 = SO_2$$

$$2SO_2 + O_2 = 2SO_3$$

Reaction with Nitrogen

$$NO + O_3 = NO_2 + O_2$$

$$NO_3 + NO_2 = N_2O_5$$

When air is saturated with water droplets (humid conditions), N_2O_5 invariably reacts with water vapors to form droplets of HNO_3.

$$N_2O_5 + H_2O = 2HNO_3$$

Besides some HNO_2 is also formed

$$N_2O_3 + H_2O = 2HNO_2$$

SO_3 in humid conditions forms droplets of H_2SO_4.

$$SO_2 + 1/20_2O_2 + H_2O = H_2SO_4$$

HNO_3 and H_2SO_4 thus formed combine with HCl to generate precipitation, which is commonly referred to as acid rain.

The primary reason for concern is that acid deposition acidifies streams, and taken on coarse, sandy soils low in lime: The effect is seen particularly in headwater areas and in wet montane environments, wherever sulphate loading from anthropogenic sources is strong. The chemical and physical consequences of lake acidification include, increased leaching of calcium from terrestrial soils, mobilization of heavy metals such as aluminium, zinc, and manganese and an increase in the transparency of lake waters. The biological consequences include market changes in communities of aquatic plants and animals, with a progressive lessening of their diversity.

Acid deposition may further impoverish forests soils, developed on sandy substrata poor in lime. As a consequence of accelerated leaching of nutrients, such as phosphorous, potassium, magnesium and calcium from these soils, forest productivity would eventually be reduced. Moreover, the acid sulphate particles that contribute to acid precipitation are in the size range that penetrates deep into the lung, and they may well exacerbate lung diseases and increase mortality rates.

Ozone Layer Depletion

Joseph Farman, of the British Meteorological Survey, and colleagues reported in the scientific journal Nature that concentrations of stratospheric ozone above Antarctica had plunged more than 40 percent from 1960s baseline levels during October, the first month of spring in the Southern Hemisphere, between 1977 and 1984. It meant that for several months of the year a hole forms in the ozone layer, which protects animals and plants from ultraviolet solar radiation. Suddenly it seemed that the chemical processes known to deplete ozone high in the earth’s atmosphere were working faster and more efficiently than predicted.

Chemistry of the Ozone Layer

Oxygen molecules (O_2), abundant throughout the atmosphere, are split apart into individual atoms (O + O) when energized by radiation from the sun. These atoms are free to collide with other O_2 molecules to form ozone (O_3). The particular configuration of the ozone molecules allows them to absorb the sun’s radiation in ultraviolet wavelengths that are harmful to life if they penetrate to the earth’s surface. The ozone molecules formed by collision are partially removed by other naturally occurring chemical reactions, and so the overall concentration of stratospheric ozone remains constant. High above the stratosphere, the density of gases is. so low that oxygen atoms rarely find other molecules to collide with, and ozone does not form in abundance. Below the ozone layer, too little solar radiation penetrates to allow appreciable amounts of ozone to form. Thus most of the world’s ozone is in a stratospheric layer bulging with ozone at latitudes from 10 to 35 kilometers.

Closer to the ground, in the troposphere, ozone produced through a series of chemical reactions involving hydrocarbons and nitrogen oxide emissions from vehicles and industrial activity is an effective greenhouse gas. Thus, ozone plays two very different roles in global environmental change: one in the stratosphere as a shield against harmful ultraviolet radiation, and another nearer the ground in the troposphere as a greenhouse gas find a health hazard.

The researchers hypothesized in 1974 that increasing concentrations of chlorofluorocarbons (CFCs), synthetic compounds that are chemically very stable in the lower atmosphere, rise unchanged through the lowest atmospheric layer, the troposphere. Even though CFCs are produced mostly in the industrialized countries of Europe and North America—where they are used in a wide variety of applications such as for solvents and refrigerants.

The researchers surmised that upon reaching the stratosphere, the CFCs encounter high-energy ultraviolet light', which breaks them down, releasing their chlorine atoms. The chlorine atoms can then engage with ozone in a catalytic reaction in which each chlorine fragment can destroy up to 100,000 ozone molecules before other chemical processes remove the chlorine from the atmosphere.

The Antarctic Ozone Hole

Now, many scientists describe the Antarctic ozone hole as the first unequivocal evidence of ozone loss due to man-made chlorine and one of the first clearly definable effects of human-induced global change. They found that the ozone levels dip at about the same latitudes where levels of chlorine monoxide ascend. Scientists are convinced that the elevated levels of chlorine and bromine account for much of the ozone depletion. The ozone molecules are formed over the tropics and are delivered along with chlorine to the Antarctic, as well as to the Arctic, via atmospheric motions. In Antarctica, a circulation pattern known as the Antarctic polar vortex traps the ozone cover the South Pole for several months. It is within this vortex that scientists have measured such shockingly low ozone concentrations during the first two weeks of October shortly after the beginning of the Southern Hemisphere spring. The chemical reactions that take place on these surfaces convert chlorine from forms that do not react with ozone to other, less stable forms that readily break up in the presence of sunlight and go on to destroy ozone. Both cold temperatures and sunlight arc critical to the process leading to ozone depletion in the Antarctic. Antarctic ozone is depleted not during the winter, when temperatures are coldest and the South Pole is immersed in darkness, but in the southern spring, after sunlight returns but temperatures are still low.

Effect on Line

The ozone layer is essential to life because it shields it from damaging ultraviolet radiation. Researchers are trying to learn how humans, vegetation, and aquatic ecosystems each may be affected by ozone depletion. Direct exposure to ultraviolet radiation can damage the human immune system, cause cataracts, and increase the incidence or skin cancer. The EPA estimated in 1986 that the incidence of skin cancers would rise 2 percent for each 1 percent depletion of stratospheric ozone. As part of the effort to understand the effects on vegetation and crops, researchers have tested more than 200 plant species, two-thirds of which show sensitivity to increased ultraviolet exposure. Soybeans, one of civilization's staple food crops, are particularly susceptible to ozone damage, as are members of the bean and pea, squash and melon, and cabbage families. Plant responses to ultraviolet radiation include reduced leaf size, stunted growth, poor seed quality, and increased susceptibility to weeds, disease, and pests. Scientists are also in the early stages of understanding how ultraviolet radiation might affect marine ecosystems and animals. Concern about these systems begins with phytoplankton, microscopic marine algae that form the base of the marine food web. Studies in the tropics have shown that significant amounts of ultraviolet radiation can kill them, while lesser amounts can slow photosynthesis and thus productivity. In Antarctica, this could affect kill, tiny crustaceans a notch up the food chain, and then fish, birds and marine mammals including seals and whales. While water provides some protection from radiation, crude estimates indicate that ultraviolet radiation can penetrate to depths of 10 to 20 meters. Some phytoplankton is known to be tolerant of ultraviolet radiation, whereas others cannot tolerate any. A likely response will be for tolerant species to replace sensitive ones, though no one knows how this would affect the fish that eat them.

Nations Joining to Protect the Ozone Layer

The Montreal Protocol on Substances That Deplete the Ozone Layer, negotiated in September 1987, calls for 50 per cent reduction in CFC production from 1986 levels by 1999. Forty-nine nations- including Canada, the United States Japan, and many nations in Europe, which together consume 80 percent of the chemicals controlled-have ratified the protocol. The protocol is a delicate balance between the most up-to-date scientific information, reliable industrial expertise, and committed political leadership, all supported by strong and informed public interest. The Montreal Protocol may prove to be a model for actions that span national boundaries and interests as the world addresses common environmental issues such as greenhouse warming and other forms of global change.

Conventions

Several conferences in the recent years have taken place which have provided international policy framework to be considered when dealing with the science of the global climate change as under:

Vienna Convention for the Protection of the Ozone Layer (Vienna, Austria, March 22, 1985). This convention was signed by 20 states and the EEC at a conference convened by the UNEP. The object of the convention was the protection of human health and the environment against adverse effect resulting or likely to result from human activities, which modify or are likely to modify the ozone layer. International conference on the assessment of the role of CO_2 and other green house gases in climate variations and associated impacts (Villach, Austria, October 9- 15, 1985) and follow up workshops (Viliach, Austria, September, 28, October 2, 1987 Bellagio, Italy November 9-13, 1987). The Viuach conference held with 29 countries recommended that the- governments and intergovernmental organizations should take into account the results of the assessment made in their environmental programmes, and should favour the increase of public information effects on the global change issues. This meet was in regard with the assessment of the presence of carbon' dioxide in the atmosphere.

Montreal Protocol on substances that deplete the Ozone Layer (Montreal, Canada, September 16, 1987). This protocol signed by 24 of the 46 countries attending a Conference in Montreal seeks to inhibit the production, consumption and trade of ozone-depleting compounds. The compounds are divided into groups: Group I (certain CFSs) and Group II (specific halons) each subject to different limitations. The protocol also distinguishes between two groups of countries, the more developed with relatively high levels of consumption of the contoured ozone depleting substances and the developing countries with relatively low levels of consumption.

International Conference on the Protection of the Global Atmosphere (The Hague, The Netherlands, March 11, 1989). This conference held at the initiative of the French Prime Minister and co-sponsored by the French, Dutch, and the Norwegian governments, produced "The Hague Declaration" which called for the development within the UN framework of a new institutional authority, either by strengthening existing institutions or by creating new institutions. The declaration also called for the creation of an "Atmospheric Fund" to provide "fair and equitable assistance to compensate countries bearing and abnormal or special burden as a result of decisions taken to protect the atmosphere."

Earth Summit-United Nations Conference on Environment and Development (Rio de Janeiro 3-14 June, 1992)- The historic Earth Summit held from June 3-14, 1992 in Rio de Janeiro was attended by over 115 heads of states or governments. The major achievement was the adoption of Agenda 21, a voluminous 800 pages document that details how countries would go about achieving sustainable development with detailed chapters on the financial principle and mechanisms involved. There are also chapter on technology transfers.

Scientific Programmes an Other Activities of International Organizations

The UNEP (United Nations Environment Programme), UNDP (United Nations Development Programme) are some of the environment programmes, which are making active efforts and are doing research in this field. Apart from them, Economic Commission for Europe (ECE), the European Economic Community (EEC), the European Science Foundation (ESF), The Food and Agricultural Organization (FAO), International Social Science Council (lSSC), World Meteorological Organization (WMO), The Inter-governmental Oceanographic Commission (IOC) - this a part of UNESCO, the Scientific Committee on Ocean Research (SCOR) and many other such organizations. Apart from them there are other scientific activities underway which are funded by different organizations such as the World' Weather Watch (WWW), World Climate Research Programme (WCRP), World Climate Programme (WCP), World Climate Impact Studies Programme (WCIP), Past Global Change (PAGES), Integrated Global Ocean Station System (IGOSS), (Human Dimension of Global Change (HDGC), Global Environment Monitoring System (GEMS), Global' Change and Terrestrial Eco-System (GCTE).

The Earth's atmosphere is being changed at an unprecedented rate by pollutants resulting from human activities, inefficient and wasteful fossil fuel use and the effects of rapid population growth in many regions. Global climate is changing because of the build up in the atmosphere of carbon dioxide methane, nitrous oxide, the CFC's (powerful greenhouse gases as well as destroyers of stratospheric ozone), and other greenhouse gases produced by fossil fuel burning, by deforestation and by producing food for the rapidly increasing population at a global level.

Wasteland Reclamation

What is land degradation? Land degradation refers to the physical or chemical processes, which make land, unfit for a variety of purposes like agriculture, commercial, residential etc. Why land becomes degraded? Geological processes and anthropogenic activities are chiefly responsible for land degradation. Can degraded land be reclaimed or rejuvenated? To answer this grave question we have Central Arid Zone Research Area (CAZRA) at Jodhpur concerned with the conservation of land.

During recent years increase in human activity has led to the degradation of habitat including cultivated land forests. Mangroves etc. About 50% of the land throughout the planet is arid with problem of acidity and salinity. Restoration of these areas is a matter of concern for developed as well as developing countries. However, in sites method are relatively in efficient. With the advent of biotechnology however a number of opportunities for 'recovery of degraded land have arisen through manipulation of biological systems.

Wasteland

Land, which does not give enough economic return or is otherwise useless, can broadly be termed as wasteland. National Wasteland Development Board (NWDB) in the ministry or Environment and Forest have defined wasteland as that land which is degraded and is presently lying unutilized. Further it has classified it into two categories as i) Culturally wasteland and ii) Non-cultural wasteland. Characteristics features of wasteland can be summarized as under:

- The land becomes ecologically unstable and unproductive.
- Land that has nearly or completely lost its topsoil.
- Land that has developed toxicity in the zone of roots for the growth of most plants.

Land Reclamation

It is a process of making an uncultivable land fit for cultivation which is then said to have been reclaimed. Generally it is carried out either by temporary or permanent control.

Temporary Control Includes

1. Ploughing of salt-'surface crust deeply into the soil.
2. Removing surface accumulation from the soil.
3. Neutralizing the effects of certain salts by use of other salts or acids.

Permanent Control Includes

1. Adequate lowering of water table.
2. Satisfactory water infiltration.
3. Leaching excess salts out of the soil.
4. Intelligent management of soil.

Physical Improvements Involves

1. Applying enough water.
2. Keeping drains open and in good repair.
3. Preventing excessive evaporation.

A few biotechnological methods are described below: .

(*i*) Reforestation — through micro propagation (*ii*) Improvement in soil — by mycorrhize

(*iii*) Improvement of soil — through N_2 fixation

(*iv*) Development of stress tolerant plant through biotechnology manipulation.

(*v*) Toxic site reclamation through selective engineer microbes.

Reforestations (Micro Propagation)

Ex *situ* conservation activities have been carried out through establishment of gene banks. They have become particularly important for the conservation of crop varieties or Improvement of crops and & a forestation programmes. The UNEP has advocated for in-situ and ex-situ conservation efforts. However, funds for ex-situ conservation have been enhanced recently. A special emphasis has been given to a forestation since forest is a good source of food, fodder, fiber and pulp. Moreover they help in maintaining climatic stability and biodiversity. It has been shown that degraded lands can be effectively used and restored by planting forests. Using trees of wide adaptability and productivity for this purpose clonal propagation method have been prescribed rather than using seeds of uncertain genetic quality. Clonal micro propagation can be achieved through techniques of tissue culture.

It has been estimated that multiplication state of 100-200 per year is technically possible for many species towards this objective genotypes capable of growing well on degraded land have been selected for mass propagation/multiplication.

The clonal multiplication involves 4 steps.

1. Maintaining an aseptic culture.
2. Shoot multiplication using apical meristem or buds.
3. Rooting of in vitro forms shoots.
4. Acclimatization and transfer of micro propagated plantlets to the field.

According to an estimate in 1990 500 million plants of diverse nature were produced through micro propagation in 60 countries. In New Zealand large number of micro propagation plantlets – Pine trees (Pinus radiata) are been used and it is estimated that 2 million plantlets were in the field in the year 1992.

Stress Tolerant Plant

A large number of biotic factors can create stress to the plant as well as animals. The survival of plant under such stress conditions like deserts marshland saline acidic and alkaline condition can be manipulated by suitable strategies. Efforts are under-way for development of plant resistance to such conditions using biotech methods. Cell lines exhibiting resistance or tolerance to salt stress have been selected in a large number of plant species and can be used to reclaim degraded land suffering from salinity.

These are as follows:

Brassica sp.	Capsicum annum
Cieer arietinum	Citrus aurantium
C. sinensis	Dacus carota
Nicotiana tobaccum	Oryzae sativa
Triticum aeslivium	*Sapiendus trifoliala*

There are several species of trees that exhibit moderate resistance to salinity that can be used for reclamation of saline soils. These are *Prosobis, Spicigera, Beautea monosperma, Terminalia ballacca*. Efforts are being made to understand the basis of salt tolerance and isolate the gene responsible for this attribute so that salt tolerant plant can be developed through genetic engineering. Attempts have been made to develop acidic resistant crops. Man made synthetic crop 'triticale' has been found to be suitable in acidic soils, in countries like: Poland, Kenya. & Mexico, on dry and sandy soils e.g. Brazil, on alkaline and calcareous soils e.g. Spain, USA, on mineral, deficient & high boron soils.

Methods For Reclaiming Land

1. Reclamation & management of saline and alkaline soils can be done through:

Alkali soils usually contain excessive amounts of sodium and therefore have a poor physical condition. To be reclaimed these soils must be changed chemically and improved physically. The chemical changes consist of exchanging calcium for sodium and thus leaching away the Na salts. Application of PO_4 fertilizers is usually recommendable for low phosphorous containing soils.

2. Reclamation of waterlogged land:

Agricultural land is said to be water logged when its fertility is affected by the height of water table, due to flooding of root zone of plants, ill-aeration results. They can be made productive by providing efficient surface drainage and sub-surface drainage:

1. Pipe/tile drains
2. Deep open trenches
3. Reclamation of soils damaged by sea water:

   Areas near seacoasts suffer occasional flooding by seawater. In such cases soils have reclaimed by pumping out the excess salts, water & drainage e.g. Netherlands.
4. Reclamation of mined wasteland:

Mining and its allied works have ravaged the land surface. To reclaim such ravaged lands species selected should be able to quickly grow and effectively stabilize and improve the soil. Mixture of grasses rather than woody perennials is preferred.

Reclamation Work In India

In India reclamation of limestone & rock phosphate mines in Dehradun and Mussourie has been successfully accomplished with the help of Pinus, Ledrus, Acacia sp. The story of degeneration and regeneration of Jhabua-poor tribal districts of Madhya Pradesh bordering Gujarat is also satisfactory. It was reclaimed with watershed development in mid 1990' s under the Rajiv Gandhi Mission. In 1993, the intervention of a NGO, the Samaj Pragati Sahyog in Neemkheda, a remote Village in Dewas district of M.P. took a number of watershed development activities. An area of nearly 300 m2 has been reclaimed in Baiera Village (Kangra, H.P.) by an old co-operative farming society (1965-66).

Conclusion

All these instances show that the regeneration of the environment is possible with political will, competent and committed bureaucratic support, people's participation & enforcement of stringent laws.

Consumerism and Waste Products

Increase in demand on depleting resources is never-ending and human beings quest to achieve breakthroughs in technical advancements will never be final. People to satisfy their wants and lead a more comfortable life relate the concept of consumerism to increased usage of consumer goods. People easily adapt to disposable life-style as it leads to a cut down on household chores. The market forces devise such things to sell comfort to people, which attract people, the most. Soon people realize that comfort has become the necessity of life. The Indian market trend and culture is fast adapting to the western society where packed food material and other life supporting commodities are readily available in packed condition. Market strategies set to work trying new tactics to get consumers buy more. People in turn make consumption a way of their life, which leads to generation of solid Waste problems. People consume and throwaway the refuge at an ever-growing rate.

Packed food resource consumption is, in itself a great problem to deal with. We get easy food supply even in aeroplanes and trains in packed condition. Besides our daily life activities related to consumption of flour, vegetable, milk, butter, marketing of household goods and others all takes place through plastic bags, paper bags, tin cans and others. Plastic bags are non-biodegradable. So when they are thrown away, they create havoc that is potentially eternal. Municipal reports from Assam and Haryana speak of drains clogged by discarded plastic bags, backflow in sewage pipes, and disease spreading through pond-like accumulation of sewage, which also serves as sites of mosquito breeding.

Nations with high standard of living generate more of solid waste than developing countries. This causes an ever-increasing burden of garbage, which in turn is related to their disposal problems. Even land filling and other methods of disposal have their own limitations. We need ample of land to bury, burn or dispose waste. Ash from incineration is also a major problem because the ash contains lead, cadmium, mercury, and arsenic in various proportions from batteries, lighting fixtures and pigments. The toxic substances are more concentrated in the ash than in the original garbage and can lead to water pollution. Case studies shows that even land beneath landfills get polluted and cause air pollution above the ground and water pollution below the ground.

The most fundamental way to reduce waste is to prevent it from ever becoming waste. Another way market operations reduce waste is by making consumer products in concentrated form. Municipal composting is another source-reduction technique. On an individual level, we can all attempt to reduce the amount of waste we generate. Every small personal commitment from each of us could have the cumulative result of a significant magnitude in reducing the solid waste production.

Residues and Wastes

As man engages in the activities associated with living, wastes are produces, these are products, which have no apparent useful purpose, or they are of such marginal utility that recovery is uneconomical. Such products include human, residential, agricultural, commercial and industrial wastes of all kinds. The continuous removal and safe disposal of these wastes is essential to the continued existence of any community. These wastes may be solid, liquid or gaseous. Bodily discharges have historically been considered to be very hazardous to mankind. Intestinal diseases are readily transmitted where water or food is contaminated directed or indirectly by human wastes. Such wastes also provide a medium for fly breeding. Food scraps and waste food constitute garbage. When combined with other household waste, residential refuse is generated. The organic portion will attract and sustain flies and rats. Where wastes are water-carried, pollution of water supplies may occur. Commercial and industrial liquid wastes may contain particulate and chemical pollutants.

Many activities of man-driving an automobile, generating electric power, processing chemicals and petroleum, manufacturing certain products, disposal of wastes - may result, if uncontrolled, in the discharge of solid particles and gaseous pollutants to the atmosphere. Excessive pollution of the air has been cited as a cause of disease and death. In summary, these wastes, if improperly handled endanger man's life support systems.

The Environment Protection Act, 1986

(No. 29 of 1986) An Act to provide for the protection and improvement of environment and for matters connected therewith. Whereas decisions were taken at the United Nations Conference on the Human Environment held at Stokholm in June 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment;

Short Title, Extent and Commencement

1. This Act may be called the Environment (Protection) Act, 1986.
2. It extends to the whole of India.
3. It shall come into force on such date as the Central Government may, by notification in the Official Gazette, appoint and different dates may be appointed for different provisions of this Act and for different areas.

The Act clearly states and explain each and every term very precisely like environment, environmental pollutants, environmental pollution, handling, hazardous substance, occupier, prescribed.

General Powers of the Central Government

Power of Central Government to take measures to protect and improve environment.

1. Subject to the provisions of this Act, the Central Government shall have the power to take all such measures, as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment.
2. Planning and execution of a nationwide programme for the prevention, control and abatement of environmental pollution;
3. Laying down standards for the quality of environment in its various aspects;
4. Laying down standards for emission or discharge of environmental pollutants from various sources.
5. Restriction of areas in which any industries, operations or processes or class of industries, operations or processes shall not be carried out or shall be carried out subject to certain safeguards;
6. Laying down procedures and safeguards for the handling of hazardous substances;
7. Examination of such manufacturing processes, materials and substances as are likely to cause environmental pollution;

8. Carrying out and sponsoring investigations and research relating to problems of environmental pollution;
9. Inspection of any premises, plant, equipment, machinery, manufacturing or other processes, materials or substances and giving, by order, of such directions touch authorities, officers or persons as if may consider necessary to take steps for the prevention, control and abatement of environmental pollution;
10. Preparation of manuals, codes or guides relating to the prevention, control and abatement of environmental pollution.

Air Pollution Act, 1981

An Act to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for conferring on and assigning to such Boards powers and functions relating thereto and for matters' connected therewith. Whereas decisions were taken at the United Nations Conference on the Human Environment hold in Stockholm in June, 1972, in which India participated, to take appropriate steps for the preservation of the natural resources of the earth which, among other things, include the preservation of the quality of air and control of air pollution and whereas it is considered necessary to implement the decisions aforesaid in so far as they relate to the preservation of the quality of air and control of air pollution.

Short title, extent and commencement

1. This Act may be called the Air (Prevention and Control of Pollution) Act, 1981.
2. It extends to the whole of India.
3. It shall come into force on such date as the Central Government may, by notification in the official Gazette, appoint.

The Act clearly states and explain each and every term very precisely air pollutant, air pollution, approved appliances, approved fuel, automobile, central board, chimney, control equipment, emission, industrial plant, member, occupier, prescribed, state board.

Water Pollution Act, 1974

An Act to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution, for conferring on and assigning to such Board powers and functions relating thereto and for matters connected therewith. Whereas it is expedient to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution and for conferring on and assigning to such Boards powers and functions relating thereto.

Short title, application and commencement

1. This Act may be called the Water (Prevention and Control of Pollution) Act, 1974,
2. It applies in the first instance to the whole of the States of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and. Kashmir, Karnataka, Kerala, Madhya Pradesh, Rajasthan, Tripura and West Bengal and the Union Territories; and it

shall apply to such other State which adopts this Act by resolution passed in that behalf under clause (1) of the article 252 of the Constitution.

3. It shall come into force, at once in the States of Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Kamataka, Kerala, Madhya Pradesh, Rajasthan, Tripura and West Bengal and in the Union Territories; and in any other State which adopted this Act under clause (1) of article 252 of the Constitution on the date of such adoption and any reference in this Act to the commencement of this Act shall, in relation to any State or Union Territory, mean the date on which this Act comes into force in such State of Union territory.

The Act clearly states and explain each and every term very precisely like board, central board, member, outlet, pollution, prescribed, sewage effluent, sewer, state board, state government, trade effluent etc.

The Wildlife (Protection) Act, 1972

An Act to provide for the protection of wild animals and birds and for matters connected therewith or ancillary or incidental thereto.

Short title, extent and commencement

1 This Act may be called the Wild Life (Protection) Act, 1972

2 It extends, in the first instance, to the whole of the States of Andhra Pradesh, Bihar, Gujarat, Haryana, Himachal Pradesh, Madhya Pradesh, Manipur, Punjab, Rajasthan, Uttar Pradesh and West Bengal and to all the Union territories; and it shall also extend to such other State as may adopt this Act by resolution passed in that behalf in pursuance of CI. (1) of Art. 252 of the Constitution.

It shall come into force in a State of Union territory to which it extends, or may become extended in future, on such date as the Central Government may, by notification, appoint, and different dates may be appointed for different provisions of this Act or for different States or Union territories.

The Act clearly states and explains each and every term very precisely like animal, animal article, big game, board, captive animal, cattle, chief wild life warden, closed area, collector, commencement of this act, dealer, director, game reserve, government property, habitat, hunting, land, license, manufacturer, meat, national park, notification, permit person, prescribed, sanctuary, small game, special game, state government, taxidermy, trophy, uncured trophy, vehicle, vermin, weapon, wild animal, wild life, wile life warden.

Forest Conservation Act

India's Forest Policies

Development of forest is guided by the policies adopted by a nation to manage them. Scientific forestry was adopted in India since over a century back. Country's first forest policy was enunciated in 1894. After the Independence Indian Republic therefore formulated her National Forest Policy in 1952. The National Commission on Agriculture established in 1970 went into the forestry situation in the country and suggested a need for a new forest policy, in their Report of 1976. The Constitution of the Independent India placed forests under the State List of the Seventh Schedule in 1950. The States were vested with the administration of the forests. The Constitution has recognized the importance of protection of forests and their improvement. It is stipulated in Article 48-A, that the State shall endeavourer to protect and improve the environment and to safeguard the forests and wildlife of the country.

The period between 1950 and today has witnessed large-scale depletion of forests and attrition of forestlands. Forests lands were cleared and diverted to other uses like agriculture, industries, hydroelectric projects, settlement of displaced persons and foreign refugees, etc. This also resulted in diminishing wildlife in the country due to loss of their habitat. Realizing the importance of forests for the well being of the nation, the Parliament, by the 42nd Amendment to the Constitution, in 1976, brought Forests and Wildlife on the concurrent list in Seventh Schedule. In the year 1980, the President of India promulgated the Forest (Conservation) Ordinance, 1980, which put severe restrictions on de-reservation of forest or use of forestland for non-forest purposes, without prior approval of the Central Government.

Forests play three important roles in national economy of any country, they are: (*a*) protective, (*b*) productive, and (*c*) as a source of accessory benefits. This calls for an effective legislation. The Indian Forest Act, 1927, is in force today for the same purpose. Similarly a comprehensive legislation for the protection of wildlife and nature is to be found in the Wildlife (Protection) Act, 1972.

Forest Policy of 1894

Enunciated in 1894 India's first Forest Policy laid down 'public benefit' as the sole objective of the administration of public forest. The Policy suggested the maintenance of forests in hilly areas for preservation of climatic and physical conditions and for protection of cultivated plains below from the divesting action of hill torrents. Forests with valuable timbers were to be managed on commercial lines. The forests of inferior quality were to be managed mainly in the interest of local population.

Guiding Principles for Forest Policy

India's Forest Policy was revised once again in 1988. The main plan of the revised Forest Policy of 1988 is protection, conservation and development of forests. Its aims are (*i*) maintenance of environmental stability through preservation and restoration of ecological balance, (*ii*) conservation of natural heritage, (*iii*) check on soil erosion and denudation in catchments area of rivers, lakes and reservoir, (*iv*) check on extension of sand dunes in desert areas of Rajasthan and along coastal tracts, (*v*) substantial increase in forest/tree cover through massive a forestation and social forestry programmes, (*vi*) steps to meet requirements of fuel for wood, fodder, minor forest produce and soil timber of rural and tribal populations, (*vii*) increase in productivity of forest to meet the national needs; (*viii*) encouragement of efficient utilization of forest produce and optimum substitution of wood, and (*ix*) steps to create massive people's participation with involvement of women to achieve the objectives and minimize pressure on existing forests.

Forest Conservation

The increasing destruction and degradation of forests and tree lands especially in the Himalayas and other hill areas, is leading to heavy erosion of topsoil, erratic rainfall and recurring floods. Another area of concern has been degradation of forests due to biotic pressure. Guidelines have been framed for preparation of working plans and felling in forests. Some of the salient features are (*i*) working plans should be up-to-date and stress conservation (*ii*) preliminary working plan should have a multidisciplinary approach, (*iii*) tribal rights and concessions should be high-lighted along with control mechanisms, (*iv*) grazing should be studied in detail and specific prescriptions should cover fodder propagation, (*v*) shifting cultivation and encroachments need to be controlled (*vi*) clear-felling with artificial regeneration should be avoided as far as possible and clear-felling blocks should not exceed ten hectare in hills and 25 hectare area in plains, and (*vii*) banning all felling above 1,000 meter altitude for a few years should be considered to allow these areas to recover. Critical areas in hills and catchments areas prone to landslips, erosion, etc. should be totally protected and quickly afforested.

Issues involved in enforcement of Environmental, Legislation.

Politics and the environment cannot be separated. The late 1980s and early 1990s witnessed a new international concern about the environment, both in the developed and developing nations of the world. Environmentalism is also seen as a growing factor in international relations. This concern is leading to international cooperation where only tension has existed before. While there exists no world political body that can enforce international environmental protection, the list of multilateral environmental organizations is growing.

There is no international legislature with authority to pass laws; nor are there international agencies with power to regulate resources on a global scale. An international court at the Hague in the Netherlands has no power to enforce its decisions. Nations can simply ignore the court if they wish. This environmental "coming of age" is reflected in the broadening of intellectual perspective. Governments used-to be preoccupied with domestic environmental affairs. Now, they are beginning to broaden their scope to confront problems that cross international borders, such as transboundary air and water pollution, and threats of a planetary nature, such as stratospheric ozone depletion and climatic warming. It is becoming increasingly evident that only decisive mutual action can secure the kind of world we seek.

Factors Affecting International Environmental Laws

- **Identification and gravity of the problem:** It is easier tofind a solution to a problem once it is widely acknowledged as critical.
- **Statistics:** Sufficient fieldwork should be done to collect the required data on the extent of the problem to find possible solutions.
- **Geo-Location:** To identify the sources and cause of problems and the areas under its effects.
- **Law and order:** Whether countries have laws protecting the environment and administrative proceedings to enforce those laws.
- **National and international pressures:** Who favors and who opposes action on the issue in each country.
- **Infrastructure (Institutions and policies):** Whether there is a mechanism in place for cooperative action among the interested countries.
- **International cooperation:** Whether the affected countries have a tradition of cooperation or conflict.

Indian scenario

Laws need to be strengthened and implemented properly to protect the environment. Although India has a number of rules and regulations to protect the environment they have still not reached the stage of full compliance. The growth of environmental laws is a reflection of the speed with which environmentalism has established itself as a potent political force. But many of the laws are either trivial or short-lived and vulnerable to political pressure. Politicians do not violate laws, but the laws are so modified to suit their vested interests. Environment regulations may thus be modified to tap the tourist potential of an area or to set up some other industry. There have been many instances where laws have been changed to accommodate commercialization in hill areas.

The Wildlife (Protection) Act, 1972, gives wildlife wardens the power to protect animals in wildlife parks and sanctuaries. But we also find that these wardens exercise their power on traditional entertainers. Monkey, bear and snakes shows on streets are a common scene. The state earns money by putting wild animals on exhibition in zoological parks and permits circus companies to train animals for entertainment to earn profit. Environmental values are difficult to integrate into Indian law. Though regulatory controls have become stricter, the state of the environment has not improved because of the financial crunch, absence of basic infrastructure, reliance on litigation, absence of comprehensive industrial location policy and absence of relevant technology.

In India, several legislations have been passed to check pollution, such as the Air (Prevention of Pollution) Act, Water (Prevention and Control of Pollution) Act, Environment (Protection) Act. The legislation on air has some loopholes since it does not provide for the prevention of interstate air pollution. It deals with the control of noxious emissions from specified industrial processes, automobiles and noise pollution. Smoke and other non-noxious emissions are not covered under this Act. There has to be transparency in the judicial system. The public has the right to know what is going on. The judiciary has to think before passing judgments. Without thinking of alternatives' such as rehabilitation, these verdicts will just continue to push up the cost of illegal management.

Public Awareness

Environmental Science aims at creating understanding among masses of the delicate balance, which exists, between natural environment and its dependents (humans) to optimize the exploitation of resources on economic basis, which would lead to sustainable development. Secondly, it encourages students and researchers to make careers in the field of environment knowledge of the basic principles of ecology and environmental science would inbuilt a sense of duty in the citizens to care and. manage the natural resources on an optimal basis. Such awareness is essential because the causes and solutions to environmental problems are often linked.

Public awareness addresses issues by which a common man becomes aware of activities, which would result in improvement of the overall environment When public awareness rises to a level where masses come to know the do's and don'ts of the environment, the rules and regulation have little role to play. People should understand that how they should. react to pollution' problems, natural hazards, anthropogenic hazards, waste-disposal problem, hunting, deforestation and ecosystem problems (bio-magnification, food chain and food web concept). Public awareness increase upon making the people understand how malpractices affect environmental systems and in turn how environmental systems affect whom. But one important question arises here. Who would inform whom and when? Public participation in environmental decision-making can help to a great extent. Their participation has both moral and practical implications.

Environmental awareness increases easily in financially stable and better-educated people through book reading, films, newspaper, magazines and other electronic media. Nongovernmental organizations (NGOs) can play a better role in spread of information 'up to village levels. Addressing issues of environmental significance to private voluntary organizations, NGOs, farmers, organizations, cooperatives, schools, universities - and private entrepreneurs, can increase public awareness. This would bring more information to bear on the planning process. Among the various sources, which can increase the public awareness the role of mass media, is vibrant. It is so because people love to watch T.V., listen radio, read newspaper and magazines.

Suggestions

- It is an effective tool for the spread of Environmental Science.
- Media people should be trained in addressing environmental issues to the public.
- Special employees should be deputed in press, radio and T.V. media.
- Environmental folk plays, puppet shows etc. should be organized to make the ignorant and simple people aware of the present day problems.
- Drawing, craft and essay writing contests can be used as an effective tool at school level.
- Visual, and calligraphic displays should be mounted in trains and buses as these are used by common masses.
- Storybooks and cartoon network can help the future generation to mould itself according to environmental needs.

QUESTIONS

1. What do you understand by the word sustainable development? Explain.
2. What are urban problems? How we can solve the problem related to water conservation?
3. What are the ways to resettlement and Rehabilitation of people affected by the pollutions?
4. What are the environmental ethics? Write in 200 words.
5. Explain the Environment Protection Act in your own words.
6. What are the issues involved in enforcement of environment legislation?

CHAPTER

7 Environmental Science : Human Population and Environment

Introduction

Human society is governed by interaction and cooperation with other human beings. Latest trends in technology and medical knowledge are available to control human population growth and to improve the health. Still population continues to increase and poverty become greater than ever before. Humans are social animals who have freedom of choice. They largely take decision by heart rather than mind. It is evident from historical records, social situations, ethical and religious considerations and personal desires. Today the greatest hindrance to controlling human population is no more biological but falls into the province of philosophers, theologians, politicians, sociologists, and others. The cause of the population problem is to be understood if we are to deal successfully with the population problem.

Carrying Capacity

The carrying capacity of an area is the number of individuals of a species that can survive in that area over time. In most populations, four broad categories of factors determine the carrying capacity for a population. These factors are: (1) the availability of raw materials, (2) the availability of energy, (3) the accumulation of waste products and their means of disposal and (4) interactions among organisms. The total of all of these forces acting together to limit populations size is known as environmental resistance, and certain limiting factors have a primary role in limiting the size of a population. In some cases, these limiting factors are easy to identify and may involve lack of food, lack of oxygen, competition with other species, or disease.

Population Characteristics

A population can be defined as a group of individuals of the same species inhabiting an area. Some of the characteristics or a population are nasality (birth rate), mortality (death rate), sex ratio, age distribution, growth rates, and special distribution.

Natality refers to the number of individuals added to the population through reproduction. In human populations, natality is usually described in terms of the **birth rate**, the number of individuals born per one thousand individuals in the population per year. It is important to recognize that the growth of a population is not determined by the birth rate (natality) alone.

This is expressed as

B (Natality rate) = N_n/t which means = No. of new individuals added to population time.

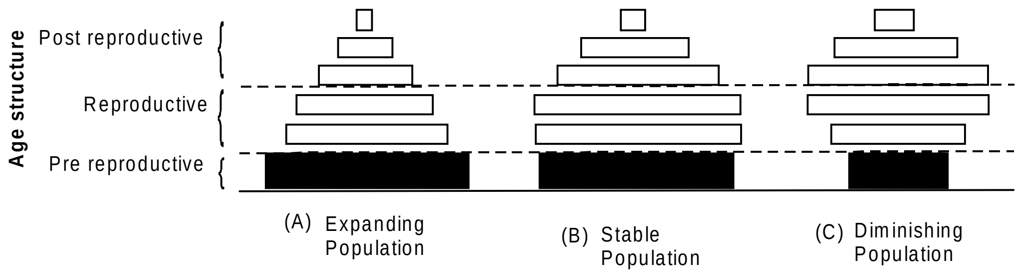
Mortality is the number of deaths per year. In human population studies, mortality is usually discussed in terms of the death rate, the number of individuals who die per one thousand individuals in the population per year.

Population Density is population size in relation to some unit of space and time. It varies with food availability and climatic conditions. It can be measured as:

$$D = \frac{N / a}{t}$$

where D is population density, n = number of individuals, a = area and t = time.

Population Age Distribution refers to the individuals of different age groups in a population. The natality and mortality is also different for respective ages. Bodenhelmer (1938) recognized three ecological ages as: (*i*) Pre reproductive, (*ii*) Reproductive and (*iii*) Post reproductive Fig. 1. Duration of these ages varies in different organisms e.g. Insects have a very long pre-reproductive period, a very short reproductive period but no post reproductive period at all. In man all the three stages are equal in length.



Type of Population

Figure 7.1. Age structure in different types of populations

Biotic Potential is the maximum reproductive power. The constant percent growth rate of a population under optimum environmental conditions thus represents its biotic potential or reproductive potential. Letter designates it g.

$$g = \frac{\Delta AN / AT}{N}$$

where, N = number, t = time, D = constant.

The **sex ratio** refers to the number of males relative to the

Number of females in the population.

The Human Population Issue

Current population growth has led to famine in areas where food production cannot keep pace with population growth; political unrest areas with great disparities in availability of resources (jobs: goods, food); environmental degradation by poor agricultural practices (erosion, desertification); water pollution by human and industrial waste; air pollution caused by the human need to use energy for personal use and for industrial applications; extinctions caused by people converting natural ecosystems to managed agricultural ecosystems; and. destructive effects of exploitation of natural resources (strip, mining, oil spills, groundwater mining). In addition to population size, the kind of demands a population places on its resources is also important. Highly industrialized populations require much more energy and material resources to sustain their way of life than do the populations of the less-developed world.

A Population Growth Curve

Sex ratios and age distributions within a population directly influence the rate of reproduction within a population. Each species has an inherent reproductive capacity, or **biotic potential,** which is its ability to produce offspring. However, this high reproductive potential results in a natural tendency for populations to increase. For example, two mice produce four offspring, which, if they live, will also produce offspring while their parent's are also reproducing. Therefore, the population will tend to grow in an exponential fashion.

Population growth tends to follow a particular pattern, consisting of a lag phase, an exponential growth phase, and a stable equilibrium phase. Fig. 15 shows a typical population growth curve. During the first portion of curve, known as the lag phase, the population grows very slowly because the process of reproduction and growth of offspring takes time. Most organisms do not reproduce instantaneously but must first mature into adults. Mating and the development of the young ones into independent organisms follow this period. By the time the first batch of young has reached sexual maturity, the parents may be in the process of producing a second set of offspring. Since more total organisms now are reproducing, the population begins to increase at an exponential rate. This stage in the population growth curve is known as the exponential growth phase. This growth will continue for as long as the, birth rate exceeds the death rate. Eventually, however, the death rate and the birth rate will come to equal one another, and the population will stop growing and reach a relatively stable population. size and is said to be the stable equilibrium phase. Hence, populations cannot grow continuously because of the concept of carrying capacity.

(*a*) *S-Shaped growth curve*

When a species is introduced into a new habitat, the population grows exponentially until the individuals become numerous. The further increase in their number is checked by the environmental resistance factors that the population growth declines until zero population growth is reached. (i.e. constant) and it becomes stable (K). Such curves are called **sigmoid curves**.

The study of growth curves in S-shaped growth pattern is a self-limiting one where the rate of growth is more and more as density increases. If the limitation is linearly proportional to density we get a symmetrical S-curve so as to approach upper level or limit-K, the carrying capacity. This pattern enhances stability as population regulates itself. Actually the density often overshoots or is more than K and because of time lags in feedback control resulting in oscillations as shown in graphs.

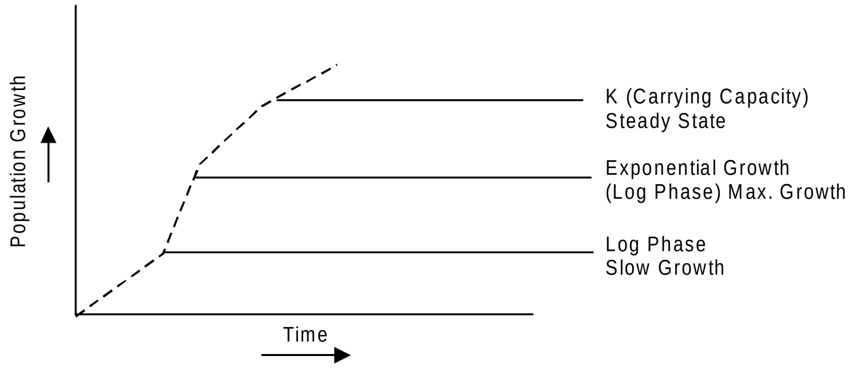


Figure 7.2. S-shaped growth curve.

(b) J-Shaped growth curve

The population increases whenever there is an increase in birth rate over death rate. The factors of environmental resistance do not check population growth or stabilize the growth (zero growth not established) then a J-shaped curve is obtained Fig. 3. It is hard to speculate in the future of human population growth curve whether it will be S-shaped or J-shaped. Growth curve are thus the graphical representation of a population in given time period. It may be of S-shaped or J-shaped as mentioned.

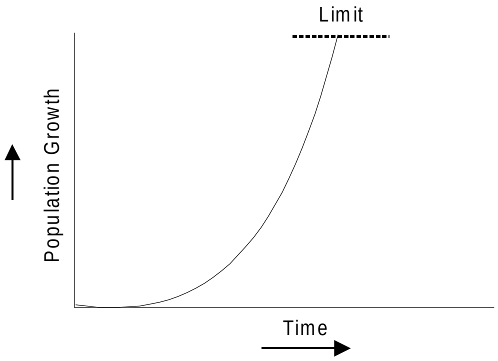


Figure 7.3. J-shaped growth curve.

When population increase in exponential (E) or geometric fashion (*e.g.* 2, 4, 8, 16, 32 ....) until the population runs out of some resources or encounters, some other limitation (N). Growth then comes to a more or less abrupt halt in such cases and density usually declines rapidly until conditions for another rapid growth is restored. Population with this kind of growth form instability unless regulated by factors outside the population.

(*i*) Growth rate decreases as density increases. (Self-limiting or inverse density-dependent type.)

(*ii*) Growth rate is high until density become high and factors from outside of the population become limiting. (Density independent type.)

(*iii*) Growth rate is highest at intermediate density.

Causes of Population Growth

There is an ultimate carrying capacity for the human population and limiting factors will come into play to cause populations to stabilize. However, unlike populations of other kinds of organisms, human populations are also influenced by a variety of social, political, economic, and ethical factors. Humans have accumulated knowledge that allows for predictions about the future and can make conscious decisions based on the likely course of events and adjust their lives accordingly. Part of that knowledge is the certainty that as populations continue to increase, death rates and birth rates will become equal. This can be accomplished by allowing the death rate to rise or by choosing to limit the birth rate. It would seem that controlling human population should be a simple process. Once everyone understands that lowering the birth rate is more human than allowing the death rate to rise, most people should make the "correct" decision; however, it is not quite that simple.

Biological Reasons for Population Growth

The study of human populations, their characteristics, and what happens to them is known as demography. Demographers can predict the future growth of a population by looking at several different biological indicators. When we look at birth rates and death rates in various countries of the world, in almost all cases the birth rate exceeds the death rate. Therefore, the size of the population must increase. Some countries that have high birth rates and high death rates, with birth rates greatly exceeding the death rates, will grow rapidly (Afghanistan and Ethiopia). Such countries Usually have an extremely high mortality rate among children because of disease and malnutrition. Some countries have high birth rates and low death rates and will grow extremely rapidly ~Guatemala and Syria). Infant mortality rates are moderately high in these countries. Other countries have low birth rates and death rates that closely match the birth rates and will grow slowly (Sweden and the United Kingdom). These and other more, developed countries typically have very low infant mortality rates.

Obviously, the most important determinant of the rate at which human populations grow is related to the number of women in the population who are having children and the number each will have. The **total fertility rate** of a population is the number of children born per woman per lifetime. A total fertility rate of 2.1 is known as **replacement fertility**, since in the long run, if the total fertility rate is 2.1, population growth will stabilize. When population is not growing and the number of births equals the number of deaths, it is said to exhibit **zero population growth**. The age structure of a population also has a great deal to do with the rate of population growth. If a population has a large number of young people who are in the process of raising families or who will be raising families in the near future, the population will continue to increase even if the families limit themselves to two children.

Factors Controlling Population Growth

Man is the only one who has regulated his population by developing new astonishing technologies for better and secured future on one hand. And on other hand, created a problem of population explosion. Some factors are:

(*i*) Famines in a country or state lead to destruction.

(*ii*) Natural calamities like floods, droughts, earthquakes and volcanic eruptions, hurricanes etc. lead to death of thousands of people.

(*iii*) Epidemic diseases, endemic diseases wipe a big number of populations.

(*iv*) Wars cause heavy casualties.

(*v*) Unnatural accidents caused during transportation, fires etc. Some factors that have helped the population growth are:

(*a*) High production of food and better technologies for storage, processing and distribution.

(*b*) Better medical facilities provided during childbirth and under five years age by immunization.

The factors are many but they can be grouped into three as:

(*i*) **Geographic factor:** Like climate, soil, water, mineral resources, transportation etc.

(*ii*) **Demographic factor:** Like birth rates (natality), death rates (mortality), sex ratio etc.

(*iii*) **Socio-economic factors:** Like marriages, job availability, resources etc.

In the developed countries, population has started declining because of-

(*i*) Better medical and family planning facilities.

(*ii*) The low death and high birth rates. .

(*iii*) The educated people who know about 'the abuses of over population have small family.

Population and Standard of Living

Standard of living is a difficult concept to quantify since different cultures have different attitudes and feelings about what is good and desirable. Here, we compare averages of several aspects of the cultures in three countries: (1) the United States, which is an example of a highly developed if industrialized country; (2) Argentina, which is a moderately developed country; and (3) Zimbabwe, which is less developed. Obviously, tremendous differences exist in the standard of living among these three countries. What the average U.S. citizen would consider a poverty level of existence would be considered a luxurious life for the average person in a poorly developed country. Standard of living seems to be closely tied to energy consumption.

Population Explosion-Family Welfare Programme

Growth of Human Population

Emigration: The number of individuals going out from a population to join another population in a new locality resulting in decrease of the original population.

Immigration: It is the addition of new individuals to the population from other localities.

Density dependent factors: An increase in population leads to competition, since all its individuals have identical requirements for food and space. Population increase causes scarcity of food, consequently leading to death due to starvation.

Density independent factors: Interaction between populations in a given area can lead to mutual benefits, to competition for resources or dependence of one on the other.

Population explosion: The very great and continuing increase in human population in modern times. This is a great hazard to the development and prosperity of a nation.

Consequences of population explosion:

(*i*) It can lead to depletion of resources.

(*ii*) Severe competition for food and space.

(*iii*) Increase in psychological stress and strain.

(*iv*) Rapid pollution of environment.

(*v*) Large scale unemployment.

To meet the demands- of growing population, forests are cut, oceans are exploited and the entire natural equilibrium gets disturbed. A growth human population first faces the problem of food, then shelter and thirdly other socio-economic problems. Even if enough food is produced and the population growth does not show a steady slow growth but explosions then many secondary problems will certainly arise which are more persisting and problematic. Like in increase in competition for shelter, education, medical, rise in price index, ecological crisis etc.

Human Population: Malthus's Human Population Theory

In 1798 T.R. Malthus published an essay on population, the great economist outlined the problem of population graphically and stated that human population tends to increase in geometrical pattern (1-2-4-8.......) whereas the food production increases by arithmetic progression (1-2-3-4.........). This is called as theory of human population growth proposed by Malthus. For nearly 150 years Malthus view was nearly forgotten as the advancement of technologies to place. The world population during Stone Age was only 10 million as indicated in records. Earlier the annual growth rate, in last three centuries was roughly 0.4 = 0.5% where as it reached. to 2% in last two decades. The doubling time (the time required by a population to double itself) reduced from 200 years in 1650 A.D. to merely 35 years in 1980. During 1800 A.D. the birth rate and death rate was almost balanced.

Table 7.1: World Population Increase

S.No.	Date	Population (million)
1.	5000 B.C.	50
2.	800 B.C.	100
3.	200 B.C.	200
4.	1200 A.D.	400
5.	1700 A.D.	800
6.	1900 A.D.	1,600
7.	1965 A.D.	3,200
8.	1990 A.D.	5,300
9.	2020 A.D. (estimate)	8,230

Source: Population Reference Bureau, Inc., Washington, DC.

Current Population Trends

Currently, the world population is over 5.5 billion. By the year 2010, this is expected to increase to just over 7 billion people. In Africa, Asia, and Latin America, which already have nearly 80 percent of the world population. The total population of Africa, Asia, and Latin America will increase from the current 4.4 billion to over 7 billion by 20 I 0, when they will contain 83 percent of the world's people. These regions not only have the highest population growth rates, but also have the lowest per capita gross national product (GNP). The GNP is an index that measures the total goods and services generated within a country. This large difference in economic well being is reflected in a dissimilarity in the standard of living, an abstract measure of the degree to which necessities and comforts of daily life are met.

Table 7.2: Population growth rates in selected countries (1993)

S.No.	Country	Births per 1,999	Deaths per 1,000	Infant Mortality Rate (deaths per 1,000)	Rate of natural increase (annual %)	Time Needed to double population (years)
1.	Germany	10	11	6.7	0.1	-
2.	Belgium	13	11	8.4	0.2	330
3.	United Kingdom	14	11	7.1	0.3	267
4.	Japan	10	7	4.7	0.3	217
5.	Sweden	14	11	6.2	0.3	210
6.	USSR (Former)	16	11	2.8	0.6	123
7.	United States	16	9	8.6	0.8	82
8.	Canada	15	7	6.8	0.8	87
9.	Argentina	21	8	25.6	1.3	53
10.	Turkey	29	7	59.0	2.2	32
11.	Paraguay	34	6	48.0	2.7	26
12.	Afghanistan	49	22	168.0	2.8	25
13.	Ethiopia	47	20	127.0	2.8	25
14.	Zimbabwe	41	11	59.0	3.0	23
15.	Guatemala	39	7	59.0	3.1	22
16.	Syria	45	7	48.0	3.8	18

Source: Enger & Smith, 1995

Consequences of Continued Population Growth

As the human population continues to increase, the pressure for the necessities of life will become greater. Differences in standard of living between developed and less-developed countries will remain great because most population increases will occur in less-developed countries. The supply of fuel and other resources is dwindling. The pressure for these resources will intensify as the industrialized countries seek to maintain their current standard of living. People in less developed countries will continue to seek more land to raise the crops needed to feed themselves unless major increases in food production per hectare occur. Developed countries may have to choose between helping the less developed countries while maintaining their friendship, or isolating themselves from the problems of the less developed nations.

Even if the industrialized countries continue to get a disproportionate share of the world's resources, the amount of resource per person will decline as population rises. It seems that, as world population increases, the less developed areas will maintain their low standard of living.

Table 7.3: Twelve most populous countries in 2025 (population in millions)

S.No.	Country	1950	1992	2025
1.	China	554.8	1,165.8	1,590.8
2.	India	357.6	882.8	1,383.1
3.	United States	152.3	255.6	295.5
4.	Indonesia	49.5	184.5	285.9
5.	Pakistan	79.5	121.7	281.4
6.	Brazil	39.5	150.8	237.2
7.	Nigeria	53.4	90.1	216.2
8.	Bangladesh	32.9	114.4	211.6
9.	Russia	41.8	149.3	170.7
10.	Iran	16.9	59.7	159.2
11.	Mexico	28.0	87.7	143.3
12.	Japan	83.6	124.4	124.1

Source: Data from the Population Reference Bureau, Inc., 1993.

Environmental Implications of Food Production

The human population can increase only at the expense of the populations of other animals and plants. Each ecosystem has a finite carrying capacity and, therefore, has a maximum biomass that can exist within that ecosystem. There can be shifts within ecosystems to allow an increase in the population of one species, but this always adversely affects certain other populations because they are competing' for the same basic resources. When the population of farmers increased in the prairie regions of North America, the population of buffalo declined.

When humans need food, they turn to agricultural practices and convert natural ecosystems to artificially maintained agricultural ecosystems. Mismanaged agricultural resources are often irreversibly destroyed. In most cases, if the plants were fed to animals, many people would starve to death. In contrast, in most of the developed world, meat and other animal protein sources are important parts of the diet. Many suffer from over nutrition (they eat too much); they are "malnourished" in a different sense. The ecological impact of one person eating at the carnivore level is about ten times that of a person feeding at the herbivore level. If people in the developed world were to reduce their animal protein intake, they would significantly reduce their demands on world resources.

The current situation with respect to world food production and hunger is very complicated. It involves the resources needed to produce food, such as arable land, labour and machines, appropriate crop selection, and economic incentives. It also involves the maldistribution of food within countries. This is often an economic problem, since the poorest in most countries have difficulty finding the basic necessities of life, while the richer have an excess of food and other resources. Improved plant varieties, irrigation and improved agricultural methods have dramatically increased food production in some parts of the world. In recent years, India, China and much of southern Asia have moved from being food importers to being self-sufficient, and in some cases food exporters.

Population trends in India

India accounts for nearly. 1.5 per cent of the world population. Population has undergone an approximately three-fold increase during the last 80 years. According to the census of 1901, there were 235,396,327 people in this country. The number slightly came down in 1921 as a result of some epidemics. In ‘1951, the population was 361,008,0,90, which went up to 439,234,771 and 548,159,652 in 1961 and 1971, respectively. The main reason for the rapid growth is fall in death rate as a result of better medical care. The sex ratio in India’ in 1981 was 1071 males per 1000 females. In Punjab in 1981, there were 1138 males per 1000 females whereas the number of males to females in Kerala was 969: 1000. The age ratio of Indian population shows that there is high proportion of young people belonging to the pre-reproductive age group i.e. 42.2 per cent in the age group of 0-14 years.

Table 7.4: Population estimates for some of the states in India (1991)

S.No.	State/Union territory	Population
1.	Uttar Pradesh	1,38,760,417
2.	Bihar	86,338,853
3.	Maharashtra	78,706,719
4.	West Bengal	67,982,732
5.	Andhra Pradesh	66,304,854
6.	Madhya Pradesh	66,135,862
7.	Tamil Nadu	55,638,318
8.	Karnataka	44,817,398
9.	Rajasthan	43,880,640
10.	Gujarat	41,174,060
11.	Orissa	31 ,512,070
12.	Kerala	29,011,237
13.	Assam	22,294,562
14.	Punjab	20,190,795
15.	Haryana	16,317,715
16.	Delhi	9,370,475

Measures to Control over Population

Various methods for discouraging population growth in shortest period are:

(*i*) To educate the people about the abuses of overpopulation (Population education), food production, self-employment.

(*ii*) To provide free family planning aids (Family planning methods).

(*iii*) Motivating people to undergo sterilization process (Birth control) .

(*iv*) More incentives to families observing family planning norms (Limited family)

(*v*) By imposing legal restrictions (by laws).

(*vi*) Over-population is one of the numerous problems facing India. The solution of the population problem is very urgent. The population problem can be solved by major steps, which are given below:

(***a***) **Education:** The enormous rate at which Indian parents have been producing children is because of illiteracy and ignorance. People should be educated about the consequences of over-population and uses of planned and small family.

(***b***) **Family planning:** The expression family planning means a deliberate effort, and the adoption of suitable methods, to restrict the growth of family. That is to say family planning involves a deliberate limitation on the size of family. Following are some of the important family planning measures:

- Use of contraceptives (Mechanical, Chemical and Natural methods): Contraception means the prevention of conception. There are many contraceptive techniques available for use e.g. Today etc.
- Sterilization
- Abortion
- Use of other natural methods

Mechanical method

- **Condom** (For male's use): The condom is a sheath of rubber, which fits over the erect penis. It is placed on the penis of male before it is introduced into the vagina for copulation.
- **Diaphragm** (For female's use): The diaphragm is a rubber cup stretched over collapsible metal spring coil. It is designed to fit over the cervix (the mouth of uterus).
- **Intrauterine Contraceptive Device (IUD):** It is a small metal or plastic device, which is designed to fit inside the uterus mouth. A doctor must fit and remove **IUD**.
- **Norplant:** A new implant has been cleared by Health Ministry of India. The implant placed below the skin, ensures the contraceptive power up to 5 years. It is new contraceptive to India and there is some resistance to woman's body. Initially it will be used in urban areas.

Chemical Method

- **Jellies, creams and foam:** A number of different spermicidal jellies, creams, and foams are available for use of contraceptive agents. These jellies, creams or foams are inserted into vagina five to fifteen minutes before copulation to take place. Oral contraceptive: These are popularly known as pill are combinations of synthetic sex. Hormones (estrogens and progesterone) e.g. overall, mala. They suppress the production of ovum by hormones and alter the adulatory cycle.
- **Sterilization:** It is surgical technique by which the passage of sperms or ovum is disconnected. Both men and women can be sterilized without loosing their ability to function sexually.
- **Vasectomy:** In man the sterilization procedure is called a vasectomy. In this procedure the vesa differentia, the tubes that lead from the testes to the ejaculatory ducts, are cut so that the sperm produced in the testis cannot reach the ejaculatory ducts to enter the ejaculate.
- **Tubectomy:** In females tubectomy is done. In this procedure, the fallopian tubes, which transport the egg from the ovaries to the uterus are cut and tied off.

Environment and Human Health

Webster Collegiate Dictionary defines health as "the state of being hale and sound in body mind or soul especially from physical disease or pain. The concept of health incorporates physical state free from diseases, social and mental caliber of a human being. Community refers to a group of persons living at one place that shares and have social contact. A healthy man is an asset to the country, but a sick man is a burden. Community health services provide medical treatment of various diseases, controls the spread of communicable diseases, control of pests and insects, social welfare health service, maternity and child welfare services, school medical services, hospital, research institutions etc. Lack of nutrition, clothing and improper housing, etc. spread many communicable diseases. Maternal and infant mortality rate raises poverty also leads to child abuse, liquor and drug addiction, exploitation and crime against women, etc.

Environment and health are inter-dependent. Physical environment include climate, sound and radioactive pollution sunrays and heat, air pressure, water and air directly or indirectly affect our health. A person is surrounded by biological environment where insects and many other biological microbes, which in turn spread diseases. Social and economic environment also determine the standard of health. Man's social environment is developed in a family and family is the basic unit of a society. Small-sized families where family members are happy and prosperous their health will be in good condition. In large families rearing of children become a difficult task. Meeting the demands of nutritious food and health are not given priority with the result children's personality and overall development suffers.

(*i*) *Socio-economic factor*

Leads to inadequate family resources, which cannot fulfill the wants and thus reduces the health standards and food problem is more prevalent in poor families. Lack of sanitary habits and inappropriate nutritional food will develop communicable and harmful diseases. Illiteracy is one of the major defects to raise the standard of living, sanitation and health.

(*ii*) *Communicable disease problem*

In India communicable diseases generally spread on a large scale. The contaminated food and water intake, dirt, sewage waste, improper light and pure air, Improper ventilation arrangements in the house, stagnant water and dirt, over crowding, lavatory and cleanliness are some of the causes for the spread of diseases. Communicable diseases may spread through air, contact, contaminated food and water directly. Cholera diarrhea, typhoid etc., are some of the diseases. Insects and microbial parasites spread malaria and plague like diseases.

IMPORTANCE OF ENVIRONMENT

Vegetative plants and trees are called autotrophy because they can produce their own food through the process of Photosynthesis, this category is primary productive unit and their entire living organism depends on the vegetation for acquiring food. Photographs like insects, animals, birds and all human beings cannot produce their own food. Some microorganisms like bacteria, fungus, microbes, etc., derive food from dead plants and animals. Thus, all the living organisms are interdependent for their survival.

Human being is always adjusting to the ever-changing environment and in the past he has never attempted to alter it. But after twentieth century there has been a tremendous increase in physical wants and desires. Fast development in every sphere of life has undergone with the ever-increasing wants and demands for food products. Ever increasing pressure on land has caused forestland to be utilized for cultivation.

There is all-round development and progress in the field of science and industries, new technology is being introduced and I variety of products are now being produced. As a result environmental pollution has increased. New technology has provided us goods to make our lives happier, more comfortable and luxurious, pollution hazards and its ill effect are being observed in every sphere of life. There is general reduction in physical power and energy, also deterioration of health standards. Development and destruction are co-related and give rise to many problems due to environmental pollution, water pollution, air pollution, destruction of forests, disappearing wild life, radiation effect, on living organisms.

Man is acquiring essential resources from the nature itself. Hence, it is essential to protect and preserve the natural resources. Natural disaster and destruction have increased the temperature on the earth is steadily rising. Certain drastic steps are needed in order to save our planet.

DISEASES

(***a***) **Through respiration:** By nose, mouth, lungs, cough, sneeze, spit, spreads cold, measles, tuberculosis, pneumonia, etc.

(***b***) **Through intestine:** Human excreta spread typhoid, diarrhoea, intestinal worms, cholera, poliomyelitis, etc.

(***c***) **Skin:** Scale of the skin, skin pus like smallpox, measles, etc.

(***d***) **Through blood:** AIDS, malaria, yellow fever, dengue, filarial, etc., are some of the diseases which spread through blood.

1. DIPHTHERIA

It is an acute infectious and communicable disease caused by involvement of respiratory system. The microorganisms of this disease attack the tonsils, trachea, nasal passage and sound box and secrete a false membrane of oxotoxin, which cause inflammation. In severe conditions it causes difficulty in breathing. This disease is quite common among the children of the age of 6 months to five years. It can also occur up to the age of 15 years. The mortality rates are 50% in respect of diphtheria occurring below the age of 5 years.

Pathogenic organism: The microbes spreading diphtheria belong to bacillus group and are of three types:

1. C. Diphtheria gravies
2. C. Diph. Intermedius
3. C. Diph. Miti

Mode of spread: The spread of this disease may be by:

(*a*) Direct contact chiefly through the carriers, whether sick or healthy. Nasal carriers are more dangerous than throat carriers.

(*b*) Indirect transmission through infected articles such as, clothes, toys, utensils, etc.

Incubation period: It is of 2 to 5 days duration when the microbes enter the body.

Infective period: After the patient shows the symptoms of diphtheria and the period when microorganism leave the body is of 2-5 weeks on an average.

Symptoms: Initially the patient feels weak, nausea, and loses appetite and alertness.

Immunization: D.P.T. (Diphtheria, Whooping cough, Tetanus) vaccine is introduced to the child at the age of 6 weeks to 9 months in three doses. This vaccine is given at the interval of one month. A booster dose is given at the age of 2 years.

Prevention and Control

- The patient should be isolated.
- Disinfections of the home, bedding clothes, toys, utensils, etc., is done thoroughly.

2. WHOOPING COUGH OR PERTUSIS

Whooping cough or pertusis is an acute respiratory infections disease caused by *Bacillus pertusis* involving trachea, bronchi and bronchioles creating intense cough. Whooping cough occurs in all ages. Effect of cold weather and in colder regions enhances the incidence of disease.

Spread of disease: Since it is an infectious disease main source is the nasal discharge and cough. It spreads directly from person to person.

Incubation period: It is of seven to fourteen days.

Infective period: Three weeks after the symptoms are observed. Symptoms: The patient coughs frequently and its severity increases at night loss of appetite insomnia, weakness persists. Immunization: Vaccine is prepared from dead bacillus and is administered along with D.P.T. (Diphtheria, pertusis, tetanus).

3. TUBERCULOSIS

It is a chronic bacterial disease and highly infectious. Tuberculosis spreads through air and affect the lungs of the person. It is caused by tubercle bacillus. This is prevalent both in tropical and temperate climate.

Spread of disease: Tuberculosis spreads in the following manner:

(*a*) The infection spreads by inhalation of droplets expelled by the patient through, sneezing, coughing, yawning etc.

(*b*) Through direct contact

(*c*) Infected articles, clothes, utensils, etc. may spread the disease.

Incubation period: Incubation period is about four to six weeks.

Symptoms: Initially, the patient feels easily exhausted, fatigue doing ordinary work and feels excessive fatigue. Loss of appetite, hoarseness of throat, pain in the chest due to infected lungs. Patient sweats profusely at knight and feels weak.

Immunization: Child should be given B.C.G. (Bacillus Chalmette Guerine) vaccine by intra-dermal injection within the first three months of age.

Control and prevention: Following steps need to be undertaken to control the spread of tuberculosis:

- Health and general sanitary conditions of the community should be taken good care of. Every human being should live in fresh air and sunshine.
- Workers of cotton and ginning mills, coalmines, tobacco bidi making etc. should wear protective shield to prevent inhalation of dust or silica dust.
- Patient should be isolated. The disinfections of clothes, utensils, articles rooms etc. should be properly ensured.

4. CHOLERA

Cholera is an acute infectious disease caused by the infection of intestinal canal, characterized by sudden vomiting, watery diarrhea, cramps in legs and leads to fast dehydration.

Pathogenic organisms: Cholera producing microorganisms are Vibrio species and they can belong to two sub-groups:

1. Vibrio cholerae
2. Vibrio El tor

Vibrio cholerae: *Vibrio cholerae* is found in stools and vomits of the patient. It is active, mobile and grows in alkaline medium. It dies at 55°C in minutes. In contaminated water the organism can survive for two weeks. Insects, particularly housefly disseminates this disease.

Vibrio El tor: The other germ Vibrio el tor spreads in the Bay of Bengal and coastal areas in large scale through direct contact, unhygienic conditions, over-crowding, fair and feast on festivals incubation period: The duration of incubation period is very short, ranging from a few hours to five days.

Period of communicability: Lasts until the patient is free from cholera germs.

Symptoms: Patient starts vomiting and suffers loose motions. This may lead to loss of water and minerals in the body.

Immunization: Vaccine is prepared from dead Vibrio cholera and is given when there is a danger of spread of cholera.

Prevention and Control

- All deject should be collected in the can in which quick lime is placed at the bottom.
- Anti-fly measures should be adopted.
- Avoid eating of rotten fruit, boiling of water and milk, protection from flies and dust.
- Phenyl, bleaching powder and other disinfectant should be sprayed in the area.
- Segregation and disinfections of soiled clothes, articles used by the patient.

5. MALARIA

Malaria spreads in the rainy season. The malarial parasite is a protozoon named 'Plasmodium'. It survives in the red blood corpuscles of the human blood. Man acquires infection by the bite of an infected female anopheles mosquito, which inject the malarial parasites in the form of spores.

The malarial parasite is of four types:

(*i*) *Plasmodium:* It has a life cycle of 48 hours causing fever after every two days. .

(*ii*) *Plasmodium malaria:* It has a life cycle of 72 hours causing fever after every three days.

(*iii*) *Plasmodium falciparum:* Irregular fever may occur after every '48 hours. The symptoms are very severe and of malignant type: high fever, delirium and death

(*iv*) *Plasmodium ovale:* This virus produces mild kind of malaria. They are found mostly in Africa.

Incubation Period: The time when the insect bites and till the symptoms appear is called incubation period, which is as follows:

1. Plasmodium vivex—14 days
2. Plasmodium malaria—30 days
3. Plasmodium falciparum—12 days

Spread of disease: Female anopheles mosquito spreads malaria disease. For the spread of the disease, the optimum conditions are a mean temperature of 20° to 30°C with 63% humidity. Economic conditions, insufficient food, over-crowding, increase the incidence of malaria. Irrigation, leakage in canals, water logging, and rice cultivation may serve as the breeding place for mosquitoes.

Symptoms

The cold stage: The patient feels cold and suffers from fever, headache, nausea and vomiting.

Anemia and enlargement of spleen and liver are the after- effects of the disease.

Prevention of Malaria:

Malaria can be prevented in the following manner:

- Proper drainage, removal of stagnant water.
- To destroy mosquitoes at some stage of his life cycle i.e., during larva stage, or adults. Use of oil, diesel, kerosene. Gammexane, etc. can destroy the breeding.
- Cutting of vegetation, which has grown thickly, and servers as a breeding place in the daytime. Putting net, wire grill on doors and windows.

6. TETANUS

A toxin of tetanus bacillus induces tetanus or lockjaw, followed by wound. *Tetanus bacillus* lives in the contaminated soil of road, gardens and agriculture land. These microbes survive in the intestinal track of horses and cattle. They attack the nervous system and causes instant death.

Spread of disease: The bacillus enters the body through various wounds and spread their toxin in the blood stream like during operations, unhygienic deliveries of babies, etc.

Incubation Period: Generally it is of 8 to 10 days.

Immunization: Tetanus toxoid vaccine is given along with D.P.T. (Diphtheria, Pertusis, Tetanus). Intra-muscular injection is given in three doses at the interval of one month. One booster dose is given at the age of 5-6 years and another booster dose is repeated when the child is 10 years and 16 years of age. Tetanus vaccine is given as a preventive measure.

Prevention

All wounds should be treated carefully especially if there is a fear of contamination with refuses or soil wound should be thoroughly cleaned with disinfectant or 3% iodine solution. In addition, ATS (Anti Tetanus-serum) injection should be given.

Human Rights

A right may be defined as something to which an individual has a just claim. Human rights are those that individuals have by virtue of their existence as human beings. The right to life itself and the basic necessities of food and clothing may be considered fundamental human rights. Human rights traditionally have been put in two categories as:

(*i*) Natural rights and

(*ii*) Civil rights.

Natural rights are those that belong to individuals by virtue of their humanity: the right to remain alive, to sustain life with food and shelter and to follow the dictates of their conscience.

Civil rights are based on positive law: they are derived from laws and judicial decisions. Civil or legal rights are those granted by a government.

The entitlements are defined in the Universal Declaration of Human Rights adopted by the United Nation's General Assembly on Dec. 10, 1948, as "a common standard of achievement for all people and nations". It urged the right to political, economic, social and cultural self-determination the right to peace, the right to live in a healthful and balanced environment and the right to share in the Earth's resources.

Here, we are dealing with that part of Human natural rights which encompasses protection of environmental issues as these ultimately govern human health and survival:

(*i*) The right to life.

(*ii*) The right to an adequate standard of living and social security.

(*iii*) The right to education.

(*iv*) For children, the right to freedom from exploitation.

(*v*) The right of access to health-care services, with States aiming to reduce infant and child mortality and abolish traditional practices prejudicial to health.

(*vi*) The right of access to clean air to breathe.

(*vii*) The right of access to drink-clear and clean water.

(*viii*) The right to live in noise pollution free environment.

(*ix*) The right of access to gifts of nature/ resources.

(*x*) The right to live in a disease free environment.

VALUE EDUCATION

Aims of Health Education

The aims for community health education are as follows:

(*i*) Healthy practices in day-to-day living should be inculcated among the children from a very early age. This is how they will be able to understand the importance of health, hygiene and sanitation. .

(*ii*) The knowledge about our body and various organs of our body and their functions helps a person to understand the disease, its causes and common ailments.

Such factors which affect the health standards like smoking, eating tobacco, drug addiction intake of liquor etc., can be checked by resorting to some law and amendments to Improve the health standards. .

(*iii*) In order to create a clean environment in a city or town, people should be encouraged and awareness be created. Clean and safe drinking water system, good sanitary lavatories be provided at crowded places.

(*iv*) Proper arrangements for providing better health services to the people should be ensured and they should be introduced to various governmental health programmes like mother and child welfare, child welfare services, family planning, etc.

(*v*) Training programmes for officers, health workers, private doctors, nurses, midwives, etc. should be undertaken from time to time.

(*vi*) Health education can be imparted in an effective manner by personal contact programmes.

(*vii*) Personal hygiene, regular exercise and rest, importance of nutritive foods, ventilation and its effect on health, clean sanitary environment, causes of pollution and its prevention are some of the general topics for health education.

(*viii*) Practical knowledge should be provided about communicable diseases, serious health problems and first aid and emergency services.

Principles of Health Education

Every individual learns and understand some thing from his culture and social background. Based on school health programme adult-education programme is planned accordingly. Before understanding various teaching methods one should know the principles behind learning. These principles are as follows:.

(*i*) Every individual has learning capacity throughout his life.

(*ii*) Learning capacity is not affected by advancing age of an individual, but by lack of interest and desire for learning.

(*iii*) For learning the same material, all individuals will not learn the same way. This variation is due to the background experiences and individual's circumstances and exposure.

(*iv*) Individuals own effort will play a significant role in making a change in habits and concepts. Learning is not the outcome of one individual saying something to other individual, but it is learnt through his own efforts and willingness.

(*v*) An individual learns for love, satisfaction. and basic human needs of survival, food and social approval. .

(*vi*) People learn faster when they are acquainted with the objectives and goals. Means of achieving those goals and use the resources properly should be clear.

(*vii*) An individual take an appropriate time to learn something new, so one should be given enough time to absorb what he has learnt.

Purification of water at domestic level

Purification of water at domestic level can be achieved by the following methods:

1. Distillation
2. Boiling
3. Filtration
4. Chemical method of sterilization
5. Ultra-violet sterilization.

(*i*) **Distillation:** In the process of distillation water is heated and evaporation takes place, whereby water changes back to water when cooled. This process is called condensation. The condensed water is the purest form of water, free from microbes and impurities.

(*ii*) **Boiling:** It is boiled for ten minutes to kill the microbes present in it and also removes the temporary hardness of water.

(*iii*) **Filtration:** Different varieties of filters are used to purify the water at domestic level.

Chemical methods for water sterilization

(*i*) **Aluminium sulphate:** It is largely used to purify muddy water.

(*ii*) **Chlorine:** Chlorine gas or tablet is added to destroy disease-producing germs. It is a very cheap and convenient method.

(*iii*) **Potassium permanganate:** It oxidises the organic matter and destroys 98% of the microorganisms in four to six hours.

(*iv*) **Purification by the use of ultra-violet rays:** Ultra-Violet rays have the power of destroying microorganisms from the water without any chemical change. They exert their action only when the water is fairly clear and bright.

VENTILATION

Ideal ventilation is possible only when there is sufficient pure air. Ventilation is defined as the "Science of maintaining atmospheric conditions which are comfortable and suitable to the human body." Ventilation incorporates comfortable and appropriate balance of gases, also optimum temperature adequate humidity, movement or flow of air and free from disease producing microorganisms.

(a) Internal Ventilation

Proper ventilation of the rooms is known as 'internal ventilation. Lack of efficient and adequate ventilation leads to many discomforts and diseases. When the carbon-dioxide concentration exceeds 0.04% and reaches 0.06% then the air in the room gets suffocating. Every person needs 3000 cu feet of air every hour and if the impurities in the air exceed 0.02%, the air is regarded as impure and unhealthy.

(b) External Ventilation

Fresh air flows into the house from the surroundings and open space. This type of ventilation is known as external ventilation. This is ensured by making the streets wide and straight, providing open space, parks and gardens.

Artificial Ventilation

Artificial ventilation is easily controlled and, installed. The means of artificial ventilation are coolers, air conditioner, which are more frequently, used equipments. Humidifiers and dehumidifiers are used where there is problem of humidity. Exhaust fans also play an important role in bringing in fresh air and flushing out polluted and impure air.

Inadequate Ventilation and Health

Inadequate ventilation has following effect on the occupants of the room:

(*i*) Lack of oxygen leads to early fatigue and reduces alertness.

(*ii*) Results in sweating, heat exhaustion and faintness.

(*iii*) Foul odours from skin, mouth, stomach and clothes produces uneasiness, sickness etc.

(*iv*) Unventilated environment leads to digestive disorder loss of appetite, anemia, metabolic disturbances, etc.

(*v*) Cold, cough, infectious diseases, influenza, pneumonia etc. are some of the problems of inadequate ventilation.

(*vi*) Gases from exhaust vehicles and industries damage the eyes and trachea.

The Aids Pandemic

The AIDS (Acquired Immune Deficiency Syndrome) virus has caused a worldwide epidemic, which can be called a pandemic because it continues to spread throughout the world. Millions of people have been infected. The virus was first identified as the cause of AIDS in the late 1970s. Since then, individuals with the infection have been reported in nearly every country in the world. Estimated mortality rates are about 60 percent, according to the U.S. Centres for Disease Control and Prevention. The disease is spread through direct physical contact, between individuals in which body fluids containing the, virus enter the bloodstream. Sharing of contaminated needles among intravenous drug users and sexual contact are the most-likely methods of passage. In the United States, the disease was once considered a problem only for the homosexual community and those who use intravenous drugs. This perception is rapidly changing. Many of the new cases of AIDS are being found in women infected by male sex partners and in the children of infected women. In parts of Africa, the disease has always been primarily a heterosexual disease.

In the poor countries of central Africa, many believe that permissive sexual behaviour and prostitution have created conditions for a rapid spread of the disease. In addition, there is little opportunity for medical care. Many people have already died from the disease. Others who are currently infected will die in the near future. Some villages are already beginning to notice a change in the structure of their populations. With the death, of young infected' adults, villages are composed primarily of older people and children. The disease is spreading at an alarming rate, and, it has no cure as yet and no vaccine so far. The disease is almost fatal. People in the age group 20-39 are more susceptible to getting AIDS.

Causative germ of AIDS is a virus named HIV (Human Immunodeficiency Virus). It has been detected in body fluids like blood, semen, saliva, tears and urine. It attacks the immune system (i.e. the' cells that fight against infections) and the patient suffers seriously from even minor infections of other diseases. Even cancers appear when the immune system fails.

Incubation period i.e. the time between receiving the infection and the' appearance of symptoms may even be more than 10-12 years. During this period the persons show positive results for HIV infection and they are popularly called HIV-positive. Most individuals, when AIDS is fully developed, die within 3 years from other infections or cancers. Symptoms during this period may include swollen lymph nodes, fever, night sweats and weight loss.

Transmission of Aids

The AIDS virus is highly infective. It is transmitted by any one of the following methods:-

(*i*) **Sexual intercourse** between a man and woman, when anyone of two is infected. (The virus occurs in the fluids of the reproductive passages). Prostitution is the biggest source to spread the infection. Safest is the single partnership wife and husband relationship.

(*ii*) **Homosexual intercourse** (anal sex) with an infected person. The disease is more common in homosexual males.

(*iii*) **Contaminated blood transfusions.** In many situations the patients have to be given blood transfusions as in excessive bleeding resulting from injury, or during surgery, etc. Some children are born with the disease thalassemia with defective hemoglobin of the blood. Such children have to be given regular blood transfusions usually every 3-4 weeks and very often the blood transfused is from professional donors.

(*iv*) **Mother to child transmission.** The germ from the infected mother may cross through the placenta and reach the embryo in the womb.

(*v*) **Injection needles** if shared by more than one person may introduce the virus from one individual to another. The disease is quite. common in drug abusers. For the same reason, doctors in hospitals now use only disposable syringes, which are used just once. AIDS is not transmitted by contact with patient's clothes and other articles, shaking hands, eating together and sharing bathrooms and toilets.

Women and Child Welfare

Women and Environment

As child bearers, 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. Women's work is generally undervalued. 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.

Child Power

Children begin to acquire an extremely important economic role. They do many crucial tasks like caring for younger children, fetching fuel, fodder and water and grazing animals, so that the adults can undertake waged labour. "Children have become the unwitting victims of the continuing energy hunger in a family below the poverty line, is compelled to meet its energy needs only by producing several children." But this will not only have important implications for the education, health and nutrition of children but also for the country's massive family planning programmes and the health of women. If underfed and overworked, women are also expected to bear many children, the impact on their health will obviously be drastic.

Some organizations working for women and child welfare are:

- National Institute of Public' Co-operation and Child Development (NIPCCD)
- World Health Organization
- Central Social Welfare Board
- Voluntary Health Association of India
- Indian Council of Child Welfare
- United Nations Children's Fund and others.

(A) Central Social Welfare Board

Central social welfare board was established in 1953 under the social Welfare Ministry. It generally assists in the improvement and development of social welfare activities. Grant in aid programme, welfare programme development, control and evaluation work, training and motivation are the main objectives of the social welfare board. Its functions are:

(*a*) The spirit of continued partnership between statutory and voluntary welfare services to act as complementary and supplementary to each other.

(*b*) Provides technical and financial aid to the Panchayati Raj Institutions in accordance with the schemes and principles approved by the government of India.

(*c*) Promotes social welfare activities intended for family, women, children and the handicapped. Assistance in case of unemployment, under employment, old age, sickness, disablement and other cases of under served organization.

(*d*) It is change over from un-organized charity to the systematic line of support by state government wherever considered necessary or desirable.

(*e*) Need for rationalizing the system of rendering financial assistance to voluntary organization for the uncovered areas.

(*f*) Conducting of regular surveys regarding the needs and requirements of the social welfare organization.

(*g*) Co-ordination and cooperation among the voluntary organizations functioning at all levels, amongst themselves and with the governmental agencies, between the concerned government departments at central and state level, district and local levels.

Other functions of Central Social Welfare Board

(*i*) *Mahila Mandal Programme:* Various voluntary Mahila Mandals are getting assistance from the central social welfare board.

(*ii*) Holiday Homes for Children are organized for 15 days for socially and economically backward families. The camp aims at giving training to children in discipline, sense of group living and team spirit, help in national integration, apart from exposure to new surroundings.

(*iii*) *Creches Programme:* This programme provides day care services for children of working and ailing mothers.

(B) VHAI-Voluntary Health Association of India

Indian Women's Sabha: The Indian Women's Sabha organizes Maternity and child health centres. The branches of this Sabha ate found all over the country, clinics, hospitals, adult education centres, milk distribution centres and family planning programmes are managed by the women's sabha.

(C) Indian Council of Child Welfare (ICCW)

Indian council of child welfare was established in 1952 for the welfare of children and providing health services to them. The council has its branches in every state with its head quarters at New Delhi. The main functions of the institution are:

(*i*) Initiate, undertake or aid directly or through its branches or affiliated bodies schemes for the furtherance of child welfare in India.

(*ii*) It provides dissemination of knowledge and information and to educate public opinion for child welfare programmes on a scientific basis.

(*iii*) Establish a central bureau for the study and collection of data and statistics in respect of child welfare work.

(*iv*) It cooperates with national and international organizations having similar objectives.

(D) United Nations Children's Fund (UNICEF)

It is an international agency, a subsidiary body of the General Assembly. It came into being on 11th December 1946 after the Second World War. Now the words 'international' and 'emergency' have been dropped from the name of the organization. It is now called United Nations Children's Fund but abbreviation in vogue is still UNICEF. UNICEF has completed 48 years of service in India. UNICEF is not financed through the regular U.N. budget, but by voluntary contributions from the member countries, besides individual organizations. 10% of its resources come from the sale of UNICEF greeting cards. Aid is given only for those projects, which aim to prevent disease and promote health of the mothers and children.

India and UNICEF

UNICEF has completed 48 years in the year 1997 and has provided assistance, training programmes and many regional projects started from time to time. UNICEF has changed many facets and programmes for the ever-changing health standards. In 1959 WHO and F AO along with UNICEF started a nutritional programme for the children of less than 5 years of age. Then it was changed to Extended Nutritional Programme, which was organized through Mahila Mandals. In 1963 this programme was made more useful by giving nutrition to children and also to pregnant and lactating mothers and named as Applied Nutrition Programme. In the decade 1980-90, UNICEF expanded its services to remote rural areas.

Functions of UNICEF

(*i*) *Child Development and Survival*

UNICEF provides priority to infant and children's health and nutrition programmes. Child and infant mortality rate during the decade 1985-95 declined from 110/1000 children to 8711000.

(*ii*) *Universal Immunization*

Expanded Programme on immunization (EPI). This programme was started by the W.H.O. in 1974 for providing immunization against six fatal diseases i.e. measles, poliomyelitis, diphtheria, whooping cough or pertusis, tetanus and tuberculosis. This fulfils the concept of providing primary health protection for all children.

(*iii*) *Nutrition*

UNICEF assist in conducting the Applied Nutrition Programme by establishing nutrition centres, school and community gardens. Provides funds for training and nutrition programme at rural level.

(*iv*) *Primary Health Care*

The UNICEF sponsors Child health care programmes. It provides funds for the training of doctors, nurses, and public health officers, health workers. UNICEF is providing equipment and material for primary health centres and sub-centres as well as hospitals and laboratories, which support them.

(*v*) *Formal and Informal Education*

UNICEF provides stipends for refresher training to teachers including primary-school teachers.

(*vi*) *Water and Sanitation*

Water and sanitation are part of health programming and UNICEF co-operates in programmes to supply safe water and improved sanitation.

(*vii*) *Urban Services*

UNICEF provides stipends to more women and girls for training in child care, home-crafts, food preservation and income-earning skills and provide stipends to train local leaders to help organize activities in their own villages and communities.

Information and Electronic Revolution

With the beginning of the electronic age in recent years, Our world has become a place where information and communication are regarded as the most valuable resources. Our world has now shrunk to a 'global village' and we now have access to places our grandparents didn't know existed. Information from cosmopolitans to unexplored frontiers are all now available at a drop of a hat, it's just a matter of mouse-click. Data flows at the speed of light in today's wired world, or shall, we say the wireless, paperless and non-messy world. The advent of the Internet has, in a way, brought continents together once again.

Modern technology has also minimized our utilization of resources; *e.g.* today's, sophisticated engineering has replaced the blind usage of metals in every production. Thanks to the marvel of lightweight alloys and composite building materials, automobiles now require half as much metal as they typically used to do a generation ago. Today 1,000 soft drinks cans are manufactured with around 6 kg of aluminium, which once used to require 50 kg of steel. In the 1970's, when the fear of an impending shortage of metals gripped the world, countries like the United States began stockpiling essential minerals to keep their resource inventory up-to-date. Copper for electric wiring, telephone cables, and electric motors were in short supply. But then glass-fibre optic cables, ceramic magnets, microwave relay systems and satellite communication networks were invented. We now have a copper surplus.

Similarly, technology has also cut down our fuel consumption. Diesel engines replaced coal-based steam engines in locomotives, which were, further replaced by more efficient and pollution-free electric engines. The popularity of high-mileage yielding, fuel-efficient vehicles have made the gasoline guzzling vehicles obsolete in the market. Such advancements in the field of information technology have made distance between two places immaterial. Today, people can communicate via teleconference and transmit data through fax machines and computer networks, and save precious time & fuel wasted earlier in traveling for meetings and business appointments. It is no longer necessary for all workers to commute to an office building in the congested city to do their work. Increasingly, workers have home offices linked electronically to co-workers, clients, libraries, databases, and business opportunities elsewhere in the world. Commercial establishments are moving away from the brick-and-mortar set-ups to more affordable, cost-efficient, far-reaching virtual offices on the Internet.

Suggestions

Almost every country in the world is spending more & more in the information technology. Just-in-time delivery systems and recycling further reduce the amount of virgin materials we use. We will probably never reach a point at which we don't need to extract resources from nature, but we may greatly lower our consumption rate as well as the rate at which we produce wastes and pollution. This would surely have important environmental benefits.

QUESTIONS

1. What do you understand by the population growth and population explosion? Explains.
2. What is the relation between the environment and human health?
3. Write about the human rights and value education in 500 words.
4. How we can prevent the HIV/AIDS in the world?
5. What is the Role of information echnology in environment and human health and how it helps the population?

CHAPTER 8

Environmental Science : Field Trip

Introduction

Today, educationists have come to realize that the immediate Environment is a wonderful curriculum laboratory providing extremely dynamic, interesting and real life opportunities for learning. In its historical records every Environment has the stories of people and resources woven into the pattern of national development. Basic social processes and problems operate in every Environment in action for or against. As we investigate social problems they become concrete in our own communities. Thus, the Environment provides concrete data on cultural, industrial, political and geographical facts and relationships. As these data are tangible, seeable and describable the school should take itself to the Environment, regard it as laboratory, discover its resources, understand its culture, appreciate its problems and also suggest solutions to these problems. Through the use of resource people, field trips, environment surveys, service projects, etc. it should open doors for experience for a child to have knowledge about the factories and farms, social agencies and museums, council sessions and union meetings.

The school and the Environment must work together in the process of education in a co-operative and collective quest. In the absence of this living, dynamic relationship between the two, education will be anemic, unreal, and unable to make any abiding impact on the mind and character of children. The life of the Environment is powerfully influenced by social purposes the techniques of production, knowledge and culture. Not able to keep pace with these changes and adjust its programmers to them the school becomes an outdated, backward looking agency. Modern school cannot be an island in the midst of the Environment. It must enrich the Environment and the Environment must support it. The two-way traffic should not only be possible but also pleasant and useful.

"Let us study the Environment, use the Environment, serve the Environment and involve the Environment in the educational process." Let Environment Education reform shall start with the relining of the school to Environment and the restoring the intimate relationship with the environment.

Methods of Utilizing Environment Resources

There are basically two ways in which the teacher may make use of environment resources—

A. Taking the school to the Environment

B. Bringing some of the Environment to the school

A. METHODS OF TAKING THE SCHOOL TO THE ENVIRONMENT

The emotions of children are most easily reached not by words but by sights and sounds. This is possible through field trips, surveys, camping, service projects, etc.

1. Field Trips

Environment Education teaching programmers are not complete without a field trip. Field trips may be undertaken for securing information, changing at des awakening interest, developing appreciation, promoting ideals, enjoying new experiences. Initiating a unit of study they can be a part of the core of it or they can give it the finishing touch. They are a means of getting first-hand knowledge and confirming and supplementing second-hand knowledge. They are a means for sharpening observation, testing principles and doing everything, which Environmental Science requires.

Types of Field Trips

1. Complex undertakings—These require elaborate transportation, full-day planning, and additional adult helpers. These longer trips to historical sites and special events beyond the local Environment have exciting destinations to be explored for problem-solving and project executing the offer valuable opportunities for observation of the easily planned visits to factories, radio stations, newspaper plants, whole-sale and retail establishments, libraries and the like.
2. Simple undertaking—These may be embarked at the moment of conceiving the idea—the walk around the block to see nature and man getting ready for winter, the Journey to the neighboring farm, the walk through the park to gather some needed specimens etc.

Uses of Field Trips

(*i*) Stimulating imagination and laming through sensory perceptions—Some examples are the taste of fresh milk, the breathtaking heat of a glass furnace, the metallic hum of a weaving room, the sight of real things in the real world of adults.

(*ii*) *Integrating classroom instruction*—This is done by exposing the artificiality of traditional subject-matter divisions and enabling the pupils to view facts and forces as they exist in their everyday relationship in living communities.

(*iii*) Environment Realization through the field trips the student may come to realize Environment in ways different from bookish laming. They may come to know, see and feel their Environment as a way of life, “acting with vividness”

(*iv*) *Laming the art of living with others*—Traveling in the same conveyances, sharing rooms, sitting at the same table, participating in the same experiences are helpful on marking. Character qualities and defects come to the surface.

(*v*) *Expanding emotional and intellectual horizons*—This may be done making us acquainted with people whose manner, customs, living standards, outlook and interests may be quite different from our own.

Procedure of Field Trip

1. Preparation

A field trip should be planned democratically, organized properly, and executed carefully. Permitting our pupils an immediate reconciliation with "life in the round" requires a preface and follow-up connected with and extend to classroom study. It should be much more than "going to places and seeing things."

2. Objective

Every pupil, as well as the teacher, should become fully aware of the objective why this particular trip is being planned, and of how it is related to his own classroom experiences and activities.

3. Guidance

Appropriate audio-visual aids may be used both for initial motivation and for general orientation to what will be seen on the trip itself. It will be better if the teacher suggests guide questions, which the pupils might put, while approaching Environment leaders from whom they want useful information about the various aspects of Environment life. Major purposes should be clarified and made specific.

4. Information

The teacher should be thoroughly familiar with the best route, bus stops provisions for guide service, things to be seen and done by the group, aspects or phases of the resource centre to be stressed or ignored, eating arrangements, time needed at each stage of the trip, etc.

5. Definite follow-up activities

These also form an integral part Utilizing Environment Resources in Teaching Environmental Science of any well-arranged trip. They may take the form of reading books on the places observed, writing reports or descriptive accounts, preparing scrap-books, panel or forum discussions.

6. Evaluation

Trips should be evaluated in terms of the originally established purposes. Mistakes and difficulties should be diagnosed; the conduct of the group should be discussed. The letters of thanks should be written to the persons concerned.

ENVIRONMENT RESOURCES

Environment Surveys

Environment surveys provide excellent educational experience to senior pupils. They constitute an organized and systematic method for an accurate determination of social or physical data.

1. Surveys foster comprehensive understanding of Environment structure and processes in their everyday operation, interaction and complexity.
2. They are extremely useful in stimulating depth of insight into vital Environment problems, which should be met.
3. They suggest possibilities for student participation in the affairs of the Environment. Such constructive participation imparts training to the pupils in democratic citizenship.
4. They develop awareness of human inter-dependence and of the practical necessity of general civic cooperation in carrying on successful individual group living.
5. Existing conditions can be critically examined and the way it is prepared for superior citizenship.

Scope of Environment surveys

1. Any aspect of the Environment, which has meaning for young people.
2. Past history of the locality, the social institutions, the customs, the traditions, the conventions, the ceremonies, the folk ways, the folk songs, and folk stories.
3. Problems of the Environment such as the problems of housing, health, sanitation, employment, taxes, traffic is some problems in which pupils will be interested.

Use of Environment Surveys

1. Procedure

Environment surveys can be useful only if they are conducted properly. The actual survey should be preceded by much discussion and framing of questions, for the best results are obtained, when the investigators have got warmed up to problems and seek answers and solutions to questions that have stirred in their minds.

2. Teachers

They should possess definite awareness of directions and possibilities before the group undertakes such explorations. They should spend as much time as possible in personal observations of the Environment in order to get the feel of it.

3. The interest of the pupil

The -teacher should arouse interest by relating the proposal for a survey with factors that touch the life of the pupils. He should see that survey has its basis in the good and bad achievements of people. Instead of starting with statistical summaries he should start with people.

4. Objectives preparation

(*i*) The purpose of the survey must be made clear.

(*ii*) The problem must be properly analyzed.

(*iii*) Practical limits to the survey should be set.

(*iv*) Techniques to be used for collecting data should be decided upon.

(*v*) Data once gathered should be verified.

(*vi*) Collected data should be recorded for future use.

5. Teacher's attitude

The teacher should have an encouraging attitude, never an "I have been through all this before" attitude. The teacher and pupils should work co-operatively together in a spirit of shared research. Environment survey ought not to be a one-man job. The entire staff on a continuing basis should carry it on co-operatively, year after year. The pupils and the teachers can approach local experts, old residents and social workers by collecting data. Various types of important persons can be interviewed; places of interest can be visited.

6. Resources

The resources, uncovered in the survey, should be grouped in a logical way such as local industries, places of historical interest, governmental agencies, civic establishments, places of geographic importance, - persons to interview, persons of cultural significance and similar categories.

3. School camping

The drift to cities and the rapid tempo of modern living is creating a need for developing a closer relationship between human beings and natural resources. Called a classroom in the woods, the camp is a part of the larger Environment. The outdoor environment, in and around the camp, offers tremendous possibilities for true education. The opportunities to learn, work and play amidst the natural resources of the area stimulate interest and concern for the protection and wise use of the natural resources of the Environment.

Advantages of School Camping

1. Learning by doing

School camping encourages direct learning experiences and has potential life-situations that are conducive to the most effective teaching methods, through learning by doing, seeing, hearing, testing, smelling and feeling with a minimum of answers given by teachers and resource leaders.

2. Miniature environment

The school camp is a miniature Environment with the campers and teachers as citizens. Many of the problems, faced by the Environment are inherent in the camp social as the handling, preparation and eating of food, sanitation, sewage disposal, housing health habits; social and cultural differences and the process of representative government.

3. Democratic group life

Camping experience, is democratic group living, which proves useful in inculcating good qualities in the pupils. It enables the pupils to understand the physical environment and to use natural resources wisely. It provides additional real situations including work-experiences, where may be applied many of the ski1I and attitudes developed in the classroom.

4. Duration and types

Duration of the camping will depend upon the age of the pupils. Camping can be taken during school time for a one-week period, two weeks or a longer period. Similarly, the types and patterns of camping will vary according to the .age of the pupils. Appropriate activities can be taken up by the campers depicting the, folklore and history of the area, Indian life, transportation, correction of soil erosion, excavation of relics, etc.

5. Environment Service Project

The pupils for civic welfare involving individual activity of an integrated mental, physical, emotional can take up Environment Service projects and spiritual nature, Service-projects are of educational value to the pupil as well as to society.

Examples of Service Projects

1. Social service among the backward population of the town. This includes cleanliness, 'anti-mosquito campaigns, bathing young children, attending on the sick.
2. School labour service being organized on special occasions. These may be Republic day, Independence Day, Gandhi Jayanti and Gandhiji's Death Anniversary. Activities like planting of trees, road repairs and erection of platforms, cleaning of drains, digging of manure pits and drain, may be taken up.
3. Animal welfare. This may be done through provision of water facilities, fodder and medical aid.
4. Beautification of villages. This may be done through' planting of trees, laying out of avenues, clearing up of public paces like streets, temples, drains, etc.
5. Relief Parties. Relief parties consisting of teachers and pupils may go out in the service of the Environment at times of natural emergencies such as floods, epidemics, fire, earthquakes, etc., They may leave their classrooms to plant trees in out-of the way places of the Environment. They may help the Environment on fairs, festivals, and elections. They may undertake anti-mosquito campaigns, attend the sick, etc., or work on fund raising for the welfare of the poor.

Advantages of Environment Service Projects

1. They lift education from the dull routine of leading each generation in the footsteps of its predecessor, to earnest yet joyous adventures in cooperative welfare.
2. They help in raising the status of the pupils. Their all-round growth and development is stimulated. Service projects help in making world citizens out of provincial youngsters because they lift the imagination from personal matters of the moment of the enduring life concerns of all peoples everywhere.
3. Children have a hunger for participation, which may be fed by experience. Schoolroom walls should disappear. The school and Environment must combine to meet the challenges of the crises that may beset the Environment so often.

Precautions in Use of Environment Projects

1. Service projects undertaken by the school should not be too complex, costly, dangerous, involved or delicate. These should be discovered through Environment surveys and other informational learning activities.
2. Education weeks, clean-up weeks and youth weeks, projects in public safety, civil beauty, health, agricultural and industrial improvement, local history and protection of resources are some of the projects through which the pupils and Environment can mutually benefit.
3. Teachers of foresight and patience shall do much to provide functional, realistic and democratic education through such Environment service programmers.

4. Service projects must be planned, executed and evaluated with extreme care.

Form of Environment Project Information Card

Type:

Data needed:

Person to call:

Equipment needed:

Expenses:

Age of children:

Educational value:

Length of time:

Comment:

B. METHODS OF BRINGING THE ENVIRONMENT TO THE SCHOOL

1. Lectures by resource persons

People as well as books are desirable sources of information and inspiration. In every Environment no matter how small or isolated, the scores of person of rich and varied background, who can open doors to vivid learning experiences? These include the banker, the doctor, the engineer, the merchant, the artist, the sarpanch, the municipal commissioner and the editor. These are Environment's human resources, which can be utilized by the enterprising teacher to enrich and vitalize the school programmed. These distinguished men are resource persons who can explain to students their own important role in the Environment and services rendered by them to Environment in the different directions. Important persons from other towns, states and countries can also be invited to create better understanding of different types of people. This will help students identify themselves with other people and their problems.

Lectures by resource persons provide the students opportunities for developing social skills in real life-situations such as letter writing, making introductions, receiving guests, carrying on conversations, listening attentively and leading discussions.

Form of Data regarding the resource persons Name:

Address and phone:

Subject:

Has child in school- Yes/No

Class:

Comment:

2. Parent-teacher associations

It has been well said that people "care when they share". Parent-teacher associations create a constructive involvement of parents in the school policy and programmed planning, execution and evaluation. They co-operate in making the school a real Environment centre, to locate and list resource visitors to the classroom, to assist with field trips and surveys and to develop the Environment programmed generally. Parents' participation in the school programmed is also an intrinsically rewarding process for them. They know what is going on in the school and what is expected of their wards. When the parents of the children in his charge appreciate the work of a teacher, it gives him encouragement and inspires him towards better and greater efforts. Thus, parent-teacher associations serve as two-way channels of communication between school and Environment.

In these associations, parents meet the pupils in the school and relate their experiences. Their success serves, as mottos and failures as eye-openers for the pupils. When they 'talk' to children in the school the gulf between and Environment is bridged.

The experiences from the parents may be used in socio-drama in which children play the role of parents and other important characters of the Environment. The characters acted out by the children can be made use of in teaching to give factual information regarding skills, biographical comparisons, local customs and individual's peculiarities. It can be a rich source of conveying social, economic and moral values.

3. Social service activities

The school furniture; the rooms, the playgrounds, the school hall, the school gymnasium and audio-visual aids may be lent to the adult Environment for purposes of education and recreation. School can be made the centre of social education. Bulletin Boards may be set up, containing daily news and other useful information about the local Environment in particular and the country in general. .

4. Celebration of festivals and national days

Environmental Science teaching can be improved with the help of fairs, festivals and national days celebrated in the Environment. Every child is told about the significance of these social events, which provide opportunities for dynamic, interesting and real life learning. Celebrations of the birth and death anniversaries of great men like Janm-Ashtami, Good Friday, Easter Day, Shabe Barat, Id-ul-Zuha, etc, make the children familiar with the noble ideas and deeds of the great men. These can tell the children about the different religions and the beliefs of India. Familiarity with them can develop in the children a noble ideal of toleration and a spirit of accommodation. Cultural festivals like Raksha Bandhan may help to give an insight to the children into Indian culture. Festivals like Lohri and Basant Panchami, national days and U.N. Day, Human Rights Day and Red Cross Day may develop international understanding and make the children understand the life of human beings allover the world. Celebration of Children's day may enable them to realize their own charter of rights. Observance of Social Education Day may show them the magnitude of illiteracy in our country.

5. Local fairs and festivals

A number of local fairs and festivals are celebrated in every locality. These can enlighten the pupils about the local traditions and local customs. Interesting talks may be arranged on how to celebrate local fairs.

6. Talks on National and International Problems

The school authorities may arrange talks on current problems of national and international interest. Members of the Environment may be cordially invited to listen and participate in the discussion.

7. Financial aid by the Environment members

Well-to-do-members of the Environment may be asked to help the school enterprise financially.

8. Apprenticeship

Local trades can provide apprenticeship experiences to the students. The Role of Teacher in liaising Environment Resources the role of the teacher for the proper utilization of the Environment resources is very important. There is always a likelihood of the existence of evil trends like favoritism, nepotism, dishonesty, hypocrisy, etc. in the Environment life. The teacher should bring home to the pupils the idea that children should study the Environment life, and fight these evil trends. The teacher should make a wise and judicious study of Environment life to build reasonable pride on its past achievements, and faith in its future possibilities. He is required to make the pupils alert about the processes of the Environment. He must develop the right attitudes towards the Environment local, national and international. By displaying initiative and resourcefulness, foresight and patience to, build the Environment understanding of the pupils, he can prepare them to be worthy members of the Environment.

Advantages of Utilizing Environment Resources in Environmental Science

1. *Natural way of imparting education.* A study of the Environment is useful for imparting education in a natural way. Proceeding from the known to the unknown and from the near to the distant it is natural process of establishing relationship, particularly suitable to young students.
2. *Growth of new interests.* A survey of the Environment and a study of its problems, provide opportunities for the growth of new interests, which are natural and creative, not imposed from outside but developed from within.
3. *Choice of vocation.* Study of Environment offers a wide choice of vocation to school children who observe various groups of people in the Environment engaged in different economic activities for the welfare of the Environment. This observation creates interest and urge in the minds of some boys to explore industries, means of transport and communication, trade, commerce, business, agriculture and so on in their adult life. Some girls may feel inclined to home nursing, preparation and distribution of food, teaching or religion. Thus, a choice of vocation for adult life-may be made by students right from the primary or secondary school stage.
4. *Social use of leisure.* Interested in the Environment outside the school, the student would spend his spare time in the study of some specific portion of the Environment life. Carrying this interest beyond school days, he may acquire a technique for using the increased leisure at his disposal creatively and usefully.
5. *Development of skill and attitudes.* After studying the problems of one's Environment, one may think of development of one's city, town or countryside. The students may

grow into useful citizens, anxious of tackling social problems: They may build, a sense of values and take pride in participating in their own Environment life. Friendships and appreciations may develop. Skills may be fostered. A sense of security may give a sense of pride in one's Environment past achievements and a reasonable degree of faith in its future possibilities. Emotional values arise from a sense of attachment to the Environment.

Suggestion

Environment experience enrich social study instruction, in order to achieve the purpose of Environmental Science, the child must become a real part of the Environment in which he lives, interact with it and contribute to it. He must become a responsible member of Environment with civic attitudes and ideals compatible with the spirit of democracy. Again, venturing into the Environment, gives children an opportunity to observe and to participate in the basic human activities that characterize living in the social group under the careful guidance of the school and of cooperating Environment groups and field trip is the best way to develop these type of skill in the students at school level.

QUESTION

1. How can the environment enrich and support in the learning of environmental science in schools?
2. Explain the importance of good environment, home and school relationship.
3. What are the duties of the environmental science teacher in this regard? Explain in your own words.
4. Discuss the ways and means to arrange a field trip in the secondary school students of class VIth.
5. What information would you collect to acquaint your students with the life of the local environment and how would you collect it?

CHAPTER 9 Environmental Science : Modern Methods

INTRODUCTION

"Even the best curriculum and the most perfect syllabus remains dead unless quickened into life by the right methods of teaching and the right kind of teachers." According to Secondary. Education Commission. As the means of reaching predetermined ends method forms the most important link in the total teaching-learning chain. It is middle link connecting the objectives with its value. It determines the quality of result. The Environmental Science is a very important subject at the higher secondary level and for its teaching teacher should have to select effective methods and effective strategies to teach them. Some important strategies and methods are explained below:

Meaning of Teaching Strategies

"Teaching strategy is generalized plan for a lesson, which includes structure, desired learner behavior in terms of goals of instruction and an outline of planned tactics necessary to implement the strategy. The lesson strategy is a part of a larger development scheme of the curriculum." E. Stones and S. Morris.

Type of Teaching Strategy

It may be able to be classified under the following two major heads:

1. Autocratic styles

A. Lecture
B. Lesson Demonstration
C. Tutorials, and
D. Programmed Instruction

2. Permissive Styles

A. Question-Answer
B. Project Strategy

C. Review
D. Group Discussion
E. Role Playing
F. Discovery
G. Brain Storming
H. Leaderless Group

Autocratic style of teaching strategies is traditional. These strategies achieve different objectives more than permissive styles of teaching strategies. The autocratic style strategies are content centered, teacher remains more active, and students are passive listeners. The autocratic teaching strategies realize cognitive and effective while permissive teaching strategies tend to achieve effective objectives. The main emphasis is on presentation. These strategies do not consider the student abilities, interests and personality of the learner. There is no freedom for the learner in the teaching process. These are highly subjective and conventional styles of teaching process.

Permissive style of teaching strategies is based on "Modern Theory of Organization of Task and Relationship centre". This style seems less conventional. It is mainly child-centered; the pupils largely determine content. The affective objectives are mainly achieved by permissive style strategies. These strategies create situations for student and teacher interaction and both remain active in teaching. Teaching is organized with the consideration of student interest, abilities and values. These strategies encourage the creativity of the pupils.

Importance of Instructional Strategies

1. These are highly subjective and conventional styles of teaching process.
2. Teachers are more active and students are passive listeners.
3. Teachers are free in their classroom teaching.
4. It establishes class rapport, remedial help and educational guidance to the learner.
5. It creates a new link with the previous knowledge of learner.
6. It gives more emphasis to achieve learning objectives rather than students' interest.
7. The learning conditions and learning objectives should be achieved.

Objective of Teaching Methods

Teaching procedures in Environmental Science should be governed by the objectives of its teaching. The specific goals or purpose as well as the nature of the content of a unit determine the methods to be used in teaching it. Suitable methods are needed for the achievement of comprehensive objectives of teaching Environmental Science such as to expose the pupils to knowledge and experiences helpful in the development of understandings, critical thinking, practical skills and interests discussed earlier. Methods also give training in constructive thinking, reasoning and critical judgment. The goal expectations in the teaching of Environmental Science involve deeper and extensive participation of students. Besides the lecture or question-answer method, students should be exposed to a variety of learning experiences involving book learning, observation, interviewing, surveying, interpreting, reviewing, recording, reporting, and evaluating. Learning experiences should be geared to the type of growth and behavior changes to be brought about in the student and the need to make him an enlightened, discriminating, dynamic, productive and democratic citizen.

Need of Modern Methods in Environmental Science

1. There are many roads to successful learning to be tried for meeting particular needs and situations. To make the subject interesting, vital and living the teacher should also use permutations and combinations of methods, devices, and techniques for example to lend color to class teaching. He may use lecture or discussion method or a combination of these two. The teacher should be conversant with a variety of methods of Environmental Science.
2. Different lessons or units should be taught by different methods of teaching. It can be very monotonous to use the same methods for every circumstance. In the past few decades a tremendous increase in equipment materials, means and teaching procedures has been witnessed. These should be utilized to provide variety and color to teaching Environmental Science. To create and maintain their interest and avoid monotony children should be exposed to varied experiences.
3. No single method can be the best for all situations, and for all teachers and pupils. The suitable method should emerge out of the abundance of information and skill of the teacher. It should be harmonized with the content to be taught. Every teacher of Environmental Science should be familiar with the different means for reckoning the desired ends.

Characteristics of Good Teaching Method

1. Group Related Experiences and Activities

A good method should provide a group of related experiences and activities, arranged on an individual as well as group basis, particularly designed to produce changes' in terms of knowledge, understanding, habits, attitudes and skills, and behavior of the students.

2. Scope for Creative Expression

A good, method should provide scope for the creative expression of the child's individuality.

3. Interests in Content

Rather than be a mechanical device for passing on facts and figure a good method should rouse a large range of interests in the minds of the students.

4. Shift in emphasis

Through purposeful, concrete and realistic situations a good method should shift emphasis from verbalism and memorization to learning.

5. Training in Self-Study

A good method should train the, students in the techniques of self-study and the methods of acquiring knowledge through personal effort or intuition.

6. Stimulation and Awakening Interest in Study

A good method should stimulate the desire for further study and exploration. A good method should awaken interest in the materials and techniques of Environmental Science. It should give pupils peep into the workshop of the Environmental Science to enable them to know the varied interpretations of events and clash of characters.

DIFFERENT METHODS OF TEACHING ENVIRONMENTAL SCIENCE

After selecting the content or subject matter, the teacher should see that the subject is properly taught, learnt and experienced, with the application of most effective methods of teaching. As methods are closely related to aims and objectives of teaching a particular subject the major specific aims of teaching Environmental Science must be remembered. There are:

1. Lecture Method
2. Lecturer cum Discussion Method
3. Project Method
4. Source Method
5. Socialized Recitation
6. Supervised Study

1. LECTURE METHOD

The lecture method means, "Teaching by means of the spoken word". It means a formal talk by the teacher. It may be known as "Telling of Story or Conversational method" with primary and lower middle classes. With higher secondary and college classes it may be known as "Lecture Method".

The lecture method may be safely used at higher and college stages. Even at this stage the lecture must not be dry but well prepared and well presented to stimulate interest and mental activity of the students. The students should be prompted to ask questions at the end of the lecture. Their questioning is a sure proof of the success of the lecture.

Lecture Method at School Level

Based on traditional authority lecturing is a time-honored device for imparting knowledge. But it has fallen into very ill repute as a method for secondary school pupils. A good teacher of secondary school is careful not to talk too much. He does not dominate the learning process. Assuming major share of the responsibility for planning and guiding a number of activities, experiences and situations the teacher provides functional learning for the group of pupils in his class. For carefully selecting the proper techniques to meet the needs, interests and capacities of his pupils at a particular time and particular situations a lecture may be taken as a technique of description, explanation and clarification.

Utilization of Lecture Method

1. Ineffective Method

A spoken word is always more effective than a printed one. By his tone, gesture and facial expression the teacher can indicate the exact meaning that he wishes to convey dramatizing a scene, a story or a message, he wishes to give but he can add color and vividness to his talk, which a printed book cannot do.

2. Quickly Repeated and Modified

If a teacher feels that his talk is not being followed or appreciated by his pupils, he may repeat the ideas or expand arid modify his statement. He should never like, to "talk over the head" of his pupils.

3. Experiences in Learning by Hearing

In democratic countries children in schools must be trained for adult life so that they may participate fully and effectively in affairs of national and international importance as democratic citizens. Lectures and talks play an important part in adult life whether one is a leader or follower. Children are to be prepared from the school stage for this through occasional talks and interesting lectures arranged for all types of school children.

4. Saving of Time and Energy

Sometimes because of their complicated nature, facts of Environmental Science are not clear to students in their textbooks as details are seldom given and sometimes interpretations may also be wrong in textbooks. The students may spend a lot of their valuable time and energy in going through other sources for the clarification of such complicated points. Here a well-presented lecture by the teacher is most helpful.

5. Stimulation for Students

As a lecture, demands a lot of preparation on the part of the teacher, its advantages are transferred to the class as a whole. Teachers own preparation, his enthusiasm and his interest stimulate good students. They may now like to pursue projects, problems and other such activities to gain "more and more knowledge.

Objectives of Lecture Method

1. To stimulate students.
2. To clarify concepts.
3. To supplement the knowledge, of pupils.
4. To sum up the findings of pupils.
5. To prepare the students to undertake an assignment, a project or an activity.

Limitations of Lecture Method

1. Unnatural Way of Learning

Not usually considered to be a natural way for the pupils to learn Lecture Method places them in the position of passive listeners. During the course of the talk, they may wander off to some more pleasant thoughts and may not attend to the talk at all.

2. Requires Trained Teachers

Many teachers do not know how to lecture in an effective way. They cannot prepare and deliver well-connected and relevant talks on the topic given in the textbook. Only trained teachers can succeed in this method.

3. A Heavy Teaching Load on Teachers

A teacher who is required continuously teach in the school from the first period up to the last and not lecture in each period. He will not have the capacity to prepare so many simple and interesting lectures each day. It is physically possible for him to speak continuously for four or five hours a day. Hence, lecturing period should be very limited.

4. Harmful Extensive Use

The lecture method tends to substitute the teacher for the textbook is used extensively. Only occasional and informal talks may be desirable for realizing definite purposes in view.

5. Monotonous and Dullness

Only exceptional teachers can stimulate interest through their talks at all grade levels. To avoid dullness and to give effectiveness to the lesson they use a variety of methods and not only one or two of them. The lessons may become dull and dry if only the lecture method is used.

Effectiveness of Lecture Method

As lecturing is an art, its successful performance depends upon the teacher's knowledge and upon his awareness of interest and motivation. Primarily meant to reinforce key ideas and facts and to place them in a context of thought a lecture seeks to present a whole out of many related fragments of information obtained piecemeal by other means. People flock by thousands to listen to interesting, fascinating, inspiring, informative and exciting lectures. Similar type of talks should be presented in the classroom to ensure success. A teacher should follow these points:

1. Giving background of a topic.
2. Giving as over-view of a large unit.
3. Creating interest in the people.
4. Explaining and correcting some faulty ideas or introducing an intelligent assignment.

Delimitation of Lecture Method

1. Sometimes, the teacher can give a hint about some topic or unit to be developed in some later lecture. Pupils, thus, can be led to anticipate a lecture with eagerness.
2. The teacher should prepare a synopsis of the lecture and give it to the pupils before lecturing. Besides saving the teacher from pointless digression it will help the pupils to pay undivided attention to the lecture.
3. While delivering the lecture teacher should speak clearly and slowly so that the pupils may keep pace with him. He should talk to the students rather than lecture to a class. Rise and fall in his voice is also necessary to lay emphasis on a point and also to attract the pupils. Frequent but natural changes of positions help him to feel at ease, and to ensure that every member of the class gets an equal opportunity to see and hear.
4. Lecture should be full of humor enlivened by analogies, comparisons, illustrations and anecdotes, which bear upon the topic. The lecture is made interesting by aids such as pictures, films, filmstrips, slides, diagrams, etc.

5. Lecture may be followed by a written test to measure the success or otherwise of the lecture. The lecture is successful if the pupils have learnt well. The teacher can revise his methods if the lecture does not seem to affect.

Suggestions

Lecture method is a very effective method but it has own limitation after some changing and innovation according to Indian schools we can use this method effectively. Lecture should be subject based and it should be in limited time. Listener should be given time to think and they should ask the questions from time to time it means the listener should participate in the lecture. Presentation should be effective and audio-visual should be used during the lecture.

2. LECTURER CUM DISCUSSION METHOD

Lecture method is a one of the best method but it cannot be used every time and it is not suitable for each and every topic and also for subjects. It can use as a main method and other teaching methods can be used with it. The discussion method is the supporting method and it can be used with the lecture method. Some social scientist says that it is a one of the most valuable methods of teaching Environmental Science is discussion and “two heads are better than one”. Wonderful results are achieved when a number of heads combine to solve a problem.

Advantages

1. This method is best for a problem, an issue or a situation in which there is a difference of opinion. In the discussion method of teaching Environmental Science there is exchange of opinion accompanied by a search for its factual basis.
2. Speech is free and responsible. And values are created not quarreled about. The participants are engaged in a process of competitive cooperation. Agreement is the declared purpose of discussion that is an ordered process of collective decision-making.
3. If agreement is not reached, discussion has the value of clarifying and sharpening the nature of agreement.

Objectives of Discussion Method

As a method of teaching Environmental Science discussion may be used for the following Objectives:

(*i*) To lay plans for new work;

(*ii*) To make decisions concerning future action;

(*iii*) To share information;

(*iv*) To obtain and gaining respect for various points of view;

(*v*) To clarify ideas,

(*vi*) To Inspire interest; and

(*vii*) To evaluate progress.

Steps in Discussion

1. In the case of problems

(*i*) Locating and defining problems of common interest and significance;

(*ii*) Working together to find ways of solving the problems;

(*iii*) Allocating responsibilities for the solutions suggested; and

(*iv*) Evaluating the effectiveness of the suggested solutions and their implementations.

2. In case of plans for projects and programs

(*i*) Deciders on the programmed and the particulars such as date, time and place;

(*ii*) Enumerating the jobs to be done in organizing the programmed;

(*iii*) Allocating duties to the members of the group; and

(*iv*) Evaluating the results.

FORMS OF DISCUSSION

There are many types of discussion defined in the teaching of Environmental Science but important methods are given below, which are mostly used in Indian schools:

1. Informal discussion.
2. Classroom discussion.
3. Debate.
4. Symposium.
5. Panel discussion.
6. Brain storming

1. Informal Discussion

When we discuss political matter in the tea stall or a group of students or people near the road discuss about their problems or when we discuss our personal problems with our friend with an objective that discussion is considered as informal discussion because that discussion is only for talk and after discussion we are not finding any result. So such type of discussion is under the Informal discussion category.

2. Classroom Discussion

Most of the time students discuss their problems with the teacher in the classroom and that is for caused based problem or some time students discuss their problems related with the teaching and such type of discussion is objective based and after discussion we try to find out some result. This type of discussion comes in the category of Classroom discussion.

3. Debate

In the program of debate two or more students holding contradictory opinions present arguments on a particular problem. They also rebut the opposite side. Finally the rest of the class is encouraged to ask questions from the debaters or engage in a brief discussion with them. A debate requires a moderator. The teacher should work both with the debaters and the. Class in order to get significant results.

Some Topic for Debate

(*i*) Globalization is necessary for the economic development of India.

(*ii*) Capitalism is responsible for the poverty of our country.

(*iii*) Five Year Plans have failed to generate proper development.

(*iv*) Democracy is the best form of government.

(*v*) For forms of Government let fools contest that which is governed least is best.

(*vi*) Democracy in India is more formal than real.

(*vii*) Fundamental rights are of no use in India.

(*viii*) Used needs total disarmament.

4. Symposium

In a symposium the participants present to the audience through speeches or proper reading their views about various aspects of a selected problem or topic. To quote Struck, "We think of a symposium as a. group of comments, either, spoken or written; which portrays contrasting or at least different points of view".

Objective of Symposium

The objective of the symposium is to clarify thoughts upon controversial questions. The audience listens to the discussion. Each person forms his own conclusions concerning the validity of the points of view presented. The ideal number of pupil participants in a symposium is four or five.

Some Suggested Topics for Symposium

1. Proper organization of the community project is necessary for rural economic development.
2. Profit is the dominant motive in all-economic ventures.
3. Mahatma Gandhi and his thoughts.
4. The achievement of the Aryans in the fields of science, literature, government, art and the life of an ordinary Indian.
5. Super leader in Indian History Pt. Jawaharlal Nehru.
6. Declaration of assets and liabilities of the Members of Parliament.

5. Panel Discussions

It is a discussion among selected group persons, large enough for variety and small enough for purposeful deliberations. The ideal number may be four to six persons. The participants in a panel discussion are usually eminent persons in their fields. They present various points of view before an audience, which subsequently joins in the discussion.

Purpose of Panel Discussion

The purpose of panel discussion is to get important facts from different angles, to stimulate thinking and lay a basis for wide participation. The members among them make no speeches only informal conversations take place.

Rotation System

The rotation system may be followed in a panel discussion. Each member expresses his opinion in turn or the members speak briefly as the thought comes to them one after the other.

Advantages

Panel discussion method provides a natural setting in which people get the opportunity to ask questions, to evaluate replies and to contribute constructively. Some topics for Panel Discussions are:

1. The role of planning in economic development.
2. Nationalism can no longer solve the problems of under-developed countries.
3. Nowhere was the achievement of the Aryans greater than in social organization.
4. "The President represents the nation but does not rule the nation. He is the symbol of the nation and his place in the administration is that of the ceremonial device or the seal by which the nation's decisions are made known" ____ B.R. Ambedkar.
5. An active king, whose, opinions were a matter of public concern, is unthinkable within the framework of our (England's) constitution" Laski Herold.
6. The role of planning in economic development.
7. Nowhere was the achievement of the Aryans greater than in social organization.

6. Brain Storming

In this form of discussion the brains of the participants are stimulated to create a storm of ideas and give suggestions regarding the topic without any deliberation to find whether or not they are meaningful and purposeful. When the brain is let go thus without social institutions, it would be able to give expressions to some of the most useful and practical suggestions. For example "Small saving could do a lot to strengthen the savings movement" is a good subject for brainstorming.

Method of Discussion

1. To make proper use of the discussion method the teacher and student representatives should do considerable planning. In planned and well-directed procedure discussion the whole process may be divided into three *stages-preparation, discussion and evaluation.*
2. For through preparation for the discussion the teacher should read wide and deep purposefully and critically and prepare the material conscientiously. Arranged logically points to be discussed should be written on the chalkboard for guidance. If the students do not initially feel the need of the problem to be discussed they should be made to do so.
3. The conducting the discussion should be disciplined. The arrangement of seats should ensure face-to-face talk. The strength of the discussion is obtained from the information and viewpoint of all members of the group. All should contribute to its progress as it is a thinking-together process which breaks down if one member of the group dominates it. Ensuring that every member of the group participates the

teacher should encourage sincere questions and comments. He must gear the discussion to the realization of specific objectives and development of proper skills and methods:

4. A relaxed and informal climate is essential to achieve desirable results. As the discussion is truly a cooperative experience not a competitive quarrel. The teacher must continually discourage attack upon persons and seek to bring the participants to focus their comments on the proposition not the person. He should be ensured that discussion is objective-oriented, the questions should be skilful and direction sound. A happy rapport should be established between the teacher and the taught.
5. Discussion results in expanding information or lessening or removing prejudices, changing attitudes or ideals, increasing the range of interest, altering ideas concerning national and international policies, or causing a member to become a more active citizen. One must evaluate the discussion with these motives in mind.

Advantages of Discussion

1. Useful both for the Juniors and Seniors

Junior children learn through conversation and discussion, to take turns, listen attentively, act cooperatively, speak distinctly, stand and sit correctly, respect the ideas of others, share interests, ask pertinent questions, utilize simple information and comprehend the problem before the group. Senior children plan and discuss problems with the entire group and in smaller units. The group learns together and presents important information, makes suggestions, shares responsibility, comprehends the topic, evaluates the findings and summarizes results.

2. Clarification and Sharpening of the Issues

In discussion new ground is discovered both for agreement, disagreement, and old ideas and new ones may replace values.

3. Increase in Knowledge

Through discussion children crystallize their thinking and identify concepts needing further study. Therefore, their knowledge of Environmental Science becomes clear.

4. Moderation

Through discussion students know and understand that difference in perspective need not result in disaster and that people may believe in the same thing for different reasons.

5. Knowledge of Limitations

The student discovers what he did not know, what he has overlooked and wherein he was mistaken both as to facts and the method of interpreting them. He may find out what he knows and the surety with which he knows it.

6. Intellectual Teamwork

Discussion represents a type of intellectual teamwork resting on the principle that the pooled knowledge, ideas' and feelings of several persons have greater merit than those of a single individual.

7. Tolerance

Discussion engenders toleration for views, which are at variance from those one holds.

8. Discovering Leaders

Discussion helps the teacher in discovering students with a potential for becoming genuine leader.

3. PROJECT METHOD

The most concrete of all types of activity methods Project method provides learning experiences suited to individual differences. Now here is a question that what is a project? We can explain in these words that project is an activity willingly undertaken by the pupils for the solution of a felt problem and leading to learning as prescribed in the curriculum. It is concrete activity directed towards the learning of a significant skill or process. Having a wide connotation project includes any activity like dramatics, pageants, making models, drawing maps and charts, collecting pictures, preparing scrap books, going on historical tours and exhibitions, preparation of Environmental Science wall newspaper, organization of debates, etc. The project method transcends the subject -barrier because it is possible to learn some literature, mathematics, art, etc., also while undertaking a project of Environmental Science.

Basic Principles of the Project Method

1. *Activity:* The project involves mental or motor activity.
2. *Purpose:* Project should be purposeful, a felt need of the pupils.
3. *Experience:* Project should provide varied type of experiences to the pupils such as manipulative, concrete, mental, etc.
4. *Reality:* Project should provide real experiences.
5. *Freedom:* the pupils should be free to undertake the different activities connected with the project.
6. *Utility:* the activities undertaken in a project should be useful.

Steps of Project Method

1. Providing a situation

First of all, the project provides a suitable situation where the pupils feel a spontaneous craving for carrying out a useful activity through conversation, discussion or exhibition of pictures and models etc. the teacher discovers the interests, needs, tastes and aptitudes of the children. While telling a story or taking the pupils out on a field trip initiates the pupils to the world of projects, they are exposed to so many situations and they determine the selection of the project. Enough opportunities should be given to the children to express their ideas and to have discussions among themselves, as well as with the teacher. The situations or problems provided to the pupils should be social as these provide better social training and greater satisfaction.

2. Choosing

One of the important duties of the teacher is to so guide the pupils that they may choose a good project.

3. Purposing

Kilpatrick has well said that the part of the pupil and part of the teacher in the most of the school work depends largely on who does the purposing. It is practically the whole thing. Purposing is the most important thing about a project. The teacher might fall a prey to the temptation of making the choice of the project himself due to desire to get quick and good results. This violates the most important principle of the method. The pupils should make the final selection of the project. By self-choice and self-imposition pupils work wholeheartedly and energetically. Thorough execution and successful completion of the project they are stimulated to better planning. The teacher's guidance to pupil-effort should not hinder the development of the pupils who must make the final choice of the project. The purpose must be common and acceptable to the whole class. The project "must enlist the whole-hearted enlistment of the student."

4. Teachers Role

The teacher should see that the projects satisfy a real felt need of the children and also have educative potentialities. He should check that the' pupils may not make a wrong choice. He should forestall ill feelings arising out of failure. He should lead the students tactfully to give up that choice and to make another. He should expose the pros and cons of the project and1et the students reconsider their decision if the choice is not good. He should resist the temptation of imposing his own idea on the pupil. Pupils do not take interest in an activity thrust upon them.

5. Freedom and Utility

The pupils should be free to undertake the different activities connected with the project. The activities undertaken in a project should be useful. Execution of the project requires a lot of pupil activity. It is the longest of all steps. A series of activities have to be taken up by the pupils such as collecting information, visiting places and peoples, interviewing important personalities, consulting labels, observing specimens and curios, preparing maps charts, diagrams and graphs of the data collected by various groups, surveying the locality, studying books, keeping records, calculating prices, inquiring rates, writing letters, and 'Thank you' notes. The teacher should guide the pupils about the sources of relevant information. He should provide them with necessary information sought for. He should supervise the activities and watch the progress of the project. He should co-ordinate the knowledge to be imparted through a project. He should see how an activity such as the production of a play or a concert involves elocution, music, literature, craft-work, needle-world and art, along with the many calculations required in planning expenditure, keeping accounts and producing a balance sheet or the practical science involved in stage lighting and effects. The teacher should see that pupils get a variety of experiences and learn a good deal as they undertake the activities.

6. Evaluation

In evaluation or appraisal of the work done the pupils must find out their shortcomings and good points and review their work to find out that nothing has been omitted and that the work has been carried out in accordance with the plan laid down. He should see that mistakes committed are noted to serve as eye-openers for the future: Useful experiences and successes should be reviewed to serve as good examples. The pupils should critically appraise their work.

7. Recording

As impressions left unrecorded are likely to be wiped away from memory, pupils should maintain a complete record of all activities connected with the project. Everything should put down in the project book such as the choice of the project, 'the discussions held, proposals advanced and accepted, duties assigned, books and journals consulted, information sought for, work undertaken, difficulties felt and experiences gained, short and long-term gains obtained, self-appraisal important guidelines and future references etc. Thus, project-book embodies the valuable experiences of the group. Well-prepared project books may be awarded prizes to encourage the-pupils.

Teacher's Role in the Project

1. As the teacher has got mature experience, deeper and broader knowledge than the pupils, his guidance and prompting is indispensable. As the pupils are out on a venture they need suggestions arid guidance at every step.
2. The teacher should save the pupils from faltering and floundering. He should give help whenever it is required.
3. As a good prompter, just behind the curtain, the teacher should not make his appearance on the stage for the stage is meant for the pupils.
4. As a keen observer and a true sympathizer the teacher should win the goodwill of the pupils so that the pupils feel encouraged.
5. As a storehouse of information and knowledge the teacher should be able to anticipate the difficulties and suggest remedies as and when necessary. The pupils might look to him for help, guidance, solace and affection. As no method, however, good, is superior to teachers, the need for devoted teachers is established.

Some examples of projects:

1. Story of Transportation through the Ages.
2. Akbar and his Age.
3. Mohammad and Islam.
4. The Age of the Ramayana.
5. The Mughal Age.
6. The Indian Renaissance.
7. Communication through the Ages.
8. One World,
9. Our Country.
10. Our City.
11. Our Food
12. Nationalist Movement in India.
13. Achievement After Independence in India.
14. The Socialist Movement.
15. Stages of Evolution of Human Beings.

Advantages of Project Method

1. Psychological.

Project method is planned in accordance with the psychological laws of learning. It provides the most natural conditions of learning. Therefore, the child remembers the principles learnt for a longer time.

2. Freedoms and Self-direction

Project method has an element of freedom. It is a method of self-direction. In it the child learns to improvise, to invent, to experiment, to know in all ways possible and to translate the knowledge into action. Thus, it develops the creative mind.

3. According to Maturity

According to the psychological concepts of maturation the Project method provides learning material that suits one's particular stage of mental development. While the more mature pupils are given abstract and difficult features of the task in hand the simple leaner are left to the others who are slow learners.

4. Social Benefits

As separate groups take responsibility for making their own contributions, which are subsequently pooled and become the class effort, project method results in social benefits.

5. Training

Project method provides training for social adjustment. It develops the pupil's capacity to adapt themselves to their environment, to make use of whatever is available and to meet a situation resourcefully.

6. Doing after Knowing

In project method the pupils learn and do because they understand the value of what they learn and do in the carrying out their purpose. .

7. Democratic

Project method trains children in a democratic way of life. It encourages them to co-operate, to think and act together of a common goal. Teaching students to be responsible, it gives them freedom within the framework of cooperative democracy.

8. Practical

Project method provides learning through practical problems by encouraging pupils to achieve a deeper insight into principles through actually seeing them in operation.

9. Growth

Both the student and the teacher grow through project method. Stimulated by and encouraged in his exploration of many materials the student approaches other areas of learning in a similar manner. The teacher also grows in his understanding of a child's creative development.

10. Evaluation

An intrinsic standard of evaluation is set up in project method. As the pupils learn to evaluate their own work, this evaluation reveals the mistakes and helps in rapid progress and true learning.

Limitations of Project Method

1. Less Knowledge

While children taught by the project method often show astonishing knowledge of details in odd things but they reveal real ignorance outside the projects. For example, while an Environmental Science project may deal with construction of an ancient house with great thoroughness yet the pupils may have no knowledge of the administration of Chandra Gupta Maurya.

2. Difficult to Formulate

At a later stage of education, it is not easy to formulate projects having a satisfactory degree of width and comprehensiveness.

3. Lack of Progress in Instruction

There is much difficulty in ensuring any kind of systematic progress in instruction.

4. Requires High Qualification of teachers

Very highly qualified teachers are required for success in this method. Teachers should be zealous and well prepared.

The spirit of the project method is, in the words of Raymont, "whole-hearted purpose on the part of the pupil." It gives a wonderful practical approach to the learning of both theoretical and practical problems. The responsibility of the success or otherwise of project method rests with the teacher.

4. SOURCE METHOD

According to source method, pupils build up historical, political, social and economic accounts, with the help of available sources, documents, historical accounts, biographies and inscriptions, coins, travel accounts, religious and secular literature, etc. Pupils learn to know about particular events to understand the process through which they arrive at the product. Use the source method does not aim at converting the school children into full-fledged historians and social scientists.

Objectives of Source Method

1. To enable the pupils to develop critical thinking by using the Sources and weighing the evidence.
2. To enable the pupils to form their own independent judgment through a critical analysis of sources.
3. To develop skills of collecting data, sifting the relevant data organizing them and interpreting them.
4. To create proper atmosphere to make the people and events of bygone times more real to students.
5. To stimulate the imagination of the students for reconstruction of the past.
6. To develop and promote proper interest and right perspective inthe study of Environmental Science.

Different Stages or Source Method

1. Primary Stage

According to Dr. Keatings original sources can be used for creating atmosphere in the lower forms as such a use does not necessitate any great exposition. For example, reading of Guru Gobind Singh's Zafarnama will make the pupils realize the atmosphere lead to his death. Reading of couplets of Bhakti movement will help them to realize the causes leading to it.

2. Secondary Stage

Sources can be profitably used in the secondary stage to encourage pupils to collect, examine and correlate the facts and to compare and rationalize different conflicting accounts of characters. To begin with the exercise should be fairly simple.

Following points should be borne in mind to achieve satisfactory

1. The children themselves must read an original source carefully. The source book is not available to all the pupils. Cyclostyled copies of the extracts should be pasted on the blackboard to be copied by them.
2. Use of Library after the oral work by the teacher is over the pupils should go to study the source books in the library
3. Now a separate time should be fixed when the teacher, along with his pupils, could discuss the sources.
4. After the discussion is over, the teacher may give the assignment to the pupils. At the initial stage it is better to give a little practice in giving well-considered answers. The pupils should be asked to write their own impressions and inferences.

Use of Sources at Various Stages of the Lesson

1. At the pre-lesson stage sources can be used to motivate the pupils for a particular lesson. For example, while dealing with the Ranaissance Movements in India and highlighting its causes the teacher may quote Raja Ram Mohan Ray and Keshab Chandra Sen. To prepare the pupils for the study of Bhakti Movement he may recite a number of couplets of Bhakti saints.
2. Sources can be used for developing the lesson. For example, the teacher may quote the following extracts from the accounts of Hieun Tsang while teaching about the people of India during Harsha's period.
3. Although they are naturally light-minded, yet they are upright and honorable. They are not deceitful in their conduct and are faithful in their oaths and promises. In their rules of government, there is remarkable rectitude.
4. Such extracts may create more appeal they may impart reality and vividness to the lesson and reinforce the impact of teaching. As curiosity of the pupils is whetted they are eager to learn more and more.
5. Sources can be used when the teacher finishes the lesson he may give to the students interesting and useful extracts from the original or secondary sources. The students may be asked to write answers to some questions on this basis. Sources are particularly useful for the gifted students who can be encouraged to

pursue their interest in a particular topic make critical thinking, analysis and prepare, an account of study.

Advantages of the Source Method

1.Creating a sense of vividness and reality

Use of sources in the teaching of Environmental Science gives a touch of realism to the subject.

2. Satisfying the Curiosity of Children about the Question

Sources give the children an insight into the methods by which Environmental Science have been built up. The sense of curiosity so important for a student of Environmental Science can be particularly developed through this method.

3. Creating a Right Type of Atmosphere

The sources vitalize the subject and create a congenial and motivating atmosphere for its study.

4. Mental Exercises

These include right thinking, and imagination, comparing and analyzing, drawing inferences, self-expression and discussion.

5. Illustration and Supplementation

The original sources can be used to illustrate more important points in support of an oral lesson or to supplement the one-sided picture of historical, political, economic and social accounts.

6. Initiation in Research

The method initiates the pupils in research, which can later prove useful.

7. Use at all Stages

Though most suitable .for the pupils of higher classes this method can be used by the pupils of primary classes also with advantage.

8. Meaning

The study of Environmental Science through source method makes' the subject more concrete and meaningful.

Limitation of Source Method

1. It is not a possible way for the teacher of schools to have easy access to the original sources.
2. Use of sources is not easy for the teachers who are not trained in their use.
3. Source method is too complex and technical. Its use is difficult at the junior stage and at the senior stage also its frequent use is doubtful.
4. As the sources are available in many languages and scripts covering a period of more than three thousand years, the teachers cannot be conversant with sources in different scripts. This makes their use difficult.

5. There is also the difficulty of sifting the suitable evidences from a multiplicity of sources for their use.

Suggestions

In the case of use of source method in Environmental Science, "The road traveled is more important than the destination reached." Use of the method for selected topics may make the study of Environmental Science more real and interesting. The use of sources should be well planned and purposeful, well directed and geared to the need of the subject and to the specific skills and understandings it seeks to develop. Finally, there is no single method of teaching Environmental Science under all topics' and all situations. There are many and varied methods, which may be used depending upon the ingenuity of the teacher, available resources and receptivity of the pupils.

5. SOCIALIZED RECITATION

Socialized Recitation is an ideal classroom procedure, aiming at Eliminating of the traditional formal and lifeless classroom atmosphere. Generally speaking, the wider the participation of the pupils, the greater and quicker the learning on the part of the pupils. Socialized Recitation meets this demand. It promotes better relationship among pupils and between teacher and pupils along with a sense of freedom and spontaneity. Under this method pupils achieve better, results with less strain upon their energy.

Objectives of socialized recitation

According to Harold Benjamin the following are the main objectives of Socialized Recitation :

1. To develop techniques useful in-group work.
2. To stimulate reflective thinking.
3. To supplement previous knowledge.
4. To encourage creative expression.
5. To practice the techniques of co-operative thinking.

1. The chief evil was the old-time recitation of emphasis on teacher activity, to the neglect of pupil activity. The subject matter occupied the most important place in teaching. The main function of the teacher was the drilling of the facts into the minds of the pupils. As no worthwhile attitudes or skills were developed the pupils felt indifferent lifeless and dull under such a procedure. It was almost impossible to motivate study under these conditions. Pupils regarded their lesson as a tedious and tiresome task.
2. Many proposals were made against this passivity and listlessness in the classroom. Shaken from the teacher emphasis was placed on the pupils who become the centre of educational process. The old system of teaching was replaced by a new procedure of socialized recitation, which brought about more pupil activity a liberation of school control and a new era in the classroom, which made the pupil and his activities more prominent than the teacher or the subject matter. The traditional class was transformed into a socialized one not dominated by a few individuals but belonging to all members of the class. In fact, Socialized Recitation is "Group

consciousness and the feeling of individual responsibility towards the group.” Group discussions became very common. Various devices and aids of teaching supplemented textbook. The pupil’s personality developed in a natural way under such conditions. Incentive was provided for exercising initiative, originality and independent thinking. Group thinking was developed. The classroom becomes a unit of dynamic group life in an atmosphere of freedom and spontaneity.

3. Committee Meeting. Varying from a simple informal organization to a complex parliamentary one informal Socialized Recitation may assume any form. It may be a sort of committee meeting in which the members decide on an agenda freely express their ideas willingly share their information and arrive at some definite conclusions about a certain issue or problem.
4. It may be a form of socialized group discussion in which members of the group elect their own chairman to guide the discussion.
5. It may have a president, a secretary and to the reflected officials to carry on the discussion in a parliamentary procedure. However, no procedure can be used exactly the same for all teachers as both teachers and classes have different characteristics. A wise teacher should evaluate these forms and use them in building up a technique of his own.

General Plan of socialized procedure. In a general plan of socialized procedure used with success in many schools the lesson or topic is divided into four or five parts and the classes also divided into four or five groups. Each group of students is assigned one part of the lesson under its chosen student leader. Each group plans its own work and executes it according to its own plan. The teacher approves planning though he does not dictate. Questions are asked, comments are offered and discussions are held freely and frankly in groups. The members of the group may discuss any point that is not clear to them. After the group has completed the discussion, the leader offers additional information that he thinks essential. Members of the groups place there, observations and conclusions before the whole class. Then the teacher offers his own remarks if he feels that certain points have not been touched upon by the pupils or if define conclusions have not been reached. The leadership should be changed from lesson to lesson to provide equal opportunities to all pupils. This creates confidence in even intellectually backward students.

Role of the teacher in Socialized Recitation

The success of socialized recitation depends upon the role of the teacher. He sets the stage, gives the promptings as and when necessary and then sums up the conclusions or generalizations, arrived at. Socialized Recitation succeeds due to the careful planning and judicious guidance of the teacher who no longer dominates the scene but acts simply a member of the group. He retains control of the class as a guide, a leader, an adviser and a helper rather than a traditional master.

Limitation of Socialized Recitation

1. *Proper attitudes skills and ideals.* As important classroom procedures Socialized Recitation develops proper attitudes, skills and ideals. As the aims of education-are constantly changing today attitudes and ideals are emphasized more than mere knowledge in Environmental Science in _which the development of right attitudes is the major aim of teaching.

2. *Socialization of the child.* Socialized Recitation trains pupils for participation in a social environment, which implies freedom in conversation, readiness to mix in friendly groups and ability to work with others for a common cause. Under the stimulus of group consciousness, the child develops a spirit of initiative, organization, co-operation, courtesy and goodwill.
3. *Training in leadership.* Socialized recitation method imparts training in initiative and leadership. In ordinary classroom procedure, training in these traits of character is very much neglected. In Socialized Recitation, ample opportunities are provided for pupil leadership and pupil planning. Each individual is given a chance to express what he feels and thinks.
4. *Spirit of co-operation.* Socialized Recitation is possible only when pupils are co-operative with one another as well as with their teacher. This develops the spirit of co-operation. In our present day complex society, the feeling of inter-dependence and the spirit of willingness to sacrifice self for the group are needed more than anything else. As Socialized Recitation contributes greatly to this ideal, it occupies' an important place in our educational programmed.
5. *Clear thinking.* The pupil was not expected to think at all under the old system of recitation. He was required to produce what was given in the textbook. In new Socialized Recitation method only pupils are provided with opportunities to discuss to criticize and to evaluate problem facing them. This creates clear thinking so much needed today. In a newly born democracy sound judgment and constructive criticism are not possible without clear thinking.
6. *Self-expression.* Socialized Recitation method provides ample opportunities to pupils to express their thoughts in an atmosphere of freedom and spontaneity. If the pupils are provided chances to express themselves" better understanding prevails in the learning process. It develops the power of talking and expressing oneself.
7. *Motivation.* Socialized Recitation provides motivation. The pupil is engaged in a co-operative task with the list of the group. Each pupil begins to feel his responsibility. In accomplishing the work at hand everyone tries to do his very best for the group. This motivates learning essential in all teaching procedures. .

Delimitation of Socialized Recitation

1. *Inadequate acquisition and mastery.* The use of this method is not adequate for the acquisition and mastery of subject matter. Much time is uselessly wasted in Socialized Recitation procedure.
2. *Wandering away from the subject*. This method creates the tendency of the class to wander away from the subject. By careful guidance the teacher must lead the class to the point at issue through his tact and resourcefulness. He should be merely a stage-setter and a passive spectator of the lesson.
3. *Futile discussion.* Socialized recitation may lead to futile discussion. Some students argue things for the sake of argument. Others argue simply to prove their point, though it has no direct connection with the lesson and topic in hand. Here the teacher should be alert enough to prevent useless debates.

4. *Domination by a few assertive pupils.* Here while few pupils may dominate the entire lesson such domination is not conducive to the values that should result from the use of this method. It is the duty of the teacher to plan recitation in such a way that a few students do not monopolize the lesson. The teacher must ensure the socialization. Of all the pupils and not merely a few of them.
5. *Exclusive use of socialized recitation.* The exclusive use of this method at all times is a dangerous move. There are times when it should not be used at all. Every lesson should be more or less socialized in the sense that students are given chances to actively participate in it. However, mere socialization cannot serve the purpose in Environmental Science.

Suggestion to Make Socialized Recitation Effective

1. It should centre round a topic important from the pupil's point of view and in which pupils express interest.
2. The teacher should prepare how to handle possible conflicts and reduce tensions and blocks in good human relations. The planning should be flexible enough to permit adjustment as the socialized recitation proceeds.
3. A friendly atmosphere should prevail during the period of socialized recitation. Each pupil should be made to feel that he has something significant to contribute and that his ideas are valuable. The teacher should help pupils to understand that one. May disagree without being unpleasant or destructive.
4. The teachers should have adequate control over the procedure. He should be able to see that socialized recitation "keeps on the track" and the class moves from discussion to decision' and from decision to action. The degree of control to be exercised by the teacher depends on maturity of the group, previous practice in self-direction, interest and spirit of cooperation among pupils.
5. Socialized recitation should never be used to spread prejudice. Pupils should be encouraged to substantiate their own personal opinions with accurate information and typical thinking about the topic or issue. Each pupil should be given an opportunity to clarify his point and to convince the groups of the wisdom of his own insight to truth. Monopolized by a few students. The teacher must ensure the socialization of all the pupils and not merely a few of them.
6. The exclusive use of this method at all times is a dangerous move. There are times when it should not be used at all. Every lesson should be more or less socialized in the sense that students are given chances to actively participate in it. However, mere socialization cannot serve the purpose in Environmental Science.

6. SUPERVISED STUDY METHOD

Immediate surroundings and community afford many opportunities for supervision. Concrete tangible, visible and describable data on cultural, industrial, political and geographic facts and relationships prove invaluable for the teaching of Environmental Science. Observation lends vitality to the subject matter of Environmental Science. Direct experiences are more effective in the process of learning they are also retained for a longer period of time. As rich, full-bodied purposeful experiences seen, handled, tasted, touched, felt and smelled. They are the unabridged version of life itself. A trip to a monument, a fort, a temple, an institution, provides its first-hand experiences, which are real. The children can see them, ask questions about them and examine them. Such experiences are highly conducive to learning.

Utilization of Supervised Study Method

Under the careful guidance of Environmental Science teacher's supervision provides the pupils ample opportunities for asking questions, gathering data and pooling information. Visit to telephone exchanges, newspaper and telegraph offices clarify ideas about communication. Study trips to airports and their transportation centre show how people and goods are moved about. Production and consumption can be understood better when pupils see the stores, the markets and factories of the community.

Techniques for Supervision Study

1. Field Trips

Field Trips are under taken for securing information, changing attitudes, awakening interests, developing appreciation, promoting ideas and enjoying new experiences. Used to initiate a unit Method of Teaching of study they may be a part of its core and they can give it the final touch.

2. Community Surveys

Community surveys foster comprehensive understanding of community structure and processes in their everyday operation, interaction and complexity. In stimulating depth of insight into vital community problems and trends, which have been influenced by past conditions, present developments and future prospects community surveys are very useful.

3. Community Service Projects

Community service Projects involve individual activity of an integrated, mental, physical, emotional and spiritual nature. They are of genuine educational value to the pupil as well as to the society.

There can be no difficulty in preparing a catalogue of the available resources for proper and detailed study if the teacher is resourceful and the class is enthusiastic and clever. The resources, which need to be observed by the pupils, vary from community to community. There may be classified under various heads such as resources of geographical, historical, cultural, economic and scientific interests.

Suggestion for Supervision Study

Supervision study is a most scientific and new teaching method adopted by the Indian Education system. Under this method the subject teacher observed and supervised the student to study. With the help of subject teacher students prepared their program and completed their content.

This method cannot be successful with out the help of subject teacher but due to its limitation it is not much successful in Indian education system.

Conclusion

Used with other methods and procedures such as supervised study Socialized Recitation may be profitably used for review-work and for problem solving. The socialized recitation procedure can use all the devices, projects, problems and activities available under other methods.

It is not a solution to all classroom problems but only a procedure to be frequently used by the teacher too much advantage. As teaching is not a mechanical process anyone method can be recommended for all occasions. To summarise success in the use of Socialized Recitation depends upon the class, the teacher and the aim of the lesson that teacher keeps before him.

QUESTIONS

1. Describe the various methods adopted for the teaching of environmental science in the primary classes. Which is the best and why?
2. Describe the various methods. Which can be adopted for the teaching of environmental science in the secondary classes? Which is the best and why?
3. Discuss the characteristics of the lecture method of teaching environmental science. Point out its advantages and disadvantages.
4. Discuss the advantages and disadvantages of supervised method of teaching environmental science.
5. Socialized recitation method is one of the best methods of teaching environmental science. Discuss.

CHAPTER

10

Environmental Science : Modern Library

INTRODUCTION

An important centre of resources for instructional purposes in Environmental Studies is the modern school library. Modern instructional program emphasizes the training of pupils to think and form judgments independently. This requires the provisions of a variety of material of which school library is the central clearing-house. As an important service agency it provides guidance to teachers in curriculum construction to pupils in the selection of books and to adults in reading and in counseling. In a democratic society like ours, the school library lays the foundation for free enquiry and intellectual development, so essential for sharing public opinion.

The school library has expanded from a depository of books into a resource centre, used extensively by all members of the school family. It reaches every classroom, touches every pupil and teacher and even moves out into the community. It helps the teacher to enrich the curriculum and facilitates personal and professional reading. It helps the student to gain meaningful learning experiences. It provides for recreational and hobby interests to the community. It is a storehouse of all types of teaching aids, including maps, charts, pictures, models, manuscripts etc. It gives new depth to the learning experiences and the personal lives of the pupils. Its place in a modern school cannot be filled by any other agency.

Functions of the School Library

1. Providing materials of instruction and reading

The school library renders valuable service to both the teacher and the pupil *by* providing a wide variety of text and reference books, related to various school subjects. It provides a lot of reading material to the pupil for answering questions, doing assignments and solving problems.

2. Stimulating reading for enjoyment and recreation

The school library contains a number of books of general interest, both for the pupils and the teachers. Interesting story-books, biographies, books on travels, adventures, inventions and discoveries etc. motivate pupils and stimulate reading for the sake of recreation and enjoyment.

3. Teaching the techniques of searching references

School library teaches the techniques of searching references by a proper use of the variety of material, contained therein. A definite procedure is followed in purchasing, organizing, storing, issuing and receiving books, periodicals, pamphlets and other materials in the library room.

4. Providing opportunities to pupils to assume responsibilities

The pupils are taught to keep books with care, to serve on library communities, to act as library assist's' and other odd jobs connected with library service. They learn to work in co-operation with others, to help other pupils in the selection of books and to assist them in the solution of some of their' problems. It gives them an insight into human relationships; to understand economic efficiency and to take action as responsible citizens, when need arises.

Essential Equipment for the Library

1. Shelves

In the library room shelves contain books of all types as well as albums of records, films, filmstrips, school made slides and the like, arranged in a definite order, subject and section wise.

2. Tables and Chairs

The tables in a library should be of proper height and size and the chairs, strong and comfortable to accommodate students and teachers to read and work in the library. The librarian should be provided with a separate chair and desk to discharge his duties effectively.

3. Filling Cabinets for Catalogue Cards

Cabinets and drawers of a standard size accommodate catalogue cards easily.

4. Racks for Newspapers and Magazines

Daily newspapers as well as journals and magazines in different languages, on all subjects are placed in different racks, especially got prepared for this purpose. These racks are placed in different corners of the library room or in the reading room, attached to the library of that teachers and pupils come and read them in their vacant periods. Lock magazine covers are essential for journals and magazines. They preserve the magazines and journals from soil and theft. Rods in special frames may be used for the daily newspapers.

5. Bulletin Boards

Bulletin boards are used for displaying book-jackets and other illustrative material to advertise new arrivals in the library for those who are not regular visitors. A portion of the space, allocated to the library is used for the bulletin boards.

6. Storage Room and Work Room

The library storage room stores books that need binding and equipment essential for the audiovisual material. A workroom or an adequate closet space with a big table is used for mending books, mounting pictures and preparing books for the shelves.

Important Library Resources for Environmental Studies.

(A) Book Resources

These are essential for meeting individual needs in reading for presenting different points of view and for providing rich background of understanding of the people, the processes and the places, so essential in Environmental Studies instruction. Book resources include the following:

1. Text-books

A number of good textbooks in history, geography, civics, economics and Environmental Studies are available in the library. In view of the rapidly changing human life in all parts of the world, new and revised editions of standard textbooks must be purchased for school library for supplying most up-to-date knowledge to pupils and teachers.

2. Unit Booklets

In addition to textbooks, a number of unit booklets should also be available in the Environmental Studies library. These booklets are on a variety of topics ranging from family life and neighborhood to people of other land and places.

3. Reference Materials

These include reference books, encyclopedias, dictionaries, yearbooks, atlases, biographies, bibliographies, directories and government bulletins etc.

4. Literary Materials

These include biographies, fiction, folklore, short stories, travel books, books of adventure and hero-stories, romance, drama and poetry to provide reading for enjoyment and pleasure to all concerned.

5. Source Books

These include diaries, minutes and proceedings of meetings, original accounts of travelers and contemporary historians, manuscripts and timetable etc.

(B) Non-book Resources

1. Periodicals

These include current events periodicals and magazines about various aspects of life, including art literature, music, dance etc. as these reflect social tends of the period.

2. Pamphlets

Pamphlets are usually written about one specific topic and generally illustrated with pictures, photographs and drawings. The Environmental Studies teacher should keep himself in touch with currently published pamphlets, connected with his subject. As most of the pamphlets are published by various government agencies and bureaus for specialized services these are low priced. They provide important information about different walks of social, economic and political life.

3. Newspapers

A local newspaper is a must for every school library as it highlights local events, happenings, issues, personalities and developments, correlated with the immediate social and physical environments of the pupils. One or two daily newspapers of all-India circulation are also desirable for the library. A good newspaper is a mirror of the world events. Its study is essential for all teachers and students of Environmental Studies to keep themselves informed of all that is happening around them in the national and international fields.

4. Special Documents and Publications

Almost all the state governments publish brochures, yearly calendars or data books or activities within the states. Important business, concerns, railways and tourist bureaus also publish folders, containing rich information about various places, regions and towns. These provide primary source materials.

5. Audio-visual or Non-reading Materials

Non-reading materials play a very important role in Environmental Studies program. Many of these materials present information difficult to obtain through reading. They add realism and furnish the class with a common background of experience.

The Librarian as a Resource Person

1. A trained librarian maintains school library as an important resource centre to provide planned, expert service and guidance to teachers and students. At least one full-time librarian, with a permanent assistant should be provided to every secondary SCDOOI. They should be given a separate workroom and adequate office space to function effectively.
2. Creating creates an atmosphere of friendliness, self-control and self-direction. A whole-time trained librarian helps the students in acquiring good study habits and in developing a love of good books. He works with teachers in making the library, an important resource centre and a living agency. He makes available the needed resource materials to Environmental Studies classes.

Collateral Reading and the Library

Collateral and supplementary reading form an essential part of Environmental Studies programmed. The students collect information about various facts and movements after consulting many books and periodicals, besides their text-books for solving problems, doing assignments and participating in discussion etc. Library resource can furnish a rich supply of books, periodicals and pamphlets for; collateral reading. Textbook material must be supplemented by additional reference reading. The students should be encouraged to read widely on topics of their own interest, both for the sake of information and entertainment. They should be guided how to select, read and make use of the knowledge thus obtained to form good reading habits along with proper study procedures. They should be encouraged to take notes and to keep a regular record of their readings.

Suggestions for Motivating Pupils to Utilize Library

1. Reading List

The teacher for each pupil should fix a minimum amount of supplementary reading in the beginning of the year. Lists of different types of books, both fiction and non-fiction, especially connected with Environmental Studies instruction, should be prepared by the teacher in consultation with the librarian. These should be provided to all pupils and they may be asked to read the required number of books, out of which not more than half may be fiction.

2. Marks for Supplemental Reading

The teacher should set apart some marks in his subject for supplementary reading. They may be added to the total number of marks, the child receives in Environmental Studies at the end of the session. This will definitely motivate the pupils to read.

3. Questions in Tests

At least one question out of supplementary readers with adequate choice for different categories of pupils, should be given in the question paper, and it must be attempted compulsorily.

4. Programmed for Supplementary Reading

While teaching a certain unit about a particular period in Environmental Studies the teacher should bring with him such books which contain interesting accounts of living conditions in those days and read out a few paragraphs in the class from those books. He should also give to his pupils the names of the books, the names of the authors and those of their publishers and ask them to collect material there from, connected with the unit under study. After a day or two he may ask a pupil who has gone through a certain book and prepared reports and notes, to stand up and read out what he has collected, pertaining to the lesson in hand.

Teacher's Duty in Motivating Library Studies

The teacher should himself be a wide reader familiar with all the books published in his field. He should see that all those books are available to students in the school library. He should also be a regular reader of newspapers and periodicals. A good selection of newspapers and magazines should be available in the school library. Pupils should be encouraged to make use of this material. If the teacher has himself formed a habit of reading a daily newspaper, at least one or two monthly magazines pertaining to his own subject and making current affairs basis of the study of some important units in Environmental Studies he can motivate the study of newspapers and magazines available in the school library. He should keep a record of the reading of each pupil. A careful checking of pupil's reading may help him in evaluating books while preparing his lists of library books for various grades, from year to year.

LIST OF BOOKS AND OTHER INSTRUCTIONAL MATERIAL FOR HISTORY LIBRARIES

A. Books on Teaching of Environmental History

Aggarwal, J.C., *Teaching of Environmental History: A Practical Approach.* New Delhi, Vikas Publishing House. Pvt. Ud. 1992.

Beals, A.C.F., *A Guide to the Teaching of Environmental History in Schools.* London, University of London Press,1937.

Binning, AC., and Binning, D.R, *Teaching in Environmental Studies in Schools,* New York. OK Graw Hill Book Co., 1952

Bloch, Margate Historian's Craft. Manchester University Press, 1959.

Brown, C.F., *The Environmental History Room.* London, Historical Association, Pamphlet No. 86, 1948,

Chaudhary, K.P., *Audio-Visual Aids in Teaching Indian Environmental History.* Delhi, Atma Ram & Sons, 1965.

Chaudhary, K.P., *Contents of Environmental History in Indian Schools.* New Delhi, Ministry of Education, Government of India, 1953.

Chaudhary, K.P., *The Effective Teaching of Environmental Environmental Studies in India.* A Handbook for Environmental Studies Teachers, New Delhi, NCERT, 1975.

Chaudhary, K.P., *Preparation of Lesson Notes.* Calcutta, Bookland, 1955.

Dale, E., *Audio-Visual Methods in Teaching,* New York, Dryden/Press 1954.

Dobbson, D.P., *A Handbook for Environmental Studies Teachers. London,* Methuen, 1929.

Dymond, D., *A Handbook for Environmental Studies Teachers. London,* McMilan, 1929.

Findlay, I.J., *Environmental Studies and its Place' in Education.* London,University of London Press, 1923.

Ghate, V.D., *The Teaching of Environmental Studies,* Delhi Oxford University Press, 1973.

Ghosh, K.D., *Creative Teaching of Environmental Studies.* Calcutta, Oxford University Press, 1951.

Gustavson, Carlg, *A Preface to Environmental Studies.* New York, McGraw Hill, 1955.

Hill, C.P., *Suggestions on the Teaching of Environmental Studies Towards World Understanding.* Paris, UNESCO, 1954.

Johnson, H. *Teaching of Environmental Studies in Elementary and Secondary Schools.* New York, Macmillan, 1942.

Knowlton, D.C. *Making Environmental Studies Graphic.* New York, Scribner, 1925.

Kochhar, S.K., *Teaching of Environmental Studies.* New Delhi, Sterling Publishers Pvt. Ltd, 1989.

Ministry of Education, *Handbook of Suggestions for Teachers,* London, H.M. Stationery Office, 1950.

Ministry of Education, *Teaching of Environmental Studies.*" London, H.M. Stationery Office, Pamphlet No. 23, 1950.

National Institute of Education, *Improving Instruction in Environmental Studies.* Vol. II, New Delhi, 1969.

NCERT, *Teaching Environmental Studies in Secondary Schools.* A Handbook for Environmental Studies Teachers. New Delhi, NCERT, 1970.

Pandey, B.N. and Khosla, D.N., *Student Teaching and Evaluation.* New Delhi, NCERT, 1974.

Srivastava, H.S. and Udin, Qamar, *Sample Unit Tests in Environmental Studies.* New Delhi, NCERT, 1982.

Vajrwswari, *R.A., Handbook for Environmental Studies Teachers.* New Delhi, Allied Publishers, 1973.

B. BOOKS ON ENVIRONMENTAL STUDIES

Basham, A.L., *The wonder that was India.* London Sidgnick & Jack son, 1985.

Basham, *A.L., The Indian Sub-continent in Historical Perspective.* London School of Oriental and African Studies, University of London, 1954.

Bharatiya Vidya Bhavan, *Environmental Studies and Culture of Indian People.* Vol. I, Bombay, the Author.

Bose, M.L.A., *Social and Cultural Environmental Studies of Ancient India.* New Delhi, Concept, 1980.

Burke, S.M., *Akbar the Greatest Mughar.* New Delhi, Munshiram Manoharlal, 1989.

Carr, I.R,What is Environmental Studies? London, Macmillan & Company, 1961.

Chandri, Bipin, etc., *Freedom Struggle.* New Delhi, N.B.T., 1972.

Colling Wood, R.G., *The Ideal of Environmental Studies.* London, Oxford University Press, 1961

Colling Wood, R.G., *The Ideal of Environmental Studies.* London,Oxford University Press, 1951.

Desai, A.R., *Social Background of Indian Nationlism.* Bombay, Popular Prakashan..

Dutt, R.C., *Environmental Studies of Ancient and Modern India.* New Delhi, Arlbant, 1990.Edwardes, Michael Environmental Studies of India. New Delhi, Asia Publishing, House, 1961.

Goal. P.L., *The Imperial Guptas.* Varanasi Vidyalaya Prakashan, 1974.

Ghos, H.R., *Outline Environmental Studies of the Indian People.* Delhi, Publications Division, Ministry of Information and Broadcasting, Government of India, 1961.

Guide to Environmental Literature

Sari, Parsed, *Short Environmental Studies of Muslim Rule in India.* Allahbad, The Indian Press Ltd., 1965.

Jain, Krishan Lat, *Hindu Raki in the World.* Delhi, Akshat Pub. 1989.

Kosambi,. D.D., *An Introduction to Indian Environmental Studies.* Bombay, Popular, 1990.

Kumar, Nirmala, *The Stream of Indian Culture.* Bombay, Bharatiya Vidya Bhavan, I979.

Lal, B.B. and Gupta, (Eds.), *Frontiers of the Indus Civilization,* New Delhi” Books and Books, 1989.

Law, D.A. (Eds.), *Indian National Congress,* New Delhi, Oxford University Press,1989.

Mahajan, Y.D., *Ancient India.* New Delhi, S. Chand & Co., 1989.

Majumdar, R.C. and Chopra, P.N., *Main Currents of Indian Environmental Studies,* New Delhi, Sterling Publishers Pvt. Ltd., 1979.

Majumdar, R.C. (Ed.), *The History and Culture of the Indian People,* Bombay, Bharatiya Vidya Bhavan, 1951.

Ministry of Information, *India, Early History*. New Delhi, Publications Division, Government of India, 1988.

Fuller, H. and Trepan, R., *Muir's Historical Atlas—Medieval and Modem*. London, George Phillip and Sons Ltd., 1962.

Gilbert, Martin, *Recent History Atlas 1870 to the Present Day*. London, Weidenfold and Nicholson, 1967.

Kina and Rio, *Oxford Pictorial Atlas of Indian History*. Madras, Oxford University Press, 1973.

Patron, James. *The American Heritage Pictorial Atlas of United States' History*. 1966.

Name of Producer Distributor

1. Producer: Almeryn Studio, Bombay, Distributor, Christian Association for Radio and TV, Jablpur.
2. Producer, EBF, USA; Distributor Photo phone Pvt. Ltd.
3. Producer, EBSS, U.S.A.; Distributor. Photo phone Pvt. Ltd.
4. Producer, EBF, U.S.A.; Distributor, Photo phone pvt. Ltd.
5. Saki Vlhar Road, Bombay. Do Producer Common Ground, London: Distributor, NEIE Sapporo, Bender, and Bombay.
6. Christopher Columbus.
7. Florence Nightingale.
8. Pasteur and Microbes.

IMPORTANT SOURCES OF FILMS AND FILMSTRIPS

1. British Council Raffia drag, New Delhi.
2. Children's Film Society of India (CFSI).
3. Department of Instructional Education of each state-Films

Suggestions

Not merely a depository of books Environmental Studies library a resource centre extensively used by all members. As a resource centre, it reaches every classroom, every pupil and teacher and even the community. It helps the teacher to enrich curriculum and facilitate personal and professional reading. It helps the students to gain meaningful experiences in reading, thinking and forming independent judgments. It provides for recreational and hobby interests to the community. It is also a storehouse of all types of teaching aids including maps, charts, pictures, models, and manuscripts etc, which are easily accessible to all concerned. It can lift classroom teaching to new heights and give new depth to the learning experiences and the personal lives of all students.

QUESTIONS

1. Why does the library occupy an increasingly important place in the environmental science program? What are the important functions of school library?
2. What should be the essential equipment for a school library? Mention the various books resources for environmental studies instruction.
3. What use should be made of newspapers and magazines in a high school? How can a environmental science teacher encourage his pupils to read them?
4. Why is it essential for every secondary school to have a whole-time librarian?
5. How can the teacher motivate his students to read library books?

CHAPTER

11 Environmental Science : Modern and Effective Teacher

Introduction

"We are, however, convinced that the most important factor in the contemplated educational reconstruction is the teacher-his personal qualities, his educational qualifications, his professional training and the place that he occupies in the school as well as in the community. The reputation of a school! And its influence on the life of the community invariably depends on the kind of teachers working in it.

—Secondary Education Commission (1952-53)

Since ancient times, the teacher's role in the teaching-learning process has been pivotal, because the teacher is that person who influences the personality of the child at a large extent. So, he himself should have some desirable qualities of physical, moral and executive. The importance of the teacher has enhanced even after that, the role and importance of the teacher has not declined because for the concerned subject that he teaches. So, up to a great extent, the success or failure of commerce education depends on the Environment teacher.

—Kothari Education Commission (1964-66)

Stated-Of all the different tractors which influence the quality of education and its contribution to national development, the quality, competence and characters of teachers are undoubtedly the most significant, nothing recruits to the teaching profession, providing them with the best possible preparation and creating satisfactory conditions of work in which they can be fully effective. In view of the rapid expansion of educational facilities expected during the next three plans, and specially in view of the urgent need to raise standards to the highest level and to keep them continually improving, these problems have now acquired unprecedented importance and urgency. The efficiency of the teaching profession and its contribution to national development in general and educational importance in particular will depend largely on its social status and morale. This will, in its turn, depend upon two Inter-related factors: economic status and civic rights of teachers, and their professional competence, characters and sense of dedication."

1. Sir John Adam

"In case the teacher wants to be a man-maker then it is essential that he should possess specific qualities of character, intellect, and personality."

2. Dr. Radha Krishnan

"The teacher's place in society is of vital importance. He acts as the pivot for the transmission of intellectual traditions and technical skill, from generation to generation he helps to keep the lamp of civilization burning."

3. Binning and Binning

"Teaching is a progressive occupation and the teacher must ever be a student."

4. Henry Adams

"A parent gives life, but a parent gives no more. A murderer takes life and his deeds stop there. A teacher affects eternity, he can never tell where his influence stops."

5. Prof. Humanyun Kabir

"Teachers are literally the arbiters of a nation's destiny." The above mentioned definitions show that a teacher of commerce or other subject cannot do justice to his teaching profession unless he is also efficient and experienced in inculcating the interest of subject in the students.

QUALITIES OF A ENVIRONMENT TEACHER

A.S. Barr (1958), mentioned the following characteristics of successful teacher (as quoted by N.R. Saxena):

1. Good cultural background.
2. Substantial knowledge of the subject taught.
3. Substantial knowledge of professional practices and techniques.
4. Substantial knowledge of human development and learning.
5. Skill in the use of language-spoken and written.
6. Skill in human relationships.
7. Skill in research and educational problem solving.
8. Effective work habits.
9. Interest in professional growth.
10. Interest in school and community.
11. Interest in professional cooperation.
12. Interest in teaching.
13. Interest in the subject.
14. Interest in the pupils.

In America, **Dr. F.L. Clapp** (1913) suggested 10 qualities for being a good teacher such as:

1. Address
2. Personal Appearance
3. Optimism
4. Reserve
5. Enthusiasm
6. Fairness of mind
7. Sincerity
8. Sympathy
9. Vitality
10. Scholarship

Bagle and **Keith** (U.S.A.) suggested 3 more traits along with above mentioned ten traits of a good teacher.

1. Tact
2. Capacity for leadership
3. Good Voice

The 15th Annual Gallup Pool of the Public Attitude towards the Public Schools in the U.S.A. in 1983 mentioned the following qualities of a teacher (as quoted by M.H. Siddiqui):

1. Ability to communicate, to be firm and fair
2. Patience
3. Ability to discipline-to be firm and fair
4. High Moral character
5. Friendliness
6. Good Personality
7. Sense of Humor
8. Dedicated to teaching profession
9. Enthusiasm
10. Ability to inspire and motivate students
11. Intelligence and
12. Caring about students.

In New York, Education Department mentioned the following traits of a teacher:

T—Thoughtful

G—Gregarious

R—Reliability

O—Open mindedness

A—Abilities in Leadership

O—Originality

I—Integrity

D—Discernment

T—Tidiness/Tact

A—Ability to do creditable college work

E—Enthusiasm

A—Adaptability

C—Cooperativeness

H—Health

E—Effectiveness

R—Resourcefulness

S—Sense of Humor

O—Objectivity

F—Fluency

From above mentioned traits of teacher, we can show the significance of each letter of the word 'Environment teacher' in the following way:

C—Champion of Commerce subject

O—Orator

M—Manner, Mastery over the subject

M—Marks-man in child psychology

E—Expositor

R—Recitative

C—Conscience

E—Euphony in Language use

T—Tact, thoughtful

E—Effectiveness

A—Alertness

C—Co-operativeness with students

H—Health (Physical and Mental)

E—Enthusiasm

R—Reliability, Resourcefulness

CLASSIFICATION OF AN EFFECTIVE ENVIRONMENT TEACHER

The quality and effectiveness is very necessary for a subject teacher. The effectiveness is defined in different manners by so many educationists. In my option the quality and effectiveness of subject teachers is also effected by their background and providing of teaching aids as well as the environment of teaching and learning situation. But after all we should not forget that there are some common skills for teaching and it is required for any subject teacher what ever their background. Some important are given below:

1. Individual Qualities
2. Interest in Commerce
3. Patience and Self Confidence
4. Good Health
5. Resourcefulness
6. Pleasing Personality of Teacher
7. Humorous Temperament
8. Professional Qualities
9. Educational Qualification
10. Knowledge of Subject
11. Knowledge of Psychology
12. Ability of Self-Expression
13. Knowledge of different Teaching Methods
14. Studious and Scientific Attitude
15. Knowledge of different Teaching Aids
16. Interest in the Research Work
17. Social Qualities
18. Quality of leadership
19. Democratic Attitude
20. Justice Loving
21. Faith in the World Citizenship
22. Honesty and Impartiality
23. Friendly and Sympathetic
24. Individual Qualities

1. Interest in Commerce

A Environment teacher must have zeal and zest in his teaching subject commerce and should have full mastery over subject matter. Otherwise he would feel that he has been assigned a very boring job.

2. Patience and Self-Confidence

As we know that commerce is not an easy subject, so a Environment teacher should have full confidence and patience while teaching Book-keeping, Income Tax or Accountancy etc. These both traits of Environment teacher help him to a large extent in solving the problems of students effectively.

3. Good Health

As a proverb says 'A healthy mind lives in a healthy body.' It suits up to a great extent with Environment teacher can teach efficiently with long hours. Here Good health denotes both mental and physical health.

4. Resourcefulness

'Teacher of Commerce' should be creative and imaginative in arranging the different available teaching means according to needs of the class. If there is no availability of any teaching mean in the school, he can borrow the teaching means, such as Typewriter, Duplicator, Xerox machine etc. from the community or the guardian of the students.

5. Pleasing Personality of Teacher

The Environment teacher should have a pleasing personality. Healthy physique, proper clothes and impressive way of talking with others, are included in the pleasing personality.

6. Humorous Temperament

Jolly mood of the teacher keeps the students active and his humorous temperament creates the suitable environment in the classroom.

Professional Qualities

1. Educational Qualifications

An Environment teacher must have some basic essential academic qualification for teaching commerce to a particular class. Along with some basic academic qualifications, he should have some professional qualifications for teaching purposes, *i.e.,* B.Ed, or M.Ed. etc. A teacher who wants to teach commerce at +2 level, should possess the B.Ed. Degree.

2. Knowledge of Subject

Environment teacher should have thorough knowledge of commerce and should have good mastery so well that his students may get convinced of his teacher's mastery over subject easily. It is necessary for being a successful teacher.

3. Knowledge of Psychology

Environment teacher should have the knowledge of psychology because it helps the teacher in understanding the child psychology, individual differences, stages of mental and physical growth etc.

4. Ability of Self Expression

For being a good teacher, the teacher should have the ability of self-expression according to the class standard and mental level of the students. He should express his views in lucid language. He should not be too slow, nor unnecessarily high and shrill while teaching the students. In between his teaching, he should take the help of blackboard to elucidate the content/topic. The teacher should use following methods:

1. Laboratory method
2. Project method
3. Problem method
4. Analytic and Synthetic method
5. Socialized Recitation method
6. Discussion method
7. Supervised study method
8. Unit method

He should have mastery even the techniques usually used in teaching commerce:

1. Questioning Techniques
2. Assignment Techniques
3. Narration Techniques
4. Illustration Techniques
5. Examination Techniques
6. Drill techniques
7. Demonstration Techniques

6. Students and Scientific Attitude

Not one can become a good teacher unless he is studious and endeavors to acquire the mastery over the subject. An Environment teacher should be studious and should devote his sufficient time in increasing the subject knowledge. **R.N. Tagore** has rightly said, "A lamp cannot light another lamp unless it continues its own flame burning."

7. Knowledge of Different Teaching Aids

The teacher should have the full knowledge of different teaching aids. *i.e.*, how to operate them, and when to use them in the classroom for making of his teaching effective.

8. Interest in the Research Work

For being a good teacher of commerce, one must be good at research work. The Environment teacher can use discovery methods, for the solution of different managerial problems and high cost of the product problem.

Social Qualities

1. Quality of Leadership

Environment teacher's leadership is totally based upon his personality and character. A teacher having sound character and personality can motivate the student to do the task in the group collectively. This quality of the teacher makes him active and famous in the school.

2. Democratic Attitude

"Teacher can foster the qualities of ideal citizenship." **–Bining**

The teacher should provide freedom, fairness, equality and brotherhood to the students while dealing with them. This attitude denotes the democratic attitude of the teacher.

3. Justice Loving

The Environment teacher should have the quality of justice loving and should not be biased while he is in the chair of judge. This quality of the teacher will convert him as an ideal for the students.

4. Honesty and Impartiality

Environment teacher should behave all the pupils impartially. Teacher's working and his deeds both should be same. Those teachers, who have something in minds/hearts and something else on their tongues, do not get any respect from others.

5. Friendly and Sympathetic

Environment teacher's behaviour with his students should be like a friend. He should try to trace the problems of the children and try to tackle with their problems effectively as far as possible.

PROFESSIONAL GROWTH OF ENVIRONMENT TEACHER

As we know that education is dynamic process. It changes with advent of every new research in the field of education. Commerce is a practical subject, which plays a significant role in the development of commercial sector. So, now it is the duty of an Environment teacher to avoid the old and outdated information's for this very purpose. He must continue to grow professionally, abreast of up to date scholarly contributions in the field of commerce. R.N Tagore rightly remarked in this context "A lamp cannot light another lamp unless it continues its own flame burning."

An Environment teacher can avail of the following programs to grow professionally. They are such as:

1. Professional Refresher Course
2. Professional Orientation Course
3. Extension Lecture
4. Professional Seminar
5. Professional Workshop
6. Professional Conference
7. Professional Writing
8. Professional Study Group
9. Professional Indirect Training
10. Professional Research
11. Membership and professional Councils.

1. Professional Refresher Course

Environment teacher should go to attend the refresher course on new techniques in commerce teaching on order to be him up to date. Actually, refresher course if concerned with in-service training and such type of courses are designed to revise and underline existing skills and knowledge.

2. Professional Orientation Course

Such type of courses is organized in summer vacations by NCERT (Education department) to make the professional knowledge of the teachers up to date. The main motto of organizing such types of programmes is:

1. To make familiar with mental health of the students.
2. To make familiar with construction of objective type test, and evaluation techniques.
3. To reform the old system of education
4. To impart the latest educational researches in commerce.

3. Extension Lectures

It means that teaching or instructional work carried out by college, university or other educational establishment for extending the normal range of a subject or allowing for the pursuit of related interest. It helps the Environment teachers to keep themselves up to date.

4. Professional Seminars

Professional seminars refer to an occasion when a teacher or a group of expert people meet to study and discuss something. It is also called small group discussion session. Such type of seminars is organized to think and analyses the existing problems in the society. At the end of seminar, some important decisions are usually made.

5. Professional Workshop

As we know that the area of commerce is very wide and related with several professions and subjects. So only individual study is not enough for the Environment teacher. It is compulsory to know that what is occurring in commerce related subjects. Upto a large extent, it is like a seminar.

6. Professional Conference

The Environment teacher should attend the conferences over his subject, because several teachers come from different places and gather at a particular place to discuss the emerging practical problems. Eventually, this will broaden the knowledge of Environment teachers.

7. Professional Writing

Environment teacher should contribute his research findings through his papers in journals of repute. This way, he can help the other Environment teachers to benefit from his research findings.

8. Professional Study Group

In commerce education, several teachers of commerce subject may organize their own group to discuss the emerging practical and theoretical problems of the commerce subject. Generally, teacher's training college lecturers or H.O.D. shoulders the responsibility of organizing such type of groups.

9. Professional Indirect Training

Environment teachers can avail of these to grow professionally.

1. Studying the published magazines and journals by NCERT.
2. To listen Radio and to watch T.V.
3. To participate in commercial organization.
4. To visit the bank, market and business centers etc.

10. Professional Research

The keen research of commerce subject should be provided special facilities such as computer typing, free postage facility, free entry to all university central libraries to consult the journals, book and encyclopedia etc. This will add the merits to the professional growth of Environment teachers.

11. Membership of Professional Councils

The Environment teacher should enjoy the membership of any professional council. The main functions of these professional councils are:

1. To organize the commercial fairs in the schools to demonstrate the commercial activities before the students.
2. To get the magazines or journals published timely with high standard. Teacher of commerce can know about his extent of success in teaching profession and styles with the help of self-evaluation by teacher. For this very purpose, he may take the help of supervisor who evaluates the teacher through rating scales.

Rating Scales To Evaluate the Performance of Environment teacher

Evaluation Qualities of Teachers	Rating Excellent	Better	Good	Ordinary	Poor
1. Personality Aspect					
(*a*) Physical					
(*i*) Outer Appearance					
(*ii*) Health					
(*iii*) Language					
(*iv*) Voice					
(*b*) Individual					
(*i*) Sympathy					
(*ii*) Objective					
(*iii*) Impartiality					
(*iv*) Tolerance					
(*v*) Self-control					
(*vi*) Social					
(*vii*) Liberal					
(*viii*) Regularity					
(*ix*) Dutiful					
(*c*) Practical					
(*i*) Self-confidence					
(*ii*) Resourceful					
(*iii*) Organizer					
(*iv*) Director					
2. Educational Aspect					
(*a*) Mastery over subject					

(*b*) Knowledge of the current affairs

(*c*) Knowledge of commercial geography

(*d*) Knowledge of teaching of commerce

(*e*) Practical knowledge and outlook of subject.

3. Professional Aspect

(*a*) Training

(*b*) Attitude towards teaching profession

(*c*) Knowledge of latest methods of teaching

(*d*) Scientific and broad outlook towards educational problems.

4. Teaching

(*a*) Planning

(*b*) Application of teaching methods

(*c*) Use of blackboard

(*d*) Questions

(*e*) Use of A.V. Aids

(*f*) Class discipline

Suggestions

The teacher is the guide of the society and nation; it is the statement of the Father Of Nation Bapu (Mahatma Gandhijee). In the light of above statement we have to justify the role of the teacher in the society in the development of the nation and it is true not from today but from the Vedic periods. The society and nation has given so many examples for us. The coming generation and new teacher should understand that their role as a teacher is very important in the development of society and nation and it depends upon the economic of nation and it will be guided by the Environment teachers of the nation. So they should maintain a character and should present a role teacher in their subject because the teacher is the model for their students.

QUESTIONS

1. How can an environment teacher keep pace with the latest development in education?
2. What are the essential qualities that a teacher of commerce should have in order to create impact on children?
3. What qualities and qualifications should good environment teacher have? Discuss.
4. Teacher is the maker of man. In the light of this statement, discuss the essential qualities of a environment teacher.

   (*a*) Individual qualities (*b*) Professional qualities

   (*c*) Social qualities (*d*) None of these.

Ans. (*c*)

5. Who stated, "Teacher can foster the qualities of ideal citizenship?"

(*a*) John Adam (*b*) Kothari Education Commission

(*c*) Bining (*d*) Henry Adams

6. Which quality does not come under social qualities?

(*a*) Justice Loving (*b*) Interest in the research work

(*c*) Honesty and impartiality (*d*) Quality of leadership.

Ans. (*b*)

GLOSSARY

Adaptation—Any feature of the organism or its parts, which is of definite significance in allowing that organism to exist under the conditions of its habitat, is called adaptation.

Animal Ecology—It is the interpretation of animal behaviour under natural conditions.

Applied Ecology—The wild life management, range management, forest conservation, biological control, animal husbandry, pollution control are the various aspects dealt with in the applied ecology.

Avian Ecology—Ecology of birds. .

Biogeochemical Cycles—More or less circular pathways, through which the mineral elements, including all the essential elements of the protoplasm, circulate in the biosphere from environment to organisms and back to the environment.

Biological Clock—It is the rhythmic occurrence of processes taking place within the organisms.

Community Ecology—Study of distribution of animals in various habitats.

Community Ecology—Study of living components of a community, major concerns of community ecology are (*a*) nature of interdependence between individuals of different species (*b*) causes of diversity in a community (*c*) reasons of a community located in a particular habitat and (*d*) change and interaction among different communities.

Cytoecology—Cytological details in a species in relation to population in different environmental conditions.

Ecad—An ecad is a population of individuals, which although belong to the same genetic stock, but differ markedly in external characters such as size, shape and colour etc.

Ecological Niche and Ecological Equivalent—Ecological niche of an organism is the physical space occupied by it, its functional role in the community i.e. tropic position, its position in environment and the conditions of existence. Organisms that occupy the same or similar ecological niches in different geographical regions are known as Ecological Equivalents.

Ecosystem Ecology—Relation and interaction of both plant and animal communities with their total environment.

Ecotype—Population of individuals of a species, which are genetically different.

Environment—The sum of all factors affecting the organisms is termed as the environmental complex.

Environmental Biology or Ecology—Living organisms are inseparably related with their physical and biological surroundings. This interrelationship of organisms with their physical and biotic environments is studied under a separate discipline of science, which is known as environmental biology or ecology.

Factor—A factor is an external force, substance or condition that affects organisms In any way.

Fauna—Fauna is a collective term used for all the animals in a given region or geological period.

Flora—Collective term for all the plants big and small found in a given region or geological period.

Geographic Ecology or Eco-geography—Study of geographical distribution of organisms.

Habitat—The place where an organism lives, eats and reproduces is known as its habitat. The habit of an organism actually represents a particular set of environmental conditions suitable. for its successful growth.

Insect Ecology—It is the ecology of insects.

Limnology—It is the study of freshwater bodies like ponds, lakes and their organisms.

Mammalian Ecology—Ecology of mammals.

Oceanography—Study of marine habitat and organisms.

Palaeo-ecology—Organisms and their environment in geological past.

Pedology—Study of fossils, in particular their acidity alkalinity, humus content, mineral contents, soil types etc., and their influence on the plant and animal life.

Population and Community—A population represents a group of individual organisms of the same species in a given area. A community is a group of populations of different species in a given area.

Population Ecology—It includes the study of population, its growth, competition, means of dispersal etc.

Production Ecology and Ecological Energetic—These branches of ecology deal with the mechanisms and quantity of energy conversion and energy flow through different tropic levels in food chain and rate of increase in organic weight of the organisms in space and time. The productivity is measured both in gross and net values. The total organic production is called the *gross production*, and the actual gain, i.e. the gross production minus the loss in respiration is termed as the *net production*, It includes the proper management of different ecosystems so that the maximum yield can be obtained. e.g. agriculture and horticulture.

Radiation Ecology—The gross effect of radiation and radioactive substances over the environment and living organisms.

Space Ecology—It is the modern subdivision of ecology. It is concerned with the development of those ecosystems, which support life of man during space flights or during extended exploration of extraterrestrial environment.

Species—A uniform interbreeding population spread over time and space.

Terrestrial Ecology—It is the study. of biomes and the organisms distributed therein. It can further be differentiated into (i) forest ecology, (ii) cropland ecology and (iii) grassland ecology.

Vegetation—Collection and continuous growth of plants in space is called vegetation. Thus vegetation is the totality of plant growth including large or small populations of each species intermixed in a region.

Biotic—environmental factors that are nonliving components of ecosystems.

Abundance—The total number of organisms in a biological community.

Acid precipitation—The deposition of wet acidic solutions or dry acidic particles from the air and includes acid fog, snow, etc.

Aerosols—Small particles or droplets suspended in a gas.

Agricultural revolution—The discovery of techniques for domesticating animals and cultivating crop plants some 10,000 years ago.

Alpine—The high, treeless bio-geographic zone of mountains that consists of slopes above the timberline.

Aquifers—Porous, water-bearing layers of sand, gravel and rock below the earth's surface; reservoirs for groundwater.

Autotrophy—An organism that synthesizes food molecules from inorganic molecules by using an external energy source, such as light energy.

Bioaccumulation—The selective absorption and concentration of molecules by cells.

Biocide—A broad-spectrum poison that kills a wide range of organisms.

Biodegradable plastics—Plastics that can be decomposed by microorganisms.

Bio-geographical area—An entire self-contained natural ecosystem and its associated land, water, air and wildlife resources.

Biological community—The populations of plants, animals and microorganisms living and interacting in a certain area at a given time.

Biological pests—Organisms that reduce the availability, quality or value of resources useful to humans.

Bio-magnification—Increase in concentration of certain stable chemicals (e.g., heavy metals or fat-soluble pesticides) in successively higher tropic levels of a food chain or web.

Biomass fuel—Organic material produced by plants, animals or microorganisms that can be burned directly as a heat source or converted into gaseous or liquid fuel.

Biosphere reserves—Our world heritage sites identified by the lUCN as worthy for national park or wildlife refuge status because of high biological diversity or unique ecological features.

Biotic potential—The maximum reproductive rate of organisms, given unlimited resources and ideal environmental conditions.

Birth control—Any method used to reduce births, including celibacy,. delayed marriage, contraception; methods that prevent implantation of fertilized zygotes and induced abortions.

Blue revolution—New techniques of fish farming that may contribute as much to human nutrition as miracle cereal grains but also may create social and environmental problems.

Carcinogens—Substances that cause cancer.

Carnivores—Organisms that mainly prey upon animals.

Carrying capacity—The maximum number of individuals of any species that can be supported by a particular ecosystem on a long-term basis.

Chloroplasts—Chlorophyll-containing organelles in eukaryotic organisms; sites of photosynthesis.

Composting—The biological degradation of organic material under aerobic (oxygen-rich) conditions to produce compost, a nutrient-rich soil amendment and conditioner.

Conifers—Needle-bearing trees that produce seeds in cones.

Consumer—An organism that obtains energy and nutrients by feeding on other organisms or their remains.

Deciduous—Trees and shrubs that shed their leaves at the end of the growing season.

Decomposers—Fungi and bacteria that break complex organic material I into smaller molecules.

Desalinization—Removal of salt from water by distillation, freezing or, ultra filtration.

Desertification—Denuding and degrading a once-fertile land, initiating a desert-producing cycle that feeds on itself and causes long-term changes in soil, climate and biota of an area.

Diversity—The number of species present in a community (species richness), as well as the relative abundance of each species.

Ecosystem—A specific biological community and its physical environment interacting in an exchange of matter and energy.

Endangered species—A species considered to be in imminent danger of extinction.

Endemism—A state in which species are restricted to a single region.

Energy—The capacity to do work (i.e., to change the physical state of motion of an object).

Energy pyramid—A representation of the loss of useful energy at each step in a food chain.

Environment—The circumstances or conditions that surround all organisms or group of organisms as well as the complex of social or cultural conditions that affect an individual or community.

Environmental ethics—A search for moral values and ethical principle in human relations with the natural world.

Environmentalism—Active participation in attempts to solve environmental pollution and resource problems.

Environmental resistance—All the limiting factors that tend to reduce population growth rates and set the maximum allowable population size or carrying capacity of an ecosystem.

Environmental resources—Anything an organism needs that can be taken from the environment.

Environmental science—The systematic, scientific study of our environment as well as our role in it.

Estuary—A bay or drowned valley where a river empties into the sea Fresh water mingling with salt water brings in sediment and nutrient and creates a gradient of salinity that makes estuaries among the most diverse and biologically productive ecosystems on earth.

Eutrophication—An increase in biological productivity and ecosystem succession caused by human activities.

Exhaustible resources—Generally considered the earth's geologic endowment: minerals, non-mineral resources, fossil fuels and other materials present in fixed amounts in the environment.

Exponential growth—Growth at a constant rate of increases per unit of time; can be expressed as a constant fraction or exponent.

Extinction—The irrevocable elimination of species; can be a normal process of the natural world as species out-compete or kill off others or as environmental conditions change.

Family planning—Controlling reproduction; planning the timing of birth and having as many babies as are wanted and can be supported.

Fauna—All of the animals present in a given region.

Floodplains—Low lands along riverbanks, lakes and coastlines subjected to periodic inundation.

Flora—All of the plants present in a given region.

Food chain—A linked feeding series; in an ecosystem, the sequence of organisms through which energy and materials are transferred, in the form of food, from one tropic level to another.

Food web—A complex, interlocking series of individual food chains in an ecosystem.

Gene banks—Storage for seed varieties for future breeding experiments.

Geometric growth—Growth that follows a geometric pattern of increase, such as 2, 4, 8,16, etc.

Grasslands—Biological communities of grasses, seasonal herbaceous flowering plants and open savannas.

Green revolution—Dramatically increased agricultural production brought about by "miracle" strains of grain.

Habitat—The place or set of environmental conditions in which a particular organism lives.

Hazardous—Describes chemicals that are dangerous, including flammables, explosives, irritants, sanitizers, acids and caustics; may be relatively harmless in diluted concentrations.

Health—A state of physical and emotional well being the absence of disease or ailment..

Herbicide—A chemical that kills plants.

Herbivore—An organism that eats only plants.

Heterotopy—An organism that is incapable of synthesizing its own food and, therefore, must feed upon organic compounds produced by other organisms.

Human resources—Human wisdom, experience, skill, labour and enterprise.

Industrial revolution—Advances in science and technology that have given us power to understand and change our world.

Insecticide—A chemical that kills insects.

Jet streams—Powerful winds or currents of air that circulate in shifting flows; similar to oceanic currents in extent and effect on climate.

Keystone species—A species that determines the essential characteristics of a community.

Land rehabilitation—A utilitarian program to repair damage and make land useful to humans.

Landfills—Land disposal sites for solid waste; operators compact refuse and cover it with a layer of dirt to minimize rodent and insect infestation, wind-blown debris and leaching by rain.

Marine—Living in or pertaining to the sea.

Matter—Something that occupies space and has mass.

Metabolism—All the energy and matter exchanges that occur within a living cell or organism; collectively, the life processes.

Mineral—A naturally occurring, inorganic, crystalline solid with definite chemical composition and characteristic physical properties.

Mitigation—Repairing or rehabilitating a damaged ecosystem or compensating for damage by providing a substitute or replacement area.

Mutation—A change, either spontaneous or by external factors, in the genetic material of a cell; mutations in the gametes (sex cells) can be inherited by future generations of organisms.

Natality—The production of new Individuals by birth, hatching, germination, or cloning.

Natural resources—Goods and services supplied by the environment.

Non-governmental organizations (NGOs)—A term referring collectively to pressure and research groups, advisory agencies, political parties, professional societies and other groups concerned about environmental quality, resource use, and many other issues.

Non-renewable resources—Materials or services from the environment that are not replaced or replenished by natural processes at a rate comparable to our use of the resource; a resource depleted or exhausted by use.

Omnivore—An organism that eats both plants and animals.

Organic compounds—Complex molecules organized around skeletons, of carbon atoms arranged in rings or chains; includes bio molecules, molecules synthesized by living organisms.

Ozone—A highly reactive molecule containing three oxygen atoms; a dangerous pollutant in ambient air. In the stratosphere, however, ozone forms an ultraviolet absorbing shield that protects us from mutagenic radiation.

Pasture—Enclosed domestic meadows or managed grazing lands.

Pathogen—An organism that produces disease in a host organism, disease being an alteration of one or more. metabolic functions in response to the presence of the organism.

Pest—Any organism that reduces the availability, quality or value of a useful resource.

Pesticide—Any chemical that kills; controls, drives away or modifies the behaviour of a pest.

Photochemical oxidants—Products of secondary atmospheric reactions.

Photosynthesis—The biochemical process by which green plants and some bacteria capture light energy and use it to produce chemical bonds. Carbon dioxide and water are consumed while oxygen and simple sugars are produced.

Pioneer species—In primary succession on a terrestrial site, the plants, lichens and microbes that first colonize the site.

Plankton—Primarily microscopic organisms that occupy the upper water layers in both freshwater and marine ecosystems.

Pollution—To make foul, unclean, dirty; any physical, chemical or biological change that adversely affects the health, survival, or activities If living organisms or that alters the environment in undesirable ways.

Population—A group of individuals of the same species occupying a given area.

Population explosion—Growth of a population at exponential rates to a size that exceeds environmental carrying capacity; usually followed by population crash.

Primary succession—An ecological succession that begins in an area where no biotic community previously existed.

Producer—An organism that synthesizes food molecules from inorganic compounds by using an external energy source; most producers are photosynthetic.

Radioactive—An unstable isotope that decays spontaneously and releases subatomic particles or units .of energy.

Rehabilitate land—A utilitarian program to make an area useful to humans.

Renewable resource- Resources normally replaced or replenished by natural processes; resources not depleted by moderate use; examples include solar energy, biological resources such as forests and fisheries, biological organisms and some biogeochemical cycles.

Resilience—The ability of a community or ecosystem to recover from disturbances.

Salinity—Amount of dissolved salts (especially sodium chloride) in a given volume of water.

Stalinization—A process in which mineral salts accumulate in the soil, killing plants; occurs when soils in dry climates are irrigated profusely.

Secondary succession—Succession on a site where an existing community has been disrupted.

Sheet erosion—Peeling off thin layers of soil from the land surface; accomplished primarily by wind and water.

Slums—Legal but inadequate multifamily rooming houses; some are custom built for rent to poor people, others are converted from some other use.

Smog—The term used to describe the combination of smoke and fog in the stagnant air of London; now often applied to photochemical pollution products or urban air pollution of any kind.

Species diversity—The number and relative abundance of species present in a community.

Sustainable development—An improvement in human well-being that allows us to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Tectonic plates—Huge blocks of the earth's crust that slide around slowly, pulling apart to open new ocean basins or crashing ponderously into each other to create new, larger landmasses.

Terracing—Shaping the land to create level shelves of earth to hold water and soil; requires extensive hand labour or expensive machinery but it enables farmers to farm very steep hillsides.

Threatened species—While still abundant in parts of its territorial range, this species has declined significantly in total numbers and may be on the verge of extinction in certain regions or localities. .

Mountains—the highest-altitude edge of forest that marks the beginning of the treeless alpine tundra.

Topsoil—The first true layer of soil; layer in which organic material is mixed with mineral particles; thickness ranges from a meter or more under virgin prairie to zero in some deserts.

Transitional zone—A zone in which populations from two or more adjacent communities meet and overlap.

Tropic level—An organism's feeding status in an ecosystem.

Urban area—An area in which a majority of the people are not directly dependent on natural resource-based occupations.

Urbanization—An increasing concentration of the population in cities and a transformation of land use to an urban pattern of organization.

Vulnerable species—Naturally rare organisms or species whose numbers have been so reduced by human activities that they are susceptible to actions that could push them into threatened or endangered status.

Water logging—Water saturation of soil that fills all air spaces and causes plant roots to die from lack of oxygen; a result of over-irrigation. **Weather-** Description of the physical conditions of the atmosphere (moisture, temperature, pressure, and wind).

Wetlands—Ecosystems of several types in which rooted vegetation is surrounded by standing water during part of the year.

Wildlife—Plants, animals and microbes that live independently of humans; plants, animals and microbes that are not domesticated.

Woodland—A forest where tree crowns cover less than 20 percent of the ground; also called open canopy.

Zero population growth (ZPG)—The numbers of births at which people are just replacing them; also called the replacement level of fertility.

REFERENCES

Anonymous, 1990, *Global Atmospheric Change and Public Health*, Elsevier, New York.

Anonymous, 2002. Biodiversity Characterisation at Landscape Level in Western Himalays, In India using Satellite Remote Sensing and Geographical Information System, Indian Institute of Remote Sensing (NRSA), Dehradun.

Cunningham, W.P. and Saigo, B.W., 1995. *Environmental Science*. W.M.C. Brown Publishers, New York, USA.

Enger, D.E. and Smith B.F., 1995. *Environment Science–A Study of Interrelationships.* W.M.C. Brown Publishers, New York, USA.

Gupta, P.K., 1997, *Elements of Biotechnology*, Rastogi Publications, Meerut.

Krebs C.J., 1985, *Ecology,* Harper Collins Publishers.

Moran, J.M. and Morgan M.D., 1991, *Meteorology–The Atmosphere and the Science of Weather*, MacMillan Publishing Company, New York.

Negi, B.S., 1991, *Geography of Resources*, Kedar Nath Ram Nath, Meerut.

Odum, E.P., 1996, *Fundamentals of Ecology*, Natraj Publishers, Dehradun.

Rastogi, V.B., 1993, *Environmental Biology and Biochemistry*, Kedar Nath Ram Nath, Meerut and Delhi.

Sharma, P.D., 1997, *Ecology and Environment*, Rastogi Publications, Meerut.

Singh, S., 1997, *Physical-Geography*, Prayag Pustak Bhavan, Allahabad.

Trivedi, P.R., 1999, *Encyclopaedia of Ecology and Environment*, 1-10, Indian Institute of Ecology and Environment, New Delhi.

Yadav, D. and Sharma, L., 2000, A Project Report, Biodiversity Characterisation at Landscape Level Using Remote Sensing and GIS in Shimla District. Indian Institute of Remote Sensing (MRS), Dehradun.