A Text Book of

ENVIRONMENTAL SCIENCES

As Per PCI Regulations

FIRST YEAR B. PHARM.

Semester - II

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Preface

It gives me immense pleasure to present this book titled **"A Text Book of Environmental Sciences"** for the students of B.Pharm. Semester II.

Our Earth is the only precious planet in this vast universe where diverse forms of living organisms like plants, animals and microorganisms live. Our very existence depends on the conservation of the environment. The environmental damage inflicted due to alarming population explosion, rapid urbanisation and industrialisation, increasing needs of energy and fast scientific and technological advancement cannot be reversed unless there is collective thinking, will and effort by the common people. These call for public awareness and participation for bringing about an attitudinal change and finally restricting further damage to the environment.

Effective implementation of environmental management and conservation programmes depends on education, awareness and training in the relevant areas. The importance of environmental awareness is that it helps individuals understand the impact we as humans have on our planet. Without an understanding of how to conserve natural resources and the compelling need to do so, few people would be motivated to participate actively in programmes on environmental conservation. Environment education and awareness thus assume critical importance.

The book is written as per the syllabus prescribed by the PCI. However, some topics are described extensively and additional information is furnished so that students can get a detailed idea about the topics instead of superficial knowledge. Teachers can make their teaching effective with field visits and observations.

Sincere efforts have been taken to make the subject comprehensive, up to date and concise. Emphasis has been laid on the basic fundamentals which are explained in a simple, lucid and understandable language. I am sure that this book will fulfill the need of students.

I express my sincere thanks to **Shri. Dineshbhai Furia, Shri. Jignesh Furia, Malik Shaikh, Roshan Shaikh** and **staff** of **Nirali Prakashan** for bringing out this book in time.

I would gratefully appreciate constructive criticism and suggestions from my colleagues and students.

January 2018 **Authors**

Syllabus

BP. 206 T Environmental Sciences (Theory)

Unit I **10 Hours**

The Multidisciplinary Nature of Environmental Studies

Natural Resources

Renewable and Non-renewable Resources:

Natural Resources and Associated Problems

(a) Forest Resources

(b) Water Resources

(c) Mineral Resources

(d) Food Resources

(e) Energy Resources

(f) Land Resources

Role of an Individual in Conservation and Natural Resources.

Unit II **10 Hours**

Ecosystems

- Concept of an Ecosystem.
- Structure and Function of an Ecosystem.
- Introduction, Types, Characteristic Features, Structures and Functions of the Ecosystems: Forest Ecosystem; Grassland Ecosystem; Desert Ecosystem; Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries).

Unit III **10 Hours**

Environmental Pollution : Air Pollution, Water Pollution, Soil Pollution.

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Chapter ... 1

THE MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

♦ SYNOPSIS ♦

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(A) The Multidisciplinary Nature of Environmental Studies

INTRODUCTION

Environmental studies or Ecology is the branch of biology which deals with the study of plants and animals in relation to their environments. According to the Committee on Environmental Health Association of America, environment comprises the surroundings in which man lives, works and plays. It encompasses the air he breathes, the water he drinks, the food he consumes and shelter he provides for his protection against the elements. It also includes the pollutants and detrimental environmental factors which adversely affect his life and health.

St. Hilaire, the French Zoologist, in 1859, proposed the term **Ethology** for the study of behaviour of animals in relation to their environment. The German Biologist, Ernst Haeckel in 1866 proposed the term **Ecology** for the study of relations of animals and plants to their surroundings. Lankester in 1889 coined the term **Bionomics** for the study of relations of organisms to their environment. Thus, all these terms have more or less the same meaning, but **Ecology** was the widely used term by most biologists. Recently, the term **Environmental biology** has been introduced, giving a lot of emphasis on the inter-relationships between organisms and their environment. Nevertheless, the two terms are synonymous.

E. P. Odum (1969) has defined the term environmental biology as '*the study of inter-relationships between organisms and their environments*'. The name Ecology is derived from two Greek words i.e. **Oikos** = House and **logos** = study. Therefore, 'the study of inter-relationships of organisms with their physical and biotic environment' can be called as Ecology. The concept of environment consists of four systems: (i) Atmosphere (ii) Hydrosphere (iii) Lithosphere and (iv) Biosphere. The biosphere system depends on other factors and man is an integral part of the biosphere.

1.1 TYPES OF ENVIRONMENT

The environment of animals and plants i.e. living organisms can be categorised under two broad divisions - the **living** (or biotic) environment and the **non-living** (or abiotic) environment. In the simplest words, environment is the biotic and abiotic surroundings of an organism or population. The biotic environment consists of other organisms (or biota) whereas the non-living or abiotic environment may be either physical, chemical or both, which influence the life of animals and plants under study. Land, air, water, light, temperature, pressure, gases, soil etc. constitute the non-living or physical environment. The chemical agents include water, oxygen, nitrogen, sulphur, phosphorous, carbon dioxide, hydrogen ion concentration (pH) and a number of mineral and chemical compounds.

Thus, the environment may be defined as 'the sum total of both biotic and abiotic constituents, which interact with animals and plants and consequently influence the life of these animals and plants'. For example, fish is an aquatic animal and so water is its physical

environment in which dissolved oxygen, pH, temperature, pressure, nutrients etc. are the physical factors. Along with fish, several other aquatic plants and animals and micro-organisms live in the water forming biotic or living environment. There are interactions between living organisms and their non-living environment and a stable environment is formed.

In any stable environment, organisms reproduce, grow, develop and die. For the life cycle to continue through generations, biotic and abiotic environment is essential. The environment has certain characteristics. The environment shows variation at different places. For example, the forest environment is different from the desert environment. The biotic and abiotic factors also show variation. The mountain environment is totally different from the river or ocean environment.

The term environment is also relative to time. During the prehistoric times, several changes occurred on our planet. Mesozoic era was the golden period of huge reptiles called dinosaurs. Earth was covered with thick forests but due to natural calamities and climatic changes all the plants and animals that were prevalent during that period became extinct. During the ice age, the conditions were not suitable for the survival of animals, many animals became extinct and some animals migrated to other favourable environment. They adapted to this new environment. Thus, changing environment is a natural phenomenon.

Moreover, animals that are adapted to a particular environment cannot survive in a different environment. For example, the animals living in the polar region cannot survive in the desert.

Natural and Cultural Environment

Man is the most intelligent amongst all living animals. He has recklessly modified the environment for his progress and development. Although man can modify the environment without disturbing the ecosystem, he has been exploiting nature to fulfill his greed. Man has constructed huge dams causing disturbances to the natural river ecosystems. He has erected a number of industrial areas, factories, constructed roads and railway lines by cutting forests. Man has polluted the environment by releasing polluted water, smoke, dust, toxic gases from industries and automobiles. The rivers and oceans are being polluted by the discharge of sewage and city wastes. Due to over population there is tremendous pressure on natural resources. Many people in the world live in polluted areas with poor sanitation. Man is thus responsible for air, water, soil and sound pollution.

(a) Natural Environment: It is created by nature. On the earth, the natural environment is hydrosphere, lithosphere and atmosphere which form the biosphere. Animals, plants and microorganisms are the biotic factors of the natural environment.

(b) Cultural Environment: Cultural environment is man made. Man can modify the natural environment as per his desire. Thus, natural and man made environment is nothing but the cultural environment. Man has created metro cities, industrial areas and agricultural belts. He has built sky scrapers. Over populated metro cities, creation of slum areas are also problems created by man. Social environment in which social and cultural values are inculcated, play an important role in the standard of living of man. Therefore, study of cultural environment is also essential.

1.1.1 Definitions of Environment

Environment is the sum total of the surrounding external conditions influencing the growth and development of animals and plants. There are several definitions of environmental science given by different experts in the field of environment.

"Environmental science provides an approach towards understanding the environment of our planet and the impact of human life upon the environment". **– J. Turk**

"Environmental science is the scientific study of various ecosystems those can sustain human existence on the planet earth and their equilibrium". **– Bernard Nebel**

"Study of inter-relationships between living and non-living things is called environmental science".

– D. Chivas

"Environmental science refers to the sum total of conditions which surround man at a given point in space and time". **– C. C. Park**

"Environmental science may be defined as the systematic study of surrounding factors that affect life on earth in the context of human existence".

1.1.2 Multidisciplinary Nature of Environmental Studies

Environmental Science is very vast and multidisciplinary subject. In this subject, we basically study interrelation between biotic (living) and abiotic (non-living) components or factors. When we study living organisms ultimately we have to study the subjects like Biology, Botany, Zoology, Physiology, Biochemistry, Biophysics, Chemistry, Mathematics, Statistics, Computer Science, Anthropology etc. The non-living or abiotic components include soil, air, water, energy, light etc. are closely related to Geography, Geology, Geophysics, Meterology and all these subjects belong to the major field of earth sciences. They provide vital information about the non-living components of environment called lithosphere and hydrosphere and atmosphere. Biosphere is the component of the environment formed by earth and atmosphere in which many smaller ecosystems exists and operates. Thus, life is sustained in biosphere. In environmental studies we study natural sciences.

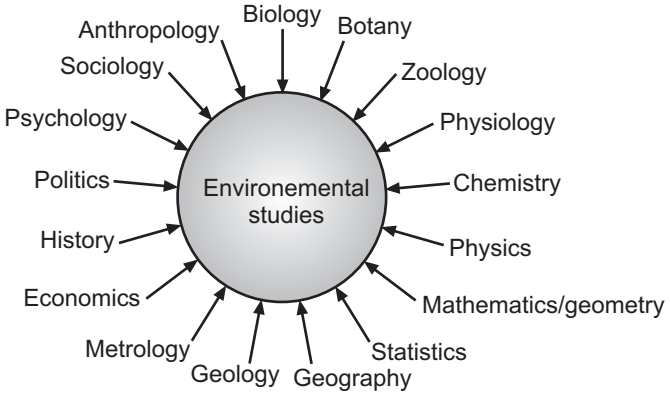


Fig. 1.1: Multidisciplinary Nature of Environmental Studies

Environmental studies is not only related to natural science but also related to social sciences like Economics, Sociology, Civics, History, Politics etc. Thus, environmental studies interact directly or indirectly with human's social, mental, economic, political and cultural aspects and hence study of social sciences is essential.

Following brief description gives an idea of multidisciplinary nature of the environmental studies.

1. **Biology and Environmental Studies:** Biology deals with the study of living organisms like plants, animals, microorganisms, fungi, bacteria, viruses etc. and they all are related to environment. Their life cycles, ecosystems, food chain, energy transfer, their conservation etc. are studied in this subject.
2. **Botany and Environmental Studies:** Botany deals with study of plants present on the earth. Variety of plants and fungi are available on earth. 33% land is covered by plants and plants play an important role in precipitation, control of floods. Deforestation results in desertification. All these things are studied in environmental studies.
3. **Zoology and Environmental Studies:** Animal life is vast on the earth and they play an important role in food chain. Their behaviour, habitat and importance in environment are studied in this subject.
4. **Physics and Environmental Studies:** Physics deals with energy, types of energy, conventional and non-conventional energy, energy crisis etc. How ecofriendly energy production can be done is studied.
5. **Chemistry and Environmental Studies:** Chemistry deals with study of different types of chemicals, chemical reactions, hazardous and toxic chemicals. Toxic chemicals and gases in air (i.e. pollution) are harmful to environment and living organisms. How global warming problem is raised by more and more emission of CO_2. All these chemicals and their ill effects are studied in this.
6. **Mathematics, Geometry, Statistics and Environmental Studies:** Ever increasing population of world, urbanization and industrialization, have created many environmental problems and they are studied with the help of maths and statistics.
7. **Civics and Environmental Studies:** There are many rights given to man by constitution. As a civilized person there are also some duties of man. For better and healthy environment every person should undertake tree plantation, conserve water and energy. One should keep our surroundings clean. If we keep our rivers, lakes and seas clean and protect them, then and only then we can protect our environment. These are our prime duties. These things we study in civics.
8. **History and Environmental Studies:** We can study and compare the environment of present and ancient time. We can also study the wars and their impact on environment and humans. During Gulf war how aquatic and arial environment was deterioted and how it affected humans and aquatic animals can be studied with the help of history.

9. **Economic and Environmental Studies:** Human needs and limited resources are balanced in Economics. Due to increasing population and unsustainable use of natural resources many problems are created in human life. These problems are studied in environmental studies.
10. **Politics and Environmental Studies:** The government of every country prepare the policies for the development. More emphasis is given on economic and industrial growth, but there is always loss of natural resources. Problems like pollution are invited. How these problems can be solved and progress can be made. This can be studied and remedies can be suggested in the study of environmental studies.
11. **Geography and Environmental Studies:** We study several environment related factors in geography. Geography and environmental studies are very closely related subjects. Inter-relation between man and environment is very well studied in the subject geography.

1.1.3 Scope of Environmental Studies

Environmental study is multidimensional, interdisciplinary and multidisciplinary subject, hence it is related with natural and social sciences. Day-by-day, this science is expanding. If we look around at the area in which we live, we see that our surroundings are originally a natural landscape such as a forest, a river, a mountain, a desert or combination of these elements. But now what picture we are observing? Most of us live in landscapes that have been heavily modified by human beings. These modifications are seen in villages, towns and cities. Human life is totally depending on environment. We cannot separate our life from environment. Our several needs are fulfilled from environment. Those who are living in cities get their food supply from surrounding villages. We are dependent on forests, grasslands, rivers, sea shores for resources such as water for agriculture, wood for fuel, fodder and fish. Thus, our daily lives are linked with our surroundings and inevitably affects them. We use water to drink and for day-to-day activities. We breathe air, we use resources from which food is made and we depend on the community of plants and animals which form web of life, of which we are also a part. So many things we get from our environment. Water, air, wood, minerals we get from environment. Everything around us forms our environment and our lives depend on keeping its vital systems as intact as possible.

Our dependence on environment is so great that we cannot continue to live without protecting earth's environmental resources. Therefore, we always refer our environment as 'Mother Nature' and most traditional societies have learned that respecting nature is vital for their livelihoods. Therefore, many traditional societies protect and preserve their natural resources. Respect for nature and all living creatures is not new to India. In our Indian culture, we worship many trees, animals and rivers. All our traditions are based on these values. Emperor Ashoka also declared that all forms of life are important for our well being in fourth century B.C.

The modern societies with the help of science and technology and technological innovations are producing more resources. For example, we are now producing more food by using fertilizers and pesticides. These results we have observed during the period of green revolution. Now with the help of genetic engineering and hybridization techniques

our scientists have developed better strains of domestic animals and crops. Irrigating farmland through mega dams. We have developed industry for rapid economic growth. But at the same time, this rapid development is resulting an ill effects which led to environmental degradation.

The fast industrial development and intensive agriculture that provides the goods for our increasingly consumer oriented society uses large amounts of natural resources such as water, minerals, petroleum products, wood etc. Overuse of non-renewable resources like minerals and oil will be exhausted in the future. Future generations will not get these resources. The renewable resources like wood and water once used they can be regenerated by natural processes like tree plantation or regrowth or rainfall. If these resources are used faster, then nature can replace them. They will deplete. For example, if the removal of timber and firewood from a forest is faster than the regrowth and regeneration of trees, it cannot replenish the supply. And loss of forest cover not only depletes the forest of its resources, such as timber and other non-wood products, but affects our water resources because an intact natural forest acts like a sponge which holds water and releases it slowly. Forests are useful for precipitation. Deforestation leads to floods in the monsoon and dry rivers once the rains are over. Thus, our routine activities create multiple effects on the environment. Therefore, natural resources should be used sustainably, so that they can be used for longer period.

Each and every individual should seriously think about our environment and our resources. Unsustainable use can result from overuse of resources, because of population increase, and because many of us are using more resources than we really need. We are wasting resources without thinking about our environment. Thus, our actions must be environmentally positive or ecofriendly. Moreover, our lifestyles should be more sustainable and will support our environment.

1.1.4 Importance

Environment is a complex branch of biology which is related to almost all the branches of science and social studies. To understand all the different aspects of our environment we need to understand Biology, Chemistry, Physics, Geography, Resource Management, Economics and Population issues. Thus, the scope of environmental studies is extremely wide and covers some aspects of nearly every major discipline.

We live on the earth where the natural resources are limited. Our life survives on the earth due to life support systems available on the earth. They are water, air, soil, minerals, oil, the various products of forests, grasslands, oceans and from agriculture and livestock. Without them, life itself would be impossible. Because of constant use of these resources the earth's resource base must inevitably shrink. The over utilization and misuse of these resources is harmful to earth. People waste or pollute large amount of nature's clean water, we produce huge quantity of harmful material like plastic that we discard after a single use. We also waste huge amount of food and it is discarded as garbage. There are several types of solid waste products produced during manufacturing processes which are discarded. Many chemicals which flow out as liquid waste, pollute water, gases and the air.

The huge amount of waste which is produced is not degraded by natural process and it is accumulated in our environment producing different kinds of pathogens causing several diseases. This ultimately seriously is affecting our lives. Thousands of people die every year due to the pollution of air and water. Air pollution causes various respiratory diseases, water pollution leads to gastrointestinal diseases and many toxic pollutants like pesticides are known to cause cancer and congenital abnormalities. How to prevent this situation? If each and every person will think seriously about the environment and actively take part in conservation of our precious environment, then and only then we could improve our environmental condition and preserve the environmental resources for future generations. The role of people in protecting the environment is important and we cannot expect Governments alone can manage to prevent environmental degradation. We should actively take part in this activity. It is the responsibility of each of us.

Value of Nature:

1. Productive Value: Nature has great productive value because there are large number of medicinal plants and animals. With the help of biotechnology we know that variety of incredible and uncountable number of chemicals are present in different plant species. These are important raw material useful for developing new medicines and industrial products. These are actually storehouses from which thousands of new products, medicines can be prepared in future. In nature, there are variety of flowering plants and different species of insects which form most species rich groups of living organisms which are very important for the future development of man. If we degrade their habitat these species will become extinct. These species once lost man cannot bring them back. There is ban on selling of the products made from an illegally killed wild species. It is our duty to inform the concerned authority. Otherwise we become a part responsible for its extinction. We get so many things from nature. The honey from honey bees, lac from lac insects, silk from silkworms, gum from trees, medicines from different medicinal plants, insects, bats, birds are responsible for pollination which ultimately yields best quality of fruits, seeds etc.

When we permit destruction of a forest, wetland or other natural area and do not prevent it, the future generations will not get these valuable resources and will blame us for this rash and negligent actions against the environment.

Thus, the urgent need is to protect all living species. We should understand the concept and act upon. Individually, we perhaps cannot directly prevent the extinction of a species. But we can create a strong public opinion to protect the National parks and wildlife sanctuaries in which large number of wild species live. This is an important aspect of sustainable living. These close links between agriculture and the forest, explains its productive value. For successful crops, the flowers, fruits, trees and vegetables must be pollinated by insects, bats and birds. Their life cycles however frequently require intact forests. All these things illustrate the productive value of the nature.

2. Aesthetic/Recreational Value of Nature: Nature possesses aesthetic and recreational values and hence it has made our existence more cheerful on the earth. Variety