

A Text Book of Environmental Science



# A Text Book of Environmental Science

**Dr (Mrs.) Vidya Thakur**

Retd. Professor

Department of Environmental Science

Dr Y.S. Parmar University of Horticulture and Forestry,  
Nauni, Solan-Himachal Pradesh 173 230 (INDIA)

 **SCIENTIFIC**  
PUBLISHERS (INDIA)

*Published by:*  
Scientific Publishers  
5A, New Pali Road, P.O. Box 91  
Jodhpur 342 001, India

E-mail: [info@scientificpub.com](mailto:info@scientificpub.com)  
Website: [www.scientificpub.com](http://www.scientificpub.com)

© Vidya Thakur, 2012

All rights reserved. No part of this publication or the information contained herein may be reproduced, adapted, abridged, translated, stored in a retrieval system, computer system, photographic or other systems or transmitted in any form or by any means, electronic, mechanical, by photocopying, recording or otherwise, without written prior permission from the authors.

Disclaimer: Whereas every effort has been made to avoid errors and omissions, this publication is being sold on the understanding that neither the editors (or authors of chapters in edited volumes) nor the publishers nor the printers would be liable in any manner to any person either for an error or for an omission in this publication, or for any action to be taken on the basis of this work. Any inadvertent discrepancy noted may be brought to the attention of the publishers, for rectifying it in future editions, if published.

ISBN: 978-81-7233-755-1 (HB)  
978-81-7233-756-8 (PB)  
eISBN: 978-93-86347-96-1

Typeset by Rajesh Ojha  
Printed in India

*To my  
Late Parents*



## Foreword

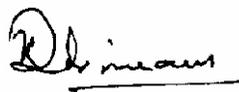
There is inseparable relationship between living organisms and their environment, which is essential for the existence and development of the living organisms as well as ecosystems. All the living organisms are affected by the environment and vice-versa. It is vicious cycle if the interaction is harmonious, but if any of the components overpower the other one it becomes dangerous or hazardous to the system, which can be well observed under today's scenario. Increasing population pressure in the third world countries and technological advancement in the developing and developed countries have severely affected all the environmental parameters and human being are facing the consequences now. Environment is the aggregate of external conditions and influences affecting living organisms.

Environmental Science, therefore, is methodology to understand causes and effects of all forces operating and affecting the surroundings directly or indirectly. Infact it is interdisciplinary subject embracing wide variety of topics and study areas to address the upcoming environmental hazards threatening the very existence of human being. Therefore, the need of the hour is to have global commitment in the form of mass movement to make the environment worth living on long term basis.

I understand environment is one of the important and essential subjects to be taught in all the educational institutions from primary school to Universities. This book covers scientific and the practical approaches for understanding, assessing and monitoring of environmental deterioration and for conservation and sustainability which are

of immense use for the various work profiles of institutions and society.

I congratulate Dr (Mrs) Vidya Thakur, Retired Professor, Department of Environmental Science College of Forestry, Dr Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan for writing this Text Book of Environmental Science.



**(K.R. Dhiman)**

Vice-Chancellor

Dr Y.S. Parmar University of

Horticulture and Forestry,

Nauni, Solan

## **Preface**

It gives me immense pleasure to bring this text Book of Environmental Science in to form after my long experience of teaching the courses of Ecology and Environment and Botany at Under Graduate and Post Graduate levels in the University.

Increasing population pressure in the third world and advanced technological developments in the developed and developing countries are deteriorating the environment besides causing loss to ecological balance of biosphere (ecosystem) day by day, resulting depletion of natural resources and loss of biodiversity, global warming and climate change. Today, man has challenge to solve these adverse conditions and influences in time to come. Environment is the aggregate of all external conditions and influences affecting the growth and development of living organisms.

The need of the hour is to have global commitment of humans to make our environment sustainable. Thus, implementation of every environmental policy, programe, project and plan comes down to the common denominator- Environmental education. Environmental Science and environmental education, therefore, is about understanding the causes and effects of positive and negative aspects of global and local issues of short and long term with their direct and indirect effects. Environmental science is a interdisciplinary subject, embracing a wide variety of topics and different areas of study that address the upcoming environmental hazards threatening the very existence of human being and formulation of policy planning to combat these hazards in a sustainable manner. Keeping in view the importance of environmental science, it forms one of the important and essential subjects to teach in

schools, colleges, universities and other institutions as per the direction given by the Supreme Court of India. Environmental science is a promising field because it deals with the management and sustainability of environment, now government is also stressing on the formulation of its policies, programmes and projects on environmental management. But the institutions of environmental education and environmental science in India are in their infancy. Therefore, there is need of perfect and well qualified trainers, teachers and researchers in this field. So, keeping in view these factors, there is dire need to develop training, teaching and research skills and capabilities in the field of environmental management and environmental science.

Now there are many books available in the market having related material. This book has been written with deep concern to fulfill the needs of Indian students, teachers, environmental managers and policy makers and others readers. The main theme of the book is to inculcate sense of environmental cleanliness and environmental management and to enhance knowledge of the basic concepts, tools and techniques of environmental science, so as to enable them to find out the causes of environmental problems and issues and to identify practicable alternatives for their resolution (solution). I hope this book will surely help in improving teaching, training and research aptitudes in environmental science and also help resource owners and managers, policy makers and governmental and non-governmental bodies in judiciously using and managing natural resources and environment as well, which is essential for the sustainability and improvement of livelihood security of rural and urban communities of our country.

The book comprises of 14 chapters which present a comprehensive and compact treatment of both theoretical and applied aspects of environmental science. Chapter 1 introduces the readers and teachers of the book with back ground history of ecology and environmental biology, concepts, scopes and approaches of ecology and environment. Chapter 2 presents the introduction of environment - definition, importance and components of environment and their interactions with living organisms. Chapter 3 presents global and Indian environment

– and their past and present status. Chapter 4 deals population ecology i.e. its characteristics, factors regulating population size, population and environment, human population and its status. Chapter 5 explains urbanization, its characteristics and causes, effects of urbanization on land use systems, opportunities and constraints and its impacts on environment. Chapter 6 discusses pollution and its types-air, water, soil and noise, their impact on living organisms, environment and socio-economy and their control measures. Chapter 7 discusses biodiversity, its definition, importance, causes of threat and values, assessment and monitoring biodiversity and environment and impact of climate change on regional and global biodiversity. Chapter 8 discusses natural resources, definition and types, causes of depletion and conservation. Chapter 9 explores the importance and scenario of environmental education in India-non-formal and formal environmental education. Chapter 10 discusses the introduction of Environmental Impact Assessment, role of Ministry of Environment and Forests, GoI in its implementation and role of EIA in implementation of projects and others developmental activities. Chapter 11 presents environmental policy and legislation in India. Chapter 12 explains eco-friendly role of biotechnology in pollution abatement-bioremediation its definition, concepts and role in water and soil pollution control, phyto-remediation and its role in soil pollution control. Chapter 13 presents introduction to environmental economics, definition and basic concepts, evolution and development of environmental economics, externalities, cost-benefit ratio, transnational characteristics of environmental issues, example of cost-benefit ratio of multi-purpose dam. Chapter 14 comprises of questions both subjective and objective.

Glossary of important technical terms related to the subject has been included at the end of each chapter.

I do not claim any originality of ideas, concepts and theories related to the environmental science presented in this book, but the new and original in the book is the way it has been synthesized, organized and presented material in the form, that is my own opinion and idea, is easy to comprehend and apply according to the need of the readers. In preparing

and writing this book and development of thought and ideas about environmental science, I have been greatly benefited from my 29 years of teaching and research experiences in ecology and environment and related subjects, thereby interaction with the students, colleagues, policy makers and managers, and of course from the literature I read that is writings, *i.e.* books and research papers of eminent ecologists, scientists, environmentalists, foresters, bio-technologists and articles of NGOs and other Institutions benefitted me. To name and list them all would not be possible here. I extend my heartfelt thanks to them all and recognize their contribution as given in the references.

I would, however, like to place on record my utmost thanks to Dr. S.D. Bhardwaj, Dean College of Forestry, Dr, Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan (HP) for the suggestions and encouragements during the preparation and writing of this book. My sincere thanks are due to Dr. K.S. Verma, Professor and Head Department of Environmental Science, for his valuable suggestions during the writing the manuscript of the book and advising me to compile the manuscript in the form of the book, otherwise it would have not been in this form. My utmost thanks are due to my parental Sanaik family – Nauhradhar, Sirmour (H.P.) for the support and encouragement, otherwise I would have never been able to do such type of assignments.

Without the understanding and encouragements of my husband Jeet and son Vijit, I would never have been able to undertake the task of writing of manuscript of this book, I do thank them.

Finally, I am thankful to the Department of Environmental Science, COF, Dr. Y.S. Parmar UHF, Nauni, Solan for providing congenial environment during the writing of this book.

My sincere thanks are due to Mrs Neeta Rawat of Department of Directorate of Extension, Dr Y.S. Parmar UHF, Nauni, Solan for her painstaking efforts in metamorphosizing the material of the book to a nice presentable form.

July, 2011

**Vidya Thakur**

# Contents

<i>Foreword</i>	<i>v</i>
<i>Preface</i>	<i>vii</i>
<b>CHAPTER 1. INTRODUCTION</b>	<b>1-13</b>
Definition of Ecology, Brief history of Ecology, Ecology in India, Concept of Ecology, Approaches to Ecology, Terminologies and definitions.	
<b>CHAPTER 2. ENVIRONMENT : ITS COMPONENTS AND FACTORS</b>	<b>14-44</b>
Definition of Environment, Importance, Environment complex, Components of Environment, Factors of Environmental Complex, Social environment, Physical Environment-Climatic factors, Edaphic factors, Biotic environment.	
<b>CHAPTER 3. GLOBAL AND INDIAN ENVIRONMENT</b>	<b>45-62</b>
Historical Back ground, Environmental parameters, Climate change-past to present, Indicators of climate change, Causes and threats of recent environmental deterioration, Present status and future trend of Global Environment, Consequences of Global Warming, Future Trends, Effect of Global Warming.	
<b>CHAPTER 4. POPULATION ECOLOGY</b>	<b>63-86</b>
Characteristics of Population, Evolution among population (Reproductive pattern – $r$ and $K$ – strategies), Population interactions, Factors regulating population size, Population resilience, Change in population size, Human population, Population pyramids, Demographic transition and three stages of population growth,	

Population and environment, Impacts on environment, Stabilizing population, Population status, Population facts- the future in just 22 years.

**CHAPTER 5. URBANIZATION AND ENVIRONMENT 87-100**

Introduction, Brief Urban History, The Industrial Revolution, Factors of Urbanization, Cause of Urbanization, Characteristics of Urbanization, Effects of Urbanization on Land use systems, Natural resources and environment, Opportunities of Urbanization, Constraints, Impact of Urbanization on rural sectors, Urban environment planning and management.

**CHAPTER 6. POLLUTION: A THREAT TO LIFE AND HUMANITY 101-138**

Introduction, Environmental pollutants, Kinds of pollution, Air Pollution– sources and pollutants, air pollution control, Water pollution-sources and types, water pollution control, Soil Pollution – major causes of soil pollution. Noise Pollution– Sources of noise, Noise level of various sources, control of noise pollution. Effects of environmental pollution on Socio-culture and socio-economy.

**CHAPTER 7. BIODIVERSITY 140-163**

Definition of Biodiversity, Scope and Importance, Values of biodiversity – Ecological, Direct and Indirect, Retaining alternative source for uncertain future. Anthropometric Values, loss of biodiversity, Causes of loss of biodiversity- Natural, Manmade, Bio-wealth of India as strength, Biodiversity of India, Indian Biodiversity is under serious threat, Conservation of biodiversity, Conservation Strategies, Conservation action- Habitat conservation, Conservation in the wake of climate change, Monitoring biodiversity, measuring biological-diversity, Environment and biodiversity, Effects of Global Climate change on biodiversity of Plants - Evidence of climate change, Plants species distribution and climate, climate change and changing plants species distributions, Susceptibility of extinction as a result of climate change, Secondary effects of Global Warming.

<b>CHAPTER 8. NATURAL RESOURCES</b>	<b>164-189</b>
Introduction, Atmosphere, Hydrosphere Lithosphere, Classifications of natural resources, Environmental challenges in India, Natural resources and their conservation, Natural atmospheric cleansing, Technical atmospheric cleansing, Water Pollution and its conservation, Soil conservation, Forest resources, Energy resources, Heritage conservation, Social aspects of conservation of natural resources.	
<b>CHAPTER 9. ENVIRONMENTAL EDUCATION</b>	<b>190-217</b>
Dimension of current environmental crises, what constitutes Environmental Education? Goals of Environmental Education, Objectives and guiding principles, Environmental Education in India, Environmental Education and training, Internationals, National and Voluntary agencies for conservation of Environment, International Conferences, Conventions and summits – major achievements.	
<b>CHAPTER 10. DEVELOPMENT AND ENVIRONMENTAL IMPACT ASSESSMENT</b>	<b>218-234</b>
History, Definition of Environmental Impact Assessment (EIA), Role of Ecologist- Ecologist <i>versus</i> Planner, Methodology, Matrices-Simple matrix, cross impact- or stepped matrix, net work methodologies, Check list methodologies, Terminologies.	
<b>CHAPTER 11. ENVIRONMENTAL POLICIES AND LEGISLATION IN INDIA</b>	<b>235-252</b>
Historical Background, Enforcement of Environmental Legislation in India.	
<b>CHAPTER 12. ENVIRONMENTAL BIOTECHNOLOGY: AN ECOFRIENDLY APPROACH FOR ENVIRONMENTAL CONSERVATION</b>	<b>253-271</b>
Definition of Biotechnology, Concepts of Biotechnology in pollution abatement- Air pollution abatement through Biotechnology, Water pollution abatement, Bioremediation – Concept and application,	

Bioremediation of hazardous waste and biosorption.  
Phytoremediation- types, availability and suitable  
plants tested, Application of Phytoremediation,  
Terminologies.

**CHAPTER 13. ENVIRONMENTAL ECONOMICS 272-284**

Environmental Economics- Concepts of Environmental  
Economics, Evolution and Development of Environ-  
mental Economics, Important- Processes and termin-  
ology- Scarcity and growth, Economic status and  
welfare, Ecological capital, Natural Capital, Externa-  
lities, Cost- Benefit analysis, Financial factors, Techno-  
logical factors, Trans-national characteristics of Envir-  
onmental issues, Environmental Impacts Analysis.

**CHAPTER-14. QUESTIONS 285-303**

Questions

1. Objective type Questions
2. Subjective type Questions

**REFERENCES 304-307**