

To Save Humans & Existence

Environmental Studies

An Analytical View

Dr. Suman Gupta



Sultan Chand & Sons

Environmental Studies

An Analytical View



Dedicated with a profound sense of gratitude

to

*“My source of inspiration, my beloved father Late Sri M. G. Gupta
and everyone who has worked tirelessly
to improve the Environment and
harmonize Humans live with Nature”*

Environmental Studies

An Analytical View

Strictly based on the Curriculum Prescribed by UGC (AECC) and AICTE for Students of Undergraduate Courses from All Branches of Higher Education
(B.A., B.Sc., B.Com., B.Tech., B.FA. B.P.Ed., B.Ed., B.H.Sc., B.Lib., B.Pharm., B.B.A, L.L.B., B.J.M.C., B.Des., Medical Courses and Polytechnic Courses)

दशकूपसमा वापी, दशवापीसमो ह्रदः ।

दशह्रदसमो पुत्रो, दशपुत्रसमो द्रुमः

Meaning: Ten wells are equal to one step well; ten step wells are equal to one pond; ten ponds are equal to one son; and ten sons are equal to one tree (Source: *Vrikshayurveda*).

“The Hindi version of this book has been awarded 2nd Prize all over India by the AICTE, New Delhi, under TPPY Scheme 2018-19”

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Foreword

F



सीएसआईआर—राष्ट्रीय विज्ञान संचार एवं नीति अनुसंधान संस्थान
CSIR-National Institute of Science Communication and Policy Research



Dr. Manish Mohan Gore
Scientist, CSIR-NIScPR
Editor, Vigyan Pragati

31 January 2024

This book has surpassed the limits of a textbook to become scientific literature that inspires the future generation to be conscious and sensitive towards the environment. At present, as the world stands on the brink of alarming climate change, facing unexpected weather, extreme heat, cyclones, and hurricanes frequently. This book becomes unique in preparing the citizens of tomorrow to be responsible. The essence of environmental conservation is embedded in International campaigns such as the Sustainable Development Goals (SDGs) and the G-20. As we all know, education begins with oneself, and it is essential for all of us to first be aware of our surroundings and biodiversity. The second most crucial need is for the steps we take today to be logically aligned, ensuring that our planet remains beautiful and life-sustaining for the coming generations.

For this, we must make optimal use of natural resources, maintain low pollution levels and bring positive changes to our behaviour while staying vigilant. Until we connect our social responsibilities with the environment and see it as an integral part of our lives, the sense of responsibility towards the environment will not be ingrained in our minds.

In this book, the author and environmental specialist, Dr. Suman Gupta, has encompassed all the environmental issues mentioned above. I believe that this book will play a significant role in making our students and readers aware of the broader perspective and concerns of the environment, helping them become sensible citizens. I congratulate the author for bringing her excellent literature to society.

Dr. Manish Mohan Gore

Preface

P

“A good preface must be the root and the square of the book at the same.”

Karl Wilhelm Friedrich Schlegel

In today's world, environmental degradation, pollution, and ecological imbalance stand as significant challenges. In this response, the Honourable Supreme Court has mandated "environmental education" at all levels of schooling, from primary to university. This book is meticulously aligned with the Ability Enhancement Compulsory Course' (AECC) of "Environmental Studies" outlined by the University Grants Commission (UGC), New Delhi, and adheres to the directives of the All India Council for Technical Education. It is crafted as per the National Education Policy 2020, which aims to comprehensively address the subject matter based on the Indian knowledge system.

I am delighted to announce that the Hindi version of this book has received the 2nd prize nationally from the Indian Government, AICTE New Delhi, under the TPPY Scheme 2018-19.

The entire content of book is divided into nine units; each unit commences with clearly defined learning objectives, unit outcomes, and our duties. Units one to seven and unit nine mirror the UGC (AECC) syllabus, while the content of unit eight includes specific social issues related to the environment, which is in selected universities, technical universities, and institutes (IITs) syllabi. Unit nine offers practical exercises structured as fieldwork, featuring simple tables and explanations to facilitate independent student engagement.

The primary goal of this book is to instill environmental awareness and understanding among students, readers, and the wider public. It is envisioned that by fostering such awareness, individuals will develop a sense of love and responsibility towards the environment, thereby contributing to its protection and conservation. The content is presented in a reader-friendly manner, incorporating illustrations, tables, and diverse examples to enhance clarity. Moreover, it integrates indigenous theories and concepts related to the environment and ecology.

Every effort has been exerted to ensure the book's simplicity, clarity, conciseness, and accuracy. However, recognizing the possibility of shortcomings, inaccuracies, or errors, readers, educators, scholars, and students are invited to collaborate in identifying and rectifying such issues. Their invaluable feedback and guidance are earnestly sought to refine the content further, enriching its utility and quality.

Suman Gupta

1 Feb. 2024, Ghaziabad

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A

*“No one who achieves success does so without acknowledging the help of others.
The wise and confident acknowledge this help with gratitude.”*

Alfred North Whitehead

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Special gratitude is owed to my colleagues and friends, whose unwavering support infused me with positivity and energy throughout the writing process. I am indebted to my family—parents, Nirmala and Madanji; my sister-in-law and brother, Manita and Amar; and my sisters, Kusum and Luxmi—for their unyielding encouragement, without which this endeavor would not have been conceivable. Sri Santosh Rai deserves commendation for enriching the common Hindi and English vocabulary with his invaluable time and suggestions. My heartfelt appreciation extends to my beloved daughter, Sumedha Rai, whose emotional and technical assistance served as a pillar of strength.

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Finally, I extend my gratitude to all the students and individuals, known and unknown, whose support and encouragement have propelled me to complete this book. With heartfelt appreciation to all those who have played a role in this journey, I conclude this expression of gratitude.

Suman Gupta

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Snapshot of the Book

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1	Introduction to Environmental Studies	5	2	2	7	14	10	31	33
2	Natural Resources: Renewable and Non-Renewable Resources	14	1	10	8	18	8	34	31
3	Ecosystems	32	1	3	8	11	13	32	34
4	Biodiversity and Conservation	3	–	5	7	17	6	30	30
5	Environmental Pollution and Disasters	2	3	12	10	16	12	38	34
6	Environmental Issues, Policies and Practices	3	1	13	11	19	9	39	42
7	Human Communities and the Environment	5	2	2	7	15	13	35	32
8	Important Issues of the Environment	1	1	–	6	15	8	29	32
9	Field Work	–	8	–	5	7	5	19	–
Total		65	19	47	69	132	84	285	268

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Syllabus

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Ability Enhancement Compulsory Course (AECC – Environment Studies)

Unit 1: Introduction to Environmental Studies

- Multidisciplinary Nature of Environmental Studies;
- Scope and Importance; Concept of Sustainability and Sustainable Development. (2 lectures)

Unit 2: Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems:
 - (a) Forest ecosystem
 - (b) Grassland ecosystem
 - (c) Desert ecosystem
 - (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit 3: Natural Resources: Renewable and Non-renewable Resources

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state).
- Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies. (8 lectures)

Unit 4: Biodiversity and Conservation

- Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots.
- India as a mega-biodiversity nation; Endangered and endemic species of India.

- Threats to biodiversity: Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. (8 lectures)

Unit 5: Environmental Pollution

- Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies. (8 lectures)

Unit 6: Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context. (7 lectures)

Unit 7: Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management: floods, earthquake, cyclones and landslides.
- Environmental movements: Chipko, Silent Valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (*e.g.*, CNG Vehicles in Delhi). (6 lectures)

Unit 8: Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems – pond, river, Delhi Ridge, *etc.* (Equal to 5 lectures)

CORE MODULE SYLLABUS OF ENVIRONMENTAL STUDIES

**And Teaching Methodologies
Prescribed by UGC and ACITE, Government of India
for all Students of**

Undergraduate Courses of All Branches of Higher Education

Unit 1: Multidisciplinary Nature of Environmental Studies

- Definition, scope and importance,
- Need for public awareness. (2 Lectures)

Unit 2: Natural Resources

- Renewable and Non Renewable Resources
- Natural resources and associated problems
 - (a) **Forest resources:** Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people.
 - (b) **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.
 - (c) **Mineral Resources:** Use and exploitation, environmental effects of extracting and using mineral resources. Case studies.
 - (d) **Food Resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer pesticide problems, water logging, salinity, case studies.
 - (e) **Energy Resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies.
 - (f) **Land Resources:** Land as a resource, land degradation, man induced landslides, soil erosion, and desertification.
- Role of individual in conservation of natural resources
- Equitable use of resources for sustainable lifestyles (8 Lectures)

Unit 3: Ecosystems

- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids
- Introduction, types, characteristic features, structure and function of the following ecosystems:
 - Forest ecosystem
 - Grassland ecosystem
 - Desert ecosystem.
 - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 Lectures)

UNIT 4: Biodiversity and its Conservation

- Introduction-Definition: genetics, species and ecosystem diversity
- Biogeographical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
- Biodiversity at global, national and local level.
- India as a mega-diversity nation
- Hotspots of biodiversity
- Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts.
- Endangered and endemic species of India
- Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity. (8 Lectures)

UNIT 5: Environmental Pollution

- Definition
- Causes, effects and control measures of:
 - (a) Air pollution
 - (b) Water pollution
 - (c) Soil pollution
 - (d) Marine pollution
 - (e) Noise pollution
 - (f) Thermal pollution
 - (g) Nuclear hazards
- Solid waste Management: Causes, effects and control measures of urban and industrial wastes
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: Drought, floods, earthquake, cyclone and landslides (8 Lectures)

UNIT 6: Social Issues and the Environment

- From unsustainable to sustainable development
- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people; its problems and concerns. Case studies
- Environmental ethics: issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies.
- Wasteland reclamation
- Consumerism and waste products
- Environment Protection Act
- Air (Prevention and Control of Pollution) Act
- Water (Prevention and Control of Pollution) Act
- Wildlife (Protection) Act

- Forest (Conservation) Act
- Issues involved in enforcement of environmental legislations
- Public awareness

(7 Lectures)

UNIT 7: Human Population and the Environment

- Population growth and variation among nations
- Population explosion, family welfare program
- Environment and human health
- Human rights
- Value education
- HIV / AIDS
- Women and Child welfare
- Role of information technology in environment and human health
- Case studies

(6 Lectures)

Unit 8: Field Work

- (a) **Visit to a local area to document environment assets:** River / forest / grassland / hill / mountain
- (b) **Visit to a local polluted site:** urban / rural / industrial / agricultural
- (c) Study of common plants, insects, birds.
- (d) **Study of simple ecosystems:** pond, river, hill slopes, *etc.* (field work equal to 5 lecture hours)

Teaching Methodologies

The Core Module Syllabus for Environmental Studies includes classroom teaching and field-work. The syllabus is divided into 8 units, covering 50 lectures. The first 7 units, which cover 45 lectures, are classroom-teaching based and intended to enhance knowledge skills and attitude to environment. Unit 8 is based on field activities, to be covered over five lecture hours, and would provide student with first-hand knowledge on various local environmental aspects. Field experience is one of the most effective learning tools for environmental concerns. This moves education out of the scope of the textbook mode of teaching and into the realm of hands-on learning in the field, where the teacher acts as a catalyst to interpret what the student observes or discovers in his/her own environment. Field studies are as essential as class work and form a unique synergistic tool in the entire learning process.

The course material provided by UGC for classroom teaching and field activities should be effectively utilised.

The Universities/colleges can draw upon the expertise of outside resource person for teaching purposes.

The Environmental Core Module will be integrated into the teaching programs of all under-graduate courses.

- (a) **Annual System:** The duration of the course will be 50 lectures. The exam will be conducted along with the Annual Examination.
- (b) **Semester System:** The Environment Course of 50 lectures will be conducted in the second semester and the examinations shall be conducted at the end of the second semester.
- (c) **Credit System:** The core course will be awarded 4 credits.

- (d) **Exam Pattern:** In case of awarding marks, the question paper should carry 100 marks. The structure of the question paper being:

Part A: Short-answer pattern-25 marks

Part B: Essay-type built-in choice-50 marks

Part C: Field work-25 marks

Outcome Based Education



Outcome based education (OBE) is an effective educational delivery model for the students in the course learning process. For proper results of outcome based education, it is very important to develop targeted outcome based curriculum, curriculum objectives, curriculum outcomes, program outcomes and inclusion of outcome based evaluation in the education system. Before studying the subject, the student should know the subject curriculum and its overall objectives. So that the learners can understand those course objectives and their related course outcomes and can be able to achieve the target of completing them and arrive at the Program outcomes. In this way, through outcome based assessment, it will be possible to know whether the learner has achieved the mentioned standard, specific and measurable outcomes. With proper inclusion of outcome based learning, learners will be committed to achieve minimum standards.

This book sets out subject-based learning objectives and skills (LOs) in each chapter (unit) for students and teachers. The determination of objectives and skills is based on Bloom's Taxonomy. This will lead to effective teaching and learning among the students and the students will be able to develop appropriate skills of *remembering, understanding, application, analysis, evaluation, and creation* (hierarchical levels of Bloom's Taxonomy).

Learning Objectives

There are 9 chapters (Units) in this book and learning objectives are given at the beginning of each unit.

Learning or Unit Outcomes (UOs and Purpose): Learners will be able to achieve learning or unit outcomes by completing the learning (unit) objectives after reading the complete unit. The purposes of the unit are captured in the unit outcomes.

Our Duty: It tells about the important duties of all of us in conserving the earth, environment and nature. It also mentors our responsibilities towards social and environmental issues.

Course Objectives

From the study of this course, the students should be able to understand the following objectives:

1. A complete, in-depth analysis of the environment, natural resources, biodiversity, ecological processes, environmental pollution, and the challenges associated with them.
2. Explain various sources of renewable energy and their exploitation processes; various sources of environmental pollution; their side effects; and environmental management.

3. Strategies and their execution for the solution of environmental and social problems.
4. To develop an ethical, value-based, positive approach to solving complex environmental and social challenges.
5. To develop sustainable conditions in all spheres of life, nature, natural resource, society, and industry.

Course Outcomes

After completion of this course, the students will be competent to achieve the following outcomes:

<i>S. No.</i>	<i>CO-No.</i>	<i>Course Outcomes or COs</i>
1.	CO-1	To conduct a thorough, analysis of the environment, natural resources, biodiversity, ecological processes, environmental pollution, and the challenges associated with them.
2.	CO-2	To explain various sources of renewable energy and their exploitation processes, various sources of environmental pollution and their side effects, and environmental management.
3.	CO-3	In formulating and implementing strategies for environmental protection, pollution control, biodiversity conservation, social equality, population control, and sustainable development.
4.	CO-4	To understand ethical value-based positive approaches to solving complex environmental and social challenges of the present and future.
5.	CO-5	To understand ethical value-based positive approaches to solving complex environmental and social challenges of the present and future.

Program Outcomes

Program outcomes should be clear, effective, and easily achievable. Appropriate program outcomes make students academically strong and proficient. Prepare students for lifelong learning. When students understand the unit outcomes at the beginning of the unit and course outcomes at the beginning of the course, they will be better able and successful in achieving the program outcomes at the end of the program.

Proper inclusion of outcome-based education will make a definite commitment for learners to achieve minimum education standard at almost all levels. Students will be able to arrive at the Program Outcomes (from Program Outcomes-1 to 12, according to the directions of the NBA) at the end of this program with the help of outcome-based education.

Expected Mapping of Course Outcome with Program Outcomes

<i>S. No</i>	<i>Course Outcome (CO)</i>	<i>Program Outcomes (POs)</i>											
		Correlation Level: 1-Weak Correlation; 2- Moderate Correlation; 3- Strong Correlation											
		<i>PO-1</i>	<i>PO-2</i>	<i>PO-3</i>	<i>PO-4</i>	<i>PO-5</i>	<i>PO-6</i>	<i>PO-7</i>	<i>PO-8</i>	<i>PO-9</i>	<i>PO-10</i>	<i>PO-11</i>	<i>PO-12</i>
1.	CO-1		3				3	3	2				
2.	CO-2		2				3	3		2			
3.	CO-3	1	2	2	2	2	3	2		2			1
4.	CO-4		2	3			3	3	3	3			
5.	CO-5		2	2			3	3	2	3			

About the Book

Environmental Studies is an important and relevant subject at present. The environment has been degraded rapidly due to industrialization, urbanization, and other human activities. All types of pollution have increased rapidly on a global scale. Overexploitation of natural resources and increasing pollution have created a threat to the existence of the entire earth, including plants, animals, and humans. Sustainable development and environmental conservation are very important for the existence of the earth and living beings. In this book, an attempt has been made to fulfil this requirement. The main aim of the book is to make students and readers aware of the importance of environmental protection, enrichment, and sustainable development. In this way, all people can contribute significantly to the sustainable development and conservation of the environment, so that the dream of a beautiful green earth full of different varieties of living beings comes true.

Salient Features

- Strictly aligned with the core module curriculum of UGC (AECC) and the guidelines of AICTE.
- The book contents include Indian theory and concepts, like the Panchatatva Energy Flow Model, etc.
- It uses simple, clear, and common colloquial words and is suitable for self-study.
- The book contents give the feeling of being teacher-friendly and student-friendly because all the hard topics tried to be explained in a very simple way with diagrams, examples, and case studies.
- The rules of excellent pedagogy are followed in the book so that the students of different disciplines, like Arts, Commerce, Home-science, Law, Engineering, etc., can easily understand the subject contents, and the faculties can explain the subject to the students easily.

Rich pedagogy includes:

- Book is based on the guidelines of NEP 2020 and outcome based learning.
- Each Unit begins with its Learning Objectives, Unit outcomes and Duties.
- The Book is based on UGC Guidelines and includes 47 Case Studies, 19 Tables & 65 Figures.
- Contains 285 Long, Short and Very Short Answer Type Questions.
- The Book also has three Model Question Papers with Answers & 268 Objective Type Questions with Answers.

About the Author

Dr. Suman Gupta has been doing teaching and administrative work in the subjects of Environmental Studies, Environmental Science, Environmental Biology, Ecology, and Botany in Colleges and Universities at the undergraduate and postgraduate levels since 1997. The author is well-versed in the subject of Environmental Science and keeps on doing programs from time to time for environmental awareness. The author has published 20 papers, 4 chapters, and 15 important articles on various topics in Science Journals, Magazines, and Newspapers. The author's three books were published in environmental science, and out of these, two have been awarded. Her book entitled *Paryavaran Adhayan-Ek Vishleshana* was awarded Second Prize all over India on November 10, 2020, by AICTE, New Delhi, Government of India.



She was awarded "Anusrijan Samman" in her book entitled *Paryavaran Aur Manav Jeevan* for outstanding contribution to Science writing in Hindi by AISECT University, Bhopal, M.P. in 2015. She was awarded the "Distinguished Service Award-2015" for outstanding contribution to the field of the Environment by the Society of Biological Sciences and Rural Development, Allahabad, U.P. She has been awarded "Focus Bharat" for excellent services in the fields of science writing, radio programs on environmental science, and a teaching and awareness program in the environmental field. She was awarded the "Best Faculty Award" by IMS Engineering College, Ghaziabad, U.P.



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