

Textbook of
Environmental Studies
for
Undergraduate Courses

FOURTH EDITION

As per 2023 UGC syllabus (NEP guidelines)

For most two decades, this book has been considered the most
e textbook on the subject for all undergraduate students.
Fourth edition has been revised as per the new syllabus
set down by the UGC (along the NEP guidelines) and has
made extremely user-friendly. The aim of this book is not
to create an awareness of environmental issues, but also to
about pro-environmental action.

Key features

Coloured precisely to the latest 2023 curriculum set down by
the UGC.

Four plates showing the biogeographical zones, and various species of flora and fauna, add
value to Unit 4.

Questions that induce reflection and follow-up
are highlighted in boxes and provide a
thought-provoking feature.

The thread of 'sustainable living' runs through
the entire book, thus awakening the students to
quality and suggests solutions for commonly
encountered environmental issues.

Unit 9 has been thoroughly revamped to include
practicals, outreach activities as well as case
studies relevant to each unit.

Image: Dr Erach Bharucha

design: Orient BlackSwan

Erach Bharucha

Dr Erach Bharucha is
Director, Bharati
Vidyapeeth Institute of
Environment Education
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implementing a variety of
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SCERT and UGC to further
the cause of formal
environmental education
and is a passionate
crusader for the well-being
of the environment.



Hon. Former President Dr APJ Abdul Kalam
releasing the First Edition in the presence of Dr Arun Nigavekar
and the author, Dr Erach Bharucha.

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Dr Erach Bharucha: *Textbook of Environmental Studies for Undergraduate Courses*
(Fourth Edition)

Erach Bharucha

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Textbook of **Environmental Studies** *for* **Undergraduate Courses**

FOURTH EDITION

As per 2023 UGC syllabus (NEP guidelines)

Erach Bharucha

for



ज्ञान-विज्ञानं विमुक्तये

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**TEXTBOOK OF ENVIRONMENTAL STUDIES FOR UNDERGRADUATE COURSES,
FOURTH EDITION**

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Foreword to the Fourth Edition

In these dynamic, rapidly evolving, and turbulent times – with the continuous onslaught of technology, unprecedented growth and development, depleting natural resources, sociopolitical imbalances, geopolitical challenges and a changing world order – the things that are rapidly and constantly worsening are environmental degradation, climate change and the increasing number of natural calamities. If we want to leave the world a better place for our children and future generations, we not only need to be mindful of these changes but also proactive in mitigating these challenges. We must educate our students about these changes and make them crusaders for environmental protection and the reversal of the damage being inflicted upon mother earth.

With this backdrop, it is my pleasure and honour to write this foreword for the important and unique *Textbook of Environmental Studies for Undergraduate Courses* written by the renowned environmentalist and accomplished surgeon, Dr Erach Bharucha.

I have known Dr Bharucha for over 30 years, initially working under him in the Department of Surgery at Bharati Vidyapeeth Medical College, Pune. His passion for the environment, biodiversity and sustainability became evident to me during this time. Dr Bharucha holds leadership roles in various national and international committees focused on policy-making in these areas.

His efforts led to the establishment of the Institute for Environment Education and Research at Bharati Vidyapeeth. In 2004, the UGC tasked him with writing a textbook on environmental studies, which was released by the then President of India, Dr A P J Abdul Kalam.

Now, I am delighted that the 4th revised and comprehensive edition of this book is being published. The book is written in a unique style, featuring numerous anecdotes, personal stories, pictures and additional material accessible via QR codes, providing essential information on the topics. It aligns with the UGC's revised guidelines for the mandatory environmental education course, which carries 4 credits. The topics prescribed by the UGC are covered in a very lucid, learner-friendly, yet comprehensive manner. This book is not only of immense value to students and learners but also to the general public, helping them understand the importance of environmental protection, the preservation of nature, biodiversity and wildlife—all critical in mitigating the disastrous effects of climate change.

This book is the need of the hour for educators, students and people in general. I am confident that after reading this book, students will become spearheads for the cause of environmental protection, gain insights into the vital issues threatening our very existence and contribute to making the world a better place.

I commend Dr Erach Bharucha for his diligent and tireless efforts in bringing out this book in the shortest possible time.

My sincere best wishes,
Dr Vivek Saoji

डॉ. अरुण निगवेकर

अध्यक्ष

Dr. Arun Nigavekar

Chairman

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Foreword to the First Edition

Our mother earth is the most precious gift of the Universe. It is the sustenance of 'nature' that is the key to the development of the future of mankind. It is the duty and responsibility of each one of us to protect nature. It is here that the understanding of the 'Environment' comes into the picture. The degradation of our environment is linked with the development process and the ignorance of people about retaining the ecological balance. Indeed, no citizen of the earth can afford to remain aloof from the issues related to the environment. It is, therefore, essential that the study of the environment becomes an integral part of the education process.

The University Grants Commission decided to address the issue of Environmental Studies by introducing a basic course on Environment at the undergraduate level. The decision of the Hon'ble Supreme Court of India made such an approach mandatory. We, therefore, appointed a Committee of Experts to advise us on the curriculum for Environmental Studies at the undergraduate level, and the Committee was also requested to produce a textbook on Environmental Studies for such an undergraduate course. This Committee was headed by Dr Erach Bharucha, a well-known Environmental Scientist of Bharati Vidyapeeth, Pune, and they have come out with a very comprehensive and useful document on this multidisciplinary subject. The material is well presented in an integrated manner and in very simple language, with a large number of examples. This has made this textbook very rich in content and would prove to be a very valuable document both for the students as well as for the teachers. I would like to compliment and also thank the Committee members for doing such a wonderful job. I am confident this book would be of great help to all those who are interested in understanding the importance of the Environment.

A. Nigavekar

(Arun Nigavekar)
Chairman

Preface to the Fourth Edition

The fourth edition of the *Textbook of Environmental Studies for Undergraduate Courses* is designed to help students from all disciplines understand and embrace pro-environment lifestyles. It aligns with the new perspective that emphasises environmental conservation as a key priority in both the National Education Policy 2020 and the National Curricular Framework of 2023. This edition closely adheres to the University Grants Commission's June 2023 guidelines and curriculum framework for environmental education at the undergraduate level.

This has led to a fresh approach to environmental education, incorporating learning tools such as system analysis, mind maps, videos, presentations and case studies. There is also a strong focus on practical work and outreach activities, which are central to the proposed four-credit system.

To support interdisciplinary learning, the textbook includes interactive QR codes for each unit, linking students to supplementary materials that enhance understanding of the topics covered. I encourage students to use these resources as part of a self-guided learning experience with a systems-thinking approach. Engaging in discussions, seminars and experiential learning at environmental sites, along with studying case studies, will inspire students to take meaningful outreach actions.

Each of us leaves a significant footprint on the earth's precious resources. Sustainability is not just a buzzword but a longstanding part of India's ethos, embedded in our diverse cultural practices. This book offers practical guidance on reducing one's environmental footprint and contributing to the sustainable use of the limited natural resources. By doing so, this generation can help build a better future for both India and the world.

Erach Bharucha
Director, BVIEER
Pune, March 2025

Preface to the First Edition

Perhaps no other country has moved so rapidly from a position of complacency in creating environmental awareness into infusing these newer pro-environmental concepts into formal curricular processes as has happened in India over the last few years. This has undoubtedly been accelerated by the judgment of the Honorable Supreme Court of India that Environmental Education must form a compulsory core issue at every stage in our education processes.

For one who has fought to implement a variety of environment education programs for schools and colleges and for the public at large, this is indeed a welcome change. The author is currently constantly asked to provide inputs to 'environmentalise' textbooks and provide inputs – at the NCERT, SCERT and UGC Levels – to further the cause of formal environment education.

This textbook has been produced as an outcome of a UGC Committee that included the author and was set up to develop a common core module syllabus for environmental studies at the undergraduate level, to be used by every University in the country. The author invites comments from those who wish to contribute towards its improvement in the coming years.

Environment education can never remain static. It must change with the changing times, which inevitably changes our environment.

Each of us creates waves around us in our environment that spread outwards like the ripples generated by dropping a stone in a quiet pond. Every one of us is constantly doing something to our environment and it is frequently the result of an act that we can hardly ever reverse, as after once the stone hits the water one cannot stop the ripple effect from disturbing the pond.

This textbook is written to bring about an awareness of a variety of environmental concerns. It attempts to create a pro-environmental attitude and a behavioral pattern in society that is based on creating sustainable lifestyles. But a textbook can hardly be expected to achieve a total behavioral change in society. Conservation is best brought about through creating a love for nature. If every college student is exposed to the wonders of the Indian wilderness, I believe that a new ethic towards conservation will emerge.

Erach Bharucha
Pune, 2005

Acknowledgements

The fourth edition of this popular textbook on environmental studies addresses new ways of learning about local, national and global environmental concerns. As the author, my thinking has been profoundly influenced by the late Dr Patangrao Kadam, Founder of Bharati Vidyapeeth Deemed University (BVDU), who advocated for environmental education and a multidisciplinary approach to life and human well-being. I owe many of the ideas on the environmental educational needs of society to him, ideas which he championed over several decades.

I extend my sincere thanks to the current leaders of BVDU – Chancellor Dr Shivajirao Kadam, Dr Vishwajeet Kadam and Dr Asmita Jagtap – for their invaluable support in bringing this newly conceptualised and differently designed textbook to fruition. I am also deeply grateful to the Hon. Vice Chancellor, whose continued encouragement at Bharati Vidyapeeth has been indispensable.

I am indebted to my senior faculty members over the years—Dr Shamita Kumar, Dr Kranti Yardi, and all other in-house and visiting faculty who have supported BVIEER and its initiatives. Their contributions have been integral to the concepts in this textbook. Dr Yardi's personal experiences with fieldwork have also enriched Unit 9 of the textbook.

I would also like to express my heartfelt thanks to my team of Environmental Educators – Kimberly Colaco, Shraddha Shigwan and Harshal Jayawant – who have been instrumental in referencing material, sharing their insights and engaging in open discussions on the innovative pedagogic tools they utilise in their educational programmes. Special thanks to Ms Saylee Joshi and Ms Anya Baphna, whose efforts were critical during the last stages, in making this textbook a reality.

The QR section of the book, a unique learning tool, has been made possible through the efforts of Mr Anand Shinde, who has carefully managed my extensive collection of photographs from across India, taken over the last 40-odd years. His ability to retrieve these visuals has greatly contributed to the book's interactive and visual learning approach.

I am thankful to my visiting faculty of many years, Ms Archana Kalyani, who provided input during the drafting stage on pollution studies, and Ms Anushka Kajbaje, who contributed to the unit on municipal solid waste. Their time and effort were invaluable in filling gaps in units 5 and 7. I thank Dr Gouri Joshi for drafting the material on the international conventions and laws.

A big thank you to Chinmaya Dunster for providing the melodies for the background music in the QR section, inspired by his experiences in India. I also extend my gratitude to my office staff at BVIEER, who supported me throughout the development of this textbook. Mr Bhosale, our Accounts Officer, and Mr Prashant Kate, in charge of administrative functions, were especially helpful during this time.

A key individual to whom I owe the successful publication of all four editions of this textbook is my long-time secretary of 25 years, Mrs Vidya Pujari. She has meticulously typed and organised the text, often working long hours to help manage the complexities of the QR section. My thanks also go to Ms Sushma Durve for the illustrations in Unit 4 and to Ms Anagha Inamdar for her diagrams in Unit 6, featured in the QR section.

I would like to thank my wife, Kapila, and my sister, Ernavaz, for allowing our home to double as an office space for several months. They have been incredibly patient with my team coming and going at all hours, and they have assisted with my computer needs and internet communications.

The teachers and school students who have participated in BVIEER's School Environment Education Programmes over the years have given me some of my most rewarding moments. My M.Sc. students at BVIEER have demonstrated the real-world impact of environmental studies, earning recognition as environmental professionals. They have been my inspiration for over 30 years through countless interactions and unforgettable academic discussions.

I cannot adequately express my appreciation for my publisher, Universities Press, and Mr Madhu Reddy, who has been instrumental in the publication of all four editions. This book, along with its QR section, would not have been possible without his unwavering support and belief in the mission of the textbook.

Finally, to Dr Gita Dattatri, my editor for the last three editions and now the all-new QR section of this edition, I offer my deepest thanks. She has worked tirelessly, contributing significantly to the content, accepting calls at odd hours, even on Sundays, to ensure the successful completion of this project.

Over the last 50 years, I have travelled extensively across our incredible nation, learning from the beauty and intricacies of its landscapes, exploring its wilderness and gaining insights from indigenous cultures. These experiences have greatly influenced the content of this textbook.

I hope this book sparks an interest in young people to promote the well-being of all living beings in our country and the world, helping to create a more environmentally-conscious society and ensure the well-being of future generations of India.

Erach Bharucha
Pune, March 2025

How to use the Textbook and QR Section

1. The **Learning Objectives** in the first page of each unit tell the student the content of the text covered in each unit. This is supported in the QR section of the unit with explanations, visuals and exercises.
2. Using the introductory video (in the web resources) provides a theme-based brief of the content in the text.
3. A list of learning tools is provided to help you understand and participate in graph learning.
4. The **Systems Learning** model gives you the links between each component element of the themes discussed in each unit. You are expected to critically examine the model and show how each element is connected to other elements by converting the links into an arrow.
 - ♦ Draw your own diagram with thick lines that are important links and thin lines that are less important from your own perspective.
 - ♦ Identify those links that form feedback loops where more than two elements are linked.
5. Read the textbook doing a critical analysis of each theme. Listen to lectures and seminars, and take excursions. Read the QR section and study the visuals.
6. Using your observational skills and participating in practical and outreach activities is a key to environment education.
7. Using the **Recap mind map**:
 - ♦ Once you have studied the text and material in the QR section, use the recap mind map, which is based on the subsections in each unit. Refer back to the textbook—please make your own mind map based on your learning priorities. This will add to your own knowledge and competence on the themes and concerns in each unit.
8. The visual material in the **PPT section** provides you with specific themes related to each unit that gives you a deeper opportunity for critical thinking and for assessing what you have learned from the textbook material.
9. **Practicals**: Basic aspects of 'learning by doing' are in Unit 9 in the textbook. Additional material on how to go about experiential learning is included in the QR section. Appreciate which of the practical exercises are most relevant in your own chosen UG subject.
10. **Outreach activities**: Outreach to different stakeholders provides you with ways to link hands-on tools with your own learning opportunities, for enhancing knowledge, skill and socially relevant actions, as a responsible citizen in your lifescape.
11. The important **Case Studies** are NOT ONLY to be read for the historical event or individuals involved BUT to be related to the context in which they were embedded in the past.
 - ♦ Compare the case study to the present scenario.
 - ♦ Think about their consequences.
 - ♦ Critically examine each case study to help you develop a better world for tomorrow.

Contents

As per 2023 UGC syllabus (NEP guidelines)

Foreword to the Fourth Edition

Foreword to the First Edition

Preface to the Fourth Edition

Preface to the First Edition

Acknowledgements

How to Use the Textbook and QR Section

Syllabus Mapping

Unit 1: Humans and The Environment

Introduction

1.1 The Man–Environment Interaction

1.2 Environmental Ethics and Emergence of Environmentalism

Unit 2: Natural Resources and Sustainable Development

Introduction

2.1 Overview of Natural Resources

2.2 Biotic Resources

2.3 Water Resources

2.4 Soil and Mineral Resources

2.5 Energy Resources

2.6 Introduction to Sustainable Development

Unit 3: Environmental Issues—Local, Regional, Global

Introduction

3.1 Environmental Issues and Scales

3.2 Pollution

3.3 Landuse and Land Cover Change

3.4 Global Change

Unit 4: Conservation of Biodiversity and Ecosystems

Introduction

4.1 Biodiversity and Its Distribution

4.2 Ecosystems and Ecosystem Services

4.3 Threats to Biodiversity and Ecosystems

4.4 Major Conservation Policies

Unit 5: Environmental Pollution and Health

Introduction

5.1 Understanding Pollution

5.2 Air Pollution

5.3 Water Pollution

5.4 Soil Pollution and Solid Waste

5.5 Noise Pollution

5.6 Thermal and Radioactive Pollution

Unit 6: Climate Change: Impacts, Adaptation and Mitigation

Introduction

6.1 Understanding Climate Change

6.2 Impacts, Vulnerability and Adaptation to Climate Change

6.3 Mitigation of Climate Change

Unit 7: Environment Management

Introduction

7.1 Introduction to Environmental Laws and Regulations

7.2 Environmental Management Systems (ISO 14001)

7.3 Concept of Circular Economy

7.4 Environmental Audit and Impact Assessment

Unit 8: Environmental Treaties and Legislation

Introduction

8.1 An Overview of Instruments of International Cooperation

8.2 Major International Environmental Agreements

8.3 Major Indian Environmental Legislations

8.4 Major International Organisations and Initiatives

Unit 9: Case Studies and Field Work

9.1 Introduction

9.2 Learning Objectives Using a Practical Approach: For Each Unit

9.3 General Outreach Activities

9.4 Practicals, Outreach Activities and Case Studies

Index

iii

iv

v

vi

vii

ix

xii

2

2

3

13

31

31

33

35

40

45

49

60

70

71

71

78

81

87

104

104

106

129

155

164

178

178

179

184

194

200

203

207

211

211

212

222

233

247

247

248

253

255

260

281

281

283

285

294

313

320

320

322

325

327

370

Index

A

abiotic resources, 34
acid rain, 79
agriculture, 4
amphibians, 121
anthropocene, 2, 7, 8, 112, 213, 217
anthropogenic, 19, 217
aquatic life, 122
atmosphere, 36, 216

B

bilateral agreements, 283
biodiversity, 104, 106
 distribution, 106
 ecosystem diversity, 110
 genetic diversity, 109
 hotspots, 114
 natural resource, 106
 species diversity, 110
biodiversity loss, 87
biogeographic zones, 112
biomass energy, 57
biosphere reserves, 307
biosphere, 39
biotic resources, 35
birds, 120

C

carbon intensity, 235
carbon neutrality, 235
Central Pollution Control Board (CPCB), 199, 300
circular economy, 255
climate action, 242
climate change, 89, 211
 1.5°C and 2°C limits, 220
 adaptation, 211, 222
 climate-resilient development, 232
 CO₂, 219
 greenhouse gas (GHG), 234
 impacts, 211, 222
 indigenous knowledge, 232
 mitigation, 211, 233
 policy, 238
 sea level rise, 224

climate justice, 242
climate, 214
 climate variability, 220
 natural variations, 214
 rainfall, 219
 temperature, 219
 extreme events, 220
Coastal Regulation Zone, 298, 310
Conference of Parties (COP), 284
conflicts over water, 44
conservation biology, 125
conservation, 104, 105
 community-based, 174
 ex situ, 166
 in situ, 166
 policies, 164
constitutional provisions, 249
continental drift, 112, 215
convention on biological diversity, 173
cost-benefit analysis, 260
cyclones, 94

D

deforestation, 82
desertification, 84
disaster management act, 98
disasters, 89
drought, 96

E

earthquakes, 93
ecocentric, 19
ecolabelling/eco mark scheme, 278
ecological succession, 131
ecologically sensitive areas, 309
economic services, 152
ecosystem, 104, 129
 coastal, 150
 composition, 131
 cultural, 149
 degradation, 157
 estuary, 150
 functions, 131
 forest, 134
 forest services, 137

grassland, 139
marine, 149
semi-arid, 143
services, 129, 151
social services, 154
structure, 131
wetland, 145
energy pyramid, 132
energy resources, 49
energy, 238
 carbon capture and storage, 239
 efficiency, 238
 renewable, 238
Environment Impact Assessment (EIA), 261
environment management, 247
environmental audit, 260
environmental ethics, 13, 15
environmental governance, 248
environmental legislations, 250, 282
environmental management systems, 253
environmental risk assessment, 263
environmental treaties, 281
environmental values, 16
equitable use of resources, 18
extinction, 112, 127

F

fish, 122
floods, 90
food chain, 131
food web, 131
fuel cells, 58

G

geothermal energy, 56
global environmental change, 12
greenhouse gas emission, 217

H

hazardous waste, 202
hot speck, 105
human rights, 15
human-induced disasters, 97
hydro power, 52
hydrogen, 58
hydrosphere, 38

I

indig knowledge, 6
industrial revolution, 7
insects, 122
Intended Nationally Determined Contributions (INDCS), 239

invertebrates, 122
ISO 14001, 254

K

key ecosystems, 127
keystone species, 105

L

land degradation, 81
landslides, 95
landuse and land cover change, 81, 159
learning, 33
life cycle analysis, 258
limits to growth, 23
lithosphere, 38

M

major Indian environmental legislations, 294
 Biological Diversity Act, 2002, 302
 Forest Rights Act, 303
 Noise Pollution (Regulation and Control) Rules, 2000, 304
 The Environment (Protection) Act, 1986, 301
 The Forest (Conservation) Act, 1980, 297
 Wildlife (Protection) Act, 1972, 294
major international environmental agreements, 285
 Convention on Biological Diversity (CBD), 285
 CITES, 288
 Kyoto Protocol, 292
 Montreal Protocol, 289
 Ramsar Convention, 288
 Stockholm Convention on Persistent Organic Pollutants, 291
 United Nations Convention to Combat Desertification (UNCCD), 289
 United Nations Framework Convention on Climate Change (UNFCCC), 292
 Vienna Convention, 289
major international organisations and initiatives, 313
 Intergovernmental Panel on Climate Change (IPCC), 316
 International Union for Conservation of Nature (IUCN), 314
 United Nations Development Program (UNDP), 317
 United Nations Educational, Scientific and Cultural Organisation (UNESCO), 315
 United Nations Environment Program (UNEP), 313
 World Commission on Environment and Development (WCED), 315
mammals, 119
man-environment interaction, 3

M C Mehta, 71
 mega-diversity, 115
 meso scales, 74
 micro level, 74
 minerals, 46
 multilateral agreements, 283

N

national ambient air quality standards, 192
 national climate action plan, 239
 National Disaster Management Plan (NDMP), 98
 National Green Tribunal, 311
 national wildlife action plan, 173
 natural capital, 33
 natural cycles, 32
 natural resources, 39
 net zero, 236
 non-conventional energy sources, 52
 nuclear accidents, 97
 nuclear energy, 51, 208

O

ozone depletion, 88, 191

P

Paris Agreement, 293
 personalised ecology, 2
 planetary boundaries, 75
 planetary goals, 76
 planetary scales, 75
 pollutants, 182
 primary, 185
 secondary, 185
 soil, 201
 pollution control and management, 264
 pollution, 178
 air pollution, 184
 non-point sources, 182
 noise pollution, 203
 point sources, 182
 soil pollution, 200
 solid waste, 200
 thermal and radioactive pollution, 207
 water pollution, 194
 population growth, 8
 protected areas, 168, 309
 Integrated Protected Area System (IPAS), 171
 national parks, 169
 wildlife sanctuaries, 169

R

3R, 277
 Ramsar sites, 306

renewable, 34, 49
 reptiles, 121
 resilience, 231
 Rio Summit, 25
 risk assessment, 100

S

SAFAR, 194
 scales, 74
 silent spring, 19, 23
 soil, 45
 soil degradation, 201
 solar energy, 53
 spatial changes, 77
 species, 122
 endangered, 122
 endemic, 122
 endemism, 123
 invasive, 163
 keystone, 127
 richness, 123
 sustainability, 277
 sustainable development goals, 62
 sustainable development, 25, 31, 60
 synaptic, 75
 systems thinking, 72

T

tectonic movements, 215
 temporal changes, 77
 threats, 128, 155
 threat categories, 115, 123
 tidal and wave power, 55
 traditional knowledge, 125, 174
 tsunamis, 93

U

urbanisation, 84

V

vulnerability, 222, 229

W

waste management, 266
 hazardous waste, 276
 Integrated Solid Waste Management system (ISWM), 269
 municipal sanitary landfill, 269
 municipal solid waste, 266
 toxic waste, 277
 waste to energy methodologies, 273
 water quality parameters and standards, 199
 wind power, 55