



ENVIRONMENT AND CLIMATE CHANGE

- Dr. Ragini Chintaman Patil
- Dr. Kiran Ramrao Borkar

ENVIRONMENT AND CLIMATE CHANGE

Dr. Ragini Chintaman Patil

Assistant Professor,
Department of Chemistry,
Rashtrapita Mahatma Gandhi Arts,
Commerce and Science College,
Saoli- 441225, Dist.Chandrapur, Maharashtra, India.

Dr. Kiran Ramrao Borkar

Assistant Professor,
Department of Zoology,
Rashtrapita Mahatma Gandhi Arts,
Commerce and Science College,
Saoli- 441225, Dist.Chandrapur, Maharashtra, India.

Kripa-Drishti Publications, Pune.

Book Title: **Environment and Climate Change**

Authored By: **Dr. Ragini Chintaman Patil,
Dr. Kiran Ramrao Borkar**

Price: ₹599

1st Edition

ISBN: **978-81-968394-1-3**



Published: **Feb 2024**

Publisher:



Kripa-Drishti Publications

A/ 503, Poorva Height, SNO 148/1A/1/1A,
Sus Road, Pashan- 411021, Pune, Maharashtra, India.

Mob: +91-8007068686

Email: editor@kdpublications.in

Web: <https://www.kdpublications.in>

© Copyright **Dr. Ragini Chintaman Patil, Dr. Kiran Ramrao Borkar**

All Rights Reserved. No part of this publication can be stored in any retrieval system or reproduced in any form or by any means without the prior written permission of the publisher. Any person who does any unauthorized act in relation to this publication may be liable to criminal prosecution and civil claims for damages. [The responsibility for the facts stated, conclusions reached, etc., is entirely that of the author. The publisher is not responsible for them, whatsoever.]

PREFACE

The environment consists of the air, water, and land as well as the interactions between them, humans, other living things, plants, microorganisms, and property. Globally, the environment affects the health of people, animals, and plants. Because of our superior intelligence, it is our responsibility to safeguard the environment from harmful pollution. The issues of global warming, climate change, health risks, depletion of natural resources such as forests and water supplies, and strain on biological diversity.

Students studying climate change can learn the fundamental scientific underpinnings of climate change management from the Environment and Climate Change book. Students will gain knowledge of national and international strategies for managing climate change, as outlined in international agreements, national laws, and voluntary initiatives. The book explains how to achieve a low-carbon economy, including green finance, as well as mitigation and adaptation strategies, as well as tracking and reporting of greenhouse gas emissions.

This book offers a thorough understanding of the fundamentals of climate change, biodiversity changes, and phytosociological changes. As a result, it offers a comprehensive range of solutions to address a variety of environmental and climate change-related problems. Researchers, legislators, academics, environmentalists, and college students would all benefit from this book.

INDEX

Unit 1: Natural Resources	1
1.1 Forest Resources:.....	1
1.1.1 Use and Over Exploitation:	1
1.2 Deforestation:	2
1.2.1 The Causes of Deforestation:.....	2
1.2.2 Deforestation Effects:.....	3
1.2.3 Case Study on Forest Resources:	5
1.2.4 National Forest Policy Statement (NFPS):.....	7
1.3 Timber Extraction, Mining, Dams and Their Effects on Forest and Tribal People:	8
1.3.1 Timber Extraction:	8
1.3.2 Types of Timber Extraction:.....	8
1.3.3 Case Study:	9
1.4 Mining:.....	9
1.4.1 Large Scale Mining Versus Small Scale Mining:.....	9
1.5 Dams and their Effects on Forests and Tribal People:	11
1.6 Water Resource:	12
1.6.1 Types of Water Resources:	12
1.6.2 Use and over Utilization of Surface and Ground Water:	13
1.7 Minerals Resources:	19
1.7.1 Categories of Mineral Resources:	20
1.7.2 Uses of Minerals:	21
1.7.3 Use and Exploitation:	21
1.7.4 Environmental Effects of Extracting and Using Mineral Resources:	24
1.8 Food Resources:	25
1.8.1 World Food Problems:	26
1.8.2 The Use of Artificial Chemicals in Agriculture:.....	27
1.8.3 The Growing Threat of Climate Change and Its Impact on Food Security:	27
1.8.4 Changes Caused by Agriculture and Overgrazing:.....	27
1.8.5 Changes Caused by Overgrazing:	28
1.8.6 Impact of Modern Agriculture on Environment:	28
1.8.7 Fertilizer-Pesticide Problems:.....	30
1.8.8 Water Logging Salinity:	31
1.9 Energy Resources:	32
1.9.1 The Growing Energy Needs:	33
1.9.2 Renewable and Non-Renewable Resources:	33
1.9.3 Alternative Sources of Energy:.....	36
1.9.4 Uses of Alternative Sources of Energy:	37
1.10 Land as A Resource:.....	38
1.10.1 Land Degradation:.....	40
1.10.2 Man Induced landslides:.....	41

1.10.3 Soil Erosion:	41
1.10.4 Desertification:.....	42
1.10.5 Role of Individual in Conservation of Natural Resources:	44
1.10.6 Equitable Use of Resources for Sustainable Lifestyle:	45
Unit 2: Ecosystems	47
2.1 Ecosystem:	47
2.1.1 Processes of Ecosystems:	47
2.1.2 Structure and Function of An Ecosystem:.....	48
2.1.3 Functions of Ecosystem:	49
2.1.4 Producers in Ecology:	50
2.1.5 Producers as the Cornerstone of an Ecosystem:	50
2.2 Consumers and Decomposers:	51
2.2.1 Decomposers and Stability:	51
2.3 Energy Flow of Ecosystem:	52
2.3.1 Laws Governing Energy Flow in An Ecosystem:	53
2.3.2 Mechanism of Energy Flow in An Ecosystem:	53
2.3.3 Trophic Levels:	53
2.3.4 Food Chain:	54
2.3.5 Food Chains Procedure:	55
2.4 Ecological Succession:	57
2.5 Food Chains, Food Webs and Ecological Pyramids:	58
2.5.1 Food Chain:	58
2.5.2 Types of Food Chains:	58
2.6 Ecological Pyramids:.....	59
2.6.1 The Pyramid of Number:.....	60
2.6.2 The Pyramid of Biomass:	60
2.6.3 Pyramid of Energy:	61
2.7 Forest Ecosystem:.....	61
2.7.1 Types of Forest Ecosystem:.....	62
2.7.2 Temperate Forest Ecosystem:.....	63
2.7.3 Characteristics of Forest Ecosystem:	64
2.7.4 Structure and Function of Forest Ecosystem:.....	65
2.8 Grasslands:	67
2.8.1 Types of Grasslands:	67
2.8.2 Characteristics of Grassland Ecosystem:	68
2.8.3 Functions of the Grassland Ecosystem:	68
2.8.4 Economic Importance of Grassland Ecosystem:	69
2.8.5 Structure and Functions of Grassland Ecosystems:	69
2.9 Desert Ecosystem:	70
2.9.1 Desert Ecosystem Characteristics:	70
2.9.2 Types of Desert Ecosystem:	71
2.9.3 Structure and Functions of Desert Ecosystems:	72
2.10 Aquatic Ecosystem:	72
2.10.1 Features of Aquatic Ecosystem:	73

2.10.2 Types of Aquatic Ecosystem:	73
2.10.3 Structure of Aquatic Ecosystem:.....	74
2.10.4 Functions of Aquatic Ecosystem:	76
Unit 3: Biodiversity And Its Conservation Introduction	78
3.1 Definition: Genetic, Species and Ecosystem Diversity:	78
3.1.1 Types of Biodiversity:	78
3.2 Bio Geographic Classification of India:	79
3.3 Values of Biodiversity:	81
3.3.1 Direct Values:	81
3.3.2 Indirect Values or Non-Consumptive Value:.....	82
3.4 Biodiversity at Global, National and Local Levels:	83
3.4.1 India-A Mega Diverse Landscape:.....	83
3.5 India as A Mega-Diversity Nation:	84
3.6 Biodiversity Hotspots in India:	84
3.6.1 Criteria to Be Satisfied for A Biodiversity Hotspot:	85
3.7 Threats to Biodiversity:	89
3.7.1 Climate Change Threats to Biodiversity:	90
3.8 Habitat Loss:	90
3.8.1 Major Kinds of Habitat Loss:	91
3.8.2 Main Causes of Habitat Loss:	91
3.9 Poaching of Wildlife:.....	91
3.9.1 Causes of Poaching:	92
3.9.2 Species Affected or Threatened by Poaching:	92
3.9.3 The Poached Animal Is a Keystone Species:	93
3.10 Man - Wildlife Conflict:	93
3.10.1 Factors leading to Human-Wildlife Conflict:	94
3.10.2 Human-Animal Conflict:	94
3.10.4 Steps to Mitigate Human-Wildlife Conflict:	95
3.11 Endangered and Endemic species of India:	95
3.11.1 Endemic Species of India:	96
3.12 Conservation of Biodiversity:	97
3.13 Conservation of Biodiversity: In-Situ and Ex Situ Conservation of Biodiversity:.....	97
3.13.1 In Situ Conservation:.....	98
3.13.2 Ex-situ Conservation:	99
Unit 4: Environmental Pollution.....	100
4.1 Definition:	100
4.2 Air Pollution:.....	100
4.2.1 Air Pollution Definition:.....	100
4.2.2 Causes of Air Pollution:	100
4.2.3 Effects of Air Pollution:	101
4.2.4 Effects on Animals:.....	102

4.2.5 Air Pollution Control:	102
4.3 Water Pollution:	103
4.3.1 Causes of Water Pollution:.....	103
4.3.2 Effects of Water Pollution:.....	104
4.3.3 Control Measures of Water Pollution:	105
4.4 Soil Pollution:.....	106
4.4.1 Causes of Soil Pollution:	107
4.4.2 Effects of Soil Pollution:	108
4.4.3 Control Measures for Soil Degradation:.....	108
4.5 Marine Pollution:.....	109
4.5.1 Causes of Ocean Pollution:	110
4.5.2 Effects of Ocean Pollution:	110
4.5.3 Control Measures of Ocean Pollution:.....	111
4.6 Noise Pollution:.....	111
4.6.1 Sources of Noise Pollution:	111
4.6.2 Effects of Noise Pollution:	112
4.6.3 Steps to Control Noise Pollution:	113
4.7 Thermal Pollution:.....	115
4.7.1 Causes of Thermal Pollution:	115
4.7.2 Effects of Thermal Pollution:	117
4.7.3 Control Measures for Thermal Pollution:	118
4.8 Nuclear Pollution:.....	119
4.8.1 Causes of Nuclear Pollution:	119
4.8.2 The Effects of Nuclear Pollution:	121
4.8.3 Nuclear Pollution Control Measures:.....	121
4.9 Human Health Risk Assessment:	122
4.9.1 Risk Assessment & Children:.....	123
4.10 Solid Waste Management:	124
4.11 Industrial Wastes: Control Measures of Urban and Industrial Wastes:.....	125
4.11.1 Control Measures of Urban and Industrial Wastes (with statistics):	125
4.12 Ganga Pollution Case: A Case Study:	130
4.12.1 Reasons behind the Pollution of Ganga:	131
4.12.2 Municipal Corporation:	131
4.12.3 Agriculture Waste:	132
4.12.4 Effective Measures by Government to Stop the Pollution:	132
4.12.5 Suggestions:	133

Unit 5: Earth's Atmosphere and Its Circulation.....136

5.1 Evolution and Development of Earth's Atmosphere:	136
5.1.1 The Evolution of Earth's Atmosphere:	136
5.1.2 Development of Earth's Atmosphere:.....	137
5.2 Milankovitch Cycles:.....	137
5.3 Earth's Energy Balance:	139
5.4 Energy Transfer in Earth's Atmosphere:.....	141

5.5 The Earth's Radiation Budget:.....	142
5.5.1 Incoming Solar Radiation:.....	142
5.5.2 Absorbed Energy:	143
5.5.3 Emitted Longwave Radiation:	143
5.6 Greenhouse Effect:	143
5.6.1 Radiation and The Climate System:.....	144
5.6.2 Greenhouse Gas:	144
5.6.3 Lesser Greenhouse Gases:	145
5.7 Greenhouse Effect:	145
5.8 A Global Warming Potential (GWP):.....	146
5.9 Movement of Air Mass:	147
5.9.1 Types of Air Masses:.....	147
5.10 Atmosphere and Climate:.....	148
5.10.1 The Atmosphere:.....	148
5.10.2 Weather and Climate:.....	150
5.11 Air-Sea Interaction:	152
5.12 Southern Oscillation:	153
5.13 Western Disturbance:.....	154
5.13.1 Formation of Western Disturbances:.....	154
5.14 Western Disturbances Variation:.....	155
5.14.1 Western Disturbances in India Effects:	155
5.14.2 Western Disturbances in India Impact:	155
5.14.3 Western Disturbances Importance:	156
5.15 El Niño and La Niña:	156
5.15.1 El Niño:.....	156
5.15.2 La Niña:	157
5.16 Tropical Cyclones:.....	158
5.17 Indian Monsoon:.....	159
5.17.1 Monsoon Onset and Early Developments:	159
5.18 Indian Ocean Dipole (IOD):.....	160
5.18.1 Indian Ocean Dipole – Concept:.....	161
5.18.2 Mechanism:.....	162
5.18.3 Neutral IOD:	163
5.18.4 Positive Indian Ocean Dipole (IOD):.....	163
5.18.5 Negative Indian Ocean Dipole (IOD):	165
5.18.6 Impact of Indian Ocean Dipole on Indian Monsoon:.....	165
5.18.7 Impact of Indian Ocean Dipole on El-Nino:.....	166
5.18.8 Impact of Indian Ocean Dipole on Australia:	166
5.18.9 Recent Phenomenons Caused by Indian Ocean Dipole:	166
5.19 Impact of Indian Monsoon on Indian Economy:.....	167
Unit 6: Meteorology, Atmospheric Stability and Chemistry	169
6.1 Meteorological Parameters:	169
6.1.1 Common Meteorological Parameters:.....	169
6.1.2 Atmospheric Stability and Mixing Heights:.....	170

6.2 Temperature Inversion:.....	171
6.2.1 Types of Temperature Inversion:.....	171
6.3 Plume Behavior:.....	173
6.4 Gaussian Plume Model:.....	175
6.4.1 Experiments:.....	176
6.5 Chemistry of Atmospheric Particles and Gases:.....	179
6.6 Smog – Types and Processes:.....	181
6.6.1 Smog Formed:.....	181
6.7 Photochemical Processes:.....	182
6.8 Ions and Radicals in Atmosphere:.....	184
6.9 Acid-Base Reaction:.....	187
6.9.1 Theories of Acids and Bases:.....	187
6.9.2 PH of Acids and Bases:.....	187
6.9.3 Theories of Acids and Bases:.....	187
6.9.4 The pH of Acids and Bases:.....	189
6.10 Atmospheric Water:.....	190
6.11 Role of Hydroxyl and Hydroperoxyl Radicals in Atmosphere:.....	191
Chapter 7: Global Warming and Climate Change	193
7.1 Global Warming:.....	193
7.2 Climate Change:.....	194
7.3 Earth’s Climate Through Ages:.....	194
7.3.1 770 Million Years Ago - Snowball Earth:.....	195
7.3.2 305 Million Years Ago - Carboniferous Rainforest Collapse:.....	195
7.3.3 66 million Years Ago - Cretaceous-Paleogene Extinction Event:...	195
7.3.4 55 million Years Ago – Permian-Eocene Thermal Maximum:.....	195
7.3.5 18,000 Years Ago – Glaciers Begin to Retreat and Our Modern Landscape Is Revealed:.....	195
7.3.6 Trends of Global Warming:.....	196
7.3.8 Global Warming Is Affecting Every Corner Of Our Planet:.....	196
7.4 Drivers of Global Warming:.....	197
7.4.1 Changes in Greenhouse Gases from Ice Core and Modern Data: ...	198
7.4.2 Indicators: Climate Change Drivers:.....	199
7.5 The Potential of Different Greenhouse Gases (GHGs) Causing the Climate Change:.....	199
7.5.1 Greenhouse Gases:.....	200
7.5.2 Greenhouse Effect:.....	201
7.5.3 A Typical Greenhouse Used to Regulate the Climate for Plant Growth:	201
7.5.4 Reduce Greenhouse Gas Emissions:.....	202
7.6 Weather Patterns:.....	202
7.6.1 Global Winds:.....	203
7.7 Sea Level Rise:.....	204
7.7.1 Measuring Sea Level:.....	206
7.8 Agricultural Productivity:.....	207

7.8.1 Importance of Agricultural Productivity:	207
7.9 Biological Responses - Range Shift of Species:	208
7.10 Range Shift of Species:	209
7.11 CO ₂ Fertilization and Agriculture:	210
7.12 Impact on Economy:	211
7.12.1 Developing Economies Likely to Be Most Impacted By Global Warming:	211
7.13 Spread of Human Diseases:	213
7.13.1 Water-Borne Diseases:	213
7.13.2 Malaria:	214

Unit 8: Ozone Layer, Environmental Policy & Agreements..... 216

8.1 Introduction:	216
8.1.1 Ozone:	216
8.1.2 Ozone Layer:	216
8.1.3 Importance of Ozone Shield:	216
8.1.4 Importance of the Ozone Layer in the Earth's Atmosphere:	217
8.2 Ozone Layer Depletion and Causes:	217
8.3 The Chapman Cycle:	218
8.3.1 The Cycle:	218
8.4 Process of Springtime Ozone Depletion Over Antarctica:	219
8.4.1 Schematic of the Growth of the Antarctic Ozone Hole:	220
8.5 Ozone Depleting Substances:	220
8.6 Effects of Ozone Depletion:	221
8.6.1 Effects:	221
8.6.2 Solutions to The Depletion of The Ozone Layer:	223
8.7 Mitigation Measures and International Protocols:	223
8.7.1 Disaster Mitigation Measures:	224
8.7.2 Structural Mitigation Measures:	224
8.7.3 Non-Structural Measures:	225
8.7.4 International Protocols:	227
8.8 Environmental Policy Debate:	228
8.9 International Agreements:	228
8.10 Montreal protocol 1987:	230
8.10.1 Purpose of Montreal Protocol:	230
8.11 Kyoto protocol 1997:	231
8.11.1 Facts about Kyoto Protocol:	231
8.11.2 The Kyoto Mechanisms:	232
8.12 Convention on Climate Change:	232
8.13 Carbon Credit and Carbon Trading:	233
8.13.1 Breaking Down Carbon Credit:	233
8.13.2 Carbon Credit and Developing Countries:	234
8.13.3 Carbon Trading:	234
8.13.4 Carbon Offset Trading:	234
8.14 Clean Development Mechanism:	235

8.14.1 Objectives of Clean Development Mechanism:	235
8.14.2 Operating Details of Clean Development Mechanism in India:	236

Unit 9: Environmental Policies & Practices237

9.1 Environmental Policies:.....	237
9.2 Environmental Policy Works:.....	239
9.2.1 Main Function of Environmental Policy:.....	239
9.3 Environmental Reporting and Eco Labeling:.....	240
9.4 Sustainability and Sustainable Development:.....	241
9.4.1 Scope of Sustainable Development:	241
9.4.2 Basic Characteristics of Sustainable Development:	241
9.4.3 Principles/Premises of Sustainable Development:	242
9.4.4 Sustainable Development Examples:.....	242
9.4.5 Importance of Sustainable Development: Battling the Environmental Crisis:	243
9.5 Climate Change:.....	243
9.5.1 Causes of Climate Change:	244
9.6 Global Warming:.....	245
9.6.1 Global Warming Potential:.....	245
9.7 Ozone Layer Depletion:.....	246
9.8 Acid Rain and Impacts on Human Communities and Agriculture:	247
9.8.1 Acid Rain is Very Harmful to Agriculture, Plants and Animals.	247
9.8.2 Acid Rain Effects on Animals and Humans:.....	248
9.8.3 Acid Rain Effects on The Building and Monument:	248
9.9 Environment Laws: Environment Protection Act:	249
9.9.1 Environmental Issues Faced in India:	249
9.10 Environment Protection Act; Air (Prevention & Control of Pollution):	251
9.11 Water (Prevention and control of Pollution) Act:	251
9.11.1 Central Board- Central Pollution Control Board:	251
9.11.2 Prevention and Control of Water Pollution:	253
9.12 Forest Conservation Act:	255
9.12.1 Constitutional Provisions for the Wildlife Act:	255
9.12.2 Need for the Wildlife Protection Act:	255
9.12.3 Constitutional Mandate for Forest Conservation:.....	256
9.13 Nature Reserves:.....	256
9.14 Tribal Populations and Rights:.....	257
9.14.1 Tribal Population in India:.....	257
9.15 Human Wildlife Conflicts in Indian Context:.....	260
9.15.1 Contributing Factors to Human-Wildlife Conflict:.....	260
9.15.2 Recent Findings on Human-Animal Conflict:.....	260
9.15.3 Steps to Mitigate Human-Wildlife Conflict:	261
9.15.4 Measures to Mitigate Human-Wildlife Conflict:.....	262

Reference263



ABOUT THE AUTHORS



Dr. Ragini Chintaman Patil, M.Sc., Ph.D. presently working as an Assistant Professor in the Department of Chemistry, Rashtrapita Mahatma Gandhi Arts, Commerce and Science College Saoli, Dist- Chandrapur Maharashtra- 441225 India. She has obtained M.Sc. in Chemistry (Organic Chemistry) and Ph.d.in Chemistry from Rashtrasant Tukdoji Maharaj Nagpur University,

Nagpur, Maharashtra, India. Imparting Knowledge in the field of chemistry from last 16 years to postgraduate graduate and engineering college students. Her research area of interest includes Material Science, Nanomaterial, heterocyclic Chemistry, Polymer Chemistry and Industrial waste treatment methodology. She delivered Lectures as Resource person in Four National Conferences in the field of Chemistry and Research. She has awarded as “Young Researcher Award 2024”. She has published 02 International Patent, 01 National Patent, 03 Books and 15 research papers/ article in International and National Journals and published book chapter. She has participated in workshops and attended national and international state level webinars. She also presented research paper at National and International conferences. She is also recognized Ph.D. Supervisor and guiding 2 Students for their Phd. at Gondwana University, Gadchiroli, Maharashtra India.



Dr. Kiran Ramrao Borkar, M.Sc. B.Ed, PhD. Presently working as Assistant Professor at Department of Zoology, Rashtrapita Mahatma Gandhi Art, Commerce and Science College, Saoli, MH, India. She has teaching experience at graduate and postgraduate levels. She has obtained M.Sc. in Zoology and Ph.D from Rashtrasant Tukdoji Maharaj Nagpur University. She

has published research papers in national and international journals.



Kripa-Drishti Publications

A-503 Poorva Heights, Pashan-Sus Road, Near Sai Chowk,

Pune - 411021, Maharashtra, India.

Mob: +91 8007068686

Email: editor@kdpublishations.in

Web: <https://www.kdpublishations.in>

Price: ₹ 599

ISBN: 978-81-968394-1-3



9 788196 839413