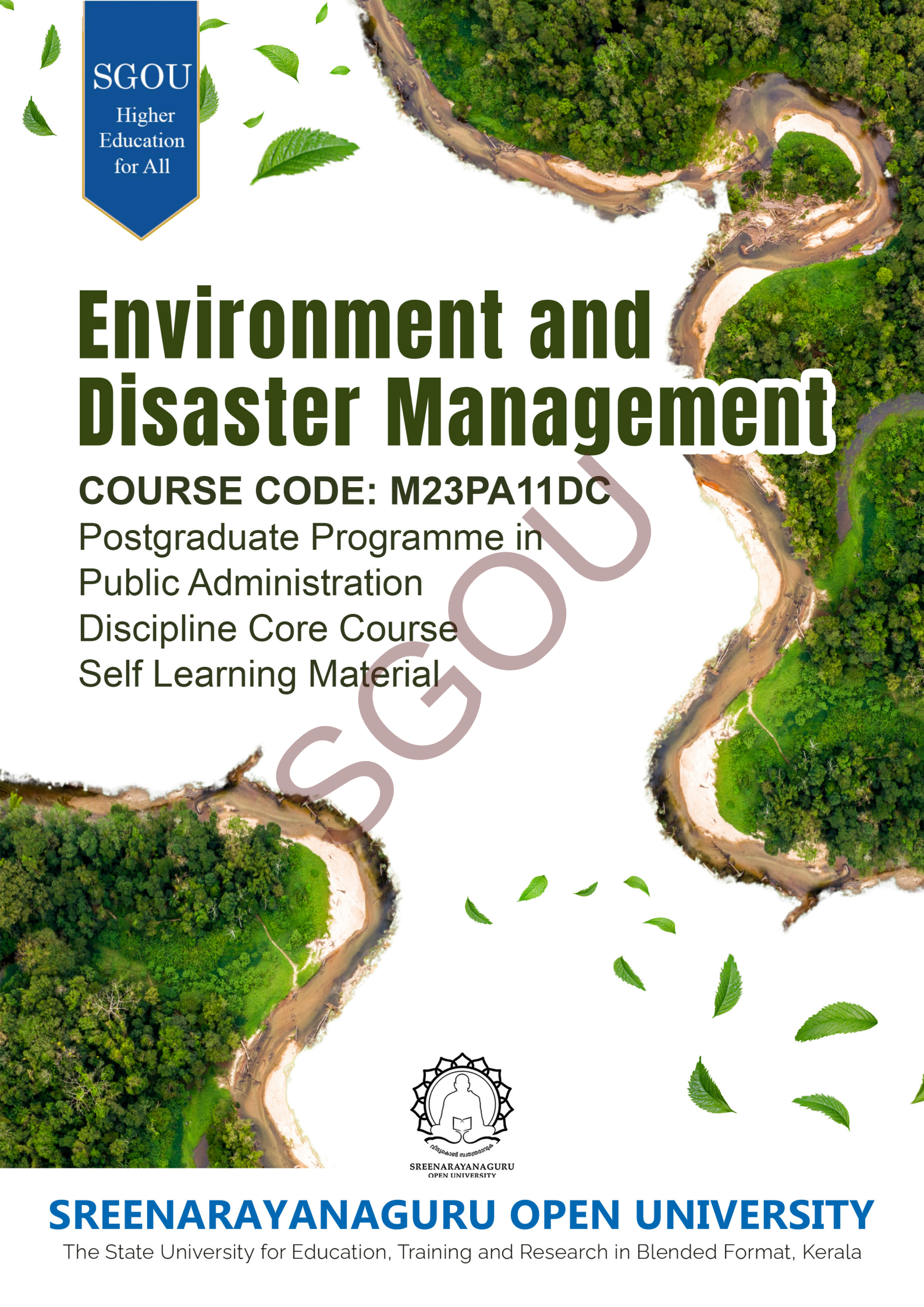




**SGOU**  
Higher  
Education  
for All

# Environment and Disaster Management

**COURSE CODE: M23PA11DC**

Postgraduate Programme in  
Public Administration  
Discipline Core Course  
Self Learning Material



SREENARAYANAGURU  
OPEN UNIVERSITY

**SREENARAYANAGURU OPEN UNIVERSITY**

The State University for Education, Training and Research in Blended Format, Kerala

# SREENARAYANAGURU OPEN UNIVERSITY

## Vision

*To increase access of potential learners of all categories to higher education, research and training, and ensure equity through delivery of high quality processes and outcomes fostering inclusive educational empowerment for social advancement.*

## Mission

To be benchmarked as a model for conservation and dissemination of knowledge and skill on blended and virtual mode in education, training and research for normal, continuing, and adult learners.

## Pathway

Access and Quality define Equity.

# **Environment and Disaster Management**

**Course Code: M23PA11DC**

**Semester - IV**

**Discipline Core Course**  
**Postgraduate Programme in Public Administration**  
**Self Learning Material**  
**(With Model Question Paper Sets)**



**SREENARAYANAGURU**  
**OPEN UNIVERSITY**

**SREENARAYANAGURU OPEN UNIVERSITY**

The State University for Education, Training and Research in Blended Format, Kerala



# ENVIRONMENT AND DISASTER MANAGEMENT

Course Code: M23PA11DC

Semester- IV

Discipline Core Course

Postgraduate Programme in Public Administration

## Academic Committee

Dr. R. Girish Kumar  
Prof. M.R. Biju  
Dr. Josukutty C. A.  
Dr. Sandhya S. Nair  
Dr. Devi Parvathy  
Dr. Ajitha S.  
Dr. Salim N.  
Dr. Ronnie Thomas  
Dr. Asha lekshmi B.S.  
Binu P.L.  
Dr. Asha T Rajan

## Development of the Content

Akhila A.K.

## Review and Edit

Dr. Salim N.

## Linguistics

Reshma R.

## Scrutiny

Akhila A.K.  
Dr. Muhammed Shabeer K.

## Cover Design

Jobin J.

## Co-ordination

Director, MDCC :  
Dr. I.G. Shibi  
Asst. Director, MDCC :  
Dr. Sajeekumar G.  
Coordinator, Development:  
Dr. Anfal M.  
Coordinator, Distribution:  
Dr. Sanitha K.K.



Scan this QR Code for reading the SLM  
on a digital device.

Edition  
February 2026

Copyright  
© Sreenarayanaguru Open University

ISBN 978-81-998069-9-3



All rights reserved. No part of this work may be reproduced in any form, by mimeograph or any other means, without permission in writing from Sreenarayanaguru Open University. Printed and published on behalf of Sreenarayanaguru Open University by Registrar, SGOU, Kollam.

[www.sgou.ac.m](http://www.sgou.ac.m)



Visit and Subscribe our Social Media Platforms



Dear learner,

I extend my heartfelt greetings and profound enthusiasm as I warmly welcome you to Sreenarayanaguru Open University. Established in September 2020 as a state-led endeavour to promote higher education through open and distance learning modes, our institution was shaped by the guiding principle that access and quality are the cornerstones of equity. We have firmly resolved to uphold the highest standards of education, setting the benchmark and charting the course.

The courses offered by the Sreenarayanaguru Open University aim to strike a quality balance, ensuring students are equipped for both personal growth and professional excellence. The University embraces the widely acclaimed "blended format," a practical framework that harmoniously integrates Self-Learning Materials, Classroom Counseling, and Virtual modes, fostering a dynamic and enriching experience for both learners and instructors.

The University aims to offer you an engaging and thought-provoking educational journey. The MA programme in Public Administration provides an in-depth understanding of modern governance challenges and solutions. It integrates cutting-edge theory with real-world applications, emphasizing innovative approaches to public service delivery. The curriculum spans strategic planning, policy analysis, public sector economics, and governance-related spheres. Through these, learners cultivate advanced problem-solving and decision-making skills. This programme also equips future leaders to drive positive change in public institutions, NGOs, and international bodies. The Self-Learning Material has been meticulously crafted, incorporating relevant examples to facilitate better comprehension.

Rest assured, the university's student support services will be at your disposal throughout your academic journey, readily available to address any concerns or grievances you may encounter. We encourage you to reach out to us freely regarding any matter about your academic programme. It is our sincere wish that you achieve the utmost success.



Regards,  
Dr. Jagathy Raj V.P.

01-02-2026

## Contents

|                                  |                                                            |            |
|----------------------------------|------------------------------------------------------------|------------|
| <b>Block 01</b>                  | <b>Environmental Management</b>                            | <b>1</b>   |
| Unit 1                           | Introduction to Environmental Management                   | 2          |
| Unit 2                           | Environmental Problems                                     | 29         |
| Unit 3                           | Environmental Protection and Strategies                    | 52         |
| <b>Block 02</b>                  | <b>Environment Laws and Planning in India</b>              | <b>82</b>  |
| Unit 1                           | Environmental Policy and Governance                        | 83         |
| Unit 2                           | Environmental Management: Planning and Control             | 110        |
| Unit 3                           | Regulatory Strategies                                      | 134        |
| <b>Block 03</b>                  | <b>Disaster Management Framework</b>                       | <b>163</b> |
| Unit 1                           | Disaster Management – An Introduction                      | 164        |
| Unit 2                           | Disasters – Classification                                 | 184        |
| Unit 3                           | Disaster Administration and Legislation                    | 202        |
| <b>Block 04</b>                  | <b>Disaster Response and Rehabilitation</b>                | <b>228</b> |
| Unit 1                           | Disaster Preparedness and Risk Reduction                   | 229        |
| Unit 2                           | Disaster Management: Recovery and Rehabilitation           | 254        |
| Unit 3                           | Recent Trends and Social Dimensions in Disaster Management | 273        |
| <b>Model Question Paper Sets</b> |                                                            | <b>292</b> |



# **BLOCK 1**

## **Environmental Management**

# UNIT 1

## Introduction to Environmental Management

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ define and explain the concept, meaning, and scope of environmental management
- ▶ explain the significance of environmental management
- ▶ trace the evolution of environmental management
- ▶ identify and discuss major global milestones and institutional developments that shaped environmental management policies
- ▶ explain the concept and principles of environmental ethics

### Background

The environment forms the very foundation of human existence. Every breath we take, every drop of water we drink, and every grain of food we eat depends on the delicate balance of natural systems around us. Yet, in the modern era of rapid industrialization, urbanization, and technological advancement, this balance is increasingly under strain. Environmental management, therefore, has emerged as one of the most vital responsibilities of governance and public policy, a bridge between human progress and ecological preservation.

This unit, aims to help learners understand how societies can develop and prosper without compromising the planet's health. It begins by explaining the concept, definition, and scope of environmental management, clarifying that it is not merely about pollution control or conservation, but about managing human–environment interactions to ensure sustainability. Environmental management involves planned and coordinated efforts to protect natural resources, regulate human activities, and create systems that support both development and ecological integrity. It is both a science and an art, the science of understanding ecosystems and the art of making informed



administrative and policy decisions that respect nature's limits.

The significance of environmental management lies in its ability to connect environmental protection with effective governance. In public administration, it helps translate environmental policies into practical actions through planning, regulation, and community participation. Administrators play a crucial role in ensuring that development projects consider environmental impacts, laws are enforced fairly, and citizens are engaged in creating a sustainable society. Thus, environmental management is central to achieving good governance, ethical policy-making, and sustainable development goals.

This unit provides the foundation for understanding how environmental protection, administrative action, and ethical responsibility come together in shaping sustainable futures. It invites learners to think critically about the balance between human needs and environmental limits, preparing them to approach the study of environmental management not as an abstract subject, but as a deeply human endeavor rooted in care, justice, and shared responsibility.

## Keywords

Sustainable Development, Natural Resource Management, Environmental Policy, Ecosystem Balance, Environmental Impact Assessment (EIA), Environmental Ethics

## Discussion

### 1.1.1 Introduction

#### Concept and Meaning of Environmental Management

#### ► Environmental management

Environmental management has become one of the most significant dimensions of modern governance, reflecting the recognition that human survival and progress are inseparable from the health of the natural environment. In simple terms, it refers to the systematic process of conserving and wisely using natural resources to ensure that development activities remain within the regenerative capacity of nature. It encompasses all efforts to prevent, control, and mitigate environmental degradation while advancing the broader goal of sustainable development.

At its core, environmental management is based on the understanding that the environment is not an unlimited source



► Environment is not an unlimited source of resources

of resources. Human society depends on natural systems such as air, water, soil, forests, and biodiversity, which provide essential goods and services necessary for life. When these systems are disrupted by overexploitation, pollution, or unplanned development, it endangers ecological balance and human well-being alike. Therefore, environmental management involves both scientific assessment and administrative coordination to maintain harmony between human needs and environmental limits.

► Institutionalising Environmental Management

In practice, environmental management is implemented through mechanisms such as Environmental Impact Assessment (EIA), pollution control measures, resource conservation initiatives, and programmes for environmental education and awareness. It also includes formulating and implementing environmental policies and laws, as well as continuous monitoring of environmental standards at national and international levels. The establishment of the Ministry of Environment, Forest and Climate Change (MoEFCC) in India, for example, reflects how environmental management has been institutionalized within the administrative system.

From an academic perspective, environmental management may be viewed as a process of managing interactions between humans and the environment through the principles of sustainability, precaution, and equity. It is not confined to technical expertise alone but also involves ethical, political, and social dimensions, since environmental decisions directly influence communities, economies, and future generations.

### **Importance of Environmental Management in Public Administration**

► Addressing environmental concerns

Public administration, as the instrument through which government policies and programmes are executed, plays a pivotal role in addressing environmental concerns at local, national, and global levels. The growing understanding that environmental problems are essentially administrative challenges; requiring coordination, regulation, and citizen participation makes this field central to contemporary governance.

To begin with, environmental management is critical for effective policy formulation and implementation. Public administrators translate environmental policies into actionable programmes through planning, budgeting, regulation,

► Effective policy formulation and implementation

and monitoring. Policy frameworks such as the National Environment Policy (2006) and laws such as the Environment (Protection) Act, 1986 highlight the importance of robust administrative systems to ensure compliance and enforcement.

► Maintain environmental standards

Secondly, environmental management strengthens regulation and accountability within governance systems. Administrators enforce pollution control standards, issue environmental clearances for industries, and oversee environmental impact assessments. Institutions such as the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) function under administrative supervision to maintain environmental standards. Thus, environmental management becomes an integral part of administrative responsibility and ethical governance.

► Judicious use of natural resources

Thirdly, it promotes the judicious use of natural resources. Public administrators are entrusted with the sustainable management of resources such as forests, water bodies, and land through mechanisms like integrated watershed management and sustainable forestry programmes. This role becomes particularly crucial in developing countries like India, where rapid industrialization and urban expansion place immense pressure on natural systems.

► Prevent crises and enhance community resilience.

Moreover, disaster and risk management is closely linked to environmental administration. Poor environmental practices often lead to floods, droughts, landslides, and other disasters that require immediate administrative response. Therefore, environmental considerations must be embedded in development planning to prevent such crises and enhance community resilience.

► Public awareness and citizen participation

Finally, public awareness and citizen participation form the ethical foundation of environmental governance. The state alone cannot achieve sustainability unless citizens are informed, engaged, and cooperative. Administrators play a vital role in facilitating environmental education, community-based initiatives, and participatory mechanisms such as local environmental committees and citizen monitoring groups.

In essence, environmental management in public administration acts as a bridge between policy intent and practical sustainability. It ensures that developmental efforts are ecologically responsible, socially inclusive, and ethically grounded.



## Interrelationship between Environment, Development, and Governance

The interrelationship between the environment, development, and governance is complex yet inseparable. These three dimensions influence one another and collectively determine the course of sustainable growth and human welfare.

The environment forms the physical and biological foundation of all life. Elements such as air, water, land, forests, and minerals are indispensable for economic and social activities. However, development pursued without environmental consideration often results in pollution, resource depletion, and ecological imbalance. Therefore, development must be designed to ensure both economic progress and environmental protection.

► Sustainable development

► Scientifically informed, ethically justified, and socially inclusive decisions

► Interdependence

► Environmental protection as a shared civic responsibility

Governance serves as the framework through which the interaction between environment and development is regulated. It comprises the institutions, systems, and processes that guide the decision-making and implementation of environmental policies. Effective environmental governance is characterized by transparency, accountability, participation, and adherence to the rule of law. It ensures that decisions are scientifically informed, ethically justified, and socially inclusive.

This interdependence is evident in various practical contexts. For example, in industrial expansion, governance determines how industries comply with environmental norms, development policies stimulate economic growth, and environmental management ensures that resource use and pollution levels remain within sustainable limits. Similarly, in urban planning, governance structures must integrate environmental considerations such as waste management, water conservation, and the creation of green spaces within developmental strategies.

In India, this interconnectedness is reflected in constitutional mandates such as Article 48A (Directive Principles of State Policy), which directs the State to protect and improve the environment, and Article 51A(g), which makes it a fundamental duty of every citizen to safeguard the natural environment. These provisions underline that environmental protection is not only a scientific concern but also a governance priority and a shared civic responsibility.

Thus, sustainable development can be realized only when



- Integrating environmental concerns into development planning

governance mechanisms successfully integrate environmental concerns into development planning. This triadic relationship environment, development, and governance forms the conceptual foundation of environmental management in public administration. It reminds us that effective administration must pursue not only efficiency and growth but also ecological integrity and intergenerational equity.

## 1.1.2 Definition and Scope of Environmental Management

- Sustainable balance between human progress and ecological stability

Environmental management has been understood both as an academic discipline and as a practical framework for guiding human interaction with the natural world. Scholars view it as a broad, evolving field dedicated to maintaining a sustainable balance between human progress and ecological stability. According to C. J. Barrow, environmental management is “a wide, expanding, and rapidly evolving field which concerns all humans and plays a crucial role in the quest for sustainable development.” It extends beyond pollution control and resource conservation, encompassing the management of all human activities that directly or indirectly affect the environment.

- Regulating human interactions with nature to prevent environmental degradation

In essence, environmental management is the systematic process of regulating human interactions with nature to prevent environmental degradation, promote sustainability, and enhance the quality of life. It involves a coordinated set of activities: planning, policy formulation, regulation, and monitoring, that ensure developmental efforts remain consistent with ecological limits. This interpretation highlights that environmental management is not merely a scientific or technical pursuit; it is equally a social, ethical, and administrative function that integrates environmental priorities into governance and public policy.

- Coordinated use of human and environmental resources

Another perspective views environmental management as the coordinated use of human and environmental resources to achieve developmental objectives without compromising the natural balance. This approach emphasizes anticipation and prevention rather than reaction and correction. In this sense, environmental management functions as a proactive system of governance, focused on prediction, precaution, and sustainable adaptation to emerging environmental challenges.





## Objectives of Environmental Management

The objectives of environmental management arise from the fundamental need to maintain harmony between development and the natural environment. These objectives are both preventive and developmental in nature, ensuring that human progress is aligned with ecological sustainability.

### ► Objectives

- Protection and Improvement of Environmental Quality – To safeguard air, water, and soil from pollution and degradation through scientific, legislative, and administrative interventions.
- Sustainable Utilization of Natural Resources – To ensure that both renewable and non-renewable resources are used judiciously to meet present needs without compromising the ability of future generations to meet theirs.
- Integration of Environmental Considerations in Development – To incorporate environmental concerns into economic, industrial, and infrastructural planning and policymaking processes.
- Prevention and Mitigation of Environmental Hazards – To anticipate, reduce, and manage the risks arising from natural and human-induced disasters such as floods, droughts, landslides, and industrial accidents.
- Promotion of Environmental Awareness and Participation – To encourage education, public awareness, and citizen involvement in environmental decision-making and stewardship.
- Conservation of Biodiversity and Ecosystem Balance – To protect species, habitats, and ecological processes that sustain life on Earth.

Ultimately, the overarching goal of environmental management is to ensure that human development is environmentally sustainable, socially just, and economically viable.

## Scope and Dimensions of Environmental Management

The scope of environmental management is wide-ranging and interdisciplinary, cutting across scientific, administrative,

► Sustainable progress by aligning developmental activities with ecological preservation

economic, social, and ethical dimensions. It provides the foundation for sustainable progress by aligning developmental activities with ecological preservation. As Barrow (1999) observes, its scope “extends beyond the short term, ranges from local to global, and integrates science, policy, and planning.”

The following dimensions outline the major components of environmental management:

- **Natural Resource Management**

► Planned and scientific use of resources

Natural Resource Management (NRM) lies at the heart of environmental management. It refers to the planned and scientific use of resources such as land, water, forests, minerals, and energy to maintain ecological balance and ensure their long-term availability. Effective NRM requires a combination of ecological knowledge, technological tools, and participatory governance. It includes activities such as watershed management, forest conservation, soil preservation, and water harvesting.

In India, initiatives such as the National Afforestation Programme and Integrated Watershed Management exemplify administrative efforts to promote sustainable livelihoods and ecosystem resilience.

- **Pollution Control and Prevention**

► Regulatory mechanisms and preventive approaches

Pollution control and prevention form another core dimension of environmental management. Their purpose is to reduce or eliminate pollutants that threaten the quality of air, water, and soil. This involves both regulatory mechanisms such as emission standards, effluent treatment, and waste management and preventive approaches, such as cleaner production methods and renewable energy use.

► Enforcing Pollution control

Pollution control is enforced through institutions such as the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs). Tools such as Environmental Impact Assessment (EIA) and environmental auditing ensure compliance with established norms. Modern approaches increasingly stress pollution prevention rather than post-facto control, focusing on innovation, industrial responsibility, and eco-friendly technologies that minimize waste at the source.



- **Environmental Planning and Policy**

► Providing direction, coordination, and a legal foundation for implementing environmental objectives

Environmental planning and policy form the strategic dimension of environmental management, providing direction, coordination, and a legal foundation for implementing environmental objectives across administrative levels. Environmental planning integrates ecological concerns into regional and sectoral development plans, ensuring that projects are environmentally sustainable. Policy frameworks such as India's National Environment Policy (2006) and global initiatives like the Paris Climate Accord (2015) illustrate the significance of this dimension.

► Ecological protection with economic growth

Public administrators play a key role in formulating, implementing, and evaluating environmental policies through participatory processes. Environmental planning also involves land-use regulation, zoning, and conservation strategies designed to balance ecological protection with economic growth. Through such mechanisms, environmental planning and policy transform sustainability principles into tangible administrative action, connecting scientific insight with policy implementation.

- **Sustainable Development and Conservation**

► Sustainable environmental management

Sustainable development represents the core philosophy of environmental management. It advocates development that meets present needs without compromising the ability of future generations to meet their own needs. Conservation, as a component of this approach, focuses on protecting biodiversity, ecosystem processes, and natural capital. Environmental management translates this philosophy into practice through long-term planning, resource-efficient technologies, and institutional reforms. Conservation measures such as protected areas, wildlife sanctuaries, biosphere reserves, and afforestation are implemented within administrative frameworks that encourage local community participation. Global initiatives like Agenda 21 (1992) and the Sustainable Development Goals (2015) reinforce the integration of conservation and development, requiring coordinated efforts among governments, scientific institutions, and civil society.

- **Environmental Education and Awareness**

Environmental education and awareness represent the social and ethical dimension of environmental management. They

- Social and ethical dimension of environmental management

aim to create an informed, responsible, and proactive citizenry capable of understanding and addressing environmental challenges. Environmental education fosters values such as stewardship, conservation, and intergenerational responsibility. Programmes like the National Environmental Awareness Campaign (NEAC) in India have played a pivotal role in mobilizing communities and educational institutions toward environmental protection.

- Shared social commitment

Administratively, public communication strategies, school curricula, and mass media campaigns are used to disseminate knowledge about issues such as climate change, waste management, and energy efficiency. The participation of NGOs, academic institutions, and local governments further strengthens this participatory model. Ultimately, awareness and education ensure that environmental management extends beyond laws and policies to become a shared social commitment rooted in understanding, responsibility, and collective action.

- Translating environmental goals into rules and programmes.

### 1.1.3 Significance of Environmental Management

#### Importance in Policy and Administrative Context

Environmental management occupies a central place in modern public policy, as environmental risks and opportunities intersect with nearly every sector of governance. Policymakers and administrators are responsible for translating broad environmental goals into practical rules, programmes, and institutional frameworks that shape behaviour and assign responsibilities. In operational terms, this involves designing regulatory frameworks for instance, emission and effluent standards reating agencies to implement and monitor these rules, incorporating environmental criteria into budgeting and project evaluation, and ensuring coordination among ministries such as energy, industry, agriculture, and urban development.

Effective environmental management thus transforms normative aspirations such as clean air, safe water, and protected ecosystems into enforceable administrative actions, bridging the gap between policy intentions and on-the-ground implementation.

A strong administrative emphasis on environmental management also helps to develop institutional and procedural capacities. This includes systems for environmental quality monitoring, formalized Environmental Impact Assessment





- Detect, address and prevent environmental damage

(EIA) procedures, licensing and inspection regimes, and mechanisms for public participation and grievance redressal. These processes enhance transparency and accountability, allowing governments to detect, address, and prevent environmental damage before it becomes irreversible.

## Role in Sustainable Development and Human Welfare

- Harmonizing present socio-economic objectives with the long-term needs of future generations

Environmental management is indispensable for sustainable development, as it harmonizes present socio-economic objectives with the long-term needs of future generations. Sustainable development requires that material progress; economic growth, infrastructure, and employment, be achieved without depleting the ecological assets and services upon which all societies depend. Environmental management operationalizes this principle by integrating ecological limits into planning and project design. This includes practices such as natural resource accounting, adopting resource-efficient technologies, and avoiding development pathways that create long-term ecological debt.

- Environmental management for human welfare

From the perspective of human welfare, environmental management safeguards public health, livelihoods, and overall quality of life. Clean air and water, fertile soils, stable local climates, and functioning ecosystems are essential foundations for food security, disease prevention, and economic resilience. By protecting these environmental preconditions, environmental management directly contributes to poverty alleviation, social stability, and community well-being, particularly for populations most vulnerable to environmental stress and climate change.

## Economic, Social, and Ecological Significance

Environmental management generates wide-ranging benefits across three interrelated dimensions: economic, social, and ecological.

- Minimise economic loss

**Economic Significance:** Sound environmental management minimises economic losses from pollution, disasters, and resource depletion. It promotes the efficient use of inputs such as energy, water, and raw materials, encourages innovation in green technologies, and opens new markets in renewable energy and waste recycling. By preventing environmental degradation that would otherwise require costly restoration, it preserves the natural capital base on which future economic activities depend.

► Reduce conflicts and promote inclusion

**Social Significance:** On the social front, environmental management promotes equitable access to natural resources, reducing conflicts over land, water, and other environmental goods. When implemented through participatory approaches, it ensures inclusion of local communities and marginalized groups in resource-use decisions. Environmental education and participatory governance strengthen civic responsibility and build social capital, making communities more resilient and cohesive.

► Maintain the resilience of ecosystem

**Ecological Significance:** Ecologically, environmental management ensures the maintenance of ecosystem functions, including nutrient cycling, pollination, water purification, and habitat provision, that support both natural and human systems. Conservation and restoration efforts, combined with pollution control measures, protect biodiversity and maintain the resilience of ecosystems against threats such as extreme weather, pest outbreaks, and disease epidemics.

Taken together, these dimensions demonstrate that environmental management is not an optional policy concern but a foundational pillar of long-term prosperity, equity, and ecological stability.

### Environmental Management and Public Administration Interface

► Mainstreaming environmental concerns

The interface between environmental management and public administration represents the point where abstract sustainability goals are converted into operational instruments, institutions, and day-to-day administrative practices. Public administrators play a key role in mainstreaming environmental concerns across sectoral policies such as integrating water resource management into agricultural planning or environmental safeguards into industrial development.

► Key tasks

This interface involves establishing data and reporting systems, creating incentive structures such as subsidies, taxes, and procurement rules that promote environmentally responsible behaviour, and ensuring coherence among different departments and levels of government. Key administrative tasks include: drafting clear and enforceable regulations, setting measurable environmental performance indicators, strengthening institutional capacity within government bodies, promoting interagency coordination to address cross-sectoral challenges, and facilitating stakeholder



engagement to align policy decisions with both scientific evidence and social values.

The success of environmental management, therefore, depends mainly on administrative design that is, how institutions are structured, how responsibilities are distributed, and how implementation is monitored, evaluated, and improved over time.

### The Role of Environmental Management in Achieving Global Goals (e.g., SDGs)

► Sustainable Development Goals

Environmental management plays a direct and enabling role in achieving several of the United Nations Sustainable Development Goals (SDGs) and indirectly supports many others. Goals such as SDG 6 (Clean Water and Sanitation), SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land) explicitly depend on environmental management through actions such as pollution control, biodiversity conservation, and the sustainable use of natural resources. Simultaneously, effective environmental management advances goals such as SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), and SDG 8 (Decent Work and Economic Growth) by preserving ecosystem services and reducing environmental risks that disproportionately affect the poor.



Figure 1.1.1 Sustainable Development goals

- Tailoring global objectives to national content

At the global level, environmental management serves as the mechanism through which international commitments; treaties, conventions, and declarations are translated into national strategies and policies. It enables countries to meet obligations related to emissions reduction, biodiversity conservation, and sustainable resource management while tailoring global objectives to national contexts.

## 1.1.4 Evolution of Environmental Management

### Early Human–Environment Relationships

- Adaptive practices that maintained a dynamic balance with nature.

Human existence has always been rooted in and dependent upon natural systems. Early human societies organized their livelihoods around local ecosystems, engaging in hunting, gathering, shifting cultivation, pastoralism, and small-scale agriculture; all activities closely aligned with seasonal cycles and regional biodiversity. These early interactions were guided by traditional knowledge and adaptive practices that maintained a dynamic balance with nature.

- Renewable resources

Resource use during this period was predominantly local, renewable, and regulated by community-based institutions such as customs, taboos, and communal rules that helped prevent overexploitation. These informal governance systems reflected an understanding of ecological limits, even if not expressed in modern scientific terms.

- Limited and socially regulated impacts

However, pre-industrial societies were not entirely free from environmental impacts. Localized problems such as soil exhaustion or deforestation did occur as agriculture expanded. The key difference between these early interactions and later developments lies in scale and intensity: early impacts were limited and socially regulated, whereas subsequent technological and demographic changes greatly magnified human pressure on ecosystems.

### The Industrial Revolution and Environmental Degradation

- Transformation in human–environment relations

The Industrial Revolution of the late 18th and 19th centuries marked a profound transformation in human–environment relations. The advent of fossil-fuel-based energy systems, mechanized production, urbanization, and large-scale resource extraction generated unprecedented economic growth, but it also introduced new and widespread forms of environmental





degradation.

Industrial activity led to air and water pollution, deforestation, soil erosion, and mounting urban waste, giving rise to persistent, cumulative, and systemic environmental problems. Two defining characteristics emerged during this era:

► Organized institutional responses

1. Scale – Environmental impacts extended across regions and sectors, transcending local boundaries.
2. Complexity – Environmental harm became intertwined with economic systems, technological processes, and patterns of social change.

As a result, environmental challenges could no longer be addressed through traditional community norms or isolated local action. They now required organized institutional responses, regulatory frameworks, and administrative mechanisms capable of managing problems at national and international levels.

### **Emergence of Environmental Awareness in the 20th Century**

► Isolated scientific findings to a global political and social movement

During the 20th century, environmental concern evolved from isolated scientific findings to a global political and social movement. Scientific research revealed the ecological limits of growth and the unintended consequences of industrialization manifested in issues such as air pollution, water contamination, and biodiversity loss.

By the mid-20th century, these concerns merged with social activism, giving rise to public environmental awareness. Two developments were particularly significant in this process:

- Scientific synthesis – The emergence of disciplines such as ecology, conservation biology, and environmental chemistry provided robust evidence of long-term and cumulative environmental damage.
- Public mobilization – Mass communication and civil society movements amplified scientific findings and created pressure for policy reform.

A landmark event in this awakening was the publication of Rachel Carson's *Silent Spring* (1962), which exposed the ecological and health risks of pesticide use. The book inspired

► Debates on the environmental costs of industrial progress

widespread debate on the environmental costs of industrial progress and helped catalyze environmental movements worldwide. This period marked the beginning of environmental management as a structured field of policy and governance, emphasizing the need to reconcile technological advancement with ecological sustainability.

### Global Milestones in Environmental Thought and Action

The latter half of the 20th century witnessed a series of global milestones that institutionalized environmental concerns within international and national policy frameworks.

► The Environmental Movements of the 1960s

The 1960s saw the rise of organised environmental movements worldwide. Citizens, scientists, and activists mobilized around issues such as air and water pollution, excessive pesticide use, and the loss of natural habitats. These movements helped place environmental protection firmly on the political and administrative agenda, creating strong public constituencies that demanded legislative action and government accountability.

► The 1972 Stockholm Conference

A major turning point in global environmental governance came with the United Nations Conference on the Human Environment held in Stockholm in 1972. It was one of the first international forum to acknowledge environmental protection as a shared global responsibility, laying the intellectual and moral foundation for future environmental action. The conference resulted in the Stockholm Declaration, which articulated guiding principles for environmental management and sustainable development, and it also led to the creation of the United Nations Environment Programme (UNEP), recognising the need for coordinated global cooperation and institutional support.

► Global architecture of environmental governance

The momentum generated at Stockholm paved the way for subsequent global milestones. The Montreal Protocol of 1987, which remains one of the most successful international agreements, united countries to phase out ozone-depleting substances. Later, the Kyoto Protocol of 1997 marked another significant milestone by committing nations to legally binding targets to reduce greenhouse gas emissions. Together, these developments strengthened the global architecture of environmental governance and demonstrated an evolving commitment to integrating environmental concerns into development planning.



► The Rise of Environmental Institutions and Policies

In the years following the Stockholm Conference, many nations introduced comprehensive environmental legislation and established specialized regulatory agencies such as pollution control boards and environmental protection authorities. These institutions formalised practices such as Environmental Impact Assessment (EIA) and established systems for monitoring, compliance, and enforcement.

At the international level, several landmark events further deepened the environmental discourse:

► Other Milestones

- The 1987 Brundtland Commission Report (*Our Common Future*) introduced and popularized the concept of sustainable development, emphasizing intergenerational equity.
- The 1992 Rio Earth Summit advanced principles of global cooperation through Agenda 21 and conventions on climate change and biodiversity.
- The 2015 Sustainable Development Goals (SDGs) reaffirmed environmental sustainability as a central pillar of global development.

► Governance based practice

These milestones collectively transformed environmental management from an ad hoc control mechanism into a systemic, governance-based practice that operates across local, national, and global levels. They redefined the role of states, institutions, and citizens in safeguarding the planet's ecological integrity.

### 1.1.4.1 Evolution of Environmental Administration in India

India's environmental administration has evolved gradually, shaped by domestic priorities, socio-economic pressures, and international environmental developments. Over time, the country has built a comprehensive framework of constitutional principles, legislative measures, and institutional mechanisms to address its diverse and complex environmental challenges.

- **Constitutional Provisions and Legislative Framework**

Environmental protection in India received constitutional recognition through both the Directive Principles of State Policy and the Fundamental Duties of citizens.

- Article 48A of the Constitution (Directive Principles of State Policy) directs the State to “protect and improve the environment and to safeguard the forests and wildlife of the country.”
- Article 51A(g) (Fundamental Duties) enjoins every citizen “to protect and improve the natural environment, including forests, lakes, rivers, and wildlife, and to have compassion for living creatures.”

► Environmental protection is not only a governmental responsibility but also a civic duty

Together, these provisions provided the normative foundation for subsequent administrative, legal, and policy actions, reflecting that environmental protection is not only a governmental responsibility but also a civic duty.

From the 1970s onwards, India developed a strong legislative framework to institutionalize environmental governance. The most significant of these statutes is the Environment (Protection) Act, 1986, which empowered the central government to take comprehensive measures to protect and improve the environment.

Other landmark legislations include:

- The Wildlife (Protection) Act, 1972 – providing for the protection of endangered species and the establishment of national parks and sanctuaries.
- The Water (Prevention and Control of Pollution) Act, 1974, focused on preventing and controlling water pollution through the creation of central and state boards.
- The Air (Prevention and Control of Pollution) Act, 1981 – aimed at regulating and reducing air pollution through similar institutional mechanisms.
- The Forest (Conservation) Act, 1980 – restricting the diversion of forest land for non-forest purposes without central approval.

► Legislative framework

In addition to these statutes, the National Environmental Policy (2006) provided a comprehensive policy framework that sought to integrate environmental concerns into all stages of development planning and decision-making.





## • Institutional Developments and Policy Shifts

India's environmental administration developed gradually, gaining institutional clarity and strength over several decades. The momentum began in 1972, following the United Nations Conference on the Human Environment in Stockholm, which encouraged countries to establish dedicated environmental institutions. In India, this led to the creation of the Department of Environment in 1980, marking the first formal step toward organising environmental policy and regulation within the Central Government. Earlier, in 1974, the Central Pollution Control Board (CPCB) and the State Pollution Control Boards were constituted under the Water (Prevention and Control of Pollution) Act to regulate water pollution and enforce environmental standards.

### ► Department of Environment

The institutional framework expanded significantly in 1985, when the Department of Environment was upgraded to the *Ministry of Environment and Forests (MoEF)*. This provided a dedicated national authority to frame policies, oversee legislation, coordinate regulatory agencies, and engage with international environmental commitments. The Bhopal gas disaster of 1984 further accelerated the strengthening of environmental regulation, leading to the enactment of the Environment (Protection) Act of 1986 and reinforcing the powers and responsibilities of pollution control boards.

### ► The Bhopal gas disaster

### ► Ministry of Environment, Forest and Climate Change

Reflecting India's growing engagement with global climate governance, the ministry was renamed the Ministry of Environment, Forest and Climate Change (*MoEFCC*) in 2014, signalling an expanded mandate that integrates climate change adaptation and mitigation into environmental administration.

### ► Integrative and participatory approach

Over the years, India's environmental administration evolved from a command-and-control regulatory model to a more integrative and participatory approach. This transformation was reflected in the introduction of Environmental Impact Assessment (EIA) procedures, Joint Forest Management (JFM) programmes, and community-based conservation initiatives that emphasized local participation and sustainable use of natural resources.

Policy priorities gradually expanded beyond pollution control to include broader issues such as:

- Biodiversity conservation and the protection of

► Policy priorities

- endangered species;
- Climate change mitigation and adaptation strategies;
- Sustainable livelihoods for forest-dependent and coastal communities;
- Mainstreaming environmental concerns into economic and development planning; and
- Alignment with international environmental commitments, including the Convention on Biological Diversity (1992) and the Paris Agreement (2015).

Through these developments, environmental administration in India has progressively matured into a multi-dimensional system that combines legal authority, administrative coordination, community participation, and global engagement. It represents a continuous effort to balance economic development with ecological responsibility within the framework of democratic governance.

## 1.1.5 Environmental Ethics

### 1.1.5.1 Concept and Meaning of Environmental Ethics

► Relationship between human beings and the natural world

Environmental ethics is a branch of applied ethics that examines the moral relationship between human beings and the natural world. It explores how humans ought to behave toward nature and what ethical principles should guide decisions that affect ecosystems, species, and natural resources. In simple terms, environmental ethics extends the boundaries of moral concern beyond human-to-human relations to include non-human entities such as animals, plants, and ecological systems.

► Transformation in human values and attitudes toward nature

The discipline emerged in the 1970s, coinciding with growing awareness of global environmental crises, including pollution, deforestation, species extinction, and climate change. Philosophers and environmental thinkers argued that these challenges could not be solved merely through technological or economic measures; they required a transformation in human values and attitudes toward nature. Environmental ethics, therefore, provides the moral foundation of environmental management, emphasising responsibility, respect, and justice toward the natural environment.

At its core, environmental ethics seeks to answer fundamental



moral questions such as:

- What duties do humans owe to other species and to future generations?
- Is nature valuable only for its utility to human beings, or does it possess intrinsic worth?
- How can societies balance economic growth with ecological preservation?

By addressing these questions, environmental ethics influences not only philosophy but also the ethical dimensions of public policy, governance, and sustainable development.

### Relationship between Ethics and Environmental Responsibility

► Ethical environmental responsibility

Ethics and environmental responsibility are deeply interconnected. Ethics provides the normative framework that defines what is right or wrong, while environmental responsibility translates those ethical principles into concrete action by individuals, institutions, and governments. Ethical awareness encourages decision-making that prioritizes long-term planetary well-being over short-term human gain.

► Humans are stewards of nature, not its absolute owners

Environmental responsibility arises from the recognition that humans are stewards of nature, not its absolute owners. This stewardship implies moral accountability for the consequences of human actions on ecological systems. Administratively, it requires decision-makers to consider intergenerational equity, the rights of non-human life, and the needs of vulnerable populations disproportionately affected by environmental degradation.

► Ethical commitment

For instance, sustainable waste management, forest conservation, and carbon reduction initiatives are not merely administrative tasks but expressions of ethical commitment. Likewise, policymakers who integrate environmental safeguards into development planning exemplify ethical governance, ensuring that environmental protection serves as a public good for present and future generations alike.

#### 1.1.5.2 Major Ethical Perspectives

Over time, several ethical perspectives have evolved to explain and guide the moral relationship between humans and nature. These perspectives differ in how they assign moral value

to the environment and in how they define the scope of moral responsibility.

### 1. Anthropocentric Approach

The anthropocentric (human-centered) approach views nature primarily through its value and utility to humans. According to this perspective, environmental protection is essential because it supports human survival, health, and welfare. This view is embedded in most policy and economic systems, where the environment is protected to ensure social stability and quality of life.

- Views nature primarily through its value and utility to humans

For example, air quality regulations or conservation programmes are often justified on the grounds that they benefit human communities. While anthropocentrism has been criticized for promoting instrumental use of nature, proponents argue that it offers a pragmatic and politically effective basis for mobilizing environmental action within human-centered societies. Hence, it continues to dominate environmental policy discourse.

### 2. Biocentric and Ecocentric Approaches

The biocentric approach extends moral consideration to all living beings, asserting that every form of life has intrinsic value, independent of its usefulness to humans. Humans, therefore, have an ethical duty to respect and preserve the well-being of other species. This perspective underlies conservation ethics and the animal rights movement, which stress compassion and non-injury toward all living forms.

- Consideration to all living beings

The ecocentric approach goes beyond individual life forms to value entire ecosystems and natural processes. It regards ecological wholes such as forests, rivers, and oceans—as morally significant entities whose integrity must be preserved. Ecocentrism views humans as integral components of, rather than masters over, the biosphere. It emphasizes maintaining ecological balance and biodiversity as moral imperatives, even where immediate human benefits are not evident.

- Value entire ecosystem and natural process

Together, these approaches promote a holistic ethical vision, focusing on the health and stability of the entire ecological system rather than isolated species or individual human interests.

### 3. Deep Ecology Perspective

The Deep Ecology movement, founded by Norwegian





► Every component of the biosphere has a moral right to exist and flourish

philosopher Arne Næss in the early 1970s, represents a radical rethinking of human–nature relations. It argues that all living beings possess equal intrinsic worth, and humans have no inherent right to dominate or exploit nature. Deep ecology promotes the idea of “biospheric egalitarianism,” where every component of the biosphere has a moral right to exist and flourish.

This philosophy calls for profound changes in human lifestyles and economic systems, emphasizing simplicity, harmony, and self-realization over consumerism and material growth. Although critics consider deep ecology idealistic and difficult to apply in policy contexts, it remains a powerful ethical and philosophical foundation for sustainability-oriented movements and ecological activism worldwide.

### 1.1.5.3 Environmental Ethics in Policy and Governance

► Ethical principles

Environmental ethics profoundly influences public policy and administrative governance. Ethical principles such as sustainability, justice, and stewardship are now embedded in both international and national frameworks. The Brundtland Report (1987) introduced the ethical principle of intergenerational equity, asserting that development should meet present needs without compromising future generations' ability to meet theirs. Similarly, the Rio Earth Summit (1992) and the Sustainable Development Goals (2015) integrate moral commitments to equity, participation, and ecological integrity.

► Moral, social, and ecological implications

In governance, environmental ethics guides policymakers and administrators to evaluate not only the economic feasibility of projects but also their moral, social, and ecological implications. Mechanisms such as Environmental Impact Assessments (EIAs), public consultations, and the “polluter pays” principle represent ethical principles institutionalised in administrative practice.

At the global level, principles like Common but Differentiated Responsibilities (CBDR) under the UN Framework Convention on Climate Change (UNFCCC) reflect moral fairness by recognizing unequal capacities and historical responsibilities among nations in addressing environmental problems. Thus, ethical reasoning provides the moral compass that shapes both domestic and international environmental governance.

#### 1.1.5.4 Role of Citizens, Administrators, and Institutions in Ethical Environmental Practices

Ethical environmental management is a shared responsibility among citizens, administrators, and institutions.

► Ethics-based environmental stewardship

- Citizens play a central role by practicing environmentally responsible behaviour—conserving resources, reducing waste, and participating in community-level conservation initiatives. Ethical citizenship involves understanding the global implications of local actions.
- Administrators act as custodians of public trust. Their duty is to integrate ethical principles into planning, lawmaking, and enforcement, ensuring transparency, accountability, and public participation in environmental decision-making.
- Institutions, including local governments, NGOs, educational bodies, and corporations, translate ethical commitments into policies, programmes, and operational standards. Academic institutions promote environmental ethics through education, while corporations contribute through corporate social responsibility (CSR) and sustainable business practices.

Ultimately, ethical environmental practice depends on a shared moral vision, one that recognizes the environment not as a commodity to be exploited, but as a community to which humans belong. Through this ethical consciousness, environmental management evolves from a mere administrative tool into a value-driven system of global stewardship that safeguards life in all its forms.



## Summarized Overview

Environmental management stands at the heart of our efforts to build a sustainable and equitable future. This unit introduced learners to the basic meaning, scope, and significance of environmental management, explaining how it functions as a bridge between human progress and the natural world. It is not just about protecting nature from harm but about managing human activities so that development remains within ecological limits. Through scientific understanding, administrative planning, and community participation, environmental management ensures that growth and conservation go hand in hand. The unit also traced the evolution of environmental management, showing how humanity's relationship with nature has transformed over time. From traditional, community-based practices to the complex systems of modern environmental governance, this evolution reflects a growing awareness that environmental protection must be a shared, institutionalised responsibility.

Finally, the discussion on environmental ethics highlighted the moral dimension of sustainability. It emphasised that protecting nature is not only a scientific or administrative concern but also an ethical duty. In essence, this unit helps learners understand that environmental management is both a practical framework and a moral commitment, an integrated effort to preserve the planet's balance while ensuring human well-being for generations to come.

## Self-Assessment

1. What is meant by environmental management?
2. What is the main goal of environmental management?
3. Mention one primary objective of environmental management.
4. Name one key component included within the scope of environmental management.
5. Which ministry is responsible for environmental administration in India?
6. Which period marked the beginning of large-scale environmental degradation?
7. Name the landmark Indian law enacted after the Bhopal Gas Tragedy.
8. Which report introduced the idea of "Our Common Future"?
9. Name one major tool used in environmental management to assess project impacts.
10. What branch of applied ethics studies the moral relationship between humans and nature?

## Assignments

1. Define environmental management and discuss its scope and objectives
2. Examine the significance of environmental management in modern public administration. How does it help translate environmental policy into administrative practice?
3. Evaluate the impact of the Industrial Revolution on the development of environmental awareness and policy interventions.
4. Discuss the role of major global milestones such as the 1972 Stockholm Conference, the Brundtland Report, and the Rio Earth Summit in shaping environmental management.
5. Define environmental ethics and analyse its importance in guiding environmental policy and governance.

## Reference

1. Brennan, A., & Lo, Y.-S. (2008, January 3). *Environmental ethics*. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2008 Edition). Stanford University. <https://plato.stanford.edu/entries/ethics-environmental/>
2. Sharma, N. K. (2010). *Environmental management*. New Delhi: KSK Publishers.

## Suggested Reading

1. Barrow, C. J. (1999). *Environmental Management: Principles and Practice*. London: Routledge
2. Wright, R. T., & Boorse, D. F. (2018). *Environmental Science: Toward a Sustainable Future* (13th ed.). Boston, MA: Pearson Education.
3. Khitoliya, R. K. (2004). *Environmental Pollution: Management and Control for Sustainable Development*. New Delhi: S. Chand Publishing.
4. Miller, G. T., & Spoolman, S. (2021). *Environmental Science*. Boston, MA: Cengage Learning.





## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU

## UNIT 2

# Environmental Problems

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ explain the meaning, scope, and nature of environmental problems and their significance in contemporary environmental management.
- ▶ differentiate between natural and man-made environmental problems
- ▶ examine the key environmental issues such as climate change, ozone layer depletion, and soil erosion
- ▶ assess the causes and consequences of man-made environmental problems

### Background

The relationship between humans and the environment has always been dynamic and interdependent. While the Earth's natural systems provide the foundation for human survival and progress, continuous exploitation of natural resources and the rapid pace of industrial and technological development have disrupted this delicate balance. In the modern era, environmental problems have become one of the most pressing global challenges, influencing every aspect of life: ecological, economic, and social.

Environmental problems refer to the adverse changes occurring in the natural environment as a result of human interference and natural processes. The unit begins by exploring the meaning, scope, and interconnected nature of these problems. It highlights how local actions can have global consequences, and how seemingly isolated issues, like deforestation or pollution, are deeply linked through ecological systems. Natural environmental problems demonstrate the Earth's vulnerability to both natural fluctuations and human-induced pressures. On the other hand, man-made environmental problems reflect the outcomes of unsustainable development patterns, population growth, and weak environmental governance. The unit also examines how these problems reinforce one another through feedback mechanisms, resulting in cumulative, far-reaching effects.

In this unit, learners are introduced to the complexity of environmental challenges and



the importance of adopting an integrated, holistic perspective to address them. The study of environmental problems is not confined to understanding their causes and effects; it also involves recognizing their implications for sustainable development and human welfare. By the end of this unit, learners will be able to appreciate that environmental problems are not isolated scientific concerns but deeply rooted in social values, economic systems, and policy decisions. An informed understanding of these issues forms the first step toward effective environmental management and global sustainability.

## Keywords

Climate Change, Biodiversity Loss, Pollution, Soil Erosion, Ozone Depletion, Integrated Environmental Management (IEM), Sustainable Development

## Discussion

### 1.2.1 Introduction to Environmental Problems

► Disturbances, damages, and imbalances that arise in the natural environment

Environmental problems refer to the disturbances, damages, and imbalances that arise in the natural environment due to human actions and natural processes. These problems occur when the relationship between human needs and the carrying capacity of the earth's ecosystems becomes unsustainable. Activities such as rapid industrialisation, deforestation, urban expansion, resource overexploitation, and pollution disturb the equilibrium of natural systems.

► Multi-dimensional problems

In the contemporary world, environmental problems have assumed complex, interlinked forms, ranging from local issues such as soil erosion and water contamination to global challenges such as climate change and biodiversity loss. These problems are multidimensional, involving physical, chemical, biological, and socio-economic dimensions. Unlike earlier centuries, when environmental damage was confined to local areas, modern technology and globalization have intensified the scale and speed of degradation.

► Ecological processes and human behaviour

The nature of environmental problems is dynamic, evolving with scientific, technological, and social changes. Their causes and effects overlap across time and space, making them both scientific and governance challenges. Hence, addressing

these issues requires a balanced understanding of ecological processes and human behaviour within the broader framework of sustainable development.

► Interdependent environmental system

The environment functions as a closely integrated system where all components, such as air, water, soil, flora, fauna, and human societies, are interdependent. A disturbance in one component often triggers reactions in others. For example, deforestation leads to soil erosion, reduced groundwater recharge, and loss of biodiversity, which, in turn, contribute to climate variability and declining agricultural productivity.

► Holistic environmental management

The principle of interconnectedness highlights that no environmental problem exists in isolation. Air pollution can contaminate water bodies through acid rain; excessive groundwater extraction can cause land subsidence and ecosystem stress. This systemic relationship underscores the need for a holistic approach to environmental management that accounts for the cumulative effects of human actions. Understanding these linkages helps in designing integrated strategies for conservation and development. It also underscores the importance of adopting a multidisciplinary perspective that integrates natural, social, and policy sciences for effective environmental decision-making.

► Local–global environmental linkages

Environmental problems operate at different spatial levels. Some are localized, such as urban air pollution, deforestation, or waste disposal, while others are global in scope, including climate change, ozone depletion, and global warming. However, the distinction between local and global problems is often blurred, as local activities contribute cumulatively to global environmental stress. For instance, industrial emissions from a single city may seem limited in scale, but when aggregated across nations, they influence global atmospheric chemistry. Similarly, loss of forest cover in one region affects rainfall patterns and biodiversity in another. Therefore, environmental management requires coordination between local action and international cooperation.

► Think globally, act locally

The slogan “think globally, act locally” captures this essential interdependence. Local communities must manage their resources sustainably, while global institutions and agreements provide frameworks for addressing transboundary issues. Thus, environmental protection is both a shared global responsibility and a local necessity.





► Environmental degradation impacts development

Environmental degradation directly affects the foundations of economic growth, human welfare, and ecological balance. Degradation of soil, water, forests, and air reduces productivity, damages health, and threatens long-term development goals. When natural systems lose their ability to regenerate, the economic cost of recovery becomes excessively high, often beyond the capacity of developing nations.

► Balance between economic advancement and environmental protection

Sustainable development depends on maintaining a balance between economic advancement and environmental protection. Depletion of natural resources, excessive energy use, and industrial pollution undermine this balance and cause irreversible damage. The effects of degradation are most severe for vulnerable populations who depend directly on natural resources for their livelihood.

► An essential precondition

In the long term, environmental degradation undermines food security, increases poverty, and contributes to climate-related disasters. Therefore, environmental protection is not separate from development; it is an essential precondition for achieving social equity, economic stability, and ecological resilience.

### 1.2.2 Causes of Environmental Problems

► Imbalance between human activities and the regenerative capacity of the natural environment

Environmental problems arise primarily from the imbalance between human activities and the regenerative capacity of the natural environment. The pursuit of rapid economic growth, technological advancement, and population expansion has intensified pressure on the Earth's ecosystems. Overexploitation of natural resources, unsustainable production and consumption patterns, and weak environmental governance have collectively contributed to widespread degradation. These causes are interrelated; social, economic, and technological factors combine to disrupt ecological stability and threaten the long-term sustainability of development. Understanding these underlying causes is essential for designing effective strategies to prevent and mitigate environmental damage. Let us discuss some of the leading causes of environmental problems,

- **Population growth and overconsumption**

► Continuous increase in the human population

One of the most fundamental causes of environmental problems is the continuous increase in the human population. As the population expands, so does the demand for food, shelter, water, and energy. This demand exerts tremendous pressure on natural resources, often pushing ecosystems beyond their

regenerative capacity. Rapid population growth also intensifies land conversion for settlements, agriculture, and infrastructure, reducing forest cover and natural habitats.

► Unsustainable consumption patterns

However, it is not merely population growth but the pattern of consumption that magnifies environmental stress. In industrialized societies, overconsumption of goods, energy, and non-renewable resources contributes disproportionately to environmental degradation. The ecological footprint of affluent lifestyles often exceeds the carrying capacity of the planet. Meanwhile, in developing regions, poverty-driven overuse of land and forests for survival adds to the pressure on the environment.

► Human needs– ecological limits

The combined effects of population growth and overconsumption are widening the gap between human needs and the Earth's ecological limits. Sustainable management therefore requires addressing both reducing excessive consumption through lifestyle changes in wealthier populations and improving resource efficiency and equity in developing societies.

► Industrial pollution and degradation

• **Industrialization and urbanization**

Industrialization has been central to economic progress, but it has also become a significant source of environmental stress. Industrial processes release large quantities of waste, effluents, and emissions that contaminate air, water, and soil. Chemical industries, mining, and energy production are particularly damaging, leading to pollution, deforestation, and habitat destruction. The reliance on fossil fuels has also contributed to global warming and climate instability.

► Urbanization and environmental stress

Urbanization, closely linked to industrial growth, has intensified these problems. Expanding cities consume vast areas of fertile land and generate enormous quantities of solid waste and sewage. Poorly planned urban growth results in congestion, inadequate sanitation, and loss of green spaces. Air pollution, caused by vehicles and industries concentrated in urban areas, poses serious health risks and deteriorates living conditions.

While urban and industrial expansion symbolise development, they must be guided by principles of environmental planning, clean technologies, and sustainable urban governance. Without these, industrialization and urbanization remain leading drivers of ecological imbalance.



- **Unsustainable agricultural and land-use practices**

► Agriculture-induced environmental degradation

Agriculture, though essential to human survival, can cause environmental degradation when practised unsustainably. Overuse of chemical fertilizers, pesticides, and irrigation depletes soil fertility and contaminates water sources. Monocropping and continuous cultivation erode biodiversity, while clearing forests for agricultural expansion destroys ecosystems and disrupts carbon balance.

► Land-use practices

Land-use changes such as encroachment into wetlands, mangroves, and hill slopes increase vulnerability to soil erosion, floods, and landslides. Intensive farming methods designed for short-term productivity often neglect the long-term ecological consequences, leading to desertification in many regions.

A sustainable approach to agriculture emphasizes soil conservation, crop diversification, organic farming, and efficient water management. Integrating traditional knowledge with modern ecological practices can restore degraded lands and ensure that agricultural productivity does not come at the cost of environmental health.

- **Technological development and resource exploitation**

► Technology-driven resource exploitation

Technological progress has greatly enhanced human capabilities to exploit nature. Advanced machinery, mining technologies, and industrial systems have enabled large-scale extraction of minerals, fossil fuels, and forest resources. While technology has improved living standards, it has also accelerated the rate and scale of environmental change.

► Unregulated technological exploitation

Unregulated technological expansion often leads to resource depletion, waste generation, and pollution. For instance, the excessive use of non-renewable energy sources contributes to greenhouse gas emissions, while modern transportation and electronic industries generate hazardous waste that is difficult to manage. The problem lies not in technology itself, but in its uncontrolled, profit-driven application without regard for ecological limits.

► Sustainable technological innovation

Adopting cleaner technologies, renewable energy systems, and resource-efficient innovations can help minimize the ecological footprint of human development. The challenge is to align technological advancement with environmental responsibility so that innovation becomes a tool for sustainability rather than exploitation.

- **Policy failures and weak environmental governance**

► Inadequate policies

Environmental degradation is often aggravated by inadequate policies and weak governance structures. In many countries, environmental laws exist but are poorly implemented. Lack of coordination among government departments, insufficient funding for monitoring, and corruption reduce the effectiveness of regulatory measures. When policies focus narrowly on economic growth without integrating environmental safeguards, unsustainable patterns of production and consumption become institutionalized.

► Limited public participation and inadequate awareness

Weak environmental governance also stems from limited public participation and inadequate awareness. Without community involvement and accountability, policies fail to address the real causes of degradation. Internationally, unequal enforcement of environmental agreements and differences in national priorities further complicate global cooperation.

► Overcoming policy failure

Effective environmental governance requires transparency, strong institutions, scientific policy formulation, and collaboration among governments, civil society, and the private sector. Strengthening environmental laws, ensuring compliance, and integrating ecological concerns into development planning are essential steps toward overcoming policy failures.

► Natural environmental disturbances

### 1.2.3 Natural Environmental Problems

Natural environmental problems refer to disturbances and changes in Earth's systems that originate from natural processes or from the complex interactions between nature and human activities. These problems include phenomena such as climate change, ozone depletion, and soil erosion, which significantly affect ecosystems and human well-being.

► Human-amplified natural changes

Although certain environmental changes are part of the Earth's natural cycles, the rapid pace and intensity of these changes in recent decades are primarily driven by human actions. The burning of fossil fuels, industrial emissions, deforestation, and unsustainable land use have amplified natural variations, transforming them into global environmental crises. Understanding the scientific basis and consequences of these natural environmental problems is crucial for developing strategies that protect both the environment and human societies.



### 1.2.3.1 Volcanic Eruption

#### ► Geological natural processes

A volcanic eruption is a natural environmental phenomenon that occurs when molten rock (magma), ash, and gases escape from the Earth's interior through cracks or vents in the crust. Volcanic activity is closely linked to natural geological processes, particularly plate tectonics and movements within the Earth's mantle. Since these processes operate independently of human action, volcanic eruptions are treated as natural environmental phenomena with significant consequences.

#### ► Magma generation and movement

The primary cause of volcanic eruptions lies in the generation and movement of magma beneath the Earth's surface. One primary mechanism is plate tectonic activity. At convergent plate boundaries, one tectonic plate moves beneath another, leading to the melting of rocks and the formation of magma. As magma accumulates and pressure builds, it may rise through fractures in the crust and erupt at the surface. Volcanic activity also occurs along divergent plate boundaries, where plates move apart, and magma rises to fill the gap. Another important cause is decompression melting within the Earth's mantle. As hot mantle material rises towards the surface, the pressure on it decreases, causing partial melting and the formation of magma. This process is responsible for volcanic activity at mid-ocean ridges and in certain continental regions. In addition, volcanic eruptions can occur at hotspots, where plumes of unusually hot mantle material rise independently of plate boundaries, as seen in island chains formed by repeated eruptions over long periods.

#### ► Ecosystem and health impacts

An eruption can cause extensive environmental disruption. Volcanic ash deposited on land surfaces damages vegetation, reduces short-term soil productivity, contaminates water bodies, and disrupts human and animal life. Fine ash particles suspended in the atmosphere affect air quality and pose serious health risks, particularly respiratory problems. Lava flows and pyroclastic materials can permanently alter landscapes and destroy ecosystems located near volcanic centres.

#### ► Influence atmospheric and climatic conditions

Volcanic eruptions also influence atmospheric and climatic conditions. The release of sulphur dioxide during significant eruptions lead to the formation of aerosols that reflect solar radiation, resulting in temporary cooling of the Earth's surface. Such climatic effects are generally short-lived but can affect weather patterns, agricultural cycles, and water availability over vast regions. Although volcanoes release carbon dioxide and other gases, their contribution to long-term global warming

is limited when compared to emissions from human activities.

► Environmental  
regeneration

Over the long term, volcanic activity can contribute to environmental regeneration. Weathering of volcanic ash and lava enriches soils with minerals, creating fertile land that supports agriculture and dense human settlement. Many productive agricultural regions have developed in areas influenced by past volcanic activity, demonstrating the complex and dual nature of volcanic impacts.

### **Eruption of Mount Tambora (1815)**

The eruption of Mount Tambora in 1815, located in present-day Indonesia, is considered one of the most powerful volcanic eruptions in recorded history. The eruption released enormous quantities of volcanic ash and sulphur-rich gases high into the atmosphere, spreading far beyond the immediate region. Vast areas of land were buried under ash, leading to widespread destruction of vegetation, agriculture, and settlements in nearby islands.

The environmental impact of the eruption extended to a global scale. Sulphur dioxide released during the eruption formed aerosols in the upper atmosphere that reflected sunlight, resulting in a temporary drop in global temperatures. This climatic disturbance led to abnormal weather conditions across many parts of the world in 1816, a year remembered as the “Year Without a Summer.” Crop failures, food shortages, and ecological stress were reported in parts of Europe, North America, and Asia.

The Tambora eruption clearly demonstrates how a natural geophysical event can trigger wide-ranging environmental and climatic consequences, affecting ecosystems and human societies far removed from the site of eruption.

### **1.2.3.2 Flood**

► Natural hydrological  
processes

A flood refers to the temporary inundation of land areas that are ordinarily not submerged, resulting from the overflow of surface water bodies or the accumulation of excess water beyond the natural or artificial drainage capacity of a region. Floods are primarily caused by natural hydrological processes, such as heavy or prolonged rainfall, river overflow, rapid snow or glacier melt, and coastal storm surges. Since these processes are part of the Earth’s natural water cycle, floods are commonly treated as natural hazards with environmental consequences. However, in the present context, most damaging floods cannot be explained solely by natural causes. Human activities have significantly altered natural drainage systems and floodplains, transforming floods from natural events into human-amplified environmental hazards.



► Human-driven flood intensification

Deforestation reduces the land's ability to absorb rainfall, unplanned urbanisation replaces permeable surfaces with concrete, encroachment of floodplains restricts river flow, and poorly designed drainage systems intensify waterlogging. As a result, manageable are increasingly leading to severe flooding. Climate change further complicates this picture by increasing the frequency and intensity of extreme rainfall events, thereby raising flood risk across many regions. While the flood itself is triggered by natural processes, its scale, duration, and destructive impact are strongly influenced by human decisions related to land use, infrastructure development, and environmental governance.

► Floods and ecosystem impacts

From an environmental perspective, floods can cause widespread disturbance to land, water, and ecosystems. During a flood, fast-moving water erodes soil, removes fertile topsoil from agricultural land, and deposits sediment over large areas. This can reduce soil productivity in the short term and damage crops and natural vegetation. Floodwaters often carry pollutants, pathogens, and debris into rivers, lakes, and groundwater, affecting water quality and making it unsafe for human and animal use. Floods also have significant effects on aquatic ecosystems. Sudden changes in water flow, depth, and sediment load can disturb river channels and marine habitats. Fish, insects, and other organisms may be displaced or destroyed, especially during high-intensity floods. At the same time, moderate flooding plays an important ecological role by recharging wetlands, dispersing nutrients, and supporting biodiversity in floodplain ecosystems.

### 1.2.3.3 Soil Erosion and Land Degradation

► Soil erosion

Soil erosion is the process by which the top layer of soil is removed by natural agents such as water and wind, or through human activities. The main types of erosion are sheet, rill, gully, and wind erosion. Unsustainable land use, deforestation, overgrazing, and improper agricultural practices accelerate this process.

When vegetation cover is removed, the soil loses its binding strength and becomes vulnerable to erosion. Construction activities, mining, and road building also disturb soil stability and contribute to land degradation.

Soil erosion reduces the fertility and productivity of agricultural land by removing nutrient-rich topsoil. It also leads

► Impacts of soil erosion

to sedimentation in rivers, lakes, and reservoirs, diminishing water quality and storage capacity. Over time, land degradation leads to desertification, biodiversity loss, and declining food security. Ecosystems become fragile, and their capacity to absorb carbon and regulate climate diminishes, aggravating global environmental issues.

► Maintain land productivity and ecological balance

Effective soil conservation measures are essential to maintain land productivity and ecological balance. Techniques such as contour ploughing, terracing, afforestation, strip cropping, and controlled grazing help reduce erosion. Integrated watershed management, coupled with community-based conservation programmes, strengthens local resilience. Promoting sustainable agricultural practices, maintaining vegetation cover, and enforcing land-use regulations are key strategies to prevent land degradation and ensure long-term environmental stability.

### 1.2.3.4 Climate Change

Climate change refers to long-term alterations in global or regional climate patterns, primarily reflected through changes in temperature, precipitation, and weather extremes. It is scientifically explained through the concept of the greenhouse effect, in which certain gases in the atmosphere; such as carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) trap heat radiated from the Earth's surface, maintaining the planet's temperature at a level suitable for life. While this natural process is essential for sustaining life, the excessive accumulation of greenhouse gases from human activities has intensified the greenhouse effect, leading to global warming. Climate change results from both natural and human-induced factors; therefore, we can't call it an exclusively natural environmental problem.

- Long-term alterations in global or regional climate patterns
- Natural causes include variations in solar radiation, volcanic eruptions, and natural greenhouse gas fluctuations, which influence the Earth's energy balance.
- Anthropogenic causes; human-driven activities are far more dominant today. These include burning fossil fuels for energy, deforestation, industrial emissions, and large-scale agricultural practices that emit greenhouse gases into the atmosphere.



► Multi-dimensional impacts

Deforestation reduces the planet's capacity to absorb carbon dioxide, while rapid industrialization and urbanization increase emissions, altering the natural climatic equilibrium.

The impacts of climate change are extensive and multidimensional. Rising global temperatures have led to melting glaciers, ocean thermal expansion, and consequent sea-level rise, threatening coastal and island communities. Changes in precipitation patterns cause droughts in some regions and floods in others, while the frequency of extreme weather events, such as cyclones, heatwaves, and wildfires, has increased significantly.

These changes disrupt ecosystems, reduce agricultural productivity, and endanger biodiversity. Human health is also at risk due to the spread of vector-borne diseases, food insecurity, and displacement caused by environmental disasters.

Globally, climate change affects every continent, with disproportionate impacts on developing nations due to their limited adaptive capacity. In tropical regions like South Asia, the effects are evident in irregular monsoons, glacial melting in the Himalayas, and increased vulnerability to floods and droughts. On a broader scale, climate change exacerbates social and economic inequalities and intensifies competition for resources. Effective mitigation and adaptation strategies such as transitioning to renewable energy, conserving forests, and promoting sustainable lifestyles are essential to reduce these far-reaching consequences.

## 1.2.4 Man-made Environmental Problems

While natural environmental problems arise from processes within the Earth's systems, the most severe and widespread environmental challenges today are predominantly the result of human actions. Man-made, or anthropogenic, environmental problems stem from the overexploitation of natural resources, unregulated industrial activities, urban expansion, and the misuse of technology, all of which disrupt the ecological balance.

Over the past two centuries, rapid economic development and technological advancement have transformed societies but have also imposed unprecedented stress on the environment. Human-induced changes, such as deforestation, habitat destruction, pollution, and greenhouse gas emissions, have

altered the composition of the atmosphere, degraded ecosystems, and accelerated global climate change. These problems are interlinked and often reinforce one another, creating a cycle of degradation that affects both nature and human welfare.

Unlike many natural processes that maintain equilibrium through gradual adaptation, man-made disturbances tend to be abrupt, large-scale, and challenging to reverse. Their consequences extend beyond ecological boundaries, influencing economic growth, social equity, and public health. Understanding the causes, impacts, and global responses to these human-induced problems is essential for designing sustainable development pathways and ensuring that technological progress does not come at the cost of environmental stability.

#### 1.2.4.1 Biodiversity Loss

► Variety and variability of life on Earth

Biodiversity refers to the variety and variability of life on Earth. It encompasses the diversity of species, the genetic variation within species, and the diversity of ecosystems in which they live. These three levels of genetic, species, and ecosystem diversity ensure the stability and resilience of natural systems. Ecosystems such as forests, wetlands, and coral reefs host intricate biological networks where each organism contributes to ecological balance.

Biodiversity supports essential ecosystem services like nutrient cycling, soil fertility, climate regulation, and pollination. The loss of biodiversity, therefore, weakens these services and threatens both ecological integrity and human survival.

► Primarily caused by human activities

The decline in biodiversity is primarily caused by human activities. Habitat destruction due to deforestation, agricultural expansion, urbanization, and infrastructure development remains the leading factor. Pollution, overexploitation of species through hunting and fishing, and the spread of invasive alien species further aggravate biodiversity loss. In addition, unsustainable resource use, poor land management, and population growth accelerate ecological degradation, particularly in developing regions.

► Disrupts food webs

Ecologically, biodiversity loss reduces ecosystem resilience, making natural systems more vulnerable to disturbances such as pests, diseases, and extreme weather events. It disrupts food webs and diminishes genetic diversity, limiting species' capacity to adapt to changing conditions.



► Biodiversity and livelihoods

Economically, biodiversity provides a foundation for agriculture, forestry, fisheries, and pharmaceuticals. The depletion of natural resources leads to economic instability, loss of livelihoods, and reduced availability of raw materials. The decline in pollinators, for instance, directly affects crop yields, while the destruction of forests and coral reefs diminishes tourism potential and natural disaster protection.

► Global agreements

The international community has recognized the urgency of biodiversity conservation through global agreements such as the Convention on Biological Diversity (CBD), adopted at the 1992 Earth Summit in Rio de Janeiro. The CBD emphasizes three objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from genetic resources.

► Biodiversity conservation frameworks

Other supporting frameworks include the Global Environment Facility (GEF), which finances biodiversity projects, and mechanisms like “debt-for-nature” swaps to promote conservation in developing nations. The CBD encourages nations to integrate biodiversity considerations into national policies and land-use planning, highlighting that conservation and development must progress together.

### 1.2.4.2 Global Warming

► Increase in the Earth's average surface temperature

Global warming refers to the long-term increase in the Earth's average surface temperature due to the enhanced greenhouse effect. Naturally, greenhouse gases trap a portion of the Sun's heat in the atmosphere, keeping the planet warm enough to support life. However, excessive accumulation of these gases from human activities has intensified this process, leading to higher global temperatures and climate instability.

► Greenhouse gases

The principal greenhouse gases are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), ozone (O<sub>3</sub>), and water vapour. Human activities such as fossil fuel combustion, industrial emissions, deforestation, and large-scale agriculture are the dominant sources. Methane emissions from livestock and rice cultivation, nitrous oxide from fertilizers, and chlorofluorocarbons (CFCs) from industrial products further contribute to atmospheric warming.

The impacts of global warming are visible across environmental, social, and economic dimensions. Rising temperatures accelerate glacial melting and sea-level rise,

► Environmental, social, and economic dimensions

threatening low-lying regions and small island nations. Changes in precipitation patterns lead to droughts in some areas and flooding in others, severely affecting agriculture and water security. Socially, global warming contributes to health problems, displacement of populations, and increased poverty in vulnerable communities. Economically, it causes losses in agriculture, fisheries, and infrastructure, particularly in developing nations that lack adaptive capacity.

Mitigation focuses on reducing greenhouse gas emissions through energy efficiency, afforestation, renewable energy adoption, and sustainable transport systems. International frameworks such as the Kyoto Protocol (1997) and the Paris Agreement (2015) guide global efforts to limit temperature rise and promote low-carbon development.

Adaptation strategies aim to minimize damage by strengthening resilience—developing climate-smart agriculture, improving water management, building coastal defences, and integrating climate risk into development planning. Effective action requires global cooperation, national commitment, and community participation to achieve long-term climate stability.

### 1.2.4.3 Pollution

► Introduction of harmful substances into the environment

Pollution is the introduction of harmful substances or energy into the environment that causes adverse changes in air, water, or soil quality. It results from both natural processes and human activities, with anthropogenic sources being the most significant.

- Air pollution arises from vehicular emissions, industrial discharges, and the burning of fossil fuels, releasing pollutants such as carbon monoxide, nitrogen oxides, and particulate matter.
- Water pollution results from industrial effluents, sewage discharge, and agricultural runoff contaminating surface and groundwater.
- Soil pollution occurs through excessive use of fertilisers and pesticides, and through the disposal of solid and hazardous wastes.
- Noise pollution is mainly caused by traffic, industries, and urban activities.





- Radioactive pollution originates from nuclear power plants, weapon testing, and improper disposal of radioactive waste.

► Pollution impacts on health and ecosystems

The major sources of pollution include industrial operations, transport systems, agricultural chemicals, and urban waste. Pollutants affect air quality, reduce visibility, contaminate water bodies, and degrade land productivity. Health impacts include respiratory diseases, cardiovascular disorders, and neurological problems. Pollution also affects wildlife habitats and contributes to ecosystem imbalance. Long-term exposure to pollutants can lead to irreversible damage to both human health and the environment.

Several regions illustrate the severe effects of pollution. The Ganga River in India is contaminated by untreated sewage and industrial waste, harming aquatic life and public health. Beijing and Delhi are examples of urban air pollution crises due to vehicular emissions and biomass burning. Industrial zones such as Bhopal (India) and Chernobyl (Ukraine) demonstrate the catastrophic outcomes of chemical and nuclear accidents, underscoring the need for strict safety and monitoring standards.

► Integrated pollution control strategies

Pollution control requires preventive, technological, and policy-oriented measures. Adoption of cleaner production technologies, use of renewable energy, and strict enforcement of emission standards are essential. Waste minimization, recycling, and public awareness campaigns support long-term solutions. Regulatory frameworks like the Air (Prevention and Control of Pollution) Act, 1981, and the Environment (Protection) Act, 1986 in India, along with international initiatives such as the Basel Convention on Hazardous Wastes, aim to reduce pollution globally. Integrated environmental management, combining legislation, technology, and community action offers the most effective approach for pollution prevention and control.

► Interconnection between human progress and ecological sustainability

Man-made environmental problems such as biodiversity loss, global warming, and pollution highlight the deep interconnection between human progress and ecological sustainability. They reveal that technological and economic growth, when pursued without regard for the environment, leads to long-term harm. Effective management demands collective responsibility, innovation, and global cooperation to ensure that human development coexists with the preservation of the planet's natural systems.

#### 1.2.4.4 Ozone Layer Depletion

##### ► Protective layer

The ozone layer is a thin shield of ozone (O<sub>3</sub>) gas located in the stratosphere, roughly between 10 and 50 kilometres above the Earth's surface. It plays a vital role in filtering harmful ultraviolet (UV) radiation from the sun, thereby protecting living organisms from genetic and biological damage. Without this protective layer, life on Earth would be exposed to dangerous levels of UV radiation, leading to severe ecological and health impacts.

##### ► Ozone-depleting substances

The depletion of the ozone layer is primarily caused by human-made chemicals known as ozone-depleting substances (ODS), such as chlorofluorocarbons (CFCs), halons, and carbon tetrachloride. These substances were widely used in refrigeration, air conditioning, aerosol sprays, and foam production. When released into the atmosphere, ODS molecules rise to the stratosphere, where ultraviolet light breaks them down, releasing chlorine and bromine atoms. These atoms react with ozone molecules, breaking them apart and reducing the ozone concentration. Natural factors, such as volcanic eruptions, also influence ozone levels, but their effects are temporary compared to human-induced depletion.

Ozone depletion allows more ultraviolet-B (UV-B) radiation to reach the Earth's surface, causing a range of harmful effects. In humans, it increases the risk of skin cancer, cataracts, and immune system disorders. In plants, it reduces growth and photosynthetic efficiency, while in aquatic ecosystems, it damages phytoplankton, which are essential to the marine food chain. Long-term depletion can thus alter ecological balance and reduce biodiversity.

##### ► International action

Global recognition of the ozone crisis led to significant international action. The Vienna Convention for the Protection of the Ozone Layer (1985) established a framework for global cooperation, and the Montreal Protocol (1987) set legally binding targets to phase out the production and consumption of ODS. These agreements are widely regarded as successful examples of international environmental diplomacy. As a result of these efforts, the ozone layer has shown signs of gradual recovery, demonstrating that coordinated global action can reverse environmental damage.



## 1.2.5 Natural v/s Man-made Environmental Problems

| Natural Environmental Problems                                                                                                        | Man-made (Anthropogenic) Environmental Problems                                                                              |
|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Environmental issues arising from natural processes and variations within the Earth's systems.                                        | Environmental issues resulting from human actions that disturb ecological balance and exceed nature's regenerative capacity. |
| Originate due to natural factors such as geological, climatic, or biological processes.                                               | Originate primarily from industrialization, urbanization, deforestation, pollution, and unsustainable resource use.          |
| Climate change (natural variability), soil erosion, ozone layer depletion (partly natural), volcanic eruptions, droughts, and floods. | Biodiversity loss, global warming, air and water pollution, deforestation, industrial contamination, and waste accumulation. |
| Often cyclical and gradual; part of long-term ecological or geological processes.                                                     | Largely abrupt and accelerated due to technological, economic, and demographic pressures.                                    |
| May be localized or global, depending on the process (e.g., volcanic eruption vs. global climate variation).                          | Usually widespread and cumulative; effects often transcend national boundaries (e.g., global warming, pollution).            |
| Often unpredictable and difficult to prevent (e.g., earthquakes, tsunamis, or natural drought cycles).                                | Predictable and largely preventable through effective planning, policy, and sustainable practices.                           |
| Can be temporary or long-term, but ecosystems often recover naturally over time.                                                      | Long-term and sometimes irreversible (e.g., species extinction, soil and water contamination).                               |

**Table 1.2.1**

### ► Natural and man-made problems

Natural environmental problems originate within the Earth's systems and are influenced by natural cycles and variability. They often become severe when combined with human activities. Man-made environmental problems, on the other hand, are direct outcomes of human development patterns and technological interventions. Unlike natural processes, these are largely controllable through conscious policy, sustainable practices, and global cooperation. Recognizing the interrelationship between the two helps in designing comprehensive environmental management strategies that combine prevention, adaptation, and restoration

## 1.2.6 Interlinkages Among Environmental Problems

### ► Interacting environmental problems

Environmental problems seldom occur in isolation; instead, they interact in complex ways that reinforce one another. Natural and human-made factors often combine to intensify the scale and severity of ecological degradation. For example, climate change, which is now largely human-induced, amplifies the effects of natural hazards such as droughts, floods, and cyclones. Similarly, deforestation, a man-made activity, reduces soil stability and vegetation cover, making landscapes more vulnerable to natural processes such as soil erosion and desertification.

### ► Human-accelerated natural changes

In many cases, human interventions accelerate natural environmental changes that would otherwise occur slowly over centuries. Unsustainable land use, for instance, accelerates erosion and sedimentation in rivers, altering hydrological cycles and increasing the frequency of flooding. Likewise, pollution and greenhouse gas emissions alter atmospheric chemistry, increasing global temperatures and thereby intensifying natural climatic fluctuations. This mutual reinforcement between human and natural systems demonstrates that environmental problems cannot be neatly divided into “natural” and “man-made” categories; instead, they exist on a continuum where human actions often act as catalysts for natural disturbances.

### ► Environmental feedback mechanisms

Environmental systems function through intricate feedback loops, where changes in one component affect others, sometimes amplifying or dampening the original disturbance. Such feedback mechanisms explain how small environmental stresses can accumulate and lead to large-scale consequences. For instance, rising global temperatures cause polar ice to melt, reducing Earth’s surface albedo (reflectivity). This, in turn, allows more solar radiation to be absorbed, leading to further warming, a positive feedback loop. Similarly, deforestation diminishes carbon sequestration capacity, increasing atmospheric carbon dioxide and further intensifying climate change.

### ► Cumulative environmental impacts

Cumulative impacts occur when multiple environmental pressures, such as pollution, overexploitation, and habitat loss, interact to exceed the resilience threshold of ecosystems. These effects are often gradual but can result in sudden ecological collapse. For example, degradation of wetlands through pollution and drainage can destroy biodiversity, increase flood risks, and disrupt regional climate regulation. Understanding these feedback relationships is essential for anticipating long-



term consequences and avoiding policies that unintentionally worsen environmental stress.

► Integrated environmental management

The interconnected nature of environmental problems calls for an integrated approach to management that considers ecological, social, and economic systems as interdependent. Traditional sectoral management, which treats air, water, and land separately, often fails because it overlooks how interventions in one area influence the others.

► Integrated sustainable development

Integrated Environmental Management (IEM) promotes a holistic perspective that emphasizes prevention, coordination, and participation. It seeks to align environmental policies with development planning, resource management, and governance frameworks. For instance, watershed management integrates land use, forestry, and water conservation to maintain ecological balance at the ecosystem level. Similarly, integrated coastal zone management combines marine conservation, fisheries regulation, and pollution control to protect fragile coastal ecosystems. The success of such integrated approaches depends on scientific understanding, interdepartmental coordination, and community involvement. It also requires decision-makers to adopt a systems-based mindset, recognizing that sustainable development can only be achieved when environmental, economic, and social objectives are pursued together.

## Summarized Overview

Environmental problems represent the growing tension between human aspirations for development and the Earth's capacity to sustain life. This unit explored the diverse and interrelated nature of environmental challenges, examining both natural and human-made factors that contribute to global ecological imbalance. Natural environmental problems highlight how human interference can intensify natural processes. Meanwhile, human-made environmental problems demonstrate the direct impacts of human activities, such as industrialisation, deforestation, and resource overexploitation. Together, these issues illustrate that environmental degradation is not confined to a single cause or region but forms part of a complex, interconnected global system.

The unit also emphasized that environmental problems are cumulative, producing feedback loops that amplify their effects on ecosystems, economies, and human well-being. Addressing these challenges requires a shift from fragmented approaches to integrated environmental management, which considers ecological, social, and economic dimensions together. In conclusion, understanding environmental problems

is the foundation for effective environmental governance and sustainable development. Learners are encouraged to view these issues not merely as scientific or technical matters, but as deeply ethical and policy-oriented concerns that demand collective responsibility, informed decision-making, and long-term commitment to sustainability. Only through such integrated and responsible action can humanity coexist harmoniously with the natural environment.

## Self-Assessment

1. What is meant by an *environmental problem*?
2. How does population growth put pressure on the environment?
3. Name two ways in which industries and cities cause environmental damage.
4. What are the leading causes of *climate change*?
5. Why is the *ozone layer* important for life on Earth?
6. Mention two reasons for the loss of *biodiversity*.
7. What is the *greenhouse effect*, and how does it lead to global warming?
8. List any three common types of *pollution*.
9. How are natural and human-made environmental problems connected?
10. What is meant by *integrated environmental management*?

## Assignments

1. Discuss the major causes of environmental problems in the modern world. How do social and economic factors contribute to environmental degradation?
2. Examine the difference between natural and man-made environmental problems. Provide suitable examples to illustrate their interconnection.
3. Evaluate the major sources and effects of different types of pollution. Suggest strategies for effective pollution control and prevention.
4. Analyse the causes and impacts of biodiversity loss. What measures have been taken globally to conserve biological diversity?



## Reference

1. Barrow, C. J. (1999). *Environmental Management: Principles and Practice*. London: Routledge
2. Wright, R. T., & Boorse, D. F. (2018). *Environmental Science: Toward a Sustainable Future* (13th ed.). Boston, MA: Pearson Education.
3. Khitoliya, R. K. (2004). *Environmental Pollution: Management and Control for Sustainable Development*. New Delhi: S. Chand Publishing.
4. Miller, G. T., & Spoolman, S. (2021). *Environmental Science*. Boston, MA: Cengage Learning.

## Suggested Reading

1. Intergovernmental Panel on Climate Change (IPCC). (2023). *Sixth Assessment Report (AR6): Climate Change 2023*. Geneva: IPCC.
2. United Nations Environment Programme (UNEP). (2019). *Global Environment Outlook – GEO-6: Healthy Planet, Healthy People*. Nairobi: UNEP.
3. United Nations Development Programme (UNDP). (2023). *Human Development Report 2023/2024: Breaking the Gridlock – Reimagining Cooperation in a Polarized World*. New York: UNDP.
4. World Commission on Environment and Development (WCED). (1987). *Our Common Future*. Oxford: Oxford University Press.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU





## UNIT 3

# Environmental Protection and Strategies

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ define and explain the concept and importance of environmental protection in global and national contexts.
- ▶ trace the evolution of international environmental protection efforts from the Stockholm Conference (1972) to contemporary global agreements.
- ▶ analyse the contribution of key international frameworks and conventions in shaping global environmental policy
- ▶ evaluate the significance of the United Nations Environment Management Group (UNEMG) in ensuring coherence and coordination within the UN system for environmental protection.

### Background

The protection of the environment has gradually evolved from being a local concern to becoming one of the most pressing global priorities of our time. The growing realisation that economic development, human welfare, and environmental integrity are inseparably linked has transformed how nations, institutions, and individuals view the planet. Today, environmental protection is not merely about conserving forests, species, or water bodies—it represents a collective responsibility to safeguard the Earth's life-support systems for present and future generations.

The journey toward organized environmental protection began in the 1970s when the world witnessed the environmental consequences of rapid industrialization and population growth. The United Nations Conference on the Human Environment, held in Stockholm in 1972, marked a turning point. For the first time, nations came together to discuss the relationship between human progress and environmental sustainability. In recent years, the focus has shifted from specific environmental problems to a broader, integrated agenda. The Sustainable Development Goals (SDGs), adopted in 2015,

represent a universal framework for balancing economic growth, social inclusion, and environmental protection. These goals reaffirm that sustainability must guide all aspects of governance, from local planning to international diplomacy.

Thus, this unit explores how environmental protection has evolved through time—shaped by international conferences, global treaties, and institutional innovations. It helps learners understand not only the historical milestones but also the strategic mechanisms that guide environmental governance today. More importantly, it invites reflection on the shared responsibility of nations and institutions to preserve Earth's ecological balance while promoting human progress.

## Keywords

Sustainable Development Goals, Global Environmental Governance, Stockholm Conference, Multilateral Environmental Agreements, Rio Earth Summit

## Discussion

### 1.3.1 Introduction to Environmental Protection

Environmental protection refers to the planned and sustained efforts made to preserve, restore, and enhance the quality of the natural environment. It involves safeguarding air, water, land, flora, fauna, and ecosystems from the adverse impacts of human activities. As defined by scholars and international agencies, environmental protection is both a scientific and ethical obligation, aimed at maintaining the ecological processes that support life on Earth. The significance of environmental protection lies in its contribution to the stability of ecosystems and the well-being of societies. It ensures the availability of natural resources for present and future generations and minimizes the risks of pollution, degradation, and ecological imbalance. The concept has evolved from simple conservation practices to a multidimensional approach that integrates ecology, economics, and social welfare.

► Environmental protection concept

► Not only a moral responsibility but also a developmental necessity

In modern governance, environmental protection is not only a moral responsibility but also a developmental necessity. Governments, international organizations, and civil societies increasingly recognize that economic progress without



ecological safeguards leads to irreversible environmental damage. Therefore, protection of the environment is now viewed as a central component of national planning and global cooperation.

► Origins of environmental thought

The concern for the environment has deep historical roots. However, organized efforts toward environmental protection began to take shape during the industrial era, when rapid urbanization and technological expansion caused large-scale pollution and resource depletion. According to C. J. Barrow (1999), early environmental thought developed through two major traditions: the utilitarian approach, which focused on the practical use and management of natural resources, and the romantic approach, which emphasized the intrinsic value and beauty of nature.

► Rise of environmental movements

The rise of industrial pollution and deforestation in the nineteenth and early twentieth centuries gave birth to conservation movements in Europe and North America. These movements later expanded into global campaigns advocating for pollution control, wildlife protection, and sustainable land use. By the mid-twentieth century, the publication of *Silent Spring* by Rachel Carson (1962) and subsequent public debates marked the beginning of modern environmental awareness.

► Global environmental consciousness

The 1972 Stockholm Conference on the Human Environment served as a turning point, establishing the environment as a central theme in international policy. This was followed by the creation of the United Nations Environment Programme (UNEP) and a series of global initiatives to integrate environmental protection into development planning. Since then, the idea of environmental consciousness has evolved from localized conservation to a global vision of sustainable development, encompassing social, ethical, and economic dimensions.

► Development–environment relationship

The relationship between development and the environment has long been a subject of global discussion. Traditionally, economic growth was pursued with little regard for ecological limits, under the assumption that technological progress could overcome resource constraints. However, environmental degradation, resource scarcity, and pollution crises have revealed that uncontrolled development can threaten both nature and human well-being.

Environmental protection and development are now understood as interdependent objectives. Sustainable development popularized by the Brundtland Report (1987),

► Sustainable development principle

emphasizes meeting present needs without compromising the ability of future generations to meet theirs. This approach highlights that environmental integrity is essential for economic stability, food security, and social welfare.

► Development–conservation integration

Modern development strategies, therefore, aim to balance growth with conservation. Environmental Impact Assessment (EIA), cleaner technologies, and international conventions such as the Rio Declaration and the Paris Agreement represent efforts to integrate environmental protection into economic and policy frameworks. The challenge lies not in choosing between development and protection, but in ensuring that both proceed in harmony to secure long-term planetary sustainability.

### 1.3.2 Evolution of Environmental Protection: From Stockholm (1972) to the Present

► Emergence of global concern

The evolution of environmental protection as a global concern can be traced through a series of international milestones that transformed environmental awareness into concrete action. Before the 1970s, environmental issues were treated mainly as domestic matters, confined within the boundaries of national policy. However, growing scientific evidence of pollution, resource depletion, and ecological decline highlighted the need for collective global responses.

► Stockholm and UNEP foundations

The United Nations Conference on the Human Environment, held in Stockholm in 1972, marked the beginning of modern international environmental governance. It was the first global platform to recognise the interdependence between human development and environmental quality, which led to the creation of the United Nations Environment Programme (UNEP). This conference laid the foundation for subsequent international agreements and conventions focused on pollution control, resource conservation, and sustainable use of natural assets.

► Evolution of global frameworks

In the decades that followed, global environmental protection evolved through significant stages; the Vienna Convention (1985) and the Montreal Protocol (1987) addressed ozone depletion, while the Rio Earth Summit (1992) introduced the concept of sustainable development and led to landmark conventions on biodiversity, climate change, and desertification. Later events such as the Johannesburg Summit (2002) and Rio+20 (2012) further deepened commitments to sustainable practices and international cooperation.





### 1.3.2.1 The Stockholm Conference on the Human Environment (1972)

#### ► Stockholm Conference background

The United Nations Conference on the Human Environment, held in Stockholm, Sweden, from 5 to 16 June 1972, marked the first major global gathering to deliberate on the relationship between human progress and environmental preservation. The post-World War II era had witnessed unprecedented industrialization, population growth, and urban expansion, accompanied by escalating pollution and resource depletion. Events such as the Torrey Canyon oil spill (1967) and rising public concern about air and water pollution pushed environmental issues into the international arena.

- The primary objective of the Stockholm Conference was to establish a common framework for guiding environmental policy across nations and to integrate environmental concerns into economic and social planning. It aimed to:
- Define the fundamental right of people to live in a healthy and productive environment.
- Identify the responsibilities of governments and international organizations in preventing and mitigating environmental damage.
- Encourage cooperation among developed and developing nations for environmental protection, emphasizing the need for financial and technological support for developing countries.

#### ► Stockholm Declaration principles

The conference produced two major documents: the Stockholm Declaration and the Action Plan for the Human Environment. The Stockholm Declaration, comprising 26 principles, articulated key values that continue to underpin global environmental governance. It affirmed that environmental protection and economic development are not opposing goals but complementary processes. Principle 1 declared that humans have “a fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being.”

The Action Plan outlined 109 recommendations under three broad categories:

- Global Environmental Assessment Programme

(Earthwatch) – for scientific monitoring of environmental trends.

- Environmental Management Activities – for integrating environmental policies into development planning.
- Supporting Measures – including capacity-building, education, and international cooperation.

#### ► Establishment of UNEP

A landmark outcome of the Stockholm Conference was the establishment of the United Nations Environment Programme (UNEP) through UN General Assembly Resolution 2997 (XXVII) in December 1972. UNEP was mandated to serve as the central coordinating body for environmental activities within the UN system. Headquartered in Nairobi, Kenya, it symbolized a commitment to decentralizing global environmental governance and giving voice to developing countries.

The Stockholm Conference thus marked a historic turning point—shifting environmental protection from national agendas to a collective global responsibility and institutionalizing it within the UN framework.

### 1.3.2.2 The United Nations Environment Programme (UNEP)

#### ► Institutionalisation of environmental protection

The establishment of the United Nations Environment Programme (UNEP) in 1972 marked the institutionalisation of global environmental protection within the UN system. Emerging directly from the Stockholm Conference on the Human Environment, UNEP was created by United Nations General Assembly Resolution 2997 (XXVII) and has its headquarters in Nairobi, Kenya—the first major UN body to be based in a developing country.

#### ► Need for global cooperation

UNEP's creation reflected the growing realization that environmental issues; such as air and water pollution, resource depletion, and biodiversity loss, transcend national boundaries and require collective international action. It was entrusted with the responsibility of serving as the United Nations' environmental conscience and guiding member states toward sustainable development through science-based policies and cooperation.



## World Environment Day

World Environment Day is observed on June 5 because it marks the opening day of the United Nations Conference on the Human Environment, held in Stockholm in 1972. During this conference, the United Nations designated June 5 as a global day to promote environmental awareness and encourage collective action for protecting the planet. The first observance took place in 1974, and since then, World Environment Day has served as an annual platform for highlighting key environmental challenges and fostering public and institutional engagement.

Since its inception, UNEP has launched a range of programmes and initiatives that have significantly influenced international environmental management, which includes:

### ► Major Programmes and Initiatives

1. Global Environment Monitoring System (GEMS)
2. Regional Seas Programme
3. Intergovernmental Panel on Climate Change (IPCC)
4. World Conservation Monitoring Centre (WCMC)
5. Green Economy Initiative (GEI) Chemicals and Waste Programme

### • UNEP's role in global environmental governance

Over the past five decades, UNEP has evolved from a small coordinating body into one of the principal global environmental authority within the UN system. Its role in governance encompasses three major dimensions:

1. **Policy Leadership and Coordination:** NEP sets the global environmental agenda by facilitating intergovernmental negotiations and promoting policy coherence. It serves as a convener of global discussions on sustainability and fosters partnerships among governments, the private sector, and civil society.
2. **Science–Policy Interface:** UNEP bridges the gap between scientific research and policymaking. Through its assessments and reports, it ensures that decisions are guided by credible evidence. For example, its involvement in the IPCC and GEO processes has been instrumental in shaping climate and environmental policies worldwide.
3. **Support for Sustainable Development Goals (SDGs):** In the era of the 2030 Agenda for Sustainable Develop-

ment, UNEP leads efforts to integrate environmental objectives into all 17 SDGs. It plays a direct role in implementing SDG 6 (Clean Water), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land). UNEP's 2022–2025 Medium-Term Strategy identifies three core priorities: climate stability, living in harmony with nature, and a pollution-free planet.

#### ► Evolving Role

**4. Global Partnerships and Cooperation:** UNEP collaborates with institutions such as the Global Environment Facility (GEF), World Bank, and regional development banks to finance environmental projects. It also promotes partnerships through initiatives such as the One Planet Network and the UN Decade on Ecosystem Restoration (2021–2030).

Its activities today extend beyond traditional conservation; addressing emerging challenges such as plastic pollution, electronic waste, and the environmental dimensions of health. UNEP's influence is evident in the growing integration of environmental concerns into national policies, corporate practices, and global trade discussions.

#### • The Vienna Convention and Montreal Protocol

#### ► Importance of ozone layer

The ozone layer, located in Earth's stratosphere, plays a vital role in absorbing most of the Sun's harmful ultraviolet (UV-B) radiation, thereby protecting life on Earth. By the mid-20th century, the rapid growth of chemical industries had led to widespread use of chlorofluorocarbons (CFCs) and related compounds in aerosols, refrigeration, and foam production.

#### ► CFCs and ozone depletion

Scientific research in the 1970s, particularly the studies by F. Sherwood Rowland and Mario Molina (1974), revealed that CFCs, when released into the atmosphere, rise to the stratosphere where they are broken down by solar radiation, releasing chlorine atoms that destroy ozone molecules. Each chlorine atom can break down thousands of ozone molecules, significantly thinning the ozone layer.

By the early 1980s, empirical evidence confirmed this phenomenon with the discovery of the “ozone hole” over Antarctica by the British Antarctic Survey. The finding, published in 1985, demonstrated a dramatic seasonal depletion





► Discovery of ozone hole

of ozone, prompting urgent calls for coordinated international action. The global community recognised that depletion of the ozone layer would lead to increased exposure to UV radiation, with severe consequences such as higher rates of skin cancer, cataracts, immune system suppression, and damage to crops and marine ecosystems.

This scientific consensus formed the foundation for one of the most successful environmental cooperation frameworks in history, the Vienna Convention for the Protection of the Ozone Layer (1985) and the Montreal Protocol on Substances that Deplete the Ozone Layer (1987).

### 1.3.2.3 The Vienna Convention for the Protection of the Ozone Layer (1985)

► Vienna Convention objectives

The Vienna Convention, adopted on 22 March 1985, was the first global treaty to address an atmospheric issue through precautionary and cooperative measures. The Convention's primary objective was "to promote cooperation among nations through systematic observation, research, and information exchange on the effects of human activities on the ozone layer."

The Convention emphasized the principle that scientific uncertainty should not delay preventive action, thus institutionalizing the precautionary approach—a cornerstone of modern environmental law. Although the Convention did not establish legally binding obligations to reduce emissions, it provided a comprehensive framework for:

- International collaboration in ozone research and monitoring;
- Exchange of scientific and technical information;
- Development of national legislation and policies to control ozone-depleting substances (ODS); and
- Establishment of mechanisms for periodic review of new scientific findings.

The Convention called for regular meetings of the Conference of the Parties (COP) and established a secretariat under UNEP to coordinate its implementation. UNEP's leadership in organizing global scientific assessments and facilitating policy dialogue was instrumental in translating research into actionable commitments.

► Foundation for  
Montreal Protocol

The Vienna Convention became a model for subsequent environmental treaties, particularly for its preventive and cooperative spirit. The Convention's success laid the foundation for the Montreal Protocol (1987), which provided the operational and legally binding framework for controlling ozone-depleting substances.

#### **1.3.2.4 The Montreal Protocol on Substances that Deplete the Ozone Layer (1987)**

► Legally binding  
ozone controls

The Montreal Protocol was adopted on 16 September 1987 and entered into force on 1 January 1989. It operationalized the Vienna Convention by setting concrete, legally binding targets for the phasing out of the production and consumption of ODS, including CFCs, halons, carbon tetrachloride, and methyl chloroform.

The Protocol is built on three key principles:

1. **Precautionary Action:** Measures to control ODS were adopted even before all scientific uncertainties were resolved.
2. **Common but Differentiated Responsibilities:** Recognizing varying national capabilities, the Protocol allowed developing countries (Article 5 Parties) a longer phase-out timeline and provided technical and financial support.
3. **Science-Based Policy Evolution:** Provisions for regular scientific assessments ensured that control measures evolved in line with the latest research findings.

The Montreal Protocol established a comprehensive implementation framework:

- **Control Measures:** Specific timelines for phasing out ODS, reviewed and tightened through periodic amendments and adjustments.
- **Financial Mechanism:** Creation of the Multilateral Fund (1991) to assist developing countries with technology transfer, capacity building, and transition to safer alternatives.
- **Non-Compliance Procedure:** An innovative, non-punitive system to help countries meet their commitments through technical assistance rather than sanctions.
- **Scientific and Technological Panels:** Regular assessments by the Ozone Research Managers and Assessment Panels



to provide scientific, environmental, and technological guidance.

The Montreal Protocol's achievements are unparalleled in international environmental law:

- **Universal Ratification:** Has been universally ratified by 198 Parties, making it one of the few treaties in history to achieve universal participation.
- **ODS (Ozone Depleting Substance) Phase-Out:** More than 98% of the ozone-depleting substances regulated by the Montreal Protocol have been phased out worldwide
- **Health and Environmental Benefits:** Prevented millions of cases of skin cancer and cataracts, and protected terrestrial and aquatic ecosystems.
- **Climate Co-benefits:** The Protocol has prevented an estimated 135 billion tonnes of CO<sub>2</sub>-equivalent emissions, making it one of the most effective climate mitigation instruments.
- **Ozone Recovery:** UNEP and WMO assessments (2022) project that the ozone layer will return to pre-1980 levels by 2066 over Antarctica, 2045 over the Arctic, and 2040 globally, provided compliance continues.

### **The Montreal Protocol as a Model for Environmental Governance**

The Protocol is widely celebrated as the most successful environmental treaty ever adopted. Its effectiveness stems from:

#### **► Achievements**

- The integration of science and policy, ensuring decisions are evidence-based;
- The flexibility of its amendment mechanisms;
- Its equity-oriented design, providing differentiated obligations and financial aid; and
- Its global cooperation model, balancing environmental necessity with developmental needs.

The Protocol's legacy extends beyond ozone protection — it has become a blueprint for tackling other global environmental challenges such as climate change, chemical management, and air pollution.

► Successful global environmental cooperation

The Vienna Convention (1985) and the Montreal Protocol (1987) together represent a landmark achievement in international environmental diplomacy. They transformed scientific warnings into coordinated global action, institutionalized the precautionary principle, and demonstrated that collective commitment can reverse environmental degradation. Their enduring success illustrates the potential of multilateral cooperation grounded in equity, science, and shared responsibility. The ongoing recovery of the ozone layer stands as tangible proof that international environmental governance can deliver real, measurable global benefits when nations act together for the common good.

### 1.3.2.5 The Rio Earth Summit (1992)

The United Nations Conference on Environment and Development (UNCED), popularly known as the Rio Earth Summit, was held in Rio de Janeiro, Brazil, from 3–14 June 1992. It represented a defining moment in the history of international environmental diplomacy, marking the global community's formal recognition that environmental protection and economic development are inseparable.

► Global participation for sustainability

The conference was convened 20 years after the Stockholm Conference (1972) to evaluate progress and develop a comprehensive strategy for achieving sustainable development. It drew participation from 178 governments, more than 100 heads of state, and over 2,400 representatives of NGOs and civil society, making it the most significant international gathering ever organized at that time.

The Summit emerged from growing global concern over deforestation, biodiversity loss, and climate change during the 1980s. Reports such as the Brundtland Commission's "Our Common Future" (1987) laid the intellectual foundation for Rio by defining *sustainable development* as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

► Agenda 21 action plan

#### Agenda 21 and the Principle of Sustainable Development

The most significant outcome of the Summit was Agenda 21, a comprehensive 40-chapter action plan designed to guide national and international efforts toward sustainable development in the 21st century.





#### ► Areas addressed

Agenda 21 addressed key areas such as:

- Combating poverty and promoting equity;
- Sustainable management of natural resources including land, forests, and oceans;
- Protection of the atmosphere and control of toxic chemicals and hazardous waste;
- Strengthening the role of major groups—women, youth, Indigenous peoples, and NGOs—in sustainable development; and
- Promoting education, awareness, and technology transfer.

A defining feature of Agenda 21 was its focus on local action. The concept of *Local Agenda 21* encouraged cities and municipalities worldwide to develop their own sustainability plans through community participation.

### Major Conventions Adopted at Rio

The Rio Summit produced landmark international treaties, addressing a critical aspect of global environmental governance:

1. United Nations Framework Convention on Climate Change (UNFCCC)
2. Convention on Biological Diversity (CBD)
3. United Nations Convention to Combat Desertification (UNCCD)

Together, these three conventions formed the “Rio Conventions”, establishing the core architecture of modern global environmental governance.

### Institutional and Policy Outcomes of the Summit

- **The Rio Declaration on Environment and Development (1992)**

One of the key outcomes of the Summit was the Rio Declaration, which articulated 27 guiding principles that serve as the ethical and legal basis for sustainable development worldwide.

To monitor and coordinate the implementation of Agenda 21, the Commission on Sustainable Development (CSD) was

established in December 1992 by the UN Economic and Social Council (ECOSOC). The CSD became the central platform for reviewing progress, facilitating dialogue, and promoting best practices among countries.

The Summit also strengthened UNEP's mandate and encouraged the integration of environmental and developmental concerns into the work of all UN agencies.

- **Financial and Technical Mechanisms**

The Global Environment Facility (GEF), initially established in 1991, was restructured at Rio to serve as the principal financial mechanism for implementing the Rio Conventions. The GEF mobilized funding for projects related to climate change, biodiversity, and land degradation, linking environmental protection with sustainable development financing.

### **Legacy and Impact of the Rio Earth Summit**

The Rio Earth Summit was a transformative event that permanently changed the global understanding of environmental issues. While implementation challenges persist, Rio 1992 remains the foundation of contemporary global environmental governance. It bridged the divide between environment and development, translating ethical aspirations into institutional action and setting the stage for subsequent global summits—Johannesburg (2002), Rio+20 (2012), and the 2030 Agenda for Sustainable Development (2015).

#### **1.3.2.6 Post-Rio Developments: From Johannesburg to the Present**

##### **1. World Summit on Sustainable Development (2002)**

The World Summit on Sustainable Development (WSSD) was convened in Johannesburg, South Africa, from 26 August to 4 September 2002, to review the implementation of commitments made at the Rio Earth Summit (1992). The Summit took place of increasing environmental degradation, widening inequality, and uneven progress toward sustainability goals. Its principal objective was to renew global commitment to the principles of Agenda 21, strengthen partnerships, and accelerate concrete actions at national and international levels.

The key outcome of the Summit was the Johannesburg Plan

► Johannesburg  
sustainability review



► Johannesburg Plan Implementation

of Implementation (JPOI), which reaffirmed the Rio principles and outlined practical strategies to achieve sustainable development. The JPOI called for:

- Eradication of poverty as an indispensable requirement for sustainable development.
- Access to clean water and sanitation as a basic human right.
- Promotion of renewable energy and improvement of energy efficiency.
- Conservation of biodiversity and sustainable fisheries management.
- Integration of health, education, and gender equality into sustainable development policies.

► Implementation and partnerships focus

Unlike the Rio 1992 Summit, which focused on policy formulation, the Johannesburg Summit shifted the emphasis to implementation and partnerships. It promoted the concept of Type II partnerships, involving governments, civil society, and the private sector working collaboratively on specific sustainable development goals. The WSSD reaffirmed that globalization must be made consistent with sustainability principles. It reinforced the need for integrating environmental protection with poverty reduction and economic growth—laying the groundwork for the later Millennium Development Goals (MDGs). The Summit also underscored that sustainable development requires collective responsibility, shared knowledge, and active participation of all stakeholders.

## 2. The United Nations Conference on Sustainable Development (Rio+20), 2012

► Rio+20 sustainability vision

Two decades after the Earth Summit, the international community reconvened in Rio de Janeiro, Brazil, from 20–22 June 2012, for the United Nations Conference on Sustainable Development (Rio+20). The conference theme “*The Future We Want*” reflected a growing awareness that economic progress must be aligned with social equity and ecological integrity.

Rio+20 sought to evaluate progress since 1992 and identify new pathways to sustainability amidst emerging global challenges such as climate change, financial instability, and resource scarcity. It focused on two key themes:

1. The Green Economy in the context of sustainable development and poverty eradication; and
2. The institutional framework for sustainable development, emphasizing governance reforms and global coordination.

### **Outcome Document: “The Future We Want”**

The outcome document of Rio+20 reaffirmed earlier commitments from Stockholm, Rio, and Johannesburg, while laying the groundwork for a new global agenda—the Sustainable Development Goals (SDGs). It emphasized:

- Integration of the three dimensions of sustainability—economic, social, and environmental.
- Strengthening of the United Nations Environment Programme (UNEP) to play a greater role in global governance.
- The need for improved financing, technology transfer, and capacity building, particularly for developing nations.
- Commitment to inclusive participation of all stakeholders, including youth, Indigenous communities, and local governments.

Rio+20 thus became a bridge between the early decades of environmental diplomacy and the emerging global development agenda centred on sustainability.

### **1.3.2.7 Recent global initiatives and multilateral agreements**

#### **The Paris Agreement (2015)**

► Limit the global temperature rise

Adopted under the United Nations Framework Convention on Climate Change (UNFCCC) in December 2015, the Paris Agreement represents a historic global accord to combat climate change. Its central aim is to limit the global temperature rise to well below 2°C above pre-industrial levels, with efforts to cap it at 1.5°C.

Key features of the Paris Agreement include:

- Nationally Determined Contributions (NDCs): Each country sets voluntary emission reduction targets, reviewed every five years.





- **Global Stocktake:** A mechanism to assess collective progress.
- **Climate Finance:** Developed countries pledged to mobilize USD 100 billion annually to assist developing countries in mitigation and adaptation.
- **Adaptation and Resilience:** Strengthened capacity to cope with climate impacts through national adaptation plans.

### **The 2030 Agenda for Sustainable Development (2015)**

Adopted at the United Nations Sustainable Development Summit (New York, 2015), the 2030 Agenda set forth 17 Sustainable Development Goals (SDGs) and 169 targets to be achieved by 2030. The Agenda integrates the three pillars of sustainability and provides a universal framework for eradicating poverty, protecting the planet, and ensuring prosperity for all.

#### ► 2030 Sustainable Development Agenda

Several SDGs directly relate to environmental protection, including:

- SDG 6: Clean water and sanitation
- SDG 7: Affordable and clean energy
- SDG 12: Responsible consumption and production
- SDG 13: Climate action
- SDG 14: Life below water
- SDG 15: Life on land

The SDGs represent the culmination of the global sustainability discourse initiated at the 1992 Rio Summit, offering a time-bound, results-oriented approach to global development.

### **The Kunming–Montreal Global Biodiversity Framework (2022)**

#### ► Aims to halt and reverse biodiversity loss

Adopted at the 15th Conference of the Parties (COP15) to the Convention on Biological Diversity, held in Montreal in December 2022, this framework aims to halt and reverse biodiversity loss by 2030. The agreement includes 23 global targets, among them the pledge to conserve at least 30% of the planet's land and oceans by 2030 ("30×30" goal).

The framework emphasizes restoring degraded ecosystems, reducing harmful subsidies, and ensuring equitable sharing of benefits from biodiversity. It reflects a renewed global commitment to protecting life on Earth as a foundation for sustainable development.

### The Global Shift toward a Circular Economy

#### ► Circular economy

In the years following Rio+20, nations and corporations have increasingly embraced the circular economy—an approach that minimises waste, keeps products and materials in use, and regenerates natural systems. Supported by UNEP and the UN Industrial Development Organization (UNIDO), this model aims to decouple economic growth from environmental degradation. Circular economy initiatives focus on resource efficiency, eco-design, recycling, and responsible consumption, aligning closely with SDG 12. The approach is now seen as essential for achieving climate neutrality and sustainable industrial transformation.

#### ► Institutional mechanisms for sustainability

The post-Rio period witnessed a deepening of institutional mechanisms for sustainability. UNEP was strengthened by the creation of the United Nations Environment Assembly (UNEA) in 2012, which provides a universal platform for environmental decision-making. Similarly, coordination between the UNFCCC, CBD, and UNCCD has improved through joint work programmes and shared reporting frameworks. At the same time, environmental governance has expanded beyond governments to include cities, businesses, and communities as active partners. Multi-level and multi-stakeholder governance is now a defining feature of global sustainability efforts.

### 1.3.3 Role of the United Nations and Its Agencies in Environmental Protection

#### ► International cooperation on environmental issues

Since its founding in 1945, the United Nations (UN) has played a central role in fostering international cooperation on environmental issues. The UN's environmental engagement evolved from sectoral initiatives in health, food, and science to a comprehensive global governance system following the Stockholm Conference (1972) and the establishment of the United Nations Environment Programme (UNEP).

The UN system functions as a multi-tiered coordination framework, integrating environmental concerns into broader goals of peace, security, and sustainable development. The



► Multi-tiered coordination framework

Economic and Social Council (ECOSOC) and the United Nations General Assembly (UNGA) provide overarching policy direction, while specialised agencies and programmes implement their respective mandates within their respective domains.

The UN Environment Assembly (UNEA), created in 2012 as the successor to UNEP's Governing Council, now serves as the highest-level global decision-making body on environmental matters. UNEA's resolutions guide the environmental dimensions of the 2030 Agenda for Sustainable Development and ensure policy coherence across UN institutions.

- **Key agencies**

- 1. United Nations Environment Programme (UNEP):**

UNEP functions as the UN's environmental authority, coordinating global responses to environmental challenges. It supports scientific research, policy development, and multilateral environmental agreements. UNEP also leads initiatives such as the Global Environment Outlook (GEO) reports and the Green Economy Initiative, guiding the integration of environmental concerns into economic policy.

- 2. United Nations Development Programme (UNDP):**

► Sustainable human development

As the UN's principal agency for development assistance, UNDP promotes sustainable human development by integrating environmental sustainability into poverty eradication and governance programmes.

- 3. Food and Agriculture Organization (FAO):**

► FAO and environmental sustainability

FAO addresses the environmental dimensions of agriculture, forestry, and fisheries. It promotes sustainable land and water management, combats deforestation, and implements programmes such as the REDD+ mechanism (Reducing Emissions from Deforestation and Forest Degradation). FAO's State of the World's Forests and State of Food and Agriculture reports provide essential data for environmental policymaking.

- 4. World Health Organization (WHO):**

WHO focuses on the intersection between environment and public health. It monitors the impacts of pollution, unsafe

► Environment and public health

water, and climate change on health outcomes. WHO's Global Air Quality Guidelines (2021) and its leadership in the Health and Environment Strategic Alliance underscore the growing importance of environmental determinants of health.

### 5. United Nations Educational, Scientific and Cultural Organization (UNESCO):

► UNESCO environmental initiatives

UNESCO contributes through environmental education, science, and conservation programmes. Its Man and the Biosphere (MAB) Programme promotes ecosystem conservation and sustainable livelihoods through a global network of biosphere reserves. UNESCO also advances climate literacy and interdisciplinary research under its Education for Sustainable Development (ESD) framework.

Collectively, these agencies represent an integrated UN environmental governance architecture, where policy formulation, research, and field-level implementation work together to advance global sustainability.

#### 1.3.3.1 The Sustainable Development Goals (SDGs)

- Evolution from Millennium Development Goals (MDGs) to SDGs

► Millennium Development Goals

The Millennium Development Goals (MDGs), adopted in 2000, were the UN's first unified framework for addressing global development challenges, including poverty, education, and health. Although they made progress in several areas, the MDGs were limited in scope when it came to environmental sustainability.

► Sustainable Development Goals

Building upon their experience, the international community adopted the 2030 Agenda for Sustainable Development at the UN Summit in September 2015, introducing 17 Sustainable Development Goals (SDGs) and 169 targets. The SDGs are universal, integrated, and indivisible, addressing the environmental, social, and economic pillars of sustainable development in a single global framework.

Unlike the MDGs, which focused primarily on developing countries, the SDGs apply to all nations, emphasizing shared responsibility for the planet's ecological and social well-being.





Collectively, these goals establish a clear environmental dimension across the 2030 Agenda. They align with earlier commitments from the Rio Conventions (UNFCCC, CBD, UNCCD) and reflect the interdependence of ecological stability and human development.

The SDGs mark a paradigm shift by embedding environmental sustainability into mainstream development planning. The UN system now employs integrated approaches—such as UN Common Country Analyses (CCAs) and Cooperation Frameworks—to ensure that environmental goals are incorporated into national policies, climate strategies, and financing mechanisms.

### 1.3.3.2 Global Partnerships and Cooperation

- **Role of multilateral institutions and funding mechanisms (GEF, UNEP, UNDP)**

The global environmental agenda is supported by several financial and institutional mechanisms designed to promote cooperation and equitable participation:

1. Global Environment Facility (GEF):

Established in 1991, the GEF serves as the primary funding mechanism for implementing the Rio Conventions. Managed jointly by UNEP, UNDP, and the World Bank, the GEF finances projects addressing biodiversity conservation, climate change mitigation, land degradation, and international waters. Over its eight funding cycles, the GEF has supported more than 5,000 projects in 170 countries.

► Funding mechanism

2. UNEP and UNDP Collaboration:

UNEP and UNDP jointly administer numerous environmental and climate projects, including the UN-REDD Programme (Reducing Emissions from Deforestation and Forest Degradation), the Climate Promise, and the NDC Partnership. These initiatives help countries develop low-carbon development strategies, build resilience, and access global climate finance.

► UN climate initiatives

3. Multilateral Development Banks (MDBs):

Institutions such as the World Bank, Asian Development Bank (ADB), and African Development Bank (AfDB) provide

► Funding for sustainable infrastructure

significant funding for sustainable infrastructure, renewable energy, and environmental restoration. The World Bank's Climate Investment Funds (CIFs), for instance, have mobilized billions of dollars for clean energy and adaptation projects.

#### 4. The Green Climate Fund (GCF):

Created under the UNFCCC in 2010, the GCF supports developing countries in implementing climate adaptation and mitigation strategies. It operates on the principle of shared but differentiated responsibilities and aims to balance investments between adaptation and mitigation efforts.

- **Collaborative initiatives between developed and developing nations**

International environmental cooperation increasingly relies on North–South and South–South partnerships. Developed nations contribute financial resources and technology, while developing nations provide local innovation and on-ground implementation. Examples include:

► Global environmental partnerships

- The Technology Mechanism under the UNFCCC, which facilitates the transfer of clean technologies.
- South–South Cooperation Platforms, such as the Partnership for Action on Green Economy (PAGE), jointly supported by UNEP, ILO, and UNIDO.
- Global Compact and SDG Partnerships, where private sector entities collaborate with governments to promote sustainable production and corporate responsibility.

These partnerships embody the spirit of collective responsibility and shared benefits, ensuring that global environmental progress is inclusive and equitable.

### 1.3.4 United Nations Environmental Management Group (UNEMG)

► Formation of UNEMG

The United Nations Environmental Management Group (UNEMG) was established in 2001, following the United Nations General Assembly Resolution 53/242 (1999), which endorsed the recommendations of the UN Task Force on Environment and Human Settlements. The decision reflected a growing need for greater coordination among UN agencies to address the increasingly complex and interlinked environmental challenges of the 21st century.



► System-wide environmental coordination

The core purpose of the UNEMG is to enhance system-wide coherence, inter-agency collaboration, and policy alignment on environmental and human settlement issues across the United Nations system. It was designed to prevent fragmentation, duplication of effort, and inconsistencies in environmental work across different UN bodies.

The UNEMG operates under the overall leadership of the United Nations Environment Programme (UNEP), which serves as its secretariat and functions as a high-level coordination mechanism to ensure that environmental concerns are integrated into all aspects of UN policies, programmes, and operations.

► Broad UN membership

The membership of the UNEMG includes over 50 UN entities, programmes, specialized agencies, and secretariats of multilateral environmental agreements (MEAs). Its members include key UN bodies such as UNDP, FAO, WHO, UNESCO, UNIDO, ILO, World Bank, WMO, and UN-Habitat, among others.

The UNEMG operates under the authority of the UN System Chief Executives Board for Coordination (CEB), which provides overall strategic direction for inter-agency collaboration.

The UNEMG's coordination structure consists of:

- A senior-level plenary, comprising representatives from all member entities, which meets annually to set priorities and review progress.
- Technical and Issue Management Groups, which address specific thematic areas such as biodiversity, climate change, sustainable procurement, and environmental safeguards.
- An EMG Secretariat, housed in UNEP (Nairobi and Geneva), which provides administrative, analytical, and coordination support.

The UNEMG primarily operates through collaborative modalities, including inter-agency consultations, joint task teams, and peer learning dialogues. These mechanisms promote synergy among UN institutions and ensure that environmental strategies complement each other rather than compete.

### 1.3.4.1 Functions and major areas of work

The UNEMG's work is oriented toward improving the

collective environmental performance of the United Nations system. Its major functions include:

#### ► Major Functions

1. **Policy Coordination and Strategic Alignment:**Facilitating coherence among UN entities in implementing global environmental agreements, including the Paris Agreement, the 2030 Agenda for Sustainable Development, and the Post-2020 Global Biodiversity Framework. Ensuring that environmental dimensions are systematically integrated into UN strategies, such as the UN Sustainable Development Cooperation Frameworks (UNSDCFs) and the Common Country Analyses (CCAs).
2. **Promoting Environmental Sustainability in UN Operations:** Developing common standards and indicators for sustainable procurement, energy efficiency, waste reduction, and climate-neutral operations.
3. **Facilitating Knowledge Exchange and Best Practices:** Conducting the Nexus Dialogue Series, which brings together UN bodies, governments, and civil society to discuss interlinkages between environmental, economic, and social objectives—such as the health–environment nexus, food–biodiversity systems, and green recovery.
4. **Supporting Implementation of Global Agendas:** Assisting UN entities in aligning their activities with the environmental goals of the 2030 Agenda, particularly SDGs 12, 13, 14, and 15. Coordinating inter-agency contributions to multilateral environmental fora such as the United Nations Environment Assembly (UNEA) and the High-Level Political Forum on Sustainable Development (HLPF).

#### **1.3.4.2 Role in promoting system-wide environmental coherence within the UN**

The UNEMG serves as the institutional bridge connecting global-level environmental policy formulation with implementation across the diverse entities of the UN system. It enhances coherence in three key ways:

1. **Harmonizing Policies:**By aligning strategies, guidelines, and performance standards across agencies, the EMG prevents redundancy and fosters a unified approach to sustainability.





► Environmental  
coordination  
Mechanism

2. **Mainstreaming Environment Across Sectors:** The UNEMG ensures that issues such as climate change, biodiversity, pollution, and resource management are not confined to UNEP or environmental divisions but are incorporated into broader programmes in health, agriculture, education, and industry.
3. **Integrating Science and Policy:** Through coordination with UNEP's scientific divisions and other expert bodies (e.g., IPCC, IPBES), the EMG supports evidence-based policymaking and collective reporting on environmental progress within the UN system.

By promoting a “One UN” approach, the EMG contributes to more effective delivery of environmental outcomes and improved accountability of the UN's sustainability performance.

### 1.3.4.3 Key initiatives and contemporary relevance

The UN EMG's current work reflects the evolving priorities of the international community and the growing complexity of sustainability governance. Major initiatives include:

► Unified, Cross-Sanctional and Science driven approach

1. **Greening the Blue Initiative (2010–Present):** A flagship EMG programme that tracks and reports the environmental performance of UN entities. The 2023 report shows significant reductions in carbon emissions from UN facilities and travel, reflecting progress toward the goal of a climate-neutral UN by 2030.
2. **Sustainability Strategy for the UN System (2020–2030):** Coordinated by the EMG, this strategy provides a unified vision for environmental and social sustainability across UN operations, encompassing procurement, waste management, and biodiversity protection.
3. **Nexus Dialogue Series:** A multi-stakeholder forum addressing cross-sectoral themes like climate–security nexus, health–environment interdependence, and nature-based solutions. The series strengthens knowledge sharing and fosters integrated policy responses.

4. Support for Global Environmental Agendas: The EMG supports coordinated UN engagement in implementing the Paris Agreement, SDGs, and Kunming–Montreal Biodiversity Framework, ensuring that all agencies contribute consistently toward shared objectives.

In the context of climate emergency, biodiversity loss, and global pollution crises, the EMG’s role has become increasingly vital. It represents the institutional mechanism for achieving policy coherence, operational efficiency, and accountability across the UN system.

By fostering collaboration among specialized agencies, the EMG helps the UN deliver as “one” on environmental sustainability. Its ongoing work reinforces the idea that protecting the planet requires a unified, cross-sectoral, and science-driven approach.

#### **Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES)**

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an independent intergovernmental body established in 2012 to provide policymakers with clear, science-based assessments on the state of global biodiversity and the benefits nature provides to people. Often compared to the IPCC in its role for climate science, IPBES brings together experts from around the world to evaluate biodiversity trends, identify the drivers of ecosystem decline, and outline policy options for conservation and sustainable use. By translating complex scientific evidence into accessible and policy-relevant findings, IPBES helps governments and institutions make informed decisions to protect nature and support human well-being.

## Summarized Overview

Environmental protection has emerged as a cornerstone of global governance and sustainable development. This unit traced the historical and institutional journey of environmental protection, from isolated national efforts to a comprehensive global movement. Beginning with the 1972 Stockholm Conference, the world recognized that environmental issues are not confined by borders and require collective action. The creation of the United Nations Environment Programme (UNEP) marked a major institutional milestone, establishing a permanent mechanism for coordinating global environmental efforts. The discussions on key international agreements such as the Montreal Protocol (1987) and the Rio Earth Summit (1992) illustrated how international cooperation can lead to meaningful environmental outcomes. The Montreal Protocol remains one of the most successful global treaties, while the Rio Summit embedded the idea of sustainable development into the global policy framework. The later adoption of the Sustainable Development Goals (SDGs) reaffirmed this vision, highlighting the inseparable link between human well-being, economic progress, and ecological balance.

Equally important, the unit highlighted the role of the United Nations and its specialized agencies in promoting environmental awareness, policy coordination, and capacity-building across countries. The establishment of the United Nations Environmental Management Group (UNEMG) further strengthened coherence and collaboration among UN agencies, ensuring that environmental concerns are addressed in a unified and cross-sectoral manner. In essence, the unit emphasizes that environmental protection today is both a shared global responsibility and a strategic administrative function. It requires strong international institutions, ethical leadership, and public participation to translate environmental commitments into concrete actions.

## Self-Assessment

1. What is the main objective of environmental protection?
2. Which international conference in 1972 marked the beginning of global environmental cooperation?
3. Which 1987 international agreement aimed to protect the ozone layer?
4. Which key global framework adopted in 2015 integrates social, economic, and environmental goals?
5. What is the full form of UNEP?
6. What is the main function of the United Nations Environmental Management Group (UNEMG)?

7. In which city was the Earth Summit of 1992 held?
8. What is the main focus of the Paris Agreement adopted in 2015?
9. How did the Rio Earth Summit (1992) contribute to global environmental governance?
10. How does the United Nations Development Programme (UNDP) contribute to environmental protection?

## Assignments

1. Trace the evolution of international environmental protection efforts from the 1972 Stockholm Conference to the present.
2. Discuss the significance of the 1972 Stockholm Conference in shaping the global environmental agenda.
3. Describe the role of the United Nations Environment Programme (UNEP) in coordinating global environmental policies and initiatives.
4. Discuss how the Sustainable Development Goals (SDGs) integrate environmental protection with economic and social development.
5. Analyse the challenges faced by international organizations in achieving effective global environmental governance.

## Reference

1. Barrow, C. J. (1999). *Environmental Management: Principles and Practice*. London: Routledge
2. Wright, R. T., & Boorse, D. F. (2018). *Environmental Science: Toward a Sustainable Future* (13th ed.). Boston, MA: Pearson Education.
3. Khitoliya, R. K. (2004). *Environmental Pollution: Management and Control for Sustainable Development*. New Delhi: S. Chand Publishing.
4. Miller, G. T., & Spoolman, S. (2021). *Environmental Science*. Boston, MA: Cengage Learning.





## Suggested Reading

1. United Nations. (1973). *Report of the United Nations Conference on the Human Environment, Stockholm, 5–16 June 1972* (A/CONF.48/14/Rev.1). United Nations Publication.
2. United Nations. (1969). *Vienna Convention on the Law of Treaties, done at Vienna on 23 May 1969, entered into force on 27 January 1980* (United Nations, Treaty Series, vol. 1155, p. 331). United Nations.
3. United Nations. (1992). *The Rio Declaration on Environment and Development*. United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, 3–14 June 1992.
4. United Nations Department of Economic and Social Affairs (UN DESA), & United Nations Development Programme (UNDP). (2012). *Synthesis of national reports for Rio+20*. United Nations.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU



# **BLOCK 2**

## **Environment Laws and Planning in India**

# UNIT 1

## Environmental Policy and Governance

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ describe the constitutional provisions related to environmental protection in India.
- ▶ explain the main features of important environmental laws such as the Wildlife Protection Act, Biological Diversity Act, and Environment Protection Act.
- ▶ assess how laws, policies, and public participation together support sustainable environmental governance in India.
- ▶ discuss the role of the judiciary and important court cases in protecting the environment.

### Background

Environmental protection has become one of the most defining concerns of our time. The growing threats of climate change, deforestation, pollution, and biodiversity loss have made it clear that the well-being of humanity is inseparably linked with the health of the natural environment. In India, this understanding has deepened over the decades, shaping a rich tradition of environmental thought and governance. From the moral vision embedded in the Constitution to the extensive network of laws, policies, and judicial interventions, India's environmental framework represents both a legal commitment and an ethical responsibility.

The evolution of environmental policy in India reflects the changing priorities of society; from resource exploitation during the colonial era to sustainable development in the modern age. The 1972 Stockholm Conference on Human Environment was a turning point that encouraged India to frame comprehensive laws such as the Wildlife





(Protection) Act, 1972, and later the Environment (Protection) Act, 1986. The tragic Bhopal Gas Disaster (1984) further highlighted the urgent need for strong legal mechanisms to prevent industrial and ecological disasters. Over time, policies like the National Environment Policy (2006) and the Biological Diversity Act (2002) have expanded the focus from mere protection to the sustainable and equitable use of natural resources.

Equally significant has been the role of the judiciary, which has interpreted the right to life under Article 21 to include the right to a clean and healthy environment. Through landmark judgments and the rise of Public Interest Litigations (PILs), the courts have ensured that environmental protection is not just a state obligation but a fundamental right of every citizen.

This unit introduces learners to the constitutional, legislative, and policy frameworks that form the foundation of environmental governance in India. It explores how environmental protection has evolved into a collective duty shared by the State, the judiciary, and the people. By understanding these frameworks, learners can appreciate how law and governance strive to balance development with ecological sustainability, ensuring that the planet we inherit remains livable for generations to come.

## Keywords

Directive Principles of State Policy, Fundamental Duties, Biodiversity Management Committees (BMCs), Environmental Impact Assessment (EIA), National Green Tribunal (NGT), Public Interest Litigation (PIL)

## Discussion

### 2.1.1 Introduction

#### ► Environmental Governance Framework in India

Environmental policy and governance have become essential in India, as rapid development, population pressure, and ecological degradation demand a coherent and legally supported response. The Constitution provides the initial justification by recognising environmental protection as vital for public welfare and sustainable progress. To address growing threats to wildlife, biodiversity, and ecological balance, laws such as the Wildlife Protection Act, 1972, and the Biological Diversity Act, 2002, were enacted. Likewise, escalating pollution and emerging environmental risks necessitated the Environmental Protection Act, 1986, and the National Environment Policy, 2006, to guide national action, regulate human impacts, and secure long-term

environmental stability.

## 2.1.2 Constitutional Provisions for Environmental Protection

### ► Environmental Protection as Fundamental Duty

The Constitution of India, though originally silent on environmental matters, has evolved into one of the most progressive frameworks for environmental protection in the world. Through judicial interpretation and constitutional amendments, environmental protection has been transformed from a moral obligation into a fundamental right and duty shared by both the State and citizens. The 42nd Amendment of 1976 marked a decisive turning point, introducing explicit constitutional mandates for safeguarding the environment. Today, India's constitutional framework stands as a cornerstone of environmental governance, ensuring the integration of ecological responsibility into governance, policy-making, and civic life.

### 2.1.2.1 Fundamental Rights and Duties Related to the Environment

Environmental protection in India is deeply rooted in the framework of Fundamental Rights and Fundamental Duties, which together define the moral and legal responsibilities of both the State and its citizens.

#### Article 21 - Right to Life and Environment

### ► Article 21

Article 21 of the Constitution guarantees the Right to Life and Personal Liberty, declaring that *"No person shall be deprived of his life or personal liberty except according to the procedure established by law."* Over time, the judiciary has expansively interpreted this right to include the right to live in a clean, healthy, and pollution-free environment. The Supreme Court, in a series of landmark judgments such as *Subhash Kumar v. State of Bihar* (1991), *M.C. Mehta v. Union of India* (1987, 1997), and *Vellore Citizens Welfare Forum v. Union of India* (1996), recognised that a degraded environment directly violates the right to life. (Thus, environmental protection is now a judicially enforceable fundamental right).

#### Article 14 - Right to Equality

Article 14 ensures equality before the law and equal protection of the laws. Arbitrary or discriminatory environmental decisions



► Article 14

by the State, such as granting permissions that endanger ecological balance or public health, can be challenged under this article. The judiciary has repeatedly upheld that environmental governance must adhere to principles of fairness, equality, and non-arbitrariness.

► Articles 19(1)(a) and 19(1)(g)

**Article 19(1)(a) and 19(1)(g) - Freedom of Speech and Profession**

Articles 19(1)(a) and 19(1)(g) together protect the freedom of expression and the freedom to practice any profession or carry on any trade or business. Citizens have the right to raise environmental concerns publicly, as seen in *Rural Litigation and Entitlement Kendra v. State of Uttar Pradesh* (1985), where public-spirited individuals used this freedom to highlight ecological degradation. However, the freedom to carry on a trade or profession is subject to reasonable restrictions under Article 19(6), ensuring that economic activity does not compromise environmental integrity or public welfare.

**Article 48A and 51A(g) - Directive and Moral Duties**

The 42nd Constitutional Amendment inserted Article 48A in the Directive Principles of State Policy and Article 51A(g) in the Fundamental Duties, explicitly articulating environmental obligations.

► Article 48A

- Article 48A (Directive Principles):  
"The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country."  
This provision reflects the State's policy responsibility to ensure ecological balance and environmental conservation as part of its governance duties.

► Article 51A(g)

- Article 51A(g) (Fundamental Duties):  
"It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife, and to have compassion for living creatures."  
This article makes environmental stewardship a civic duty, linking ecological responsibility to the broader ethos of citizenship and public morality.

Together, these provisions establish a dual responsibility: the State must create and enforce environmental laws, and citizens must participate actively in maintaining ecological balance.

### 2.1.2.2 Directive Principles of State Policy and Environmental Responsibilities

The Directive Principles of State Policy (DPSPs) in Part IV of the Constitution guide the State in formulating policies for environmental protection and sustainable development.

#### ► Directive Principles of State Policy

- Article 47: Obligates the State to raise the standard of living and public health, implicitly linking environmental hygiene with health and welfare. A polluted environment directly undermines this constitutional goal.
- Article 48A: Mandates the State to "protect and improve the environment and safeguard forests and wildlife." These provisions, though not justiciable in a court of law, are fundamental to the governance of the country. They provide a moral and policy foundation for environmental legislation such as the Wildlife Protection Act, 1972, Forest (Conservation) Act, 1980, and Environment Protection Act, 1986.
- In addition, Articles 38, 39(b), and 47, when read together, reflect the State's obligation to promote environmental justice and sustainable resource use as essential to social and economic welfare.

### 2.1.2.3 Role of Judiciary in Environmental Protection

The Indian judiciary has played a transformative role in expanding environmental protection from a policy objective to an enforceable right. Through a series of Public Interest Litigations (PILs), the Supreme Court and High Courts have developed a robust framework of environmental jurisprudence.

#### Judicial Expansion of Article 21

In cases such as *M.C. Mehta v. Union of India (Ganga Pollution Case)* and *Taj Trapezium Case*, the Court interpreted the right to life as encompassing the right to a wholesome environment. The judiciary has treated environmental degradation as a violation of fundamental rights, thereby empowering citizens to seek redress.





### M.C. Mehta v. Union of India

M.C. Mehta v. Union of India arose after a shocking 1985 incident in Haridwar, where the Ganga River caught fire due to a toxic chemical layer discharged by a pharmaceutical unit. Concerned about the worsening state of the river, environmental activist M.C. Mehta filed a PIL before the Supreme Court, alleging that government agencies had failed to curb pollution despite the availability of environmental laws. The Court asked him to focus on Kanpur, where untreated industrial and municipal effluents, especially from leather tanneries, were flowing directly into the river. This case later came to be widely referred to as the “Ganga Pollution Case.”

The Supreme Court highlighted the constitutional commitment to environmental protection under Articles 48-A and 51-A(g) and reaffirmed the prohibitions in Section 24 of the Water Act, 1974. It held that all tanneries must install primary or secondary effluent treatment plants and clarified that financial limitations could not justify violating environmental norms. The Court criticised the inaction of State authorities and the Central Government and directed them to take firm measures to stop pollution. As a long-term initiative, it instructed the Central Government to introduce environmental education in all educational institutions, supply free textbooks, and train teachers to promote environmental awareness among students.

### Public Interest Litigation (PIL) and Citizen Activism

The liberalisation of locus standi allowed any concerned citizen or organisation to file petitions on behalf of affected communities. PILs have been instrumental in addressing large-scale ecological issues such as:

#### ► Public Interest Litigation and Environment

- Industrial pollution (*Oleum Gas Leak Case*, 1987)
- Deforestation (*T.N. Godavarman v. Union of India*, 1997)
- River pollution (*M.C. Mehta v. Union of India*, 1988)

Through such cases, the judiciary not only enforced laws but also established environmental principles and procedural safeguards, creating a distinct branch of environmental law in India.

### 2.1.2.4 Principles of Environmental Jurisprudence

Indian environmental jurisprudence is mainly guided by three internationally recognised principles, repeatedly upheld by the Supreme Court:

► Internationally recognised principles

1. **Polluter Pays Principle:** This principle holds that the polluter must bear the cost of damage caused to the environment. It was first affirmed in *Indian Council for Enviro-Legal Action v. Union of India* (1996) and subsequently reinforced in *Vellore Citizens Welfare Forum v. Union of India* (1996). It ensures accountability and discourages environmental negligence by industries.
2. **Precautionary Principle:** Recognised in *Vellore Citizens* and *A.P. Pollution Control Board v. Prof. M.V. Nayudu* (1999), this principle asserts that a lack of scientific certainty should not be an excuse for postponing measures to prevent potential environmental harm. It demands proactive, rather than reactive, environmental governance.
3. **Public Trust Doctrine:** Introduced into Indian Jurisprudence in *M.C. Mehta v. Kamal Nath* (1997), this doctrine establishes that natural resources such as air, water, forests, and wildlife are held in trust by the State for public use and cannot be exploited for private or commercial gain. It places a fiduciary duty on the government to act as a trustee of nature.

These principles, embedded in Indian judicial decisions, have become the ethical and legal foundation for environmental governance, ensuring that development remains ecologically sustainable and socially just.

► Constitutional philosophy into a nation's ecological conscience.

India's constitutional provisions for environmental protection represent a synthesis of rights, duties, and policy commitments. From the Directive Principles and Fundamental Rights to the dynamic role of the judiciary, the Constitution provides a holistic framework that balances human development with ecological sustainability. By interpreting environmental protection as intrinsic to the Right to Life, the Supreme Court has ensured that environmental governance is not merely an administrative responsibility but a constitutional imperative. The evolution of environmental jurisprudence in India stands as a testament to how constitutional philosophy can shape a nation's ecological conscience.



► Wildlife  
Conservation Legal  
Framework

### 2.1.3 Wildlife Protection Act, 1972

The *Wildlife (Protection) Act, 1972* marks a crucial milestone in India's environmental history. Enacted at a time when wildlife habitats were rapidly shrinking due to deforestation, hunting, and unregulated development, this legislation provided the first comprehensive legal framework for the protection of wild animals, birds, and plants across the country. It was passed by Parliament under Article 252 of the Constitution at the request of eleven states, highlighting a cooperative federal approach to environmental conservation. The Act reflects India's commitment to both national conservation goals and global obligations, especially following the 1972 Stockholm Conference on the Human Environment.

The primary objectives of the Act are to ensure:

1. Protection of wildlife species and habitats.
2. Regulation of hunting and trade in wildlife products.
3. Establishment of protected areas such as national parks and sanctuaries.
4. Creation of institutional mechanisms to enforce conservation laws.

Through successive amendments in 1982, 1986, 1991, 1993, 2002, and 2022, the Act has evolved to meet emerging challenges, including biodiversity loss, illegal wildlife trade, and habitat degradation.

#### 2.1.3.1 Objectives, Structure, and Salient Features

##### Objectives

The core aim of the Act is to ensure the protection and preservation of India's rich wildlife heritage, recognising that wildlife plays a vital role in maintaining ecological balance and supporting human life. The Act serves to:

► Protection and  
preservation of  
India's rich wildlife  
heritage

- Prohibit hunting of wild animals and birds.
- Conserve species threatened by human activities.
- Regulate trade and commerce in wildlife and its derivatives.
- Safeguard habitats by establishing protected areas under legal control.

It provides a unified framework applicable to both Central and State governments, promoting coordinated action for wildlife conservation.

#### Salient Features

##### ► Salient Features

1. **Comprehensive Coverage:** The Act applies to the entire country (except Jammu and Kashmir until 2019) and covers both terrestrial and aquatic species.
2. **Prohibition of Hunting:** Hunting of wild animals listed in Schedules I-IV is prohibited, except for specific purposes such as scientific research, disease control, or protection of human life.
3. **Establishment of Protected Areas:** The Act empowers governments to declare regions as Wildlife Sanctuaries, National Parks, Conservation Reserves, and Community Reserves.
4. **Regulation of Trade:** Trade in wild animals and their derivatives is strictly regulated through a system of permits, licences, and penalties.
5. **Penalties and Enforcement:** Violations attract imprisonment and fines, with enhanced penalties for offences involving endangered species listed in Schedule I and Part II of Schedule II.
6. **Amendments and Modernisation:** The 2002 and 2022 amendments introduced stronger enforcement mechanisms, community participation, and better coordination among agencies.

#### 2.1.3.2 Enforcement Mechanisms and Key Institutions

To implement the Act effectively, several national and state-level authorities have been created:

##### (a) National Board for Wildlife (NBWL)

- Headed by the Prime Minister, the NBWL formulates policies, advises the government on wildlife conservation, and reviews progress under the Act.
- It plays a crucial role in approving projects within protected areas and ensuring that development aligns with ecological priorities.





(b) State Boards for Wildlife

- Chaired by the Chief Minister of each state, these boards perform advisory and oversight functions at the state level.

(c) Chief Wildlife Warden and Other Officers

- Appointed by the State Governments, these officers are empowered to enforce the Act, investigate offences, and ensure compliance with conservation norms.

► National and state level authorities

(d) Wildlife Crime Control Bureau (WCCB)

- Established in 2007 under the Ministry of Environment, Forest and Climate Change (MoEFCC), this central agency combats organised wildlife crime and illegal trade.
- It works in coordination with INTERPOL, customs, and forest departments, enhancing law enforcement efficiency.

(e) National Tiger Conservation Authority (NTCA)

- Constituted under the 2006 amendment to strengthen Project Tiger, the NTCA oversees tiger reserves and monitors ecological integrity through scientific management.

### 2.1.3.3 Amendments and Contemporary Relevance

Over time, the Wildlife (Protection) Act has undergone several amendments to address changing conservation needs and emerging threats:

1. 1982 Amendment: Allowed limited capture of wildlife for scientific research.
2. 1991 Amendment: Strengthened penalties and expanded the list of protected species; introduced community involvement.
3. 2002 Amendment: Introduced *Conservation Reserves* and *Community Reserves*; provided for the *Wildlife Crime Control Bureau*.
4. 2022 Amendment: Introduced stricter penalties for illegal trade and poaching. Rationalised Schedules from six to

four for better management. Enhanced the powers of the Central Government to regulate international trade in species as per CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

► From Reactive  
to Proactive  
Conservation

The Act remains the foundation of India's wildlife conservation regime, aligning with international commitments such as the Convention on Biological Diversity (1992) and CITES (1973). It continues to play a crucial role in protecting endangered species like tigers, elephants, and rhinos while also integrating community-based conservation models. The *Wildlife (Protection) Act, 1972* reflects India's deep-rooted ecological philosophy, which views nature as integral to human existence. It combines strict legal protection, scientific management, and community participation to ensure the survival of species and habitats. The evolution of the Act demonstrates India's shift from reactive conservation to proactive ecological governance, making it one of the most comprehensive wildlife protection frameworks in the world.

Through this legislation, India continues to uphold its constitutional and moral commitment to environmental stewardship, ensuring that development proceeds in harmony with nature rather than at its expense.

### 2.1.4 Biological Diversity Act, 2002

► Broad-Based  
Biodiversity  
Protection

Building upon the constitutional vision of environmental protection and the statutory foundation laid by earlier legislation such as the *Wildlife (Protection) Act, 1972* and the *Forest (Conservation) Act, 1980*, the *Biological Diversity Act, 2002* represents a comprehensive framework for conserving India's biological wealth. While the Wildlife Act focused primarily on fauna and protected areas, the Biological Diversity Act (BDA) broadens the concept of conservation to encompass entire ecosystems, genetic resources, and traditional knowledge associated with biological heritage.

► Three core objectives

This Act was enacted to implement India's commitments under the Convention on Biological Diversity (CBD), 1992, to which India became a signatory in 1994. The CBD emphasised three core objectives: conservation of biodiversity, sustainable use of its components, and fair and equitable sharing of benefits arising from their utilisation. The BDA, therefore, embodies the idea that biodiversity is not merely an ecological asset but



also a socio-economic and cultural resource, central to India's sustainable development and community livelihoods.

#### 2.1.4.1 Objectives and Scope

The *Biological Diversity Act, 2002* seeks to achieve three interlinked objectives:

##### ► Interlinked objectives

1. Conservation of Biological Diversity: Protecting the variety and variability of life forms-plants, animals, and micro-organisms-found in ecosystems across India.
2. Sustainable Use of Biological Resources: Ensuring that natural resources are utilised without endangering their regenerative capacity or ecological balance.
3. Fair and Equitable Sharing of Benefits (ABS): Guaranteeing that communities conserving biological resources receive due benefits from their commercial or scientific use.

The Act applies to biological resources and associated knowledge, including plants, animals, microorganisms, and their genetic material, along with the traditional knowledge embedded within local and tribal cultures.

#### 2.1.4.2 Institutional Framework

To operationalise its objectives, the Act establishes a three-tier institutional structure that links national, state, and local governance levels. This decentralised framework ensures both top-down policy implementation and bottom-up participation.

##### (a) National Biodiversity Authority (NBA)

- Headquartered in Chennai, the NBA is a statutory body under the Ministry of Environment, Forest and Climate Change (MoEFCC).
- It regulates access to biological resources and associated knowledge by foreign individuals, companies, and organisations.
- The NBA provides advisory functions to the Central Government on biodiversity conservation, sustainable use, and equitable benefit-sharing.
- It also approves applications for intellectual property rights (IPRs) related to biological resources obtained

from India, ensuring compliance with benefit-sharing obligations.

**(b) State Biodiversity Boards (SBBs)**

- Constituted by State Governments, the SBBs oversee access to biological resources within their jurisdictions.
- Their primary role is to advise, regulate, and monitor the sustainable use of biodiversity at the state level.
- They also ensure coordination with local self-governing bodies and assist in policy implementation.

**(c) Biodiversity Management Committees (BMCs)**

- BMCs represent the grassroots level of biodiversity governance, typically established at Panchayat, Municipality, or local body levels.
- Their main task is to prepare People's Biodiversity Registers (PBRs), which are local records that document biological resources, traditional uses, and knowledge systems.
- The BMCs play a vital role in ensuring community participation and in protecting local intellectual property from exploitation.

This three-tier system ensures that the governance of biodiversity is inclusive, participatory, and locally anchored, reflecting the spirit of India's federal and democratic ethos.

### **2.1.4.3 Access and Benefit-Sharing (ABS) Mechanism**

One of the most significant contributions of the *Biological Diversity Act, 2002* is its emphasis on Access and Benefit Sharing (ABS), a system that recognises and rewards communities that conserve and sustain biodiversity.

- **Access Regulation:** Any person or organisation, particularly foreign entities, seeking to obtain biological resources for research, commercial utilisation, or bio-survey must obtain prior approval from the National Biodiversity Authority. Indian citizens or organisations also need to inform the concerned State Biodiversity Board before accessing biological resources for commercial purposes.
- **Benefit Sharing:** The Act mandates that benefits





► Recognises and rewards communities that conserve and sustain biodiversity

derived from the commercial utilisation of biological resources, such as through patents, product development, or bioprospecting, must be shared equitably with the local communities that have conserved and passed on traditional knowledge. Such benefits may take the form of monetary compensation, technology transfer, joint research, or community development projects.

This mechanism helps to protect indigenous knowledge systems and prevents biopiracy, the commercial exploitation of biological resources without due recognition or benefit to their traditional custodians.

A well-known example is the case of Neem and Turmeric patents, where India successfully challenged biopiracy attempts using documentation from local traditional knowledge systems.

#### 2.1.4.4 Challenges in Implementation

While the BDA is a progressive law, its implementation faces several challenges:

► Implementation changes

1. Limited Awareness and Capacity: Many local communities and officials are unaware of the provisions and benefits of the Act.
2. Incomplete Biodiversity Documentation: People's Biodiversity Registers are still incomplete or poorly maintained in many regions.
3. Coordination Gaps: Weak coordination among the NBA, SBBs, and BMCs often delays decision-making.
4. Commercial Pressures: The demand for biological resources by industries sometimes leads to unsustainable extraction.
5. Intellectual Property Conflicts: The interface between biodiversity conservation and patent laws remains complex, requiring continued legal harmonisation.

Despite these challenges, the Act remains a vital instrument for integrating ecological conservation with community welfare.

#### 2.1.4.5 Significance and Contemporary Relevance

The *Biological Diversity Act, 2002* has expanded the scope of environmental governance in India by linking biodiversity

► Linking biodiversity with livelihood, knowledge, and justice

with livelihood, knowledge, and justice. It aligns with India's commitments under global conventions like the CBD and the Sustainable Development Goals (SDGs), especially Goal 15 (*Life on Land*). By empowering local communities and creating legal safeguards for traditional knowledge, the Act reinforces the constitutional vision of participatory governance and environmental justice. It represents a shift from *species-centric conservation* to a broader approach that respects ecological interdependence, cultural diversity, and economic equity.

► Bridges the gap between conservation and development

The *Biological Diversity Act, 2002* stands as a testament to India's evolving environmental consciousness. While earlier laws like the *Wildlife Protection Act, 1972* focused on the protection of fauna and flora, this Act brings people and their knowledge systems to the centre of conservation policy. By promoting sustainable use and equitable benefit-sharing, it bridges the gap between conservation and development, ensuring that the protection of nature becomes a shared responsibility among the State, the scientific community, and citizens.

### 2.1.5 Environmental Protection Act, 1986

► Response to growing ecological challenges

The evolution of India's environmental governance reached a defining moment with the enactment of the Environmental (Protection) Act, 1986 (EPA). This law emerged in response to growing ecological challenges and the urgent need for a comprehensive legal framework following the Bhopal Gas Tragedy of 1984—a disaster that underscored the catastrophic consequences of weak environmental safeguards. While the *Wildlife Protection Act, 1972* and the *Biological Diversity Act, 2002* focused on specific aspects of environmental conservation, the EPA was designed as umbrella legislation, integrating various strands of environmental regulation into a single, coherent structure. It provides the Central Government with extensive powers to take measures necessary for protecting and improving environmental quality across land, air, and water.

Complementing this statutory framework, the National Environment Policy (NEP), 2006, represents a strategic policy document that articulates the government's vision for sustainable development in the 21st century. Together, these two instruments form the foundation of India's modern environmental governance system, balancing ecological integrity with socio-economic growth.

The Bhopal Gas Tragedy (1984), which resulted in thousands



### ► Bhopal Gas Tragedy

of deaths due to the accidental release of toxic methyl isocyanate gas, exposed serious deficiencies in India's industrial safety and environmental regulation. In the aftermath, it became evident that existing laws-such as the *Water Act, 1974* and the *Air Act, 1981*-were inadequate to address complex, interrelated environmental risks. At the same time, India's commitment under the Stockholm Conference on Human Environment (1972) obligated the nation to establish stronger institutional mechanisms for environmental protection. These international and domestic pressures led to the enactment of the Environment (Protection) Act, 1986, under Article 253 of the Constitution, which empowers Parliament to make laws for implementing international agreements.

The Act thus serves as a bridge between India's constitutional vision (Articles 48A and 51A(g)) and its international commitments, giving the State wide-ranging powers to ensure environmental safety, regulate pollutants, and prevent hazards that endanger public health and ecosystems.

#### 2.1.5.1 Structure, Powers, and Functions under the Act

The *Environmental Protection Act, 1986* is a concise but powerful piece of legislation consisting of 26 sections divided into four chapters. It defines "environment" broadly to include "*water, air, and land and the inter-relationships which exist among and between them and human beings, other living creatures, plants, microorganisms, and property.*"

##### Key Powers and Provisions

1. **Comprehensive Scope:** The Act provides a unified legal framework for regulating all forms of pollution and environmental degradation. Unlike previous laws confined to specific resources, it encompasses the entire environment as a single, interdependent system.
2. **Centralised Authority:** The Central Government is vested with extraordinary powers to coordinate environmental policies, establish standards, and issue directions to industries, local authorities, or any individuals. These powers include:
  - Closing or regulating industries or operations causing pollution.

### ► Powers and Provisions

- Restricting the supply of electricity, water, or other services.
  - Setting environmental quality and emission standards.
- 3. Standard Setting and Regulation:** The Act empowers the government to: Establish environmental quality standards. Specify permissible limits for pollutants in air, water, and soil. Regulate hazardous substances and ensure their safe handling, storage, and disposal.
- 4. Rule-Making Authority:** Under Section 6, the Central Government can frame detailed rules for preventing and controlling environmental pollution. This has led to the formulation of key regulations such as:
- Environment (Protection) Rules, 1986.
  - Coastal Regulation Zone (CRZ) Notification, 1991.
  - Environmental Impact Assessment (EIA) Notification, 2006.
  - Hazardous Waste Management Rules, 2016.
- 5. Penalties for Non-Compliance:** Violations of the Act are punishable by imprisonment of up to five years or a fine of up to one lakh rupees, or both. For continued non-compliance, penalties can be extended to seven years, ensuring deterrence against environmental violations.
- 6. Right to Approach Courts:** Section 19 enables individuals and organisations to approach the courts by filing complaints, subject to the requirement of prior notice. This provision promotes public participation in environmental governance and strengthens accountability by allowing citizens to initiate legal action for violations under the Act.

Through these provisions, the EPA operates as the core regulatory instrument that integrates environmental concerns into India's administrative, industrial, and developmental processes.

### 2.1.5.2 Linkages with EIA, CRZ

The *Environmental Protection Act* functions as a parent





legislation from which several subsidiary mechanisms and rules have evolved, addressing specific aspects of environmental governance:

#### (a) Environmental Impact Assessment (EIA)

##### ► Functions as a parent legislation

The EIA Notification of 2006, issued under the EPA, mandates that any industrial or infrastructural project likely to affect the environment must undergo an impact assessment before approval. EIA ensures:

- Prior environmental clearance based on scientific evaluation.
- Public participation through hearings.
- Periodic monitoring and compliance reviews.

This process institutionalises the "precautionary principle," ensuring that developmental decisions are ecologically informed.

#### (b) Coastal Regulation Zone (CRZ) Rules

The CRZ Notifications regulate activities in coastal stretches to protect fragile ecosystems such as mangroves, coral reefs, and nesting grounds. They categorise coastal areas into zones (CRZ-I to CRZ-IV) based on ecological sensitivity and permissible human activity.

### 2.1.6 National Environment Policy 2006

##### ► Addressing Environmental Policy Gaps

The National Environment Policy (NEP), 2006, approved by the Union Cabinet on 18 May 2006, provides India with a comprehensive and integrated framework for environmental governance. It builds upon earlier national policies such as the National Forest Policy (1988), the National Conservation Strategy and Policy Statement on Environment and Development (1992), and the Policy Statement on Abatement of Pollution (1992). Rather than replacing these instruments, the NEP seeks to widen their scope, address persistent gaps, and respond to emerging environmental challenges in the context of India's development experience.

#### Vision of the National Environment Policy

The core vision of the NEP is:

- To achieve sustainable development by balancing

environmental protection with economic growth and social justice.

- To recognise the conservation of natural resources as the foundation of livelihood security and long-term human well-being.
- To integrate environmental sustainability into poverty alleviation and development planning.
- To promote intergenerational equity by safeguarding environmental resources for future generations.

### Conceptual Understanding of Environment

#### ► Environment– Development Integration

The policy adopts a comprehensive understanding of the environment, including natural and man-made entities and their interrelationships that provide present and future value to human society. Environmental concerns arise primarily from the degradation of these entities due to human actions. The NEP therefore treats environmental management as inseparable from development planning and governance.

### Key Environmental Challenges in India

#### ► Growth, Poverty, and Environment

The NEP identifies the close linkage between environmental degradation, poverty, and economic growth as a central challenge. The degradation of land, forests, water resources, biodiversity, and air quality disproportionately affects the poor, particularly rural and tribal communities whose livelihoods depend directly on natural resources. Urban environmental degradation, including pollution and inadequate waste management, adversely affects public health and employment opportunities. Institutional failures, weak enforcement of laws, inappropriate subsidies, market failures, and governance constraints are recognised as underlying causes of environmental decline.

### Objectives of the Policy

The objectives of the National Environment Policy are designed to address contemporary environmental challenges and may evolve over time. The key objectives include:

- Conservation of critical ecological systems, biodiversity, and natural and man-made heritage essential for life support and livelihoods.
- Ensuring equitable access to environmental resources



### ► Key objectives

and environmental quality for all sections of society, with special emphasis on vulnerable and poor communities.

- Promoting judicious and sustainable use of environmental resources to meet present needs without compromising future generations.
- Integrating environmental concerns into all policies, plans, programmes, and projects related to economic and social development.
- Improving efficiency in the use of environmental resources and strengthening environmental governance mechanisms.

### Guiding Principles of the National Environment Policy

The National Environment Policy is guided by a set of well-established principles derived from constitutional values, judicial interpretations, and international environmental law. These include:

### ► Well-established principles derived from constitutional values, judicial interpretations, and international environmental law

- Human-centred sustainable development: Human well-being is placed at the centre of environmental concerns while recognising ecological limits.
- Right to Development: Development is recognised as a right, provided it meets the environmental and developmental needs of both present and future generations.
- Environmental Protection as Part of Development: Environmental considerations are treated as integral to the development process.
- Precautionary Principle: A lack of full scientific certainty should not delay measures to prevent serious or irreversible environmental damage.
- Economic Efficiency and Polluter Pays Principle: Environmental costs should be internalised, ensuring that polluters bear the cost of environmental damage.
- Equity: Emphasis is placed on both intra-generational and inter-generational equity in access to and use of environmental resources.
- Public Trust Doctrine: The State acts as a trustee of natural resources for public use and benefit.

- **Decentralisation and Participation:** A greater role is given to State and local institutions, communities, and stakeholders in environmental governance.
- **Integration:** Environmental concerns must be integrated across sectors and levels of governance.
- **Preventive Action and Appropriate Standards:** Priority is given to preventing environmental damage through suitable and context-specific environmental standards.

### **Institutional Framework and Decentralisation**

► Greater decentralisation is promoted

The policy emphasises strengthening environmental institutions at the Central, State, and local levels. Greater decentralisation is promoted to enable State governments, Panchayati Raj Institutions, and Urban Local Bodies to address location-specific environmental issues effectively. At the same time, accountability, transparency, scientific capacity, and independence in regulatory decision-making are emphasised.

► Continuous process of monitoring, review, and revision

### **Review and Implementation Mechanism**

Recognising the dynamic nature of environmental challenges, the NEP envisages a continuous process of monitoring, review, and revision. Periodic evaluation of policy implementation is considered essential to ensure responsiveness to new scientific knowledge, socio-economic changes, and emerging environmental concerns.

► Sustainable Development Governance Framework

The National Environment Policy, 2006, marks a significant milestone in India's environmental governance framework. By explicitly linking environmental conservation with livelihood security, equity, and economic development, the policy provides a holistic vision of sustainable development. It serves as a guiding framework for legislation, administration, and participatory environmental management in India.

► Judicial interpretation and civic involvement

### **2.1.7 Judicial Activism and Public Participation**

In India, environmental governance draws strength not only from statutory laws but also from the active engagement of the judiciary and the public. While Acts such as the Wildlife Protection Act (1972), Environment Protection Act (1986), and Biological Diversity Act (2002) form the legal basis, their effectiveness has been shaped significantly by judicial interpretation and civic involvement.





## Judicial Activism in Environmental Protection

### ► Transformative role

Indian courts have played a transformative role by expanding environmental rights through Articles 14, 19, and 21. By reading the right to a clean environment into Article 21, the judiciary elevated environmental protection to the status of a fundamental right.

### Key Cases:

### ► Integrating judiciary to environmental governance

- **RLEK v. State of Uttar Pradesh (1985-87):** Ordered the closure of limestone quarries to protect the Himalayan ecosystem.
- **M.C. Mehta v. Union of India (Oleum Gas Leak, 1986):** Introduced the principle of absolute liability.
- **Subhash Kumar v. State of Bihar (1991):** Affirmed the right to a pollution-free environment under Article 21.
- **Vellore Citizens' Welfare Forum (1996):** Adopted the Polluter Pays and Precautionary Principles.
- **M.C. Mehta v. Kamal Nath (1997):** Applied the Public Trust Doctrine.
- **T.N. Godavarman v. Union of India (1997-ongoing):** Expanded the definition of "forest" and paved the way for CAMPA.

Through these decisions, the judiciary introduced core doctrines such as Sustainable Development, Intergenerational Equity, and the Precautionary Principle, making them integral to environmental governance.

### Public Interest Litigation (PIL)

Judicial relaxation of locus standi enabled citizens and organisations to file petitions on behalf of affected groups. This paved the way for landmark environmental interventions, including:

### ► PIL-Driven Environmental Enforcement

- **Ganga Pollution Case (1988)** - directing the closure of polluting tanneries.
- **Taj Trapezium Case (1997)** - shifting industries to cleaner fuels to protect the Taj Mahal.

PILs also enabled courts to monitor compliance, issue continuous mandamus, and supervise environmental administration.

## Public Participation

Judicial efforts complement public involvement, making environmental protection a shared responsibility.

► Environmental protection a shared responsibility

**Role of Civil Society:** Organisations like CSE, WWF-India, and movements such as Chipko (1973) and Narmada Bachao Andolan (1985) have influenced policy and litigation.

**Role of Media:** Acts as a watchdog by exposing pollution, illegal mining, and environmental violations.

**Role of Local Communities:** The Biological Diversity Act (2002) institutionalised community participation through Biodiversity Management Committees (BMCs) and People's Biodiversity Registers (PBRs).

## Institutional Mechanisms Supporting Participation

- **National Green Tribunal (2010):** Provides speedy environmental justice based on sustainable development and precautionary principles.
- **Environmental Impact Assessment (EIA):** Ensures public consultation for major projects.
- **Right to Information Act (2005):** Enhances transparency and accountability.

## Judicial-Public Synergy

Judicial activism often stems from citizen initiatives, and court rulings, in turn, inspire public action. Cases like Ganga Pollution, Oleum Gas Leak, and Godavarman show how legal and civic forces together drive environmental reforms.

► Powerful blend of judicial innovation and public participation

India's environmental governance is shaped by a powerful blend of judicial innovation and public participation. Courts have expanded environmental rights, while citizens, civil society, and local communities have ensured accountability and democratic legitimacy. This synergy forms the foundation of participatory environmental governance aimed at achieving sustainable development without compromising the rights of future generations.



## Summarized Overview

This unit has explored how environmental protection in India has evolved from a constitutional vision into a comprehensive system of governance. Beginning with the fundamental rights and duties enshrined in the Constitution, it highlighted how Articles 21, 48A, and 51A(g) together provide both the legal foundation and moral direction for environmental stewardship. The discussion on major legislations such as the *Wildlife (Protection) Act, 1972*, *Biological Diversity Act, 2002*, and *Environment (Protection) Act, 1986* illustrated India's commitment to conserving nature and ensuring the sustainable use of resources. The *National Environment Policy, 2006* further reinforced this vision by linking environmental goals with national development and global sustainability commitments.

The unit also examined the transformative role of the judiciary in interpreting environmental rights and principles, and how public participation, community involvement, and civil society action have deepened environmental democracy. Together, these constitutional, legal, and participatory mechanisms demonstrate that environmental protection in India is not merely a policy concern but a shared social and ethical duty. The unit thus offers a holistic understanding of how India's environmental governance strives to balance ecological integrity with economic and human development.

## Self-Assessment

1. What does Article 48A of the Constitution direct the State to do?
2. Mention any one *Fundamental Duty* of citizens related to environmental protection.
3. In which year was the *Wildlife (Protection) Act* enacted?
4. What was the main environmental disaster that led to the enactment of the *Environment (Protection) Act, 1986*?
5. What are the three objectives of the *Biological Diversity Act, 2002*?
6. Which institution is responsible for maintaining the *People's Biodiversity Register (PBR)* at the local level?
7. What is meant by the *Polluter Pays Principle*?
8. What is the main purpose of an *Environmental Impact Assessment (EIA)*?
9. What is the central goal of the *National Environment Policy, 2006*?
10. Mention one way in which citizens or NGOs can participate in environmental governance in India.

## Assignments

1. Discuss the constitutional provisions that provide a foundation for environmental protection in India.
2. Analyse the structure and functioning of the institutional framework under the *Biological Diversity Act, 2002*.
3. Discuss the importance of the *National Environment Policy, 2006*.
4. Suggest measures to strengthen environmental governance in India by integrating law, policy, and citizen participation.
5. Evaluate the impact of the *Bhopal Gas Tragedy* on India's environmental legislation and industrial safety policies.

## Reference

1. Government of India. (1972). *The Wildlife (Protection) Act, 1972*. New Delhi: Ministry of Environment, Forest and Climate Change.
2. Government of India. (1980). *The Forest (Conservation) Act, 1980*. New Delhi: Ministry of Environment, Forest and Climate Change.
3. Government of India. (1986). *The Environment (Protection) Act, 1986*. New Delhi: Ministry of Environment, Forest and Climate Change.
4. Government of India. (1974). *The Water (Prevention and Control of Pollution) Act, 1974*. New Delhi: Ministry of Environment, Forest and Climate Change.
5. Government of India. (1927). *The Indian Forest Act, 1927*. New Delhi: Ministry of Environment, Forest and Climate Change.
6. Government of India. (2002). *The Biological Diversity Act, 2002*. New Delhi: Ministry of Environment, Forest and Climate Change.
7. Government of India. (2006). *National Environment Policy, 2006*. New Delhi: Ministry of Environment, Forest and Climate Change.
8. Government of India. (2010). *The National Green Tribunal Act, 2010*. New Delhi: Ministry of Law and Justice.
9. Ministry of Environment, Forest and Climate Change (MoEFCC). (2023). *Annual Report 2022-23*. New Delhi: Government of India.
10. Supreme Court of India. (1986). *M.C. Mehta v. Union of India* (Oleum Gas Leak Case). AIR 1987 SC 1086.





11. Supreme Court of India. (1996). *Vellore Citizens' Welfare Forum v. Union of India*. AIR 1996 SC 2715.
12. Supreme Court of India. (1997). *M.C. Mehta v. Kamal Nath*. AIR 2000 SC 1997.
13. Supreme Court of India. (1991). *Subhash Kumar v. State of Bihar*. AIR 1991 SC 420.
14. Supreme Court of India. (1985-87). *Rural Litigation and Entitlement Kendra v. State of Uttar Pradesh*. AIR 1988 SC 2187.
15. Supreme Court of India. (1997-ongoing). *T.N. Godavarman Thirumulpad v. Union of India*. AIR 1997 SC 1228.
16. Government of India. (n.d.). *Constitution of India*. Retrieved from <https://legislative.gov.in/constitution-of-india>

## Suggested Reading

1. Barrow, C. J. (1999). *Environmental Management: Principles and Practice*. London: Routledge
2. Wright, R. T., & Boorse, D. F. (2018). *Environmental Science: Toward a Sustainable Future* (13th ed.). Boston, MA: Pearson Education.
3. Khitoliya, R. K. (2004). *Environmental Pollution: Management and Control for Sustainable Development*. New Delhi: S. Chand Publishing.
4. Miller, G. T., & Spoolman, S. (2021). *Environmental Science*. Boston, MA: Cengage Learning.
5. Gaur, M. (2008). *National Environmental Policy*. New Delhi, India: Alfa Publications.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU



## UNIT 2

# Environmental Management: Planning and Control

### Learning Outcomes

Upon completion of this unit, the learner will be able to :

- ▶ identify the key institutions involved in environmental planning and control in India.
- ▶ discuss how environmental standards, monitoring systems, and regulatory procedures operate at national and state levels.
- ▶ evaluate the effectiveness of India's environmental governance mechanisms by assessing institutional coordination and implementation challenges.

### Background

Understanding the environment requires more than knowing its problems; it requires knowing *how societies respond* to those problems. The previous block introduced learners to the meaning of environmental management, major global and national environmental challenges, and the evolution of international efforts to protect the planet. With that foundation, this unit moves from "what the problems are" to "how we plan, regulate, and control environmental management in India."

Environmental protection becomes effective only when supported by strong institutions, clear laws, and coordinated planning. India's system of environmental governance is shaped by a combination of constitutional principles, national legislation, regulatory bodies, and specialised adjudicatory mechanisms. This unit explores these structures in depth to help learners understand how environmental decisions are made and implemented on the ground.

At the centre of this system is the Ministry of Environment, Forest and Climate Change (MoEFCC), which functions as the national authority for environmental policy and regulation. Its work ranges from drafting laws and setting environmental priorities to coordinating national programmes on pollution control, conservation, and climate action. Alongside the Ministry, the National Green Tribunal (NGT) plays a vital role by

ensuring that environmental disputes are resolved swiftly and scientifically. Through landmark decisions, the Tribunal has influenced how industries operate, how natural resources are managed, and how principles such as the polluter-pays and precautionary approaches are interpreted in practice.

Environmental planning and control also rely on the day-to-day work of the Central and State Pollution Control Boards. These Boards monitor air and water quality, enforce environmental standards, regulate industries through consent mechanisms, and oversee waste management systems. Their activities offer practical illustrations of how environmental laws translate into field-level action-whether through checking industrial effluent discharge, assessing urban air quality, or guiding waste segregation and disposal.

Finally, the unit introduces important committees and reports that have shaped India's environmental governance framework. These bodies helped identify gaps in administration, propose reforms, and strengthen long-term environmental planning. Together, these themes equip learners with a clear and practical understanding of how environmental management functions in India-how institutions interact, how decisions are made, and how regulatory systems respond to complex ecological challenges.

## Keywords

National Green Tribunal (NGT), Environmental Governance, Waste Management Rules, Environmental Policy Framework.

## Discussion

### 2.2.1 Introduction

► Reactive solutions to preventive, sustainability-oriented strategies

Environmental management has evolved from a narrow focus on pollution control to a comprehensive system that recognises the interdependence between human activities and natural ecosystems. Rising global concerns, such as climate change, biodiversity loss, and resource depletion, have shifted attention from reactive solutions to preventive, sustainability-oriented strategies.

► Institutional approaches to environmental management

A major milestone in this shift was the 1972 Stockholm Conference, which linked environmental protection with human well-being and led to the creation of the United Nations Environment Programme (UNEP). This period encouraged countries to adopt structured, institutional approaches to environmental management and to integrate environmental





concerns into development planning.

► From Fragmented  
to Comprehensive  
Governance

India's environmental governance grew within this global context. Before the 1970s, environmental issues were handled through scattered regulations. After Stockholm, India developed a comprehensive legal framework through key laws such as the Water Act (1974), Air Act (1981), and Environment Protection Act (1986). These laws established the foundation for regulating pollution, conserving natural resources, and promoting sustainable development. This evolution also led to the creation of specialised ministries, regulatory bodies, and adjudicatory institutions that guide policy-making, enforce standards, and coordinate environmental governance across government levels.

## 2.2.2 Institutional Framework for Environmental Management

### 2.2.2.1 Ministry of Environment, Forest and Climate Change (MoEFCC)

- **Historical evolution and organisational structure**

► Institutionalising  
Environmental  
Management

The Ministry of Environment, Forest and Climate Change (MoEFCC), originally established in 1985 as the Ministry of Environment and Forests and renamed in 2014, serves as India's central authority for environmental protection and natural resource management. Its creation marked a significant shift in the country's approach to environmental governance by bringing together diverse functions, such as forest conservation, wildlife protection, pollution regulation, and environmental planning, under a single administrative framework. Over the years, the Ministry's responsibilities have expanded in response to emerging ecological challenges, scientific advancements, and India's growing engagement in global environmental initiatives.

► Scientific and  
Regulatory  
Infrastructure

Functioning through an extensive organisational network, the Ministry operates multiple divisions, regional offices, statutory bodies, and autonomous institutions that undertake scientific, technical, educational, and regulatory tasks. Bodies such as the Forest Survey of India, Wildlife Crime Control Bureau, Indira Gandhi National Forest Academy, National Zoological Park, Zoological Survey of India, Botanical Survey of India, and the Indian Council of Forestry Research and Education contribute to research, monitoring, field-level implementation, and capacity

building. This institutional arrangement enables coordinated action across the country's diverse ecological regions.

- **Major functions, divisions, and programmes**

► Formulating and implementing national policies

MoEFCC is responsible for formulating and implementing national policies and programmes related to forest conservation, wildlife protection, pollution control, and environmental management. Its mandate includes promoting afforestation, restoring degraded landscapes, conserving biodiversity, regulating environmental impact assessments, and improving overall environmental quality. The Ministry operates within the framework of key environmental legislations such as the Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; Environment (Protection) Act, 1986; Wildlife (Protection) Act, 1972; and Forest (Conservation) Act, 1980.

► National and Regional Environmental Action

To carry out its mandates effectively, the Ministry works through specialised divisions dealing with forests, wildlife, climate change, environmental education and awareness, environmental policy, and trade-environment linkages. It also implements a wide range of programmes related to biodiversity conservation, wetland and coastal zone management, environmental education, pollution mitigation, and support for regional offices and associated institutions. These initiatives reflect the Ministry's attempt to address national priorities while responding to state-level and region-specific environmental challenges.

- **Coordination role in inter-ministerial, inter-governmental, and international affairs**

► Harmonising environmental policy within national development

The Ministry plays a central role in harmonising environmental policy within the broader framework of national development. It collaborates with various central ministries, state governments, regulatory agencies, and national institutions such as NITI Aayog to integrate environmental considerations into development planning and sectoral policies. Its divisions facilitate consultations on issues such as pollution control, climate change, trade-environment interactions, and the implementation of centrally sponsored schemes. The Ministry also works closely with State Pollution Control Boards, State Forest Departments, and local bodies to strengthen environmental governance across administrative levels.



► Engaging with global environmental organisations

At the international level, MoEFCC serves as India's nodal agency for engaging with global environmental organisations and multilateral agreements. It represents the country in international negotiations, coordinates national responses to global conventions, and manages India's commitments under frameworks such as the United Nations Environment Programme, the South Asia Co-operative Environment Programme, the Convention on Biological Diversity, the UN Framework Convention on Climate Change, and the UN Convention to Combat Desertification. Through these engagements, the Ministry ensures that India's environmental priorities are aligned with international standards while safeguarding national interests.

► Important institutional response to India's growing environmental challenges

#### 2.2.2.2 National Green Tribunal (NGT)

The establishment of the National Green Tribunal (NGT) in 2010 marked an important institutional response to India's growing environmental challenges. Before the NGT came into existence, environmental disputes were dealt with either in overburdened regular courts or by statutory authorities that lacked adequate jurisdiction and technical expertise. The judiciary had repeatedly highlighted the need for a specialised forum to address complex disputes involving environmental pollution, ecological degradation, and the scientific evaluation of environmental impacts. Several landmark Supreme Court decisions, including *M.C. Mehta v. Union of India* (1997) and *A.P. Pollution Control Board v. M.V. Nayudu* (1999), emphasised the urgent need for expert-based environmental adjudication.

► Green Courts

Following the Law Commission's 186th Report (2003), which recognised the non-functioning of earlier bodies such as the National Environment Tribunal (1995) and the National Environmental Appellate Authority (1997), Parliament enacted the National Green Tribunal Act, 2010. The Act came into force in October 2010, giving India one of the world's few dedicated Green Courts. Justice Lokeshwar Singh Pant became the first Chairperson of the Tribunal.

► Resolving civil environmental disputes

The Tribunal was envisaged as a speedy, expert-driven, and accessible forum for resolving civil environmental disputes, providing compensation for environmental harm, and ensuring the implementation of key environmental statutes.

- **Composition, Powers, and Jurisdiction Composition**

The NGT is structured to blend judicial expertise

► Judicial expertise  
with specialised  
scientific knowledge

with specialised scientific knowledge. According to Section 4 of the Act, the Tribunal comprises:

- A full-time Chairperson, who must be a former Supreme Court Judge or a Chief Justice of a High Court.
- Judicial Members, who are serving or retired Judges of High Courts or above.
- Expert Members, who possess advanced qualifications in environmental science or engineering, along with at least fifteen years of experience in environmental matters such as pollution control, biodiversity, forest conservation, hazardous substance management, or climate change.

This composition ensures that each bench is supported by both judicial reasoning and technical evaluation, a requirement repeatedly stressed in earlier judicial pronouncements.

### Powers

The Tribunal exercises powers comparable to those of a civil court. These include:

- Summoning and examining witnesses,
- Receiving evidence and affidavits,
- Granting interim orders or injunctions,
- Conducting hearings guided by the principles of natural justice rather than the strict application of the Civil Procedure Code or Evidence Act (Section 19).

The NGT is obligated to apply internationally recognised environmental principles, *such as sustainable development, the precautionary principle, and the polluter-pays principle* while delivering orders (Section 20).

Additionally, the NGT Act incorporates the no-fault liability principle for accidents involving hazardous substances (Section 17), enabling the swift grant of compensation.

### Jurisdiction

Under Section 14, the NGT holds original jurisdiction over all civil cases involving substantial environmental questions arising from statutes listed in Schedule I, including: Water Act, 1974, Air Act, 1981, Forest Conservation Act, 1980, Environment





Protection Act, 1986, Public Liability Insurance Act, 1991, Biological Diversity Act, 2002

► Appellate  
Jurisdiction of NGT

The Tribunal is empowered to hear appeals against orders, decisions, or directions issued by authorities under the environmental laws specified in the National Green Tribunal Act, 2010, as provided under Section 16. The NGT is headquartered in New Delhi and functions through regional benches in Pune, Bhopal, Chennai, and Kolkata to enhance access to environmental justice across different regions of the country.

- **Landmark Judgments and Their Implications**

The NGT has contributed significantly to advancing environmental governance through a series of impactful decisions:

- *Sudiep Shrivastava v. State of Chhattisgarh* (2014)

The NGT emphasised that although the Central Government is not strictly bound by the Forest Advisory Committee's advice, it must provide reasoned justification when deviating from expert recommendations. This judgment reinforced procedural fairness and scientific scrutiny in forest diversion cases.

- *M.P. Patil v. Union of India* (2014)

The Tribunal stressed the centrality of public participation and robust Rehabilitation and Resettlement (R&R) plans for large projects. It held that incomplete disclosures during environmental clearance processes violate the principles of sustainable development.

- *Vardhaman Kaushik v. Union of India*

Taking suo motu cognisance of Delhi's air pollution crisis, the NGT issued stringent directions, restricted old polluting vehicles, controlling waste burning, requiring the construction of cycle tracks, and regulating parking. These orders highlighted the Tribunal's proactive stance in addressing urban environmental challenges.

- *Manoj Misra v. Union of India*

The Tribunal issued comprehensive directions for restoring the Yamuna floodplains, including curbs on dumping debris, regulating activities along the riverbed, and improving sewage

treatment infrastructure. This case exemplifies the NGT's ecological restoration-oriented approach.

- **Performance and Challenges**

► **Performance**

In its early years, the NGT was widely appreciated for its swift disposal of cases, scientific approach to fact-finding, and strong enforcement of environmental principles. Its proactive orders helped improve transparency in the environmental clearance system and enhanced the accountability of public bodies. By mandating timely disposal of cases (ideally within six months), the NGT significantly contributed to reducing delays that historically plagued environmental litigation.

Despite its achievements, the Tribunal continues to face structural and operational constraints:

► **Challenges**

- A backlog of cases and delays due to insufficient judicial and expert members and limited staffing support. By 2014, nearly 40% of cases remained pending across benches.
- Limited regional presence, with only five benches nationwide, restricts access to justice for individuals living in remote areas.
- Ambiguity in determining compensation due to a lack of standardised scientific criteria for assessing environmental damage.
- Jurisdictional overlap with High Courts, as writ petitions under Article 226 continue to be filed for environmental issues, creating confusion for litigants.
- An increase in frivolous litigation, partly due to broad locus standi and public visibility of environmental issues.
- Inconsistent administrative support from government agencies, including occasional confrontations between the Ministry of Environment and Forests and the Tribunal.
- Weak enforcement by pollution control boards, resulting in delays in executing NGT orders.

Despite these challenges, the NGT remains a vital pillar of environmental governance in India. Its technical expertise, specialised mandate, and commitment to environmental principles have significantly strengthened environmental adjudication and contributed to shaping India's environmental policy landscape.



### 2.2.2.3 Central Pollution Control Board (CPCB)

► Central role in shaping India's environmental regulatory framework

The Central Pollution Control Board (CPCB) is a statutory body established in September 1974 under the *Water (Prevention and Control of Pollution) Act, 1974*. This marked India's first national-level institutional mechanism to regulate, prevent, and control water pollution. With the enactment of the *Air (Prevention and Control of Pollution) Act, 1981*, the CPCB's mandate was expanded to include the regulation of air pollution as well. This dual responsibility gave the Board a central role in shaping India's environmental regulatory framework.

► Technical arm

In addition to its statutory duties under the Water and Air Acts, the CPCB also acts as the technical arm of the Ministry of Environment, Forest and Climate Change (MoEFCC) for matters related to the *Environment (Protection) Act, 1986*. Through this role, it provides scientific expertise, monitoring data, and policy support for environmental management at the national level.

- **Mandate Under the Water and Air Acts**

The functions assigned to the CPCB under the two principal environmental laws can be summarised as follows:

**Under the Water Act (1974)**

- Promote the cleanliness of streams and wells through the prevention, control, and abatement of water pollution.
- Restore and maintain the wholesomeness of water bodies, including rivers, lakes, ponds, and groundwater.

**Under the Air Act (1981)**

- Improve and safeguard the quality of ambient air across the country.
- Prevent, control, and reduce air pollution from industrial, vehicular, and other sources.

These statutory obligations form the foundation of the CPCB's regulatory and advisory functions.

- **Environmental Monitoring: Air and Water**

**National Air Monitoring Programme (NAMP)**

Air quality monitoring is a central component of the CPCB's air quality management strategy. The National Air Monitoring

► Regulatory and Advisory functions

Programme (NAMP) was created to:

- Assess the current status and long-term trends of ambient air quality,
- Support regulation of emissions from industries and other sources, and
- Provide baseline air quality information for urban planning and industrial siting.

In addition to NAMP, the CPCB operates automatic real-time air monitoring, such as the long-established station at the ITO intersection in New Delhi. This station routinely monitors pollutants including RSPM, SPM, SO<sub>2</sub>, NO<sub>2</sub>, CO, and O<sub>3</sub>, and provides weekly updates on air quality.

### Water Quality Monitoring

Water quality monitoring is equally vital. India's dependence on rivers, lakes, ponds, and groundwater-often used for drinking without treatment-makes systematic monitoring indispensable.

The CPCB's responsibilities include:

► Systematic monitoring

- Collecting, analysing, and disseminating technical and statistical information on water pollution.
- Assessing the condition of India's major, medium, and minor rivers, many of which flow only during the monsoons and carry industrial or municipal wastewater during the dry months.
- Supporting national efforts to prevent degradation of water bodies and promote their restoration.

### Functions of the CPCB at the National Level

- As defined under the Water Act (Section 16) and Air Act (Section 16), the CPCB performs the following major functions:
- Advising the Central Government on matters related to the prevention and control of water and air pollution.
- Planning and supervising nationwide programmes for pollution prevention, control, and abatement.
- Coordinating the activities of State Pollution Control Boards (SPCBs) and resolving inter-state environmental disputes.
- Providing technical assistance and scientific guidance to SPCBs and conducting or sponsoring research on





pollution problems.

#### ► Major functions

- Organising training programmes for personnel involved in pollution monitoring and control.
- Conducting mass awareness activities using media and public outreach.
- Collecting, compiling, and publishing technical and statistical data on pollution.
- Preparing manuals, codes, and guidelines for sewage treatment, effluent disposal, and air pollution control systems.
- Laying down and revising standards for streams, wells, and ambient air quality, in consultation with State Governments.
- Disseminating information on pollution prevention and environmental protection.
- Performing any other function assigned by the Government of India.
- **CPCB as State Board for Union Territories**

In Union Territories (UTs), the CPCB also functions as the State Pollution Control Board. In this capacity, it:

- Advises UT administrations on the suitability of sites for industries likely to cause pollution.
- Sets standards for sewage and trade effluent treatment and for emissions from automobiles and industrial plants.
- Develops and recommends efficient methods of waste disposal, including land-based disposal.
- Promotes economically viable methods of sewage treatment, effluent treatment, and air pollution control.
- Identifies air pollution control areas under the Air Act.
- Assesses the ambient quality of water and air and inspects industrial units, sewage treatment facilities, and pollution-control equipment.

#### ► Guide and support environmental governance

The Government of India has delegated many of these powers

to local administrations in UTs, but the CPCB continues to guide and support environmental governance in these regions.

- **Organisational Structure of the CPCB**

► Specialised technical and administrative divisions

The CPCB consists of specialised technical and administrative divisions supported by nine regional directorates located in cities such as Bengaluru, Bhopal, Kolkata, Lucknow, Shillong, Vadodara, Chandigarh, Chennai, and Pune.

**Key Structural Components**

- Chairman
- Member Secretary
- Divisions for Industrial Pollution Control (IPC I-VII)
- Air Quality Management (AQM & AQMN)
- Water Quality Management (WQM I & II)
- Waste Management Divisions (WM I-III)
- Urban Pollution Control (UPC I & II)
- Administrative divisions (accounts, personnel, coordination, building, material management, Rajbhasha, etc.)
- Laboratories specialising in water and wastewater, air quality, trace organics, instrumentation, and biological analysis.

This multi-tiered structure enables the CPCB to address complex pollution issues through coordinated scientific, administrative, and regulatory mechanisms.

► Primary authority for monitoring, regulating, and guiding efforts to prevent and control pollution

The Central Pollution Control Board occupies a pivotal position in India's environmental governance system. Established under the Water Act and strengthened by subsequent legislation, it functions as the country's primary authority for monitoring, regulating, and guiding efforts to prevent and control pollution. Through its nationwide programmes, technical divisions, and coordination with State Boards and Union Territory administrations, the CPCB plays a vital role in safeguarding India's air and water resources and ensuring compliance with environmental standards.

#### **2.2.2.4 State Pollution Control Boards (SPCBs)**

State Pollution Control Boards (SPCBs) are the primary environmental regulatory bodies at the state level in India. They were first established under the *Water (Prevention and Control of Pollution) Act, 1974* to regulate, prevent, and control



► Environmental regulatory bodies at the state level in India

water pollution, and were later entrusted with additional powers under the *Air (Prevention and Control of Pollution) Act, 1981*. Over time, their mandate expanded through various rules and notifications under the *Environment (Protection) Act, 1986*, making them central institutions in the implementation of environmental law and the monitoring of compliance across states.

► Regulatory and advisory bodies

SPCBs function as both regulatory and advisory bodies. They grant consents to industries, monitor pollution levels, enforce standards, conduct inspections, and guide state governments on environmental matters. They also play a key role in training, research, public awareness, and emergency environmental management.

► Legal basis for State Pollution Control Boards

The *Water (Prevention and Control of Pollution) Act, 1974* provides the foundational legal basis for State Pollution Control Boards (SPCBs). Section 4 mandates the constitution of an SPCB and lays down its structure and powers. Their overarching purpose is to maintain and restore the wholesomeness of water bodies in the state.

► Integrates water and air quality management

Section 4 of the *Air (Prevention and Control of Pollution) Act, 1981* designates the SPCBs constituted under the Water Act as State Boards for air pollution as well. This dual mandate integrates water and air quality management under a single institutional structure.

Although SPCBs are not directly created by the Environment Act, the Act entrusts them with a wide set of implementation responsibilities through rules and notifications related to hazardous waste, hazardous chemicals, biomedical waste, solid waste, plastics, noise regulation, and environmental impact assessment.

### • Composition and Organisational Structure

Under the Water Act and Air Act, an SPCB typically includes:

- A Chairperson with knowledge or experience in environmental protection
- Official members representing the state government
- Members from local authorities
- Non-official members representing sectors such as industry, labour, agriculture, or fisheries

- Representatives of state-owned corporations
- A full-time Member Secretary with scientific/technical expertise

The Board may also form committees and appoint officers, scientific staff, and laboratory personnel.

#### **2.2.2.4.1 Major Functions of SPCBs**

The functions of SPCBs arise from three major legal sources:

##### **Functions Under the Water Act, 1974**

SPCBs are responsible for:

- \* Planning and executing programmes for the prevention, control, and abatement of water pollution.
- \* Advising the State Government on matters relating to water pollution.
- \* Collecting, compiling, and disseminating information on water pollution.
- \* Encouraging and undertaking research on water pollution problems.
- \* Organising training for personnel working in pollution control activities.
- \* Conducting inspections of sewage and trade effluent treatment plants.
- \* Reviewing and approving plans for sewage and effluent treatment systems.
- \* Laying down and modifying effluent standards for sewage and trade effluents.
- \* Classifying state water bodies based on quality and designated uses.

These functions ensure that SPCBs are actively involved in regulating water use, monitoring water quality, and enforcing compliance.

##### **Functions Under the Air Act, 1981**

SPCBs undertake:

- \* Preparation and implementation of programmes for air pollution control.
- \* Advising the State Government on air pollution matters.





- \* Collecting and disseminating information related to air pollution.
- \* Training programmes in collaboration with the Central Pollution Control Board (CPCB).
- \* Inspection of industrial plants, manufacturing processes, and control equipment.
- \* Assessment of air quality in air pollution control areas.
- \* Advising the State Government on the siting of industries.
- \* Any other function entrusted by the Central or State Government.

Through these responsibilities, SPCBs manage industrial emissions, monitor ambient air quality, and guide state-level policy interventions.

### **Functions Under the Environment (Protection) Act, 1986**

Under delegated powers from the Ministry of Environment, SPCBs implement a wide range of environmental rules, including:

- Hazardous Waste Management Rules
- Hazardous Chemicals Rules
- Rules for Genetically Engineered Organisms
- Chemical Accidents (Emergency Planning, Preparedness and Response) Rules
- Biomedical Waste Management Rules
- Plastic Waste Management Rules
- Solid Waste Management Rules
- Noise Pollution (Regulation and Control) Rules
- Batteries (Management and Handling) Rules
- EIA Notification (Public Hearing Role)

These responsibilities demonstrate the breadth of SPCBs' regulatory functions in environmental governance.

- **Enforcement and Monitoring Powers**

SPCBs possess strong enforcement powers under the Water and Air Acts, including:

- Authority to enter and inspect industrial units
- Power to take samples of water, sewage, effluents, emissions, or air
- Power to issue directions, including closure, prohibition, or regulation
- Power to initiate legal proceedings for violations
- Power to refuse or cancel consent for industries
- Ability to establish laboratories for testing and analysis

These powers ensure that SPCBs can enforce standards and initiate corrective measures.

- **Kerala State Pollution Control Board (KSPCB)**

The Kerala State Pollution Control Board (KSPCB) functions as the state-level authority responsible for implementing the Water Act, 1974, and the Air Act, 1981, along with various environmental rules issued under the Environment (Protection) Act, 1986. The Board is headed by a Chairman and a Member Secretary, supported by technical and administrative staff at the head office in Thiruvananthapuram. Its organisational structure includes three regional offices located in Thiruvananthapuram, Ernakulam, and Kozhikode, each supervising multiple district offices across the state. These district offices coordinate regulatory functions such as issuing consents, conducting inspections, monitoring pollution levels, and responding to environmental complaints. The Board's Central Laboratory, staffed by qualified environmental scientists and engineers, undertakes sampling, testing, and analysis of air, water, and waste to support compliance and enforcement. The technical hierarchy includes posts such as Chief Environmental Engineer, Senior Environmental Engineer, Environmental Engineer, Assistant Environmental Engineer, and Assistant Engineer, while non-technical divisions handle administration and accounts. Through this decentralised structure, the KSPCB ensures continuous field-level monitoring and provides scientific, regulatory, and advisory support to promote effective prevention and control of pollution in Kerala.

► **State-Level Pollution Control Mechanism**

- **Significance of SPCBs in Environmental Governance**

SPCBs are pivotal in implementing India's environmental



► Implementing India's environmental laws at the state level

laws at the state level. Their responsibilities encompass:

- Regulating industries and ensuring compliance with pollution standards
- Monitoring environmental quality across air, water, soil, and noise
- Responding to pollution incidents and safeguarding public health
- Promoting sustainable practices among industries and local bodies
- Supporting environmental planning and policy-making

With expanding mandates, SPCBs play a central role in India's transition towards ecological protection and sustainable development.

• **Key Initiatives and State-Level Mechanisms**

**Action Plans for Polluted River Stretches**

► Restoring polluted rivers

SPCBs implement comprehensive plans for restoring polluted rivers identified under national monitoring programmes. These plans typically address sewage management, industrial effluent control, catchment protection, and enforcement measures in urban and peri-urban regions.

► Industrial Cluster Pollution Management

**Management of Industrial Clusters and Urban Hotspots**

Using indices developed at the national level, SPCBs identify critically and severely polluted industrial clusters and coordinate cluster-specific remediation measures. They collaborate with district authorities, industrial associations, and local bodies to address emissions, effluents, and waste management.

► State-Level Environmental Monitoring

**Strengthening State Monitoring Networks**

States maintain networks for ambient air quality, water quality, and noise monitoring. SPCBs expand these networks, upgrade laboratory facilities, and integrate monitoring data with national platforms for real-time analysis and reporting.

► Producer Responsibility Enforcement

**Compliance Mechanisms for Waste Management**

SPCBs implement extended producer responsibility (EPR) systems for plastic waste, e-waste, battery waste, and used oil.

They register producers, recyclers, and waste handlers and monitor compliance with recycling and collection targets.

#### **Facilitation of Cleaner Production Practices**

- Shared waste-processing facilities

SPCBs encourage industries-particularly in small and medium sectors-to adopt cleaner technologies, reduce waste generation, and improve energy efficiency. Some Boards support the establishment of common effluent treatment plants and shared waste-processing facilities.

#### **Collaboration with Local Bodies and Civil Society**

- Participatory environmental governance

SPCBs engage with municipal authorities, local communities, and civil society groups to promote environmental awareness, ensure compliance at the grassroots level, and strengthen participatory environmental governance.

### **2.2.3 Major Commissions and Reports on Environmental Governance in India**

- Commissions Shaping Environmental Governance

Environmental governance in India has evolved through an interplay of constitutional amendments, judicial interventions, expert committees, and national policies. Over the years, several high-level commissions and expert groups have examined the challenges of environmental regulation and proposed reforms to strengthen the legal, institutional, and administrative frameworks. The following sections synthesise the major commissions and reports that have significantly shaped India's environmental governance landscape.

- Recognised the need for a coordinated approach to environmental protection

#### **Tiwari Committee Report (1980)**

One of the earliest expert bodies dedicated to environmental administration, the Tiwari Committee recognised the need for a coordinated approach to environmental protection. It examined pollution control, ecological degradation, and the absence of a unified environmental authority. The Committee's recommendations directly contributed to the creation of the Department of Environment in 1980, which later evolved into the Ministry of Environment and Forests (1985). It also pushed for comprehensive legislation, ultimately paving the way for the Environment (Protection) Act, 1986.

#### **National Committee on Environmental Planning and Coordination (NCEPC)**

Established in 1972 after the Stockholm Conference, the NCEPC was India's first national-level environmental





► Environmental advisory body

advisory body. Throughout the 1970s and 1980s, it developed foundational reports on water quality, land-use regulation, industrial pollution, and ecological restoration. Its early work initiated an environmental planning culture within government departments and laid the conceptual groundwork for later statutory reforms.

**The 42nd Constitutional Amendment (1976)**

► State and citizen's duty to protect environment

Although not a committee report, this amendment is a landmark in environmental governance. By inserting Article 48A (State's duty to protect the environment) and Article 51A(g) (citizen's duty), it constitutionalised environmental responsibility. These provisions have since been invoked extensively in environmental jurisprudence.

**Post-Bhopal Gas Tragedy Committees (1984-85)**

► Preventive environmental regulation

Following the industrial disaster in Bhopal, several expert groups-most notably the S. Varadarajan Committee-examined chemical safety, liability, and emergency preparedness. Their findings underscored glaring regulatory gaps and led directly to the Environment (Protection) Act, 1986, along with a series of rules on hazardous chemicals, hazardous waste, and industrial safety. These committees marked a decisive shift towards preventive environmental regulation.

**National Forest Commission (Justice B. N. Kirpal), 2006**

► Support sustainable forest operations

The National Forest Commission undertook a detailed assessment of India's forest governance. The Commission emphasised scientific forest classification, stronger conservation mechanisms, updated legislation, and community involvement. Key recommendations include revising the Indian Forest Act, prioritising ecological security, regulating grazing, improving fire management, promoting joint forest management, and creating a Forest Conservation Fund to support sustainable forest operations. The report also stresses the need for updated schedules under the Wildlife Protection Act, stricter fire control measures, and scientific management of grasslands and wetlands. This report remains one of the most comprehensive analyses of forest policy and governance in India.

**Second Administrative Reforms Commission (ARC) - Environment Related Observations (2006-2008)**

Although not exclusively focused on the environment,

► Environmental decision-making

ARC's reports-especially on *Ethics in Governance* and *Local Governance*-highlighted the need for transparency, decentralised management, and accountability in environmental decision-making. They emphasised citizen participation, better coordination among government agencies, and the importance of ethical standards in environmental clearances and enforcement.

► Revisions in hazardous waste rules

**High Powered Committees on Hazardous Waste (Bhure Lal Committee)**

Constituted by the Supreme Court to monitor hazardous waste management, this committee inspected treatment facilities across states and documented widespread violations. Its findings led to revisions in hazardous waste rules and stricter monitoring standards. These reports strengthened compliance-based governance and enhanced judicial oversight over environmental regulatory bodies.

► Environmental protection with sustainable development

**National Environment Policy (NEP) 2006**

NEP 2006 integrates environmental protection with sustainable development principles. It highlights the use of economic instruments, environmental impact assessment reform, decentralised regulation, conservation of critical ecosystems, and community participation. Although a policy document, NEP provides a unified framework for interpreting environmental challenges and strengthening governance mechanisms.

► Major structural reforms

**T.S.R. Subramanian Committee Report (High-Level Committee on Environmental Laws, 2014)**

This high-level committee reviewed major environmental laws, including the Water Act, Air Act, Forest Conservation Act, Wildlife Protection Act, and Environment (Protection) Act. It recommended major structural reforms, such as establishing a National Environmental Management Authority (NEMA) and State Environmental Management Authorities (SEMAs) for single-window clearances and compliance monitoring. The Committee also suggested merging pollution control boards into these new authorities, creating an Environmental Reconstruction Fund, strengthening disclosure obligations, and setting up special environmental courts. It further recommended updating species lists under the Wildlife Protection Act and revising procedures for forest diversion and compensatory afforestation. Many recommendations generated debate and were only selectively adopted.



## Indian Network for Climate Change Assessment (INCCA) Reports (2010-2011)

- Scientific assessments of climate change impact

INCCA produced India's first scientific assessments of climate change impacts, greenhouse gas emissions, and sectoral vulnerabilities. These reports informed India's National Action Plan on Climate Change (NAPCC) and contributed to international climate negotiations by providing domestically generated evidence.

## National Green Tribunal (NGT) Annual Reports

- Enforcing environmental principles

Since its establishment in 2010, the NGT has played a pivotal role in enforcing environmental principles such as the polluter pays principle, the precautionary approach, and sustainable development. Its annual reports compile case trends, judicial directions, and implementation challenges, reflecting the growing importance of environmental adjudication in India's governance framework.

- Reactive regulation to proactive and scientifically informed environmental management

Together, these commissions and reports chart the evolution of environmental governance in India. They highlight the gradual shift from reactive regulation to proactive and scientifically informed environmental management. The uploaded documents-especially the National Forest Commission Report and the T.S.R. Subramanian Committee Report-offer detailed institutional and legal analyses that continue to influence policy debates and administrative reforms.

## Summarized Overview

This unit introduced learners to the key institutions and mechanisms that shape environmental planning and control in India. It explained how the Ministry of Environment, Forest and Climate Change (MoEFCC) provides national leadership by formulating policies, coordinating programmes, and guiding environmental legislation. The role of the National Green Tribunal (NGT) was discussed as an important step towards ensuring the timely and specialised resolution of environmental disputes.

The unit also highlighted the Central and State Pollution Control Boards, which form the operational foundation of environmental regulation. Their responsibilities-such as monitoring air and water quality, enforcing standards, regulating industries, and managing waste-illustrate how environmental laws are translated into everyday administrative practice. Finally, the unit underscored the significance of major committees and reports in shaping India's environmental governance framework. Together, these institutions and



policy mechanisms demonstrate how environmental protection depends on coordinated planning, scientific assessment, and strong regulatory systems. This understanding prepares learners to appreciate the complexity and importance of environmental management in India.

## Self-Assessment

1. Name the Act under which the National Green Tribunal (NGT) was established.
2. Under which Act were the State Pollution Control Boards (SPCBs) constituted?
3. Name any one international convention India is a party to in the field of climate change or biodiversity.
4. What does CEPI stand for in environmental governance?
5. Which ministry acts as the nodal agency for coordinating international environmental agreements?
6. What is the main function of SPCBs in industrial regulation?
7. Explain the historical evolution of the Ministry of Environment, Forest and Climate Change (MoEFCC). How has its mandate expanded over time?
8. Describe the organisational structure of MoEFCC
9. What is the core mandate of the National Green Tribunal (NGT)?
10. Compare CPCB and SPCB

## Assignments

1. Explain how the National Green Tribunal (NGT) helps in solving environmental disputes in India.
2. Explain the role of State Pollution Control Boards (SPCBs) in regulating industries.
3. Explain how the Ministry of Environment, Forest and Climate Change (MoEFCC) was formed and describe its main role in protecting the environment in India.
4. Write an essay on the Central Pollution Control Board (CPCB). Describe its establishment, major functions, and key programmes for controlling pollution in India.





## Reference

1. Barrow, C. J. (1999). *Environmental management: Principles and practice*. Routledge.
2. Ministry of Environment, Forest and Climate Change. (2006). *National Environment Policy, 2006*. Government of India.
3. Ministry of Environment, Forest and Climate Change. (2024–2025). *Annual report 2024–25*. Government of India.
4. Ministry of Environment, Forest and Climate Change. (n.d.). *MoEFCC initiatives*. Government of India.

## Suggested Reading

1. Wright, R. T., & Boorse, D. F. (2018). *Environmental Science: Toward a Sustainable Future* (13th ed.). Boston, MA: Pearson Education.
2. Khitoliya, R. K. (2004). *Environmental Pollution: Management and Control for Sustainable Development*. New Delhi: S. Chand Publishing.
3. Miller, G. T., & Spoolman, S. (2021). *Environmental Science*. Boston, MA: Cengage Learning.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU



## UNIT 3

# Regulatory Strategies

### Learning Outcomes

Upon completion of this unit, the learner will be able to :

- ▶ explain the meaning and significance of environmental regulation and its role in environmental governance.
- ▶ describe the key features of Environmental Auditing and Environmental Impact Assessment, including their objectives and processes.
- ▶ evaluate the effectiveness of regulatory strategies such as the Air Ambience Fund, Environmental Compensation Charge, and Electric Vehicle policies.
- ▶ assess the strengths and limitations of current regulatory mechanisms, including issues related to compliance, transparency, and enforcement.

### Background

Environmental regulation has emerged as one of the most essential pillars of environmental governance in India. As the country continues to industrialise and urbanise, the pressure on natural resources, ecosystems, and public health has intensified. Earlier units in this block highlighted how India developed a comprehensive legislative framework ranging from constitutional provisions to landmark environmental laws to safeguard the environment. Building on these foundations, this unit introduces the regulatory strategies through which environmental laws are operationalised in practice.

Regulatory strategies such as Environmental Impact Assessment (EIA) and Environmental Auditing translate policy intent into concrete procedures for evaluating, monitoring, and guiding developmental activities. These mechanisms ensure that projects do not proceed without understanding their ecological consequences and that industries remain accountable for ongoing compliance. Alongside these traditional tools, India has adopted innovative approaches such as the Air Ambience Fund, Environmental Compensation Charge, and Electric Vehicle policies, reflecting a shift toward economic instruments and sustainable technologies.

At the same time, emerging best practices like green buildings, energy auditing, and sustainable urban planning demonstrate how environmental regulation is evolving to address contemporary challenges. Collectively, these strategies help India balance developmental aspirations with ecological integrity, making regulatory interventions central to achieving sustainable development.

## Keywords

Compliance Audit, Functional Audit, Performance Audit, Green Buildings, Energy Auditing, Polluter Pays Principle

## Discussion

### 2.3.1 Introduction to Regulatory Strategies

#### Meaning and Significance of Environmental Regulation

##### ► Environmental regulation

Environmental regulation refers to the laws, policies, rules, and institutional mechanisms that govern how individuals, industries, and governments interact with the natural environment. It establishes clear standards for pollution control, environmental protection, and sustainable use of natural resources. In India, environmental regulation derives its legal foundation from instruments such as the Environment (Protection) Act, 1986, the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981. These laws empower regulatory agencies to set norms, monitor compliance, and take corrective action when environmental harm occurs.

##### ► Regulatory tools

The significance of such regulation lies in its ability to prevent environmental degradation, promote ecological balance, and ensure that economic development does not compromise the health of ecosystems or communities. Regulatory tools such as environmental audits, environmental impact assessments (EIAs), and pollution-control guidelines not only enforce compliance but also encourage industries to adopt cleaner technologies and responsible practices. In a context where pressures on land, water, air, and biodiversity are rapidly increasing, environmental regulation becomes essential for safeguarding both present and future generations.





## Evolution of Regulatory Approaches in India

### ► Foundations of Environmental Regulation

Environmental regulation in India has evolved significantly over the past five decades. In the 1970s, the primary concerns were industrial pollution and the management of water and air quality. The enactment of the Water Act of 1974 marked the beginning of systematic pollution control efforts and established Pollution Control Boards across states. This was followed by the Air Act of 1981, which expanded regulatory oversight to cover emissions from industries and vehicles.

### ► Post-Bhopal Regulatory Expansion

A significant shift occurred after the Bhopal Gas Tragedy (1984), which highlighted the urgent need for stronger environmental governance. The Environment (Protection) Act of 1986 emerged as a comprehensive legal framework enabling the central government to regulate all forms of environmental pollution. During the 1990s and early 2000s, regulatory strategies became more structured with the introduction of environmental impact assessment procedures, hazardous waste rules, and standards for noise, biomedical waste, and municipal solid waste.

### ► Environmental Impact Assessment

The Environmental Impact Assessment (EIA) Notification of 2006 brought significant reforms by categorising projects, decentralising clearances, and institutionalising public consultation processes. Parallel developments included the expansion of environmental auditing practices, the strengthening of monitoring systems through Pollution Control Boards, and the adoption of eco-friendly policy instruments such as environmental compensation, green building standards, and electric mobility policies. These developments illustrate a continuous transition from reactive pollution control to proactive environmental governance.

## Role of Regulatory Mechanisms in Environmental Governance

### ► Regulatory Instruments for Sustainability

Regulatory mechanisms play a central role in shaping environmental governance, particularly in a country with diverse ecosystems and rapidly expanding developmental pressures. They provide the institutional framework for assigning, monitoring, and enforcing environmental responsibilities. Tools such as environmental audits, as guided by the Environmental Audit Scheme of State Pollution Control Boards, help industries evaluate their environmental performance and ensure adherence to statutory requirements. Similarly, EIAs, supported

by the EIA Notification 2006, ensure that potential impacts of large-scale projects are assessed before approvals are granted, thereby integrating environmental considerations into planning and decision-making.

► Inclusive and evidence-based decisions

Regulatory mechanisms also facilitate transparency and accountability. Public hearings, environmental management plans, and post-clearance monitoring systems create spaces for community participation and continuous oversight. These tools strengthen environmental governance by ensuring that environmental decisions are not purely administrative but inclusive and evidence-based.

► Economic and technological instruments

Moreover, contemporary regulatory strategies increasingly incorporate economic and technological instruments. Measures such as environmental compensation charges, market-based incentives for pollution reduction, and electric vehicle policies reflect a shift towards regulatory approaches that not only control pollution but also encourage innovation. Collectively, these regulatory mechanisms reinforce the broader objective of sustainable development by balancing ecological concerns with economic aspirations.

## 2.3.2 Environmental Audit

### 2.3.2.1 Concept and Meaning

► Structured mechanism for identifying compliance gaps

Environmental auditing is a systematic, documented, and objective examination of how an organisation's activities, operations, and processes affect the environment. It assesses whether the entity complies with applicable environmental laws, regulatory norms, and consent conditions issued by Pollution Control Boards. As outlined in several State Pollution Control Board audit schemes, an environmental audit involves evaluating pollution control measures, waste generation patterns, resource utilisation efficiency, and overall environmental performance. It provides a structured mechanism for identifying compliance gaps and opportunities for improvement.

► Continuous enhancement of environmental standards

More broadly, environmental auditing is recognised as a valuable management tool that helps organisations understand their environmental responsibilities. It promotes a culture of accountability by encouraging industries to evaluate their environmental practices, identify risks, and adopt preventive measures. Rather than functioning as a one-time inspection, environmental auditing contributes to continuous enhancement



of environmental standards by helping organisations strengthen their internal monitoring systems, adopt cleaner technologies, and make informed decisions that align with sustainability goals.

### 2.3.2.2 Objectives of Environmental Audit

Environmental audits serve multiple purposes that collectively enhance environmental governance and industrial accountability. The primary objectives include:

#### 1. Compliance Verification

A key objective of environmental auditing is to ensure that an organisation complies with environmental regulations such as the Environment (Protection) Act, 1986, waste management rules, and conditions imposed by Pollution Control Boards. Compliance verification helps identify deviations and ensures timely corrective actions.

#### ► Objectives

#### 2. Identifying Inefficiencies

Environmental audits evaluate the efficiency of resource use—such as water, energy, and raw materials—and the functioning of pollution control systems. By highlighting operational inefficiencies, audits encourage organisations to adopt resource-efficient technologies and better environmental management practices.

#### 3. Risk Reduction

Audits help identify potential environmental risks arising from inadequate waste management, accidental releases, or malfunctioning control equipment. Highlighting such vulnerabilities supports preventive measures that reduce the likelihood of environmental accidents or regulatory violations.

#### 4. Environmental Performance Improvement

Environmental auditing aims to enhance long-term environmental performance by promoting cleaner production methods, improved monitoring systems, and effective environmental management planning. The insights gained from audits often guide organisations toward better environmental decision-making and greater sustainability.

### 2.3.2.3 Types of Environmental Audits

Environmental audits can take different forms depending

on the purpose, scope, and requirements of the organisation or regulatory authority. In India, Pollution Control Boards and audit guidelines recognise several categories of audits that together provide a comprehensive evaluation of environmental performance.

### 1. Compliance Audit

- Verifying whether an industry or organisation complies with the environmental standards

A compliance audit focuses on verifying whether an industry or organisation complies with the environmental standards and conditions prescribed by laws, rules, and consent orders. It examines emissions, effluent discharge, waste management practices, and the status of pollution control systems. Compliance audits are crucial because they ensure the organisation meets statutory requirements and avoids violations that could cause environmental harm or legal penalties.

### 2. Environmental Management Systems Audit (EMS Audit)

- Audits encourage industries to integrate environmental considerations

An EMS audit evaluates the internal systems, procedures, and practices that an organisation uses to manage its environmental responsibilities. It examines environmental policies, monitoring arrangements, emergency preparedness, record-keeping, and internal reporting mechanisms. EMS audits encourage industries to integrate environmental considerations into everyday decision-making and promote continual improvement in environmental performance.

### 3. Functional or Specific Audit

- Focuses on specific environmental aspects

A functional audit focuses on specific environmental aspects, such as hazardous waste management, water conservation, energy efficiency, air emissions, and the operation of specific pollution control devices. These audits allow organisations to conduct focused assessments of critical environmental issues, identify weaknesses in specific operational segments, and implement targeted corrective measures.

### 4. Performance Audit

- Evaluates the overall effectiveness, efficiency, and outcomes

A performance audit evaluates the overall effectiveness, efficiency, and outcomes of environmental programmes or measures. It assesses whether the organisation's environmental goals are being achieved and whether resources are being used optimally. This form of audit is particularly relevant for government departments and public-sector organisations, where the emphasis is not only on compliance but also on





environmental improvement and public accountability.

#### 2.3.2.4 Environmental Audit Scheme in India

Environmental auditing in India is conducted within frameworks established by State Pollution Control Boards, industry-specific guidelines, and national auditing standards. These schemes provide clarity on how audits should be structured and implemented.

- Apply to industries in categories with significant pollution potential

##### Applicability

Environmental audit requirements typically apply to industries in categories with significant pollution potential. Many State Pollution Control Boards mandate environmental audits for industries that handle hazardous waste, operate high-pollution processes, or fall under specific consent conditions.

- Objective, evidence-based assessments

##### Auditor Responsibilities

Auditors are expected to conduct objective, evidence-based assessments of environmental performance. Their responsibilities include reviewing compliance documents, inspecting pollution control systems, verifying monitoring data, identifying deviations, and recommending corrective actions. Auditors must maintain independence and ensure that their findings accurately reflect the organisation's environmental status.

- Depends on regulatory requirements and risk levels

##### Frequency of Audits

The frequency depends on regulatory requirements, industry category, and risk levels. Industries with higher pollution potential may be required to conduct audits annually or biannually, while others may follow schedules determined by Pollution Control Boards or environmental management frameworks.

- Observation and recommendation

##### Reporting Format

Most State Pollution Control Boards prescribe audit report templates that include sections on emissions, effluents, waste generation, compliance status, process descriptions, and performance of pollution control systems. Reports typically conclude with observations, recommendations, and a time-bound corrective action plan.

### 2.3.2.4 Process and Methodology of Environmental Audit

Environmental auditing follows a systematic sequence of steps that ensures accuracy, transparency, and accountability.

**1. Preliminary Preparation:** The auditor reviews background information, including consent conditions, past compliance status, process descriptions, and environmental monitoring reports. This stage helps identify key areas requiring close examination.

**2. Site Visit and Data Collection:** During the site visit, auditors inspect operations, examine pollution control equipment, monitor resource use, interview staff, and collect relevant documents. Direct observation is essential for validating the information provided by the organisation.

**3. Evaluation of Compliance and Environmental Performance:** The auditor evaluates collected data against environmental norms, consent conditions, waste management rules, and internal environmental policies. Any gaps or deviations from standards are recorded and analysed.

**4. Report Preparation:** A comprehensive audit report is prepared, summarising observations, compliance status, performance indicators, and areas needing improvement. The report must be clear, objective, and supported by evidence.

**5. Corrective Action Plan:** The final stage involves recommending corrective measures and timelines. Organisations are expected to address deficiencies, upgrade pollution control systems, improve management practices, and submit follow-up reports where required.

### 2.3.2.5 Benefits and Limitations of Environmental Audit

Environmental audits offer several advantages:

- **Enhanced Compliance:** They help organisations maintain alignment with regulatory norms and avoid penalties.



- **Improved Efficiency:** Audits reveal inefficiencies in resource use, leading to cost savings and better environmental outcomes.
- **Risk Management:** By identifying potential hazards, audits contribute to accident prevention and environmental safety.
- **Informed Decision-Making:** Audits provide reliable data that support environmental planning and policy development.

However, environmental audits also have limitations. Their effectiveness depends on the honesty of reporting, the technical expertise of auditors, and the willingness of organisations to implement recommendations. In some cases, inadequate data, limited monitoring infrastructure, or underreporting may restrict the scope of the audit.

### 2.3.2.6 Legal and Policy Framework for Environmental Auditing in India

Environmental auditing in India is anchored in several legal and institutional frameworks that provide authority and structure to the process.

► Reinforcing environmental accountability

**Environment (Protection) Act, 1986:** The Act empowers the central government to set environmental standards for industries and enforce compliance. Environmental audits operate within this broad legislative mandate, helping organisations demonstrate adherence to prescribed norms.

**Pollution Control Board Requirements:** State Pollution Control Boards and the Central Pollution Control Board specify consent conditions, monitoring requirements, and reporting obligations. Many SPCBs mandate environmental audits for specific industries as part of their regulatory oversight.

**Judicial Interventions:** Judicial institutions, including courts and environmental tribunals, have played a significant role in reinforcing environmental accountability in India. Through various judgments and directions, the judiciary has consistently emphasised the importance of effective compliance monitoring, transparency in environmental reporting, and timely assessment of adherence to statutory obligations. While the Rules operate within an administrative and regulatory framework, they

complement the broader judicial emphasis on strengthening compliance mechanisms and improving the quality of environmental governance.

### 2.3.3 Environmental Impact Assessment (EIA)

#### ► Structured process

Environmental Impact Assessment (EIA) is a structured process used to identify, predict, and evaluate the potential environmental consequences of proposed developmental projects before they are implemented. It examines how activities such as industrial expansion, infrastructure development, mining, or power generation may affect ecological systems, natural resources, public health, and surrounding communities. EIA functions as a preventive tool, ensuring that environmental considerations are integrated at the earliest stage of project planning, rather than being addressed after damage has occurred.

#### ► Both a technical and regulatory exercise

In the Indian context, EIA is both a technical and regulatory exercise. It provides scientific information to decision-makers, helps determine the suitability of a project site, and evaluates whether the proposed project complies with environmental standards. More importantly, it creates a transparent platform for incorporating concerns of local communities and other stakeholders into the decision-making process.

#### ► Preventive and participatory approach to environmental protection

#### Importance and Objectives of EIA

EIA plays a central role in environmental governance by offering a preventive and participatory approach to environmental protection. Its major objectives include:

##### 1. Predicting Environmental Impacts

EIA systematically analyses possible impacts—such as air and water pollution, land degradation, habitat disturbance, greenhouse gas emissions, and socio-economic consequences—before a project is executed. This helps anticipate adverse outcomes and design measures to avoid or reduce them.

##### 2. Ensuring Sustainable Development

One of the guiding principles of EIA is to balance developmental needs with ecological protection. By mandating environmental safeguards and mitigation measures, EIA helps ensure that economic growth does not compromise long-term environmental sustainability. The process also requires preparing Environmental Management Plans (EMPs) that outline strategies for mitigation, monitoring, and impact control.



### 3. Guiding Statutory Clearances

EIA serves as the basis for granting Environmental Clearance to new or expanding projects. Regulatory authorities rely on EIA reports to assess whether a project is environmentally acceptable and whether proposed mitigation measures are adequate. Through screening, scoping, public consultation, and appraisal, EIA creates a robust framework for informed decision-making.

#### 2.3.3.1 Evolution of EIA in India

The EIA system in India has developed gradually, shaped by growing environmental awareness, judicial interventions, and the need for regulatory oversight.

##### 1. Voluntary Environmental Assessments in the 1970s

The earliest environmental assessments in India were limited and mostly voluntary, undertaken by select sectors such as river valley development and large public-sector projects. These assessments were carried out to understand environmental implications, but were not legally required.

► Shaped by growing awareness

##### 2. Introduction of 1994 EIA Notification

A major milestone came with the introduction of the first statutory EIA Notification in 1994 under the Environment (Protection) Act, 1986. This notification made environmental clearance mandatory for certain categories of projects. It introduced several important features:

- Requirement of EIA reports for identified project categories
- Prior environmental clearance from the Central Government
- Inclusion of environmental conditions in project approvals

However, the 1994 notification faced criticism for delays, limited public participation, and lack of decentralisation.

##### 3. EIA Notification 2006 – A Significant Reform

The EIA Notification of 2006 marked a major shift in India's regulatory framework. Key features included:

- Categorisation of projects into Category A and B based on scale and potential impact
- Creation of State-level Environment Impact Assessment Authorities (SEIAA) for decentralised decision-making
- Introduction of screening and scoping as formal stages
- Mandatory public consultation for most projects
- Clear timelines for processing environmental clearances

The 2006 notification remains the backbone of India's EIA regime and continues to guide statutory clearances.

#### 4. Key Amendments to EIA Notification

Several amendments since 2006 have refined the EIA process: Adjustments to project categorisation, Modifications to public hearing requirements, Revised thresholds for industrial and construction activities, Procedural clarifications for appraisal committees. These amendments were introduced to streamline the process, clarify procedural steps, and address gaps identified during implementation.

The evolution of EIA in India reflects a shift from a project-oriented and reactive approach to a more systematic, decentralised, and participatory framework that integrates environmental considerations into developmental planning.

#### 2.3.3.2 Key Provisions of the EIA Notification 2006

The EIA Notification of 2006 represents a major reform in India's environmental regulatory system. It was introduced to simplify the clearance process, decentralise authority, and ensure greater transparency and public participation. The following provisions form the core of the 2006 framework.

**Categorisation of Projects (A / B1 / B2):** The notification classifies projects into different categories based on their potential environmental impact:

**Category A Projects:** These involve large-scale or environmentally sensitive activities such as major mining operations, thermal power plants, ports, and large infrastructure projects. Category A projects require appraisal and clearance from the Ministry of Environment, Forest and Climate Change



(MoEF&CC) at the central level.

**Category B Projects:** These projects have comparatively lower impacts and are handled at the state level by the State Environment Impact Assessment Authority (SEIAA). Category B is further divided into:

- B1 Projects: Require full EIA, including preparation of an Environmental Impact Assessment Report.
- B2 Projects: Do not require a detailed EIA study or public consultation. They undergo a simplified appraisal based on essential information and environmental management measures.

This categorisation is crucial because it ensures that regulatory attention is proportionate to the scale and nature of environmental impacts.

- **Role of MoEFCC, SEIAA, EAC, and SEAC**

#### **MoEFCC (Central Government Authority)**

Acts as the regulatory authority for Category A projects. It evaluates proposals, conducts appraisal through its Expert Appraisal Committees (EACs), and grants or rejects Environmental Clearance.

#### **SEIAA (State Environment Impact Assessment Authority)**

Responsible for granting clearance to Category B projects at the state level. It functions with support from the State Expert Appraisal Committee (SEAC).

#### **EAC (Expert Appraisal Committee)**

A body of subject experts constituted by the MoEFCC. The EAC examines EIA reports, evaluates potential impacts, and recommends whether a project should be approved, modified, or rejected.

#### **SEAC (State Expert Appraisal Committee)**

Performs similar functions for Category B projects at the state level. It reviews project documents and submits recommendations to SEIAA.

Together, these bodies ensure scientific evaluation,

decentralised decision-making, and regulation aligned with ecological considerations.

- **Environmental Clearance Procedure**

The EIA Notification 2006 establishes a structured clearance process that encompasses: Submission of application with project details Screening and scoping, Preparation of an EIA report (where required), Public consultation, Expert appraisal, Final decision by MoEFCC or SEIAA.

The process is designed to ensure environmental safeguards, community participation, and transparency before project approval.

### **2.3.3.3 Stages of the EIA Process**

The EIA process under the 2006 Notification follows a sequence of mandatory stages that ensure a thorough assessment of environmental impacts before a project is granted clearance.

#### **1. Screening**

Screening determines whether a proposed project requires an EIA and identifies its category (A, B1, or B2). Category A projects automatically need a full EIA. Category B projects undergo screening at the state level to decide whether they fall under B1 or B2.

#### **2. Scoping (Terms of Reference)**

In scoping, the relevant appraisal committee (EAC or SEAC) specifies the Terms of Reference (ToR) for conducting the EIA study. The ToR outlines the environmental components to be examined and establishes the scope, methods, and data requirements. This ensures that the assessment is comprehensive and scientifically grounded.

#### **3. Baseline Data Collection**

During this stage, data is gathered on the existing environmental conditions of the study area. It includes information on air and water quality, soil characteristics, biodiversity, socio-economic conditions, and land use patterns. Baseline data provides the foundation for predicting impacts and designing mitigation measures.

#### **4. Impact Prediction and Assessment**





Environmental impacts of the proposed project are predicted using scientific methods, modelling tools, and expert judgment. Impacts may occur on air, water, soil, noise levels, flora and fauna, and nearby communities. This stage also assesses the magnitude, duration, and reversibility of impacts, enabling decision-makers to understand potential risks and costs.

### 5. Public Consultation / Public Hearing

Public consultation ensures community participation in environmental decision-making. It includes:

- Public Hearing: Conducted in the project area for affected communities
- Written Responses: Invitations for comments from stakeholders

Public feedback helps identify concerns, contextual issues, and socio-economic impacts that technical studies may overlook.

► Stages that ensure a thorough assessment of environmental impact before a project is granted clearance

### 6. Appraisal Process

The EAC or SEAC appraises the project based on the EIA report, public consultation outcomes, and compliance with ToR. The committee evaluates the adequacy of impact prediction, mitigation measures, environmental management plans, and project justification before giving recommendations.

### 7. Environmental Management Plan (EMP)

The EMP outlines site-specific measures to mitigate adverse impacts. It provides detailed plans for pollution control, waste management, risk reduction, environmental monitoring, and compliance reporting. The EMP is a key tool for ensuring that environmental safeguards are implemented during project execution.

### 8. Post-Clearance Monitoring

After clearance, project proponents must monitor environmental parameters, submit compliance reports, and follow the conditions prescribed by MoEFCC or SEIAA. Regulatory agencies may conduct inspections to ensure that environmental measures are carried out effectively.

Post-clearance monitoring upholds accountability and ensures that commitments made during the approval process

translate into on-ground compliance.

#### 2.3.3.4 Strengths and Criticisms of the EIA Framework in India

##### ► Preventive approach

The EIA framework in India represents a significant institutional mechanism for ensuring environmental safeguards in the development process. Its most notable strength lies in its preventive approach, which requires potential environmental impacts to be examined before a project is approved. By mandating steps such as screening, scoping, public consultation, and expert appraisal, the EIA process introduces scientific scrutiny and public accountability to decision-making. The decentralisation of powers through the establishment of State Environment Impact Assessment Authorities (SEIAA) has further improved access and efficiency, especially for medium-scale projects. The framework also promotes a culture of mitigation and monitoring by requiring Environmental Management Plans (EMP) and post-clearance compliance reporting, thereby embedding environmental considerations throughout the project lifecycle.

##### ► Gap in public participation

Despite these strengths, the EIA system faces several persistent criticisms that affect its effectiveness. One key concern is the gap in public participation. Although public hearings are mandated, meaningful participation is often limited due to low awareness, restricted access to information, and the technical complexity of EIA reports. Capacity constraints are another major challenge. Many Expert Appraisal Committees and State authorities face shortages of technical personnel, time, and resources, which may affect the depth of project appraisal. Additionally, the system often experiences procedural delays, partly due to high volumes of proposals and partly to administrative bottlenecks at both the central and state levels.

##### ► Transparency

Issues of transparency and compliance remain equally significant. Instances of inadequate baseline data, poor-quality EIA reports, and limited monitoring of post-clearance conditions have raised concerns about the reliability and credibility of the process. In some cases, project proponents may treat EIA as a formality, while regulatory agencies may lack adequate mechanisms for strict enforcement. These criticisms highlight the need to strengthen institutional capacity, improve data accuracy, enhance public involvement, and integrate technology-based monitoring to ensure that the EIA system effectively fulfils its environmental protection mandate.



## 2.3.4 Best Practices in Environmental Regulation

### 2.3.4.1 Air Ambience Fund

► Innovative regulatory instrument

The Air Ambience Fund (AAF) emerged as an innovative regulatory instrument in India to address air pollution caused by industrial and vehicular emissions. Its origin is closely linked to the application of the 'polluter pays' principle, a guiding concept in environmental law that requires those who cause pollution to bear the cost of managing it. Some of the State Pollution Control Boards introduced the AAF as part of their regulatory strategy to ensure that industries internalise the environmental cost of emissions. The fund grew out of the need to create a financial mechanism that supports pollution control activities without relying solely on budgetary allocations, thereby promoting shared responsibility between industry and regulatory authorities.

#### Mechanism of Collection (Polluter Pays Principle)

► Industries that generate higher pollution bear a proportionately higher cost for environmental protection

Under the Air Ambience Fund mechanism, industries are required to contribute an environmental fee based on factors such as fuel type, pollution load, production capacity, or emission levels. For instance, in some states, industrial units using high-sulphur fuels such as lignite or furnace oil are mandated to pay a specified charge per metric tonne of fuel consumed. The rationale is that industries that generate higher pollution bear a proportionately higher cost for environmental protection.

This collection system aligns with the polluter pays principle by ensuring that the financial burden of environmental management does not fall solely on the state or the public. Instead, it encourages industries to adopt cleaner fuels, improve combustion efficiency, or upgrade pollution control technologies to reduce their financial liability.

#### Utilisation for Pollution Control

Funds collected through the Air Ambience Fund are earmarked exclusively for activities that improve air quality. State Pollution Control Boards typically use the AAF to:

- Install or upgrade ambient air quality monitoring stations
- Strengthen laboratory facilities for air pollution measurement
- Support research on pollution sources and emission patterns

► Fund usage

- Promote cleaner technology or fuel substitution initiatives
- Implement awareness programmes on air quality and health impacts
- Develop action plans for industrial clusters with critical pollution levels

By dedicating the fund to air pollution mitigation, regulatory authorities ensure that financial resources directly support environmental objectives and improve regulatory monitoring capacity.

### Impact and Effectiveness

► Data-driven policy decisions by generating reliable information on pollutants and emission trends

The Air Ambience Fund has demonstrated effectiveness in several ways. It has helped Pollution Control Boards expand their monitoring networks, enabling more accurate assessment of ambient air quality. Industries have also shown greater willingness to adopt cleaner fuel options or upgrade pollution-control equipment to reduce charges associated with high-emission fuels. The fund has supported data-driven policy decisions by generating reliable information on pollutants and emission trends.

► Economic instruments can supplement conventional command-and-control approaches

However, the fund's impact has largely been concentrated in Delhi, where it has been implemented under specific judicial and regulatory directions. Its effectiveness has therefore remained context-specific rather than uniform across states, with limited adoption at the national level. In the Delhi context, the Air Ambience Fund has contributed to improved regulatory compliance and has supported the operational capacity of pollution control authorities. The experience illustrates how economic instruments can supplement conventional command-and-control approaches in environmental governance, though their broader applicability as a national strategy remains constrained by uneven enforcement capacities and institutional readiness across states.

### 2.3.4.2 Environmental Compensation Charge (ECC)

The Environmental Compensation Charge (ECC) is an economic instrument imposed on specific categories of vehicles entering environmentally sensitive or highly polluted regions. It is rooted in the polluter-pays principle, which requires those who contribute to pollution to bear the cost of mitigating its harmful effects. The legal foundation of ECC emerged through



► Rooted in the polluter-pays principle

a series of directions issued by the Supreme Court of India, acting on recommendations from the Environment Pollution (Prevention and Control) Authority (EPCA). The charge was introduced as part of an urgent measure to curb rising air pollution levels in Delhi–NCR, particularly during the winter months when meteorological conditions worsen the dispersion of pollutants.

► Compensatory charge

ECC is legally enforced as a compensatory charge, meaning the collected amount is used exclusively for pollution control measures rather than general revenue. This aligns with the broader environmental governance framework under the Environment (Protection) Act, 1986, which empowers regulatory institutions to adopt financial mechanisms for environmental protection.

### Implementation in Delhi NCR

The Environmental Compensation Charge was first implemented in 2015 following a Supreme Court directive requiring commercial goods vehicles entering Delhi to pay an additional charge. The charge was applied at entry points and toll plazas to light commercial vehicles, medium goods carriers, and heavy-duty trucks. Higher charges were imposed on older or more polluting vehicles, while exemptions were provided to those carrying essential commodities.

The operationalisation of ECC in Delhi involved coordination between municipal bodies, the transport department, and pollution control authorities. The system was integrated with existing toll collection mechanisms, ensuring that vehicles paid the ECC at the same time as entry tolls. Revenues collected through ECC were consolidated into dedicated environmental funds earmarked for air quality improvement measures, including dust control, road sweeping, and public transport augmentation.

### Purpose: Reducing Vehicular Emissions

The primary purpose of ECC is to discourage the entry of polluting vehicles into areas already burdened with poor air quality. Since commercial trucks contribute significantly to particulate matter and nitrogen oxide emissions, levying a charge creates a financial disincentive for unnecessary vehicle movement through the region. ECC encourages cleaner behavioural alternatives such as:

- Re-routing freight traffic



► To discourage the entry of polluting vehicles

- Reducing night-time truck movement
- Promoting cleaner-fuel vehicles
- Improving adherence to emission standards

In essence, the charge acts both as a regulatory deterrent and an economic tool that influences polluters' choices. By linking fees to pollution potential, ECC supports broader environmental strategies to reduce vehicular emissions and improve public health outcomes.

### Issues and Challenges

► Limitations of ECC Enforcement

Despite its positive intent, implementing ECC faces several challenges. One major concern is enforcement, as monitoring all entry points to ensure compliance requires significant administrative capacity. Instances of non-payment, toll-collection leaks, or diversion of vehicles through alternative routes can reduce the effectiveness of the charge.

► Pricing and Effectiveness

Another challenge lies in determining the appropriate level of compensation. If the charge is too low, it fails to deter polluting vehicles; if too high, it may disrupt essential goods movement or impose disproportionate costs on transport operators. Additionally, the impact of ECC is often influenced by weather patterns and seasonal pollution spikes, making it difficult to attribute improvements in air quality solely to this measure.

► Utilisation and Policy Limitations

There are also concerns regarding the utilisation of collected funds. Ensuring that ECC revenues are transparently allocated for designated environmental purposes such as improving monitoring infrastructure and supporting clean transport is essential for maintaining public trust and regulatory credibility. Lastly, ECC addresses only one segment of the pollution problem; without complementary policies on fuel standards, public transport enhancement, and urban planning, its long-term impact may remain limited.

### 2.3.4.3 Electric Vehicle (EV) Policy

Electric Vehicle (EV) policies have emerged as a crucial regulatory tool in India's efforts to reduce air pollution, especially in urban areas where vehicular emissions are a major contributor to deteriorating air quality. By encouraging a transition from internal combustion engine vehicles to



► Reduce air pollution

battery-operated or hybrid alternatives, EV policies aim to significantly reduce emissions of particulate matter, nitrogen oxides, and greenhouse gases. Since transport-related emissions disproportionately affect densely populated cities, promoting electric mobility directly supports public health priorities and environmental sustainability. EV policies complement other pollution-control strategies by integrating clean technology with mobility planning, thereby offering long-term, systemic solutions to improve air quality.

• **National EV Framework (FAME and Related Initiatives)**

► Faster Adoption and Manufacturing of Electric Vehicles

India's national strategy for electric mobility is anchored in the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme, launched under the National Electric Mobility Mission Plan.

**FAME I (2015–2019)**

The first phase focused on demand creation through incentives for electric two-wheelers, three-wheelers, cars, and buses. It also supported pilot projects and the development of charging infrastructure.

**FAME II (2019 onwards)**

The second phase introduced a more structured approach, emphasising:

- Large-scale adoption of public transport EVs such as e-buses
- Incentives for electric two- and three-wheelers, recognising their dominant share in Indian mobility
- Expanded support for charging infrastructure, including fast- and slow-charging stations
- Integration of renewable energy sources into charging networks

**PM E-DRIVE Scheme**

► Promoting electric mobility and strengthening the electric vehicle ecosystem

The PM Electric Drive Revolution in Innovative Vehicle Enhancement (PM E-DRIVE) Scheme is a flagship initiative of the Government of India aimed at promoting electric mobility and strengthening the electric vehicle ecosystem. The scheme has a financial outlay of ₹10,900 crore and is being implemented over 2 years. It has been introduced as a successor to the FAME-II scheme.

The scheme provides demand-side fiscal incentives for the adoption of electric vehicles. Its scope includes incentives for approximately 25 lakh electric two-wheelers, 3 lakh electric three-wheelers, and around 14,000 electric buses. Similar to FAME-II, automakers are reimbursed by the government for eligible EV sales after the incentives are passed on to consumers at the point of purchase. Notably, electric cars are excluded from subsidy support under the scheme.

► Installation of public electric vehicle charging stations

In addition to vehicle incentives, the PM E-DRIVE Scheme supports the installation of public electric vehicle charging stations in selected cities and along identified highways. It also provides for the modernisation of vehicle testing agencies to equip them to handle emerging technologies, thereby supporting green mobility and regulatory readiness.

The national framework also includes policy interventions such as lower GST rates for EVs, exemption from certain permit requirements, and the introduction of battery-swapping guidelines. Collectively, these measures aim to encourage domestic manufacturing, reduce import dependency, and create a sustainable ecosystem for electric mobility.

- **State-Level EV Policies**

► Address regional mobility needs

Several Indian states have introduced Electric Vehicle (EV) policies to address regional mobility needs, industrial capacities, and air quality challenges. These policies complement national initiatives by creating state-specific frameworks that promote both adoption and manufacturing.

► Adoption in state level

States such as Delhi, Maharashtra, Karnataka, Tamil Nadu, Telangana, and Kerala have adopted comprehensive EV policies. Delhi's EV policy places strong emphasis on large-scale adoption of electric two- and three-wheelers, scrapping of older vehicles, financial incentives for buyers, and rapid expansion of charging infrastructure. Maharashtra has focused on promoting EV and battery manufacturing by offering capital subsidies, tax benefits, and designated industrial clusters. Karnataka, an early mover in this sector, encourages investment in EV manufacturing and innovation hubs to enhance the local industrial ecosystem.

Similarly, Kerala's EV policy aims to promote clean and sustainable mobility through measures such as encouraging electric public transport, supporting the development of

### ► Kerala's EV policy

charging infrastructure, and enabling government departments to progressively adopt electric vehicles in their fleets. These initiatives are part of a broader strategy to improve air quality, reduce carbon emissions, and support technological transition within the transport sector.

Across states, common features include financial incentives for vehicle purchases, exemptions or reductions in road tax and registration fees, support for charging station deployment, and incentives for EV-related manufacturing and research. While each state prioritises, different aspects based on its context, the collective efforts contribute significantly to expanding the EV ecosystem in India.

### • Incentives and Regulatory Mechanisms

EV policies employ a wide range of incentives and regulatory tools to encourage adoption. These include:

### ► Financial incentives

- **Financial incentives:** Purchase subsidies, reduced road tax and registration fees, interest subventions on loans, and scrappage benefits for replacing older vehicles.
- **Infrastructure incentives:** Support for public and private charging stations, land allotment for charging plazas, and guidelines for charging infrastructure in residential and commercial buildings.
- **Industry-focused incentives:** Capital subsidies, tax rebates, and ease-of-doing-business reforms for EV manufacturing, cell production, and assembly units.
- **Regulatory mechanisms:** Mandates for electrifying government fleets, promoting electric buses in public transport, and encouraging ride-sharing platforms to adopt electric vehicles.
- **Urban planning reforms:** Designation of EV zones, green corridors, and parking incentives for electric vehicles.

### ► Incentives and regulatory tools

These incentives and mechanisms reflect a comprehensive approach that integrates technological, financial, and institutional measures to build a supportive ecosystem for electric mobility.

### • Challenges in Implementation



Despite significant policy progress, the implementation of EV policies faces several challenges:

► Implementation challenges

1. **Charging Infrastructure Gaps:** A key concern is the uneven distribution and limited availability of charging stations, especially in smaller towns and rural areas. The absence of widespread fast-charging infrastructure creates range anxiety among potential users.
2. **High Initial Costs:** Although operating costs are lower, the upfront price of EVs—particularly four-wheelers—remains a barrier for many consumers. Battery costs remain a major component of total vehicle cost.
3. **Technological and Supply Chain Constraints:** Dependence on imported battery cells, limited domestic manufacturing capacity, and evolving battery technologies pose challenges for scaling production.
4. **Grid and Energy Demands:** Widespread adoption of EVs requires careful planning of electricity demand, grid stability, and integration of renewable energy sources to ensure that mobility electrification is genuinely sustainable.
5. **Policy Coordination Issues:** Effective EV implementation requires coordination among multiple departments—transport, power, industry, urban development, and pollution control agencies. Differences in priorities and administrative delays can slow progress.
6. **Consumer Awareness and Acceptance:** Many consumers remain unfamiliar with EV technology, battery life, maintenance requirements, and long-term benefits, which limits adoption despite incentives.

These challenges suggest that EV adoption requires not only policy incentives but also sustained investments in infrastructure, technological development, and public awareness.

► Encourage sustainability, efficiency, and long-term ecological protection

### 2.3.4.3 Other Emerging Best Practices in Environmental Regulation

Environmental regulation in India has increasingly moved beyond traditional command-and-control mechanisms to incorporate innovative approaches that encourage sustainability, efficiency, and long-term ecological protection. Among these



emerging strategies, Green Buildings, Energy Auditing, and Sustainable Urban Planning have gained prominence due to their ability to address environmental concerns at multiple levels—individual buildings, industries, and urban systems.

### Green Buildings

#### ► Shift in infrastructure

Green buildings represent a major shift in the way infrastructure is designed, constructed, and operated. These buildings prioritise energy efficiency, water conservation, waste minimisation, and the use of environmentally friendly materials. By integrating natural lighting, ventilation, renewable energy systems, and efficient insulation, green buildings significantly reduce resource consumption throughout their lifecycle.

#### ► Sustainable building practices

In India, rating systems such as the Green Rating for Integrated Habitat Assessment (GRIHA) and the Indian Green Building Council (IGBC) standards guide sustainable building practices. Green buildings play a vital role in environmental governance by reducing carbon emissions, promoting healthier indoor environments, and encouraging developers to adopt environmentally responsible construction practices. Many state governments now incorporate green building norms into development regulations, signalling a broader transition toward sustainable construction.

#### ► Promoting efficient energy use

### Energy Auditing

Energy auditing is another important best practice that enhances environmental regulation by promoting efficient energy use in industries, commercial establishments, and institutions. An energy audit systematically assesses energy consumption patterns, identifies inefficiencies, and recommends corrective measures to reduce waste and improve energy performance. Through equipment inspections, data analysis, and performance evaluations, energy audits help organisations transition to cleaner, more efficient operations.

#### ► Both an economic and environmental strategy for sustainable development

Energy auditing directly supports environmental objectives because reduced energy consumption leads to lower fossil fuel use and fewer greenhouse gas emissions. Regulatory frameworks increasingly encourage or mandate energy audits for energy-intensive industries, complementing other environmental tools such as environmental audits and cleaner production strategies. As energy costs rise and climate concerns grow, energy audits serve as both an economic and environmental strategy for

sustainable development.

### Sustainable Urban Planning

- Ensuring environmental quality in urban regions

Sustainable urban planning focuses on creating cities that balance environmental protection, economic growth, and social well-being. As rapid urbanisation places significant pressure on land, water, transport networks, and public services, sustainable planning has become crucial for ensuring environmental quality in urban regions. Key elements of sustainable planning include integrated land-use management, public transport systems, compact city design, green spaces, waste minimisation, and climate-resilient infrastructure.

- Incorporate planning tools

Environmental regulations increasingly incorporate planning tools such as zoning guidelines, environmental carrying capacity assessments, and restrictions on development in ecologically sensitive areas. Sustainable urban planning also emphasises community participation, recognising that inclusive governance strengthens environmental outcomes. By encouraging compact development, improving public transportation, and protecting natural ecosystems within urban areas, sustainable planning helps cities reduce pollution, manage waste effectively, and adapt to climate risks.

### Summarized Overview

This unit explained how regulatory strategies function as the operational backbone of environmental governance in India. It examined Environmental Auditing and Environmental Impact Assessment as key tools for assessing industrial activities, guiding decision-making, and ensuring legal compliance. The unit also discussed innovative regulatory practices such as the Air Ambience Fund, Environmental Compensation Charge, and Electric Vehicle policies, which combine economic incentives with pollution control. Emerging approaches like green buildings, energy auditing, and sustainable urban planning highlight the evolving nature of environmental regulation. Together, these strategies strengthen accountability and support India's broader goal of sustainable development.



## Self-Assessment

1. What is meant by environmental regulation?
2. Why are regulatory strategies important for environmental governance in India?
3. Define an environmental audit.
4. What are the main objectives of an environmental audit?
5. What is the purpose of Environmental Impact Assessment (EIA)?
6. What is the Air Ambience Fund, and how does it support pollution control?
7. What is the purpose of the Environmental Compensation Charge (ECC)?
8. How does the EV Policy contribute to improving air quality?
9. Mention two major challenges in implementing regulatory strategies in India.
10. What is meant by sustainable urban planning?

## Assignments

1. Discuss the significance of environmental regulation in India and examine how regulatory strategies contribute to sustainable development.
2. Evaluate the role of environmental audits in strengthening organisational accountability. Illustrate your answer with reference to different types of audits.
3. Evaluate the contribution of emerging best practices; green buildings, energy auditing, and sustainable urban planning; in strengthening environmental governance in India.
4. Identify the key challenges affecting regulatory strategies in India and suggest measures to improve transparency, compliance, and enforcement.
5. Analyse how Electric Vehicle (EV) policies contribute to India's climate commitments and air quality targets. What institutional challenges hinder large-scale EV adoption?



## Reference

1. State Pollution Control Board. (n.d.). *Environmental audit scheme and the guidelines for environmental audit*.
2. Ministry of Environment, Forest and Climate Change. (n.d.). *Environmental audit manual*. /mnt/data/EA-Manual-FINAL1-9-05de4f654870402-14213214-20201016153055.pdf
3. Government of India. (n.d.). *State electric vehicle policy: Comparative analysis report*.
4. Government of India. (n.d.). *Electric vehicle policy*. /mnt/data/EV policy.pdf
5. Ministry of Environment, Forest and Climate Change. (2006). *Environmental Impact Assessment Notification 2006 (Revised compilation)*

## Suggested Reading

1. Wright, R. T., & Boorse, D. F. (2018). *Environmental Science: Toward a Sustainable Future* (13th ed.). Boston, MA: Pearson Education.
2. Khitoliya, R. K. (2004). *Environmental Pollution: Management and Control for Sustainable Development*. New Delhi: S. Chand Publishing.
3. Miller, G. T., & Spoolman, S. (2021). *Environmental Science*. Boston, MA: Cengage Learning.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.



SGOU



# **BLOCK 3**

## **Disaster Management Framework**

# UNIT 1

## Disaster Management – An Introduction

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ understand the fundamental concepts of disasters
- ▶ describe the meaning, nature, and scope of disaster management
- ▶ analyse the disaster management cycle by examining its pre-disaster, during-disaster, and post-disaster components.
- ▶ assess the structural, institutional, social, and emerging challenges that influence disaster management

### Background

Disasters have become an unavoidable part of contemporary life, affecting millions of people worldwide every year. Whether triggered by natural forces or by human-induced activities disasters disrupt the normal functioning of communities and pose serious threats to life, property, and development. In a rapidly changing world marked by urbanisation, technological expansion, and climate variability, understanding disasters and managing them effectively has become an essential component of public governance. This unit introduces learners to the conceptual foundations of disaster and disaster management. It explains how disasters are not merely natural phenomena but emerge from the intersection of hazards, vulnerabilities, exposure, and human systems. By exploring the distinctions among hazard, risk, and vulnerability, the unit helps students understand why the same event affects different communities differently. This perspective is crucial because it shifts the discussion from “what happened” to “why it happened” and “how it can be prevented or reduced.”

The unit further explains the meaning and nature of disaster management as a continuous, integrated, and multidisciplinary process. Disaster management today is no longer confined to emergency response; it includes proactive efforts such as prevention, mitigation, preparedness, early warning, and long-term recovery. The



disaster management cycle provides a structured way to understand these interconnected activities, showing how each stage influences the next and how planning must continue even after the immediate crisis is over. Finally, the unit discusses the challenges in disaster management, including structural and developmental pressures, institutional limitations, social vulnerabilities, and emerging threats such as climate change and technological hazards. By examining these issues, learners gain a deeper appreciation of the complexities involved in managing disasters in a diverse and dynamic country like India. Overall, this unit provides a comprehensive foundation that prepares students to analyse, evaluate, and respond to disaster-related issues with informed judgment and a risk-sensitive perspective.

## Keywords

Prevention, Mitigation, Preparedness, Rehabilitation, Vulnerability, Hazard, Risk, Reconstruction

## Discussion

### 3.1.1 Introduction to Disaster Management

#### 3.1.1.1 Understanding Disasters

##### ► Concept of disaster

Disasters are moments when the ordinary flow of life is suddenly broken. A community going about its daily routines may unexpectedly face a situation in which homes become unsafe, essential services fail, and familiar surroundings become hazardous. Whether triggered by natural forces or human actions, a disaster represents a situation in which the impact of an event becomes too large for the affected community to manage with its own resources. This breakdown of normalcy, combined with an overwhelming need for support, is what distinguishes a disaster from an unfortunate incident. A disaster is not merely a harmful event; it becomes a disaster when its impacts exceed the coping capacity of the affected community, requiring assistance beyond routine institutional mechanisms. According to the Disaster Management Act, 2005, a disaster is a “catastrophe, mishap or grave occurrence arising from natural or man-made causes which results in substantial loss of life, human suffering, or damage to property or environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community.”



- May be triggered by natural forces, technological failures, environmental mismanagement, or social conflicts

Historically, the word *disaster* derives from the French *désastre*; a combination of *dés* (bad) and *astre* (star) meaning misfortune caused by unfavourable cosmic influences. Today, the term reflects a broader understanding: disasters may be triggered by natural forces, technological failures, environmental mismanagement, or social conflicts. They may occur suddenly, such as earthquakes or industrial explosions, or evolve gradually, such as droughts and epidemics. In a developing country context, disasters have deeper impacts due to poverty, weak infrastructure, unplanned settlements, and limited institutional resources. Decades of empirical evidence shows that countries with low human development experience higher mortality and slower recovery, demonstrating that disasters are closely linked to inequality and governance capacity. In essence, a disaster represents a profound and often unexpected disruption of community life, one that overwhelms existing capacities and demands extraordinary measures for relief, recovery, and rehabilitation.

### Distinction between hazard, risk, vulnerability & disaster

Understanding disasters requires clarity on four interrelated concepts: hazard, vulnerability, risk, and disaster.

- Potentially damaging physical event or human activity

- **Hazard:** A hazard is a potentially damaging physical event or human activity. Natural hazards include earthquakes, floods, droughts, or cyclones; human-induced hazards include industrial accidents, chemical spills, or armed conflict. A hazard by itself is not a disaster—its impact depends on exposure and vulnerability.

- Conditions that make individuals or communities more susceptible to harm

- **Vulnerability:** Vulnerability refers to the conditions that make individuals or communities more susceptible to harm. It is shaped by social, economic, environmental and institutional factors. Poverty, unsafe housing, lack of awareness, fragile ecosystems, and inadequate governance all increase vulnerability.

- Probability of harmful consequences

- **Risk:** Risk denotes the probability of harmful consequences resulting from the interaction of hazards with vulnerable conditions. It is commonly understood as:

$$\text{Risk} = (\text{Hazard} \times \text{Exposure} \times \text{Vulnerability}) / \text{Capacity}$$

The greater the vulnerability and the lower the capacity, the

► Hazard strikes a vulnerable population

higher the disaster risk.

- **Disaster:** A disaster occurs when a hazard strikes a vulnerable population and overwhelms its coping ability. Thus, hazards are the triggers, but vulnerability and exposure determine whether they become disasters.

- **Characteristics of disasters**

Disasters share several core characteristics that distinguish them from routine emergencies:

**Suddenness or Rapid Onset:** Many disasters, such as earthquakes, landslides, and industrial explosions, occur abruptly, offering little time for preparation and intensifying their destructive force.

**Scale and Magnitude:** Disasters often produce widespread destruction, high casualties, disruption of livelihoods, and breakdown of critical infrastructure. Their scale typically surpasses what local agencies can manage with routine resources.

**Severe Disruption of Normal Life:** Disasters paralyse social, economic, and administrative systems. They interrupt services such as education, health care, transport, and communication, forcing communities into prolonged hardship.

► Core characteristics

**Resource Scarcity:** Essential resources, food, water, shelter, and medicines, become scarce, while demand increases sharply. Local systems struggle to meet these needs without external support.

**Failure of Protective Systems:** Disasters frequently expose the collapse of preventive measures: poorly enforced building codes, weak dams, unsafe land use, or inadequate emergency planning.

**Context-Specific and Relative:** The severity of a disaster depends on context. A moderate hazard in a highly developed region may be managed efficiently, while the same event can become catastrophic in areas with poverty, weak governance, or fragile ecosystems.

### 3.1.1.2 Meaning of Disaster Management

When a disaster strikes, communities experience a sudden



► Systematic, coordinated effort to reduce the impact of disasters

rupture in the patterns of normal life. Roads become inaccessible, communication lines fail, essential services collapse, and people are left vulnerable. At such moments, the ability of institutions to respond quickly, organise resources, warn the public, protect lives, and guide recovery becomes crucial. This systematic, coordinated effort to reduce the impact of disasters before, during, and after they occur is known as disaster management. Disaster management is not merely a reaction to emergencies; it is a comprehensive, continuous process that spans prevention, preparedness, response, rehabilitation, and long-term reconstruction. It aims to reduce the loss of life and property, strengthen institutional readiness, and build resilient communities capable of coping with hazards of various kinds.

► Definition

The Disaster Management Act, 2005, provides the most authoritative definition in the Indian context. It describes disaster management as a “*continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for prevention of disaster, mitigation, preparedness, response, evacuation, rescue and relief, and rehabilitation and reconstruction.*” This definition emphasises a legally mandated, structured, and coordinated approach carried out through national, state, and district institutions.

► Institutional mechanisms

From an administrative standpoint, disaster management refers to the organisation and mobilisation of governmental and non-governmental institutions to anticipate, manage, and recover from disaster situations. It includes the establishment of dedicated agencies, such as the National Disaster Management Authority (NDMA), State Disaster Management Authorities (SDMAs), District Disaster Management Authorities (DDMAs), and specialised forces like the National Disaster Response Force (NDRF). Administrative disaster management focuses on institutional readiness, clarity of roles, communication channels, and coordination across sectors especially between civilian authorities, defence forces, and local bodies.

► Not only post-disaster response but also proactive efforts

In academic discourse, disaster management is viewed as a systematic process aimed at reducing disaster risk by addressing hazards, vulnerability, and capacity. It integrates knowledge from natural sciences, engineering, environmental studies, social sciences, public policy, and governance. Scholars emphasise that disaster management involves not only post-disaster response but also proactive efforts to assess risks, strengthen resilience, and minimise vulnerabilities.



- **Scope and relevance in contemporary governance**

The scope of disaster management has expanded significantly in recent years. Traditionally seen as a set of emergency responses, it is now understood as a central component of governance, development planning, and public policy.

► One of the central component of governance, development planning, and public policy

- **From Response to Risk Reduction:** The National Policy on Disaster Management (2009) highlights a shift from relief-centric approaches to a holistic risk-reduction framework. This includes: hazard assessment, vulnerability mapping, early warning systems, land-use planning, environmental regulation, building code enforcement, and community-based preparedness. The Sendai Framework for Disaster Risk Reduction reinforces this shift by emphasising prevention, resilience, and “Build Back Better” principles in recovery.
- **Essential Role in National Development:** Disasters cause enormous losses, economic, social, and environmental. India loses a significant share of its GDP each year to disaster-related damage. With over two-thirds of the landmass prone to disasters, disaster management is not optional but a governance necessity. Effective disaster management ensures: protection of lives and infrastructure, continuity of governance, economic stability, environmental sustainability, and social security for vulnerable communities.
- **Integration Across Sectors:** Disaster management today is interlinked with: urban planning, climate adaptation, public health, agriculture, energy and industry safety, coastal and marine management, and national security.

Terrorist attacks, industrial accidents, oil spills, pandemics, nuclear emergencies, and technological failures have broadened the scope beyond natural hazards. The increasing frequency of extreme weather events driven by climate change further underscores the urgency of integrating disaster management across all spheres of governance.

- **Multidisciplinary nature of disaster management**

Disaster management draws upon multiple disciplines, making it one of the most comprehensive fields in public administration and development studies.





► Disaster management  
a holistic, multi-  
layered process

**Social Sciences:** Sociology, psychology, anthropology, and political science help us understand: community behaviour during disasters, social vulnerabilities, decision-making processes, governance and coordination challenges, role of culture, gender, and social inequalities.

**Natural and Earth Sciences:** Geology, meteorology, hydrology, and climatology explain: how hazards originate, patterns of earthquakes, floods, cyclones, droughts, and landslides, environmental changes and climate variability.

**Engineering and Technology:** Civil, structural, chemical, and industrial engineering contribute to: resilient infrastructure design, building codes and safety standards, industrial safety measures, early warning technologies, communication and monitoring systems (GIS, remote sensing, modelling).

**Health and Medical Sciences** Medical sciences support includes emergency health response, trauma care, epidemic and pandemic management, psychological first aid and mental health support.

**Governance, Law and Public Policy:** Public administration, law, and policy studies provide the framework for: legal mandates, institutional roles and responsibilities, coordination across agencies, resource mobilisation, accountability and disaster governance.

**Community Knowledge and Local Wisdom:** Traditional coping practices, community networks, and indigenous knowledge systems enrich local preparedness and resilience strategies.

Together, these disciplines make disaster management a holistic, multi-layered process that requires coordination, innovation, and continuous learning.

### 3.1.2 Meaning and Nature of Disaster Management

Disaster management is best understood as a continuous effort to protect human life, property, and the environment from the potentially devastating impacts of hazards. While disasters often appear sudden and overwhelming, their effects can be significantly reduced when institutions and communities anticipate risks, plan effectively, and work together. Thus, disaster management is not simply about responding to

emergencies it is about understanding how hazards interact with society, reducing vulnerabilities, and strengthening the capacity of communities to withstand and recover from disruptions.

► Disaster as a Socio  
Natural event

Contemporary disaster studies describe disasters as *socio-natural* events meaning they emerge from the interaction between natural processes and human conditions. A cyclone or flood becomes a disaster not only because nature unleashes its force, but because people live in vulnerable settlements, lack protective infrastructure, or have limited access to timely information. For example, an earthquake in an uninhabited region may leave no impact, whereas the same earthquake in a densely populated urban area with poor construction practices may cause massive destruction. This demonstrates that disasters are shaped as much by social and developmental factors as by natural forces.

► Interconnected  
domains

Disaster management lies at the intersection of three interconnected domains:

1. Nature – geological and atmospheric phenomena such as earthquakes, floods, droughts, storms, and landslides.
2. Development – patterns of land use, quality of infrastructure, environmental management, economic activities, and urbanisation.
3. Human Systems – social structures, governance mechanisms, cultural practices, community capacities, and levels of preparedness.

### 3.1.2.1 Key Elements of Disaster Management

Disaster management consists of several interrelated components that together form a continuous cycle. These elements ensure that communities are protected before, during, and after a disaster.

#### 1. Prevention

Prevention includes actions taken to prevent disasters altogether. While not all hazards can be prevented, certain measures such as regulating construction in high-risk zones, enforcing safety standards, and controlling industrial hazards can prevent many disasters from occurring.

#### 2. Mitigation

Mitigation aims to reduce the severity or potential



impact of hazards. This can involve both structural measures (e.g., embankments, cyclone shelters, retrofitting buildings) and non-structural measures (e.g., land-use planning, environmental protection, building codes). Mitigation addresses long-term risk and is central to the shift from relief-centric to risk-reduction approaches.

### 3. Preparedness

► Interrelated components that together form a continuous cycle

Preparedness includes measures that enhance the ability of communities and institutions to anticipate and respond effectively. Examples include early warning systems, mock drills, evacuation plans, stockpiling essential supplies, and community awareness programmes. Preparedness ensures readiness when a hazard strikes.

### 4. Response

Response refers to immediate actions taken during and immediately after a disaster to save lives, reduce suffering, and protect property. Search and rescue, emergency communication, first aid, temporary shelters, and mobilising specialised forces like the NDRF fall under this stage.

### 5. Recovery

Recovery focuses on restoring normalcy in the short- and medium-term. It includes repairing essential services, restarting livelihoods, reopening schools, and restoring basic infrastructure. Recovery bridges the gap between immediate response and long-term reconstruction.

### 6. Rehabilitation and Reconstruction

Rehabilitation involves long-term efforts to restore communities to a stable, functional state, while reconstruction involves rebuilding infrastructure, housing, and public services. Modern frameworks emphasise “*Build Back Better*”, meaning reconstruction should reduce future risks, not recreate past vulnerabilities.

#### 3.1.2.2 Principles of Disaster Management

Effective disaster management is guided by several key principles that reflect global best practices and national policy commitments.

► Reflect global best practices and national policy commitments

1. **Risk Reduction Orientation:** The most important shift in contemporary disaster management is the movement from reactive relief operations to proactive risk reduction. This means identifying hazards, mapping vulnerabilities, strengthening infrastructure, and embedding safety measures into development planning.
2. **Community Participation:** Communities are the first responders in any disaster. Their knowledge, experience, and social networks are crucial. Disaster management therefore emphasises community-based approaches, participatory planning, local capacity-building, and the inclusion of vulnerable groups.
3. **Coordination and Integration:** Disaster management requires coordination among multiple agencies—government departments, local bodies, defence forces, NGOs, the private sector, and community organisations. Integration across sectors such as health, environment, urban planning, and technology ensures a unified and efficient response.
4. **Resilience-Building:** Resilience refers to the ability of individuals, communities, and systems to withstand shocks and recover quickly. Improving resilience involves strengthening infrastructure, empowering communities, diversifying livelihoods, and ensuring the availability of social protection mechanisms.
5. **Sustainability:** Sustainable disaster management links environmental protection, responsible development, and risk reduction. Activities such as conserving ecosystems, regulating land use, promoting climate-smart development, and protecting natural buffers (mangroves, wetlands) help reduce long-term disaster risks.

### 3.1.3 Disaster Management Cycle

► Continuous and interconnected set of activities

Disaster management is understood as a continuous and interconnected set of activities aimed at reducing disaster risk, preparing for potential hazards, responding effectively during emergencies, and ensuring long-term recovery and resilience. The cycle reflects the idea that disasters are not isolated events but part of a broader process involving planning, coordination, learning, and adaptation.



► Traditional disaster management cycle

The traditional disaster management cycle consists of three broad stages: pre-disaster, during-disaster, and post-disaster, each containing specific functions such as prevention, preparedness, response, and recovery. This circular model emphasises that disaster management is not linear but iterative: each phase influences the next, and lessons learned after a disaster inform future preparedness.

### The Sendai-Aligned Cycle: A Modern Approach

► Transformative shift in global disaster management thinking

The Sendai Framework for Disaster Risk Reduction (2015–2030), adopted at the Third UN World Conference on Disaster Risk Reduction, brought a transformative shift in global disaster management thinking. Unlike earlier approaches that emphasised response and relief, the Sendai Framework focuses on *proactive risk reduction* and resilience-building. It identifies four priority areas:

1. Understanding disaster risk – recognising the role of hazards, exposure, vulnerability, and capacity.
2. Strengthening disaster risk governance – improving institutional coordination and policy coherence.
3. Investing in disaster risk reduction – reducing vulnerabilities through infrastructure, technology, and planning.
4. Enhancing disaster preparedness and “Build Back Better” – ensuring effective response and resilient recovery.

The Sendai-oriented model situates the entire disaster cycle within a larger development context, highlighting that risk reduction must be integrated into planning, environmental management, and socio-economic policies. India’s national plans and policies increasingly draw from these priorities, making the Sendai Framework highly relevant to contemporary disaster governance.

### Importance of a Continuous and Integrated Approach

► Disasters do not occur in isolation

Disasters do not occur in isolation; they are shaped by existing vulnerabilities, environmental conditions, and socio-economic factors. A continuous cycle ensures that risk reduction begins long before a disaster strikes and continues long after immediate relief is completed. An integrated approach allows agencies, communities, and sectors to work together in planning, readiness, response, and reconstruction. This not only



minimises losses but also strengthens resilience against future hazards.

### 3.1.3.1 Pre-Disaster Phase

The pre-disaster phase is the most critical part of the cycle because it focuses on reducing the likelihood of disasters and limiting their potential impact.

- **Prevention**

Prevention includes actions taken to avoid the creation of disaster conditions or eliminate disaster risks wherever possible.

#### Structural measures

- Construction of dams, reservoirs, and flood control structures
- Retrofitting buildings to withstand earthquakes
- Cyclone shelters and elevated structures
- Protective embankments along rivers and coasts

► Avoid the disaster conditions

#### Non-structural measures

- Safety policies, techno-legal regimes, and risk-informed regulations
- Development control and land-use zoning
- Strict enforcement of building codes
- Industrial and environmental safety standards

Prevention recognises that appropriate planning and safeguards can stop many disaster scenarios from emerging.

- **Mitigation**

Mitigation aims to reduce the severity or consequences of hazards through long-term risk reduction strategies.

► Reduce the severity or consequences

#### Hazard mapping and vulnerability assessment

- Preparing multi-hazard maps using scientific tools such as GIS and remote sensing
- Identifying exposed populations and critical



infrastructure

- Prioritising high-risk zones for targeted interventions

Environmental management and land-use planning

- Protecting natural buffers like mangroves, wetlands, and forests
- Regulating construction in fragile ecosystems
- Promoting sustainable water, soil, and land-use practices

Mitigation reduces potential losses even when hazards cannot be prevented.

- **Preparedness**

Preparedness ensures that individuals, institutions, and communities can respond promptly and effectively when a disaster occurs.

► Ensures that individuals, institutions, and communities can respond promptly and effectively

Early warning systems which includes: Weather forecasting for cyclones, floods, heatwaves, and storms, Tsunami early warning mechanisms, Real-time dissemination of alerts through multiple channels

Community awareness and training programmes which includes: School safety programmes, Mock drills and evacuation rehearsals, Community-based disaster management committees

Emergency planning like : Preparation of disaster management plans at national, state, district, and local levels, Stockpiling essential supplies and ensuring logistics readiness, Establishing control rooms and communication networks

Preparedness reduces casualties and helps communities act decisively during emergencies.

### 3.1.3.2 During-Disaster Phase

This phase begins the moment a hazard unfolds and requires rapid, coordinated action to save lives and limit losses.

#### Response

Response includes immediate measures taken to address the emergency.

► Coordinated action  
to save lives and  
limit losses

Search and rescue measures like deployment of trained teams such as NDRF, SDRF, fire services, and military units, use of specialised equipment, canine squads, and medical support

Incident management systems for establishing command and control structures and also coordinating multi-agency actions and resource allocation

Evacuation and communication strategies like moving people to safe shelters, disseminating real-time information, maintaining communication systems during a crisis.

Role of emergency services is crucial at this stage it consist of fire services, medical teams, police, and local administration for ensuring safety, first aid, and crowd management.

The speed and efficiency of response determine the scale of human and material losses.

### 3.1.3.3 Post-Disaster Phase

This phase focuses on stabilising affected communities and rebuilding in a manner that improves future safety.

- **Relief**

Relief efforts address the immediate humanitarian needs of survivors. It consist of distribution of food, water, medicine, and clothing, setting up temporary shelters and sanitation facilities, emergency health services and trauma care, Rapid assessment of damage and needs, relief provides a foundation for subsequent recovery.

- **Recovery**

Recovery aims to restore daily life and essential functions. Restoration of essential services includes reopening schools, hospitals, markets, and transport networks, repairing electricity, water supply, and communication lines

Medium-term livelihood support like assistance for



farmers, small businesses, labourers, and informal workers, cash-for-work programmes and livelihood grants, social protection for vulnerable groups, recovery bridges relief and long-term reconstruction.

► Focuses on stabilising affected communities and rebuilding

### • Rehabilitation and Reconstruction

This phase seeks to rebuild lives, infrastructure, and community systems through long-term rebuilding including construction of durable housing, rebuilding roads, bridges, schools, and health facilities, reviving economic activities. While following Build Back Better (BBB) principles such as incorporating safety standards and resilient designs, relocating vulnerable settlements, ensuring risk-informed planning and governance; Along with strengthening resilience through capacity building of communities, strengthening local governance and disaster institutions, promoting climate-adaptive and sustainable development.

Rehabilitation and reconstruction create opportunities to correct past vulnerabilities and build safer, stronger communities.



Figure 3.1.1: The Disaster Management Cycle

### 3.1.4 Challenges to Disaster Management

Effective disaster management is often hindered by multiple challenges arising from structural conditions, institutional constraints, community-level vulnerabilities, and emerging global risks. Recognising these challenges is essential for strengthening preparedness and building resilient societies.

- **Structural and Developmental Challenges**

► Urbanisation and Demographic Pressures

Unplanned urban growth increases disaster risks in many Indian cities. For instance, Mumbai's recurrent flooding is mainly due to encroachments on natural drainage channels and inadequate wastewater systems. Similarly, landslides in rapidly expanding hill towns like Shimla and Gangtok are intensified by construction on unstable slopes. High population density makes evacuation difficult during earthquakes or fires, especially in informal settlements.

► Poverty and Social Inequalities

Poor households often live in hazard-prone areas such as riverbanks, low-lying coastal regions, and unstable slopes because safer locations are unaffordable. The 2018 Kerala floods highlighted that low-income families in unplanned settlements faced disproportionate damage and slower recovery due to limited financial buffers. Social inequalities also shape access to shelters, healthcare, and livelihood support, making vulnerable groups more exposed to risks.

Environmental degradation increases both the frequency and severity of hazards. The loss of mangrove forests in coastal India, for example, has reduced natural protection against cyclones and storm surges. In states like Uttarakhand, deforestation and unregulated development have amplified the risk of landslides and flash floods, as seen in the 2013 Kedarnath disaster.

- **Institutional and Administrative Challenges**

► Coordination Issues Among Agencies

Disaster response often requires coordination between district authorities, state departments, central agencies, defence forces, and local communities. During the 2004 Indian Ocean tsunami, delays in information flow and coordination highlighted the need for more integrated systems. Although capacities have improved since then, overlapping mandates and unclear communication channels still pose challenges during multi-agency operations.

Many districts lack specialised teams trained in urban search





► Lack of Trained Personnel

and rescue, incident command systems, or emergency medical care. For example, during the 2021 Chamoli glacier disaster, advanced rescue efforts depended heavily on specialised national forces because local teams lacked technical equipment and training.

► Resource Limitations

Resource constraints often limit preparedness measures such as stockpiling equipment, maintaining shelters, or updating early warning systems. Small and rural local bodies may struggle to allocate funds for risk reduction, as they depend heavily on state or central support.

► Technological Gaps

While India has advanced meteorological forecasting, certain regions still face limitations in real-time communication, GIS mapping, and early warning dissemination. For instance, during cloudburst events in the Himalayan areas, communication infrastructure often fails, hindering timely evacuation.

• **Social and Community-Level Challenges**

► Low Awareness and Preparedness

In many communities, people remain unaware of evacuation routes, safety measures, or hazard warnings. During Cyclone Phailin (2013), effective awareness campaigns and timely warnings helped dramatically reduce fatalities. However, in other cyclones, delays in evacuation often stem from a lack of awareness or mistrust of advisories.

► Vulnerability of Marginalised Groups

Children, older people, persons with disabilities, and women often face greater barriers during disasters. For example, during floods, physically challenged individuals may not be able to evacuate quickly without assistance, while women may have limited access to sanitation and healthcare in temporary shelters.

► Behavioural and Cultural Barriers

Cultural norms may influence how communities respond. Some people refuse to leave their homes due to fear of theft, emotional attachment to property, or the belief that the event will not be severe. Similar behavioural patterns were observed in several coastal villages during cyclones, where, despite warnings, residents hesitated to move to shelters.

• **Emerging Challenges**

► Climate Change and Extreme Events

Climate change is leading to more frequent and intense hazards. The increasing number of severe cyclones in the Arabian Sea, such as Cyclone Tauktae (2021), reflects changing climate patterns. Heatwaves in northern and central India are becoming longer and more dangerous, challenging existing

health systems and preparedness measures.

► Technological and Industrial Disasters

Rapid industrialisation has increased the risk of chemical leaks, explosions, and industrial accidents. Incidents such as the Vizag gas leak (2020) and factory fires in urban clusters highlight the need for improved industrial safety protocols and emergency management systems.

## Summarized Overview

This unit offered a comprehensive understanding of disasters and the evolving field of disaster management. It highlighted that disasters are not merely natural events but outcomes shaped by the interaction of hazards, vulnerabilities, and human systems. By examining the meaning, nature, and multidisciplinary foundations of disaster management, the unit emphasised the importance of prevention, mitigation, preparedness, response, and recovery as part of a continuous and integrated cycle. The discussion on the disaster management cycle illustrated how effective planning before, during, and after a disaster can significantly reduce losses and enhance resilience.

The unit also explained the structural, administrative, social, and emerging challenges that influence disaster governance, demonstrating that effective management requires coordination, community participation, sustained investment, and risk-sensitive development. Overall, this unit equips learners with foundational knowledge and a critical perspective needed to understand disaster risk, evaluate management strategies, and appreciate the importance of resilience-building in contemporary governance.

## Self-Assessment

1. Define the term *disaster*.
2. State any two key components of the disaster management cycle.
3. Name one stage of the disaster management cycle.
4. Mention any one activity under the recovery phase.
5. What is rehabilitation in disaster management?
6. Identify one challenge in disaster management.
7. Define *response* in the disaster management cycle.
8. What is the significance of community participation in disaster management?
9. What is the purpose of mitigation in disaster management?
10. Which stage of the disaster management cycle includes providing temporary shelters?



## Assignments

1. Discuss the meaning and nature of disaster management
2. Analyse the disaster management cycle and describe the key activities involved in each phase.
3. Analyse the emerging challenges and their implications for disaster governance.
4. The disaster management cycle is often described as a *continuous and evolving process*. Examine this statement in light of prevention, preparedness, response, and recovery functions.
5. Using recent disaster events, analyse the role of early warning systems in reducing mortality and losses. What gaps remain in last-mile communication?

## Reference

1. Government of India. (2005). *The Disaster Management Act, 2005*. Ministry of Law and Justice.
2. National Disaster Management Authority. (2009). *National Policy on Disaster Management*. Government of India.
3. Government of India. (2016). *National Disaster Management Plan (NDMP)*. National Disaster Management Authority.
4. United Nations Office for Disaster Risk Reduction. (2015). *Sendai Framework for Disaster Risk Reduction 2015–2030*. United Nations.

## Suggested Reading

1. Murthy, D. B. N. (2008). *Disaster management: Text and case studies*. Deep & Deep Publication.
2. Sinha, P. C. (2006). *Disaster management process: Laws, process and strategy*. SBS Publishers & Distributors.
3. Singh, R. (2015). *Handbook of disaster management* (Vol. 1). Horizon Press.
4. Singh, R. (2015). *Handbook of disaster management* (Vol. 2). Horizon Press.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU





## UNIT 2

# Disasters – Classification

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ explain the concept of disaster classification and differentiate between natural, man-made, rapid onset, and slow onset disasters.
- ▶ describe the causes, characteristics, and impacts of major natural disasters such as earthquakes, cyclones, and floods.
- ▶ analyse the factors contributing to man-made disasters, including industrial accidents, chemical spills, and armed conflicts.

### Background

Disasters, whether natural or human-induced, have shaped the course of human history, influencing settlement patterns, economic systems, and social development. This unit introduces learners to the classification of disasters by examining their origins, patterns of onset, and the nature of their impacts. Natural disasters such as earthquakes, cyclones, and floods reveal how powerful geophysical and hydrometeorological forces can disrupt communities with little warning. At the same time, man-made disasters, ranging from industrial accidents and chemical spills to armed conflicts, demonstrate how human actions, negligence, and governance failures can create conditions for large-scale harm.

The unit also differentiates between rapid-onset disasters, which strike suddenly and demand immediate response, and slow-onset disasters like famine and epidemics, which evolve gradually but carry far-reaching social, economic, and health consequences. Together, these classifications help students understand that disasters are not isolated events; they emerge from the interaction between hazards and human vulnerability.

By exploring the diverse nature of disasters and their underlying causes, this unit provides a conceptual foundation for more advanced discussions on disaster preparedness, mitigation, response, and recovery. It encourages learners to think critically about the broader socio-economic and administrative dimensions of disaster management in India and globally.



## Keywords

Natural Disasters, Man-made Disasters, Rapid Onset Events, Slow Onset Events, Tectonic Plate Movement, Industrial Accident

## Discussion

### 3.2.1 Disaster Classification

► Disasters vary widely in their origins and effects

Understanding how disasters are classified is a crucial starting point for analysing their causes, impacts, and management strategies. Every disaster, whether natural or human-made, has a particular pattern of onset, duration, and consequences. Classification helps us make sense of these differences and organise disaster management activities systematically and scientifically. Because disasters vary widely in their origins and effects, categorising them provides clarity for planning, prepares authorities for hazard-specific risks, and supports timely, coordinated action during emergencies.

#### 3.2.1.1 Concept of Classification

Classification refers to the systematic grouping of disasters based on shared characteristics such as origin, speed of onset, magnitude, duration, or the processes that trigger them. It helps distinguish one type of event from another by identifying:

- What causes the disaster (natural forces or human activities)
- How quickly it occurs (sudden or slow)
- How it affects people and the environment
- What kind of preparedness and response are needed

► Systematic grouping of disasters

For example, an earthquake is sudden, caused by geological processes, and requires rapid rescue efforts, while famine develops slowly due to prolonged drought and requires long-term resource planning. Thus, classification provides a conceptual framework that helps policymakers, planners, and disaster managers handle diverse emergencies professionally and efficiently.

#### Importance of Classifying Disasters

Classifying disasters is essential because different types



require different management approaches. A uniform method cannot be applied to all situations. The importance of classification can be understood through the following points:

► A uniform method cannot be applied to all situations

1. **Facilitates Better Planning:** Each disaster type has unique characteristics. Knowing these helps prepare hazard-specific plans, such as cyclone shelters for coastal hazards and earthquake retrofitting.
2. **Enhances Early Warning and Preparedness:** Meteorological and geological agencies issue warnings based on the nature of the hazard. Flood warnings differ from tsunami warnings, and this distinction improves alert quality and community readiness.
3. **Helps Identify Vulnerable Regions and Populations:** Classification makes it easier to map the areas prone to cyclones, floods, landslides, or epidemics. This ensures proper allocation of resources.
4. **Supports Effective Response and Recovery:** Response to an air crash is different from response to a chemical spill. Classification allows responders NDRF, health teams, or local bodies to adopt the appropriate procedures.
5. **Strengthens Policy and Governance:** National and international frameworks, including NDMP and the UNDRR hazard classification, use systematic categories to frame policies and establish guidelines.

### 3.2.1.2 Broad Categories of Disasters

► The categories are not rigid, and a single disaster may belong to more than one category

Disasters are often classified based on their origin and the speed at which they occur. This classification is primarily used as an analytical tool to understand different types of hazards and to plan appropriate preparedness, response, and recovery measures. These categories are not rigid, and a single disaster may belong to more than one category. Broadly, disaster may be classified on different bases such as origin and speed. Each category reflects a distinct pattern of causes, development, and impacts.

#### Natural Disasters

Natural disasters arise from natural processes that occur within the earth's physical, geological, or atmospheric

- Arise from natural processes that occur within the earth's physical, geological, or atmospheric systems

systems. Although these events originate in nature, their impact is often shaped by human settlements, environmental conditions, and levels of preparedness. Common examples include earthquakes, cyclones, and floods. Earthquakes are caused by sudden movements along tectonic plates beneath the Earth's surface and can inflict severe damage in seismically active regions. Cyclones develop over warm ocean waters, bringing intense winds, heavy rainfall, and storm surges that affect coastal communities. Floods result from excessive rain, river overflow, dam breaches, or rapid snowmelt and can inundate both rural and urban areas. These events often occur with great force and unpredictability, making hazard mapping, early warning systems, and community preparedness essential components of risk reduction.

### Man-made Disasters

- Triggered by human actions

Man-made disasters are triggered by human actions, technological failures, unsafe industrial practices, or socio-political conditions. Many of these events are preventable with appropriate regulations, monitoring, and safety protocols. Examples include armed conflict, major accidents, and chemical spills. Armed conflicts disrupt social structures, damage infrastructure, and cause humanitarian crises. Industrial and transport-related accidents, such as major road crashes, train derailments, or factory explosions, can lead to loss of life and environmental contamination. Chemical spills occur during industrial processes or the transport of hazardous materials, posing immediate threats to human health and ecosystems. These disasters highlight the importance of strict safety standards, regulatory oversight, and specialised emergency response mechanisms.

### Rapid Onset Disasters

- Occur suddenly and develop over a short time frame

Rapid-onset disasters occur suddenly and develop over a short time frame, often in a matter of minutes or hours. Their abrupt nature leaves little opportunity for preparation, making swift action essential. Air crashes and tsunamis are typical examples. Air crashes occur without warning due to technical failures, weather disturbances, or human error, requiring immediate rescue and medical response. Tsunamis, generated by undersea earthquakes or volcanic activity, produce powerful waves that reach coastlines quickly, causing widespread devastation. Because of their suddenness, rapid-onset disasters demand strong early warning capabilities, efficient communication

systems, and well-coordinated emergency teams.

### Slow-Onset Disasters

► Develop gradually over an extended period

Slow-onset disasters develop gradually over an extended period; weeks, months, or even years. Their effects may not be immediately visible, but they can become deeply destructive as conditions worsen. Examples include famine and epidemics. Famine is often the cumulative result of prolonged drought, crop failure, economic decline, or weak food distribution systems, leading to widespread hunger and malnutrition. Epidemics occur when infectious diseases spread rapidly within a population, intensified by inadequate healthcare systems, poor sanitation, or environmental changes. These disasters require continuous monitoring, strong public health measures, long-term planning, and sustained social support systems to reduce their impact.

| Category                     | Origin / Cause                                                                             | Speed of Onset                                                        | Typical Examples                                      | Key Characteristics                                                                                        |
|------------------------------|--------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Natural Disasters</b>     | Natural geological, hydrological or atmospheric processes                                  | Can be sudden or gradual depending on the hazard                      | Earthquake, Cyclone, Flood                            | Triggered by natural forces; impact depends on exposure, environment, and preparedness.                    |
| <b>Man-made Disasters</b>    | Human activities, technological failures, industrial processes, or socio-political factors | Sudden in many cases; gradual in some (pollution, resource depletion) | Armed conflict, Industrial accidents, Chemical spills | Often preventable; result from negligence, conflict, or unsafe practices; require regulatory oversight     |
| <b>Rapid Onset Disasters</b> | Natural or man-made causes that manifest abruptly                                          | Very sudden minutes to hours                                          | Air crash, Tsunami, Flash flood, Earthquake           | Minimal warning time; requires swift response, search and rescue, and efficient communication              |
| <b>Slow Onset Disasters</b>  | Long-term environmental, climatic, or socio-economic processes                             | Gradual weeks, months, years                                          | Famine, Drought                                       | Effects accumulate slowly; long-lasting impacts require sustained monitoring and long-term policy measures |

Table 3.2.1



## 3.2.2 Natural Disasters

### 3.2.2.1 Earthquakes

► Occur primarily due to the movement of tectonic plates

Earthquakes are sudden tremors caused by the release of energy accumulated within the Earth's crust. They occur primarily due to the movement of tectonic plates, which either collide, slide past, or drift apart. India's position at the boundary of the Indian Plate and Eurasian Plate makes it highly prone to seismic activity, especially along the Himalayan belt. Earthquakes often strike without any warning. The 2001 Bhuj earthquake, which devastated large parts of Gujarat, demonstrated the enormous destructive potential of ground shaking. Buildings collapsed "like a pack of cards," not because of the earthquake itself, but due to weak construction and poor enforcement of building codes. The lesson learnt globally, including from Japan, is that earthquakes do not kill; unsafe structures do. Well-designed buildings that can sway with seismic waves significantly reduce casualties.

► Seismic zone

A seismic zone denotes a region classified based on its susceptibility to earthquake-induced ground shaking. In India, seismic zoning serves as an important tool for assessing earthquake hazard and for guiding earthquake-resistant construction, land-use planning, and disaster risk reduction. As per the Bureau of Indian Standards (BIS) seismic code IS 1893 (Part 1), India is officially classified into four operational seismic zones, namely Zone II, Zone III, Zone IV, and Zone V. Earlier, five seismic zones were recognised; however, Seismic Zone I was subsequently merged with Zone II, reflecting the understanding that no part of the country can be considered entirely free from seismic risk. Under the official classification, Zone II corresponds to areas of low seismic hazard, Zone III represents regions exposed to moderate seismic risk, Zone IV includes areas vulnerable to severe ground shaking, and Zone V comprises regions of very high seismic hazard. Zone V covers the Himalayan states, the North-Eastern region, and the Andaman and Nicobar Islands. At the same time, Zone IV includes areas such as Delhi and parts of Gujarat, Maharashtra, and the Indo-Gangetic plains. Based on this zoning framework, approximately 59 per cent of India's land area falls within zones characterised by moderate to very high seismic hazard.

Earthquakes have both immediate and long-term impacts structural damage, landslides, ground rupture, loss of life, trauma, disruption of services, and economic paralysis.





► Immediate and long-term impacts

Aftershocks often continue for weeks or months, aggravating fear and complicating rescue efforts. Strengthening building codes, retrofitting vulnerable structures, enhancing community preparedness, and strict urban planning are essential to reducing earthquake risk.

### 3.2.2.2 Cyclones

► Cyclones vary in intensity

Cyclones are intense atmospheric disturbances characterised by strong winds, heavy rainfall, and storm surges. They form over warm ocean waters when moist air rises, creating a low-pressure centre that draws surrounding winds into a rotating system. The Indian coastline is highly vulnerable, especially the east coast, where the funnel-shaped Bay of Bengal amplifies storm surges. Cyclones vary in intensity from depressions to super cyclonic storms depending on wind speed and pressure differences. Their destructive power lies not only in winds but also in associated flooding, coastal erosion, and infrastructure damage. Events like the 1999 Odisha Super Cyclone, Cyclone Phailin (2013), and Cyclone Fani (2019) illustrate how rapidly coastal areas can be transformed into disaster zones.

► Forecasting cyclones

Communities living along the coast, especially fisherfolk, face unique risks. Their livelihoods depend on the sea, and they often venture out despite warnings, balancing survival with danger. This underscores the importance of disaster communication and early warning systems. Over the years, India has made significant progress in cyclone forecasting and evacuation planning, resulting in fewer casualties compared to earlier decades.

### 3.2.2.3 Floods

► Seasonal flood and Flash flood

Floods occur when water exceeds the capacity of natural or artificial drainage systems and spreads over land. India is highly vulnerable to floods, with over 40 million hectares identified as flood-prone. Heavy monsoon rainfall, river overflow, poor drainage, dam failures, cloudbursts and siltation are major contributing factors. Floods in India are both seasonal and flash. Seasonal floods occur during the monsoon months, affecting large river basins such as the Brahmaputra and Ganga. Flash floods occur suddenly due to intense rainfall or glacial lake outbursts, such as the 2023 Sikkim GLOF, which caused severe destruction downstream.

Urban floods have become increasingly common. Events in

#### ► Urban floods

Mumbai (2005), Chennai (2015), Kochi (2018) and Bengaluru (2022) show how unplanned urbanisation, blocked drains, encroachments on water bodies and inadequate stormwater systems can paralyse cities for days. Flood management requires both structural and non-structural measures. Strengthening embankments, constructing check dams, desilting rivers, maintaining drainage systems, regulating land use in floodplains and improving forecasting systems are important long-term steps. Immediate relief measures include evacuation, food and water supply, temporary shelters, medical care, and the restoration of essential services.

### 3.2.3 Man-made Disaster

#### 3.2.3.1 Industrial and Technological Accidents

#### ► Occur when systems designed to support human activity fail

Industrial and technological disasters occur when systems designed to support human activity fail due to technical faults, human error, negligence, or weak regulatory oversight. These accidents are often sudden, high-impact events that severely affect communities and the environment. Industrial explosions, factory fires, boiler blasts, and hazardous emissions are common in regions with dense industrial activity. Chemical plants, refineries, steel mills, and manufacturing units operate with materials that can become unstable under unsafe conditions. Nuclear facilities, while relatively rare, carry catastrophic potential when safety systems fail.

#### ► The Bhopal Gas Tragedy (1984)

The Bhopal disaster remains one of the world's worst industrial tragedies. A leak of methyl isocyanate (MIC) gas from the Union Carbide pesticide plant exposed thousands of people to toxic fumes. Immediate impacts included severe respiratory distress, blindness, organ failure, and mass casualties. Long-term consequences chronic illnesses, genetic disorders, groundwater contamination, and social trauma; continue to affect generations. The tragedy exposed critical lapses in site safety, emergency preparedness, industrial regulation, and corporate accountability. It also transformed India's approach to industrial safety, leading to stricter environmental laws, the Environment Protection Act (1986), and improved guidelines for hazardous chemical management. Yet, industrial accidents continue to occur across India, reflecting gaps in monitoring, worker training, hazard communication, and disaster readiness.

More recent examples include:

- Vizag LG Polymers gas leak (2020) – styrene vapour



leak affecting surrounding villages

- Bihar boiler explosion (2021) – workplace safety lapses
- Delhi Anaj Mandi fire (2019) – overcrowded industrial spaces with no fire safety compliance

These incidents highlight the continuing relevance of strong regulatory oversight and technological safeguards.

### 3.2.3.2 Chemical Spills and Hazardous Material Incidents

#### ► Causes of chemical hazard

The modern economy depends heavily on chemicals; industrial solvents, pesticides, fuels, hazardous gases, and cleaning agents. Chemical disasters occur when these substances leak, spill, or react unexpectedly during manufacturing, storage, transport, or disposal. Such incidents may be accidental or arise from negligence, improper maintenance, or inadequate safety protocols. Chemical hazards can be broadly classified into toxic, flammable, explosive, corrosive, and reactive materials. Each category poses distinct risks. Harmful chemicals may cause poisoning, respiratory distress, neurological damage or cancer. Flammable substances can ignite and cause fires. Reactive substances may explode when exposed to heat or moisture. Transport-related chemical spills are hazardous. India's expanding road and rail networks frequently carry hazardous cargo, making accidents involving tanker trucks and freight trains a recurring concern. Storage facilities also pose risks when containers leak due to corrosion, poor maintenance, or improper temperature control.

#### ► Environmental and health impacts

The environmental and health impacts of chemical disasters are severe. Contaminated soil and groundwater can render land unusable for years. Aquatic ecosystems suffer from fish kills and long-term biodiversity loss. Human exposure leads to acute poisoning, burns, respiratory injuries, and chronic illnesses. Communities living near industrial clusters are particularly vulnerable, often facing prolonged exposure to low levels of pollutants even during routine operations. Addressing chemical hazards requires a robust regulatory framework, periodic safety audits, emergency preparedness planning, hazard communication systems, and specialised response teams trained to handle toxic materials. Public awareness, proper labelling, and strict enforcement of storage and transport standards are also essential in preventing such incidents.

### 3.2.3.3 Armed Conflicts and Internal Disturbances

► Complex category of human-induced disasters

Armed conflicts and internal disturbances mostly represent a complex category of human-induced disasters where violence, political instability, or social tensions lead to widespread damage and humanitarian distress. Conflicts may arise from ethnic tensions, territorial disputes, ideological extremism, or governance breakdowns. Unlike sudden events such as industrial accidents, conflicts evolve gradually but can persist for decades, creating chronic insecurity. The impacts of armed conflicts extend far beyond the battlefield. Civilians often bear the most significant burden through loss of life, displacement, and loss of livelihoods. Infrastructure roads, bridges, schools, hospitals, water supply systems—becomes a direct target or collateral damage, disrupting essential services. Social institutions weaken as communities become fragmented, trust erodes, and standard governance mechanisms collapse. Prolonged conflict also affects children's education, access to healthcare, and opportunities for economic development.

► Not a classical case of disaster

Internal disturbances, such as riots, mob violence, communal tensions, and prolonged curfews, also disrupt everyday life. They may not involve organised armed warfare, but still generate widespread insecurity and economic loss. For disaster management agencies, these situations pose unique challenges, as response efforts must be coordinated with law-enforcement, political authorities, and community leaders to restore normalcy and prevent further escalation.

It is important to note that armed conflict is not uniformly classified as a disaster across all international frameworks. The United Nations Office for Disaster Risk Reduction (UNDRR) generally treats armed conflict as a contextual risk driver rather than a disaster hazard. However, in disaster management and humanitarian studies, armed conflicts are frequently analysed as complex humanitarian emergencies, recognising that they produce consequences comparable to those of disasters in terms of scale, severity, and long-term societal impact.

### 3.2.4 Rapid Onset Disasters

#### 3.2.4.1 Air Crashes

Air crashes constitute a highly sudden and potentially severe form of technological accident, arising from aircraft failure during take-off, flight, or landing, and often resulting in loss of



► Not all air crashes are automatically classified as disasters

control and catastrophic consequences. From a disaster studies perspective, not all air crashes are automatically classified as disasters. Isolated incidents involving limited casualties are generally treated as major accidents within aviation safety and emergency management frameworks. However, large-scale air crashes involving mass casualties, extensive damage, and complex rescue and recovery operations are recognised as disasters due to their magnitude, humanitarian impact, and the scale of coordinated emergency response required. Although aviation is one of the safest modes of transport globally, air crashes continue to occur due to a combination of technological, human, and environmental factors.

► Causes: Technical Failure and Human Error

Air accidents typically result from complex interactions between technical systems and human factors. Technical failures include engine malfunction, structural defects, electrical faults, sensor or instrument malfunction, and mechanical breakdowns. Ageing aircraft fleets and inadequate maintenance can exacerbate these risks. Human error is another major cause, ranging from pilot misjudgement, fatigue, miscommunication, and poor decision-making under stress, to errors by air traffic controllers or ground maintenance teams. Weather conditions, such as fog, storms, lightning, wind shear, and poor visibility, also contribute significantly to aviation disasters.

India has witnessed several noteworthy air crashes in recent years, such as:

- Kozhikode Air India Express crash (2020) caused by overshooting the runway during heavy rain.
- Ghatkopar charter plane crash (2018) linked to a technical malfunction.
- Ahmedabad Air Crash (2025)

These incidents highlight how multiple factors can converge to cause sudden disasters.

► Search and Rescue Challenges

Air crash response presents unique challenges. The location of the crash—dense forest, mountainous terrain, deep sea, or urban areas determines the accessibility of the site. Fire, toxic fumes, and structural debris make rescue operations hazardous. Aviation fuel spills may ignite, increasing risks for survivors and responders. Search and rescue efforts rely on coordinated action between the Air Force, National Disaster Response Force (NDRF), local authorities, and specialised medical



teams. Locating the aircraft's black box, stabilising survivors, managing crowd control, and ensuring forensic identification are critical components of the response. Rapid medical evacuation, treatment of burns and trauma, and psychological support also form essential elements of post-crash management.

### 3.2.4.2 Tsunami

► Devastating natural hazards, particularly in coastal regions

A tsunami is a series of long, high-energy sea waves generated by the sudden displacement of large volumes of water. Unlike regular ocean waves formed by wind, tsunamis arise from underwater disturbances such as earthquakes, volcanic eruptions, submarine landslides, or meteorite impacts. Their speed and force make them among the most devastating natural hazards, particularly in coastal regions. The most common cause of tsunamis is a submarine earthquake along a tectonic plate boundary. When the ocean floor is abruptly displaced, massive amounts of water are pushed upward, forming waves that travel rapidly across the ocean. Tsunamis can also be triggered by underwater volcanic eruptions or landslides, and, in rare cases, by meteorite impacts.

► Generation of Tsunami Waves

Tsunami waves originate in deep ocean waters, where they travel at extremely high speeds—often exceeding 500 km/h. Because their wavelengths are long and their amplitude (height) is small in deep water, they may go unnoticed by ships. As the waves approach shallow coastal waters, their speed decreases, but their height increases dramatically, causing massive inundation and destruction. The first wave may not be the largest, and a series of waves may continue for hours.

► Vulnerable Coastal Zones

Coastal regions near tectonic plate boundaries are especially vulnerable. In India, the Andaman and Nicobar Islands, Tamil Nadu, Kerala, Andhra Pradesh, and parts of Odisha are at high risk. Communities dependent on fishing or living in low-lying regions face heightened vulnerability due to exposure, limited evacuation time, and dependence on coastal resources.

### Indian Ocean Tsunami (2004)

► Indian Ocean Tsunami of 26 December 2004

The Indian Ocean Tsunami of 26 December 2004 remains one of the most devastating disasters in modern history. Triggered by a massive 9.1 magnitude earthquake near Sumatra, it generated waves up to 30 metres high. India suffered severe losses, particularly in Tamil Nadu, the Andaman and Nicobar Islands, Kerala, Andhra Pradesh, and Puducherry. Entire



coastal settlements were destroyed, thousands lost their lives, and livelihoods especially fisheries were severely affected.

► Need for warning system

The tragedy highlighted the urgent need for: a robust Indian Ocean Tsunami Warning System, Coastal hazard mapping, Community-based awareness programmes, Evacuation plans and shelters, monitoring of seismic activity Over time, India has significantly strengthened its tsunami preparedness, and the Indian National Centre for Ocean Information Services (INCOIS) now provides early warnings and real-time monitoring.

### 3.2.5 Slow-Onset Disasters

#### 3.2.5.1 Famine

► Multiple dimensions

Famine is one of the most severe forms of slow-onset disaster, characterised by extreme and widespread food scarcity that leads to hunger, malnutrition, disease, and sometimes mass mortality. While famines are often associated with natural events such as drought, their occurrence is rarely due solely to environmental factors. In modern disaster studies, famine is understood as a socio-economic phenomenon exacerbated by political decisions, market failures, inequitable food distribution, and systemic governance weaknesses.

► Causes: Crop Failure, Drought and Economic Factors

Drought is one of the most common triggers of famine. Prolonged absence of rainfall reduces soil moisture, damages crops, depletes water sources, and weakens livestock health. Crop failure may also result from pests, diseases, soil degradation, or extreme weather events intensified by climate change. However, agricultural failure does not automatically lead to famine; it becomes disastrous when combined with poverty, lack of access to markets, displacement, conflict, or breakdown in state support systems. Economic factors deepen vulnerability. Rising food prices, unemployment, failure of public distribution systems, inadequate social protection, and weak governance can turn a climate shock into a humanitarian crisis. Historically, famines in colonial India, including the Bengal Famine of 1943, demonstrated how political neglect, poor communication, and economic policies worsened food shortages.

The consequences of famine extend far beyond immediate hunger. Prolonged food scarcity leads to chronic malnutrition, stunting among children, increased susceptibility to disease,

► Long-term Social Impact

and long-term decline in physical and cognitive development. Families may migrate in search of livelihood, leading to displacement and social disintegration. Entire communities may lose agricultural assets, livestock, and savings, pushing them into cycles of poverty that persist for generations. Famine also erodes social cohesion, as competition for scarce resources can intensify tensions within and between communities. Today, early warning systems, improved food storage facilities, public distribution networks, and social safety measures have reduced the likelihood of large-scale famines. However, localised food insecurity remains a growing concern in drought-prone regions, especially in the context of climate change and recurrent extreme weather events.

► Spread of infectious diseases across populations

### 3.2.5.2 Epidemics and Pandemics

Epidemics and pandemics are slow onset disasters associated with the spread of infectious diseases across populations. An epidemic refers to the rapid increase in disease cases within a specific geographic area, while a pandemic denotes a global-scale spread affecting multiple countries and continents. These disasters unfold gradually as pathogens adapt, spread, and penetrate social systems, often exposing long-standing weaknesses in public health infrastructure.

► Disease Outbreaks

Disease outbreaks may be caused by viruses, bacteria, parasites, or other pathogens. Factors such as population density, mobility, inadequate sanitation, environmental changes, and close contact between humans and animals increase the risk of outbreaks. Zoonotic diseases, which jump from animals to humans, have become more common due to encroachment on wildlife habitats and globalisation.

► Transmission Patterns

Transmission varies depending on the pathogen. Some diseases, like influenza, spread through respiratory droplets; others, like cholera, spread through contaminated water. Vector-borne diseases such as malaria and dengue; depend on environmental conditions that support mosquito breeding. Understanding transmission patterns is essential for designing effective containment strategies such as quarantine, vaccination, social distancing, vector control, and public health communication.

Managing epidemics poses several challenges. The health system may become overwhelmed by surges in patient load, leading to shortages of medical staff, hospital beds, equipment,

► Public Health  
Response Challenges

and essential medicines. Surveillance systems may be inadequate, delaying detection and response. Misinformation, social stigma, and public fear can hinder compliance with preventive measures. Rural and marginalised populations often face difficulties accessing timely medical care, intensifying the impact of outbreaks.

► Managing public  
health emergencies

Cross-sector coordination, between health authorities, local governments, disaster management agencies, and civil society is essential for managing public health emergencies. Long-term strengthening of health infrastructure, community awareness programmes, and investment in research are critical to building resilience against future outbreaks.

### COVID-19 as an Example

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, is one of the most significant slow-onset disasters of the twenty-first century. Beginning as a local outbreak in late 2019, it rapidly escalated into a global crisis affecting virtually every aspect of life. The pandemic strained health systems, disrupted supply chains, halted economic activity, and resulted in widespread social and psychological stress. In India, COVID-19 highlighted both strengths and gaps in public health governance. Large-scale vaccination, rapid expansion of healthcare facilities, and community mobilisation were major achievements. However, shortages of oxygen, hospital beds, and essential medicines during peak waves revealed the challenges of managing a prolonged health emergency in a densely populated country. COVID-19 also illustrated how slow onset disasters can have cascading impacts on education, employment, mental health, food security, and social relations, reinforcing the need for resilient health systems and strong disaster preparedness.



## Summarized Overview

This unit provided a comprehensive understanding of the diverse forms of disasters and how they affect human societies. By examining natural disasters such as earthquakes, cyclones, and floods, the unit highlighted how geophysical and climatic forces can rapidly disrupt communities and infrastructure. The discussion on man-made disasters demonstrated that technological failures, industrial accidents, and conflicts can be equally devastating when safety systems, regulatory frameworks, or social stability break down. The distinction between rapid-onset events, which strike suddenly, and slow-onset disasters like famine and epidemics, which evolve gradually, emphasised the need for distinct preparedness and response strategies. Overall, the unit underscored that disasters are not merely physical events but are shaped by human vulnerability, exposure, and socio-economic conditions. Understanding the classification, causes, and impacts of various disasters is essential for designing effective disaster management policies and for strengthening resilience at the community, institutional, and national levels.

## Self-Assessment

1. Distinguish between natural and man-made disasters.
2. Give any two examples of natural disasters.
3. What is a rapid onset disaster?
4. Give one example of a slow onset disaster.
5. Identify one coastal state in India that is highly vulnerable to cyclones.
6. Give any two causes of floods.
7. What is meant by an epidemic?
8. What is the difference between urban floods and rural floods?
9. What is an industrial accident?
10. What distinguishes slow onset disasters from rapid onset disasters?

## Assignments

1. Evaluate the increasing incidence of urban floods in India. In what ways do unplanned urbanisation and environmental changes contribute to this trend?
2. Assess the social, economic, and environmental consequences of industrial and technological disasters. Illustrate your answer with the Bhopal Gas Tragedy or a recent example.





3. Compare and contrast rapid onset and slow onset disasters in terms of causes, impacts, and management strategies. Provide examples for each type.
4. Examine the challenges faced in managing rapid onset disasters such as air crashes and tsunamis. How can multi-agency coordination improve response effectiveness?
5. Discuss the long-term effects of slow onset disasters like famine and epidemics on human development. How do governance and public policy influence outcomes?

## Reference

1. Government of India. (2005). *The Disaster Management Act, 2005*. Ministry of Law and Justice.
2. National Disaster Management Authority. (2009). *National Policy on Disaster Management*. Government of India.
3. National Disaster Management Authority. (2019). *National Disaster Management Plan (NDMP)*. Government of India.
4. India Meteorological Department. (2021). *Cyclone e-Atlas and cyclone guidelines*. Ministry of Earth Sciences.
5. National Centre for Seismology. (2020). *Seismic Zonation Map of India*. Ministry of Earth Sciences.
6. Central Water Commission. (2020). *Flood management reports and flood hazard atlas*. Ministry of Jal Shakti.
7. United Nations Office for Disaster Risk Reduction. (2020). *Hazard definition and classification review: Technical report*.

## Suggested Reading

1. Murthy, D. B. N. (2008). *Disaster management: Text and case studies*. Deep & Deep Publication.
2. Sinha, P. C. (2006). *Disaster management process: Laws, process and strategy*. SBS Publishers & Distributors.
3. Singh, R. (2015). *Handbook of disaster management* (Vol. 1). Horizon Press.
4. Singh, R. (2015). *Handbook of disaster management* (Vol. 2). Horizon Press.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU



## UNIT 3

# Disaster Administration and Legislation

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ explain the evolution of disaster administration in India
- ▶ identify the structure and functions of national, state, district, and local-level disaster management authorities.
- ▶ analyse the major provisions of the Disaster Management Act, including institutional frameworks, legal mandates, and financial mechanisms for disaster governance.
- ▶ examine the roles of nodal agencies in managing hazard-specific risks.

### Background

Disasters in India have historically been handled as crises demanding urgent relief. For a long time, the administrative machinery was activated primarily after an event occurred, with the focus on providing food, shelter, and compensation to affected populations. However, as disasters grew in frequency, scale, and complexity, it became evident that a reactive approach was insufficient. Significant events such as the Latur earthquake, the Odisha Super Cyclone, the Gujarat earthquake, and the Indian Ocean Tsunami revealed critical gaps in coordination, preparedness, and long-term planning. These experiences marked a turning point in India's understanding of disaster governance.

This unit explores how India moved from a relief-centric model to a structured, legally grounded, and prevention-oriented disaster management system. The Disaster Management Act, 2005, stands as the most significant milestone in this transformation. It created a multi-level institutional framework: national, state, district, and local; ensuring that disaster management is not an isolated administrative function but an integral part of the country's governance structure.

The unit introduces learners to the roles and responsibilities of key institutions including the National Disaster Management Authority (NDMA), State and District

Disaster Management Authorities, NDRF, and specialised scientific agencies such as IMD, INCOIS, CWC, and GSI. It also highlights the growing emphasis on early warning systems, inter-agency coordination, decentralised planning, and the integration of disaster risk reduction into development activities.

By examining the legal foundations, administrative mechanisms, and functional responsibilities embedded in the DM Act, learners gain a comprehensive understanding of how disasters are managed in India today. The unit sets the stage for appreciating disaster management not merely as an emergency response activity but as an essential component of sustainable development, resilience building, and good governance.

## Keywords

National Disaster Management Authority, State Disaster Response Fund, Emergency Operation Centres, Nodal Agencies

## Discussion

### 3.3.1 Introduction to Disaster Administration in India

Disaster administration in India comprises the organised, institutional, and legally mandated arrangements through which the Union, State, District, and Local governments prepare for, respond to, and recover from disasters. As disasters have become more frequent and complex due to climate variability, population pressures, unplanned urban growth, and technological expansion, India has increasingly recognised the need to move from reactive relief-based mechanisms to a more proactive, systematic, and prevention-oriented governance framework. Modern disaster administration, therefore, integrates law, science, planning, community participation, and intergovernmental coordination to ensure that risks are reduced long before a hazard manifests as a disaster.

► Prevention-oriented governance framework

► Comprising laws, institutions, policies, plans, procedures, and coordination mechanisms

Disaster administration refers to the system of governance comprising laws, institutions, policies, plans, procedures, and coordination mechanisms through which disasters are managed across all stages: mitigation, preparedness, response, and recovery. It goes beyond emergency response and includes risk assessment, early warning systems, capacity development,





inter-agency coordination, and community involvement.

Its scope is broad and multidimensional. It includes:

► Multi-dimensional scope

- Policy formulation at the national and state levels
- Institutional mechanisms such as NDMA, SDMA, and DDMA
- Operational systems like Emergency Operation Centres (EOCs), Incident Response Systems (IRS), and Standard Operating Procedures (SOPs)
- Resource mobilisation through designated funds like NDRF and SDRF
- Coordination of multiple agencies, including police, fire and rescue, health services, defence forces, and NGOs
- Integration of disaster management with development planning, ensuring that growth is sustainable and resilient

Thus, disaster administration is not merely administrative action; it is a governance function that requires legal authority, technical expertise, and societal trust.

### Evolution of Disaster Administration Framework in India

► Disaster response was primarily relief-centric

India's disaster management framework has evolved significantly over the decades. Before the 1990s, disaster response was primarily relief-centric, with the government focusing on providing food, shelter, and compensation after major events. The responsibility largely rested with the state governments, with support from the Ministry of Agriculture at the Centre. A major shift began in the late 1990s and early 2000s, prompted by several devastating disasters; the Latur earthquake (1993), Odisha Super Cyclone (1999), Gujarat earthquake (2001), and the Indian Ocean Tsunami (2004). These events exposed the limitations of an ad hoc relief-oriented approach and highlighted the need for a structured, anticipatory, and professionally managed system.

This led to the enactment of the Disaster Management Act, 2005, a landmark legislation that created a three-tier institutional structure:

- National Disaster Management Authority (NDMA) at the Union level

- State Disaster Management Authorities (SDMAs) at the state level
- District Disaster Management Authorities (DDMAs) at the district level

The Act legally mandated disaster management plans at all levels, established the NDRF, and introduced Disaster Response and Disaster Mitigation Funds. Subsequent policies and plans—such as the National Policy on Disaster Management (2009) and National Disaster Management Plan (2016/2019)—further strengthened the governance model by aligning it with global frameworks such as the Sendai Framework.

### Importance of Governance in Disaster Management

Governance is central to disaster management because disasters are not only physical events but also administrative challenges. Effective governance ensures:

- Clear roles and responsibilities among institutions
- Coordination between Union, State, District, and Local bodies
- Efficient resource allocation and timely decision-making
- Transparency and accountability in the use of funds
- Inclusive planning, incorporating vulnerable groups, community organisations, and local governments
- Scientific and evidence-based decision making, using early warning systems, hazard zonation, and risk mapping
- Integration of disaster management into development, reducing the long-term vulnerability of communities

► Disasters are not only physical events but also administrative challenges

When governance is strong, disaster risks are reduced, response is swift, and recovery is resilient. Weak governance, on the other hand, multiplies the human and economic cost of disasters, even when scientific and technological systems exist. India's disaster administration model underscores that risk reduction is ultimately a governance function rooted in law, institutional effectiveness, and public participation.

### 3.3.2 Disaster Administration at the Union Level

The Union Government plays a pivotal role in India's disaster governance system. The Disaster Management Act, 2005,



- Combination of legal authority, specialised agencies, and inter-ministerial coordination

established a multi-tiered institutional structure that assigns the Central Government the responsibility of formulating national policies, coordinating disaster response, supporting state governments, and ensuring the availability of resources and technical expertise. Disaster administration at the national level is therefore anchored in a combination of legal authority, specialised agencies, and inter-ministerial coordination.

### **Ministry of Home Affairs (MHA) – Nodal Ministry**

The Ministry of Home Affairs is the nodal ministry for disaster management in India. Its role is central because the MHA coordinates national-level disaster response, supervises the implementation of the Disaster Management Act, and oversees the functioning of key national institutions, including the NDMA, NDRF, and the National Executive Committee.

The MHA is responsible for: Issuing national guidelines and policies, Coordinating with state governments during major disasters, Mobilising central resources, including the armed forces, Managing the National Disaster Response Fund and Mitigation Fund. During major calamities, the MHA acts as the nerve centre of decision-making and inter-agency coordination at the national level.

- Nerve centre of decision-making and inter-agency coordination at the national level

### **National Disaster Management Authority (NDMA) – Structure and Functions**

The NDMA, established under the Disaster Management Act, 2005, is the apex national body for disaster management. It is chaired by the Prime Minister of India, reflecting the strategic importance accorded to disaster governance.

#### **Structure**

- Chairperson: Prime Minister
- Up to nine members nominated by the Central Government
- A dedicated secretariat supporting planning, coordination, and research

#### **Functions**

NDMA has a broad mandate, including: Formulating national policies, guidelines, and plans, Coordinating DM activities across ministries and states, Approving national-level mitigation

► National Disaster Management Authority

projects, Promoting risk assessment, hazard zonation, and capacity building, Overseeing the functioning of NDRF, and facilitating international cooperation

NDMA's guidelines and frameworks directly influence the preparedness and mitigation strategies of states and districts.

**National Executive Committee (NEC)**

The NEC functions as the executive arm of the NDMA. It is chaired by the Union Home Secretary and includes secretaries of key ministries such as health, power, agriculture, rural development, environment, and space.

► Translating policy directives into operational actions

Its key functions include: Preparing the National Disaster Management Plan, Coordinating the implementation of policies issued by NDMA, Ensuring inter-ministerial coordination, Monitoring preparedness levels across India, Supporting states during disasters through logistical and operational assistance. The NEC plays a crucial administrative role by translating NDMA's policy directives into operational actions.

**National Disaster Response Force (NDRF)**

The NDRF is India's specialised, multi-disciplinary force constituted under the DM Act 2005 for emergency response. It operates under the overall control of the NDMA but is administratively managed by the MHA.

► Response force

**Key features**

- Currently comprises 16 battalions drawn from various forces including CRPF, CISF, BSF, and ITBP (number periodically revised)
- Highly trained in urban search and rescue, flood rescue, chemical/biological hazards, medical first response, and collapsed structure search
- Equipped with state-of-the-art tools, canine squads, and communication systems
- Deployed proactively in disaster-prone areas during early warning alerts

NDRF has become one of the most respected response forces





globally, participating in rescue operations in Nepal, and other countries.

### Role of Other Central Ministries

Disaster management is inherently multi-sectoral. Various central ministries have nodal responsibilities for specific hazards and sectors:

#### ► Multi-sectoral

- Ministry of Health & Family Welfare: public health emergencies, epidemics, medical preparedness
- Ministry of Earth Sciences (IMD, INCOIS): cyclone warnings, tsunami forecasting, weather and climate hazards
- Ministry of Agriculture & Farmers' Welfare: drought management, crop loss assessment, locust control
- Ministry of Environment, Forest & Climate Change: environmental emergencies, forest fires, chemical hazards
- Ministry of Defence: armed forces support during rescue and relief
- Ministry of Railways / Road Transport: transport-related accidents

Each ministry prepares sector-specific guidelines, standard operating procedures, and early warning protocols.

### Central Armed Police Forces (CAPFs) in Disaster Response

#### ► Supportive role

The Central Armed Police Forces (such as the CRPF, BSF, ITBP, CISF, and SSB) play a crucial supportive role in disaster response, often assisting NDRF and state agencies. Their contribution includes: search and rescue operations, evacuation and relief distribution, law and order maintenance in affected areas, infrastructure clearance and road opening, communication support in remote and inaccessible regions ITBP and BSF are especially crucial during earthquakes, landslides, and border-area disasters. CISF contributes significantly during industrial accidents, nuclear emergencies, and airport-related crises.

## 3.3.3 Disaster Administration at the State Level

► Crucial bridge  
between national  
policies and local  
implementation

Disaster administration at the state level serves as a crucial bridge between national policies and local implementation. States have the primary responsibility for managing disasters within their territories, and the Disaster Management Act, 2005, establishes a robust institutional framework to guide the planning, coordination, and execution of disaster-related functions. State-level mechanisms ensure that disaster management is integrated into development planning, supported by early warning systems, and responsive to each state's unique geographic and socio-economic conditions.

### **State Disaster Management Authority (SDMA) – Composition & Mandate**

► Composition

Every state is mandated to establish a State Disaster Management Authority (SDMA) under the chairpersonship of the Chief Minister. The SDMA usually includes a Vice Chairperson, the Chief Secretary, and up to eight nominated members, depending on the state's specific structure.

► Responsibility

The SDMA is the apex policy-making body at the state level, responsible for: Formulating the State Disaster Management Policy, Approving the State Disaster Management Plan (SDMP), Integrating disaster risk reduction into development programmes, Coordinating the functioning of various departments in disaster-related activities, Reviewing preparedness measures and capacity-building initiatives, Guiding district authorities and ensuring compliance with the DM Act.

States like Kerala have strengthened the role of SDMA by establishing dedicated research, training, and planning wings, illustrating how state bodies can adapt to emerging needs.

### **State Executive Committee (SEC)**

The State Executive Committee, headed by the Chief Secretary, functions as the executive arm of the SDMA. It ensures that policies and plans approved by the SDMA are translated into operational measures.

#### **Key Responsibilities of the SEC**

- Preparing and updating the State Disaster Management Plan
- Coordinating implementation across departments



► Translating policies into operational measures

- Monitoring early warning dissemination and response readiness
- Supporting districts in capacity building and resource mobilisation
- Ensuring departmental preparedness and compliance with SOPs
- Functioning as the central hub of communication during emergencies

The SEC also manages the State Emergency Operations Centre (SEOC) and ensures round-the-clock monitoring during high-risk periods.

### **Role of State Departments (Health, Irrigation, Public Works, Police)**

Disaster management is inherently multi-sectoral. State departments play specialised roles according to their mandates, ensuring coordinated preparedness and response.

#### **Health Department**

- Manages disease surveillance and epidemic preparedness
- Mobilises emergency medical teams
- Oversees hospital preparedness and mass casualty management
- Ensures availability of medicines, ambulances, and public health advisories

#### **Irrigation / Water Resources Department**

- Monitors river levels, reservoirs, and dam safety
- Coordinates flood forecasting with central agencies
- Implements structural mitigation measures like embankments and flood control systems

#### **Public Works Department (PWD)**

- Ensures safety and resilience of roads, bridges, and public infrastructure
- Facilitates clearance and restoration of critical routes

post-disaster

- Supports rapid assessment of damages to state assets

#### Police Department

##### ► Specialised roles

- Maintains law and order during emergencies
- Supports evacuation, traffic management, and crowd control
- Assists in search and rescue operations
- Works with NDRF, SDRF, and local responders for coordinated action

Other departments, such as Animal Husbandry, Rural Development, Revenue, and Local Self-Government Institutions (LSGIs), contribute significantly to planning, warning dissemination, and community-level response.

#### State Disaster Response Fund (SDRF)

The State Disaster Response Fund is the primary financial mechanism through which states meet immediate response and relief expenses. It is constituted under the DM Act, with contributions from both the Central and State Governments in a pre-determined ratio.

##### ► Financial mechanism

Functions of SDRF consist of supports emergency relief activities such as evacuation, temporary shelters, food, drinking water, and medical care. It allows states to respond quickly during natural disasters without waiting for central assistance. It covers early warning dissemination, emergency communication, and preliminary restoration works, enables the state to mobilise district administrations and frontline responders efficiently.

During severe disasters, the National Disaster Response Fund (NDRF) may supplement SDRF based on central government assessments.

#### State-level Early Warning and Preparedness Mechanisms

States maintain their own early warning and preparedness systems, coordinated through the State Emergency Operations Centre (SEOC). These systems integrate scientific data, real-time monitoring, and technological tools.



### Key Components

► Critical to minimising casualties, enhancing readiness, and enabling communities to respond promptly

- State Emergency Operations Centre (SEOC): The 24×7 nerve centre for receiving alerts, disseminating warnings, and coordinating response.
- Technical Partnerships: States collaborate with agencies such as IMD, CWC, INCOIS, and the Geological Survey for hazard-specific forecasts.
- State-Specific Warning Systems: Some states, such as Kerala, have advanced systems including river gauge networks, lightning detection systems, rainfall radars, and community alert systems.
- Preparedness Activities includes mock drills and capacity building, community awareness programmes, pre-monsoon safety audits, activation of district and local disaster management plans, stockpiling of essential relief materials

Early warning systems are critical to minimising casualties, enhancing readiness, and enabling communities to respond promptly.

### 3.3.4 Disaster Administration at the District and Local Levels

► First to respond and the last to withdraw

The district is often considered the most critical tier of disaster administration in India. While national and state authorities provide policies, resources, and technical support, the implementation of disaster management activities; evacuation, relief distribution, early warning dissemination, and coordination of frontline responders occurs at the district level. Because disasters directly impact communities, the district and local governments are the first to respond and the last to withdraw. This makes decentralised institutions, local leadership, community engagement, and grassroots preparedness indispensable.

#### • District Disaster Management Authority (DDMA)

Under the Disaster Management Act, 2005, every district must establish a District Disaster Management Authority (DDMA). The structure reflects the district's administrative hierarchy, ensuring strong leadership and clear lines of responsibility.



### ► Composition

#### Composition

- Chairperson: District Collector / District Magistrate (DC/DM)
- Co-Chairperson: Elected head of the Zilla Parishad (in most states)
- CEO/Member Secretary: Additional District Magistrate or designated officer
- Other Members: Heads of key departments such as police, health, PWD, irrigation, rural development, and fire services

Mandate of the DDMA includes coordinate, monitor, and implement disaster management activities in the district, prepare and update the District Disaster Management Plan (DDMP), ensure community participation and capacity building, lead the district's response during emergencies, supervise local authorities and ensure their compliance with disaster-related responsibilities, conduct mock drills, hazard mapping, and vulnerability assessments

The DDMA serves as the primary decision-making body for district-level disaster preparedness and response.

#### • Role of District Collector / District Magistrate

The District Collector (or Magistrate) is the central figure in district-level disaster administration. As chairperson of the DDMA, the Collector provides leadership, coordination, and authority during both pre-disaster preparedness and post-disaster response.

### ► Adapting state and national plans to district realities

#### Key Responsibilities

- Overall coordination of evacuation, relief, search and rescue
- Chairing meetings of DDMA and Emergency Operation Centres
- Ensuring dissemination of early warnings to all stakeholders
- Mobilising district resources, including police, fire services, health teams, and volunteers
- Liaising with the SDMA, SEC, and state departments



- Supervising damage assessment and relief distribution
- Maintaining law and order in affected areas
- Ensuring inter-departmental coordination and smooth communication

Because the Collector is familiar with local terrain, administrative practices, and community networks, their leadership is crucial in adapting state and national plans to district realities.

### • **District Disaster Management Plans (DDMPs)**

The DDMP is the foundational operational document that guides district-level disaster management. Mandated by the DM Act, the DDMP is updated regularly and integrates hazard-specific strategies, resource inventories, and response procedures.

#### Core Components of DDMP

- Hazard, risk, and vulnerability profile of the district
- Early warning mechanisms and communication protocols
- Roles and responsibilities of departments and agencies
- Evacuation routes, shelters, staging areas, and logistics planning
- Inventory of resources—boats, vehicles, medical supplies, equipment
- Standard Operating Procedures for search & rescue, relief, medical response
- Incident Response System (IRS) structure for the district
- Plans for restoration of critical services (water, power, transport, health)

► Operational document

The DDMP also includes community-level institutions—gram panchayats, municipalities, local volunteers ensuring last-mile connectivity during emergencies.

### • **Panchayati Raj Institutions (PRIs) and Urban Local Bodies (ULBs)**

Local governments both rural and urban play a critical role in

disaster administration because they are closest to communities and familiar with local vulnerabilities.

#### Role of PRIs (Rural Local Governments)

- Identifying vulnerable households, critical infrastructure, and safe shelters
- Disseminating local-level warnings through ward members and volunteers
- Supporting evacuation, relief distribution, and damage reporting
- Maintaining village-level records of resources, shelters, and beneficiaries
- Promoting awareness programs and preparedness drills

#### Role of ULBs (Cities, Municipalities, Corporations)

- Managing urban floods, drainage systems, and waste disposal
- Enforcing building codes and regulating construction in hazard-prone areas
- Operating fire and emergency services
- Maintaining stormwater networks, reservoirs, and public health infrastructure
- Leading emergency response in dense urban areas

► Familiar with local vulnerabilities

ULBs are especially important because India's rapid urbanisation has increased the frequency and intensity of urban disasters.

#### • **Community-Based Disaster Management (CBDM)**

Community-Based Disaster Management recognises that communities are the first responders and the most affected during disasters. CBDM ensures that local people participate in planning, preparedness, and response, making disaster management more inclusive and sustainable.

#### Key Features of CBDM

- Hazard and vulnerability mapping conducted with community inputs



### ► Local participation

- Formation of local disaster management committees
- Training villagers in first aid, light rescue, and early warning dissemination
- Identifying local volunteers, resources, and traditional knowledge
- Conducting mock drills, school safety programs, and awareness campaigns
- Ensuring inclusive participation of women, the elderly, persons with disabilities, and marginalised communities

CBDM reduces dependence on external agencies and strengthens local resilience.

### • **Local Response Mechanisms — Volunteers, NGOs, Faith-based Groups**

Local response networks enhance the effectiveness of disaster management by complementing government efforts with community energy, specialised expertise, and rapid mobilisation.

#### Key Local Actors

- **Volunteers:** Youth groups, trained community rescue teams, civil defence volunteers, and local residents who support evacuation, shelter management, and relief work.
- **Non-Governmental Organisations (NGOs):** Provide specialised skills in search & rescue, medical assistance, psycho-social support, logistics, child protection, and rehabilitation.
- **Faith-based Organisations:** Temples, mosques, churches, and other community institutions often serve as shelters and provide food, water, and support through local trust networks.
- **Local Clubs & Resident Associations:** Particularly active in urban areas—manage communication, assist elderly residents, distribute essentials, and help identify missing persons.

### ► Enhance the social legitimacy of disaster response efforts

These groups significantly strengthen last-mile delivery and enhance the social legitimacy of disaster response efforts. Their involvement fosters community solidarity during crises.

### 3.3.5 Disaster Management Act, 2005

#### ► Fundamental transformation

The Disaster Management Act, 2005, is the cornerstone of India's disaster governance framework. It marks a fundamental transformation in the way the country perceives, prepares for, and responds to disasters. Before the Act, disaster response in India remained largely reactive, ad hoc, and relief-oriented. The Act introduced a legislative mandate that redefined disaster management as a holistic, continuous, and multi-level governance process encompassing preparation, mitigation, response, recovery, and rehabilitation. With this law, India shifted to a structured, decentralised, and coordinated disaster management system that spans from the national to the community level.

#### ► Background and Need for the Act

India's experiences with several catastrophic disasters in the 1990s and early 2000s highlighted significant gaps in existing administrative arrangements. Events such as the Latur earthquake (1993), Odisha Super Cyclone (1999), Gujarat earthquake (2001), and the Indian Ocean Tsunami (2004) demonstrated that relief-based approaches were inadequate and that the absence of a unified legal and institutional framework resulted in delayed coordination, inefficient resource mobilisation, and lack of preparedness.

These disasters revealed the urgent need for:

- A clearly defined chain of command
- A legal mandate for national, state, and district authorities
- Early warning mechanisms
- Mitigation planning rather than post-disaster reaction
- Standardised operating procedures
- Dedicated funds for response and mitigation

The lessons learned from these events directly shaped the formulation of the Disaster Management Act.

#### **Shift from Relief-centric to Prevention & Mitigation Approach**

Before 2005, disaster management was synonymous with relief distribution—food, shelter, compensation, and temporary rehabilitation. The emphasis was on post-disaster response, not





on reducing existing vulnerabilities or preventing future risks.

The DM Act introduced a major paradigm shift by:

► Integrate disaster risk reduction into governance structures

- Recognising disaster management as a developmental responsibility
- Mandating pre-disaster planning, mitigation, and preparedness
- Emphasising risk reduction, capacity building, and institutional strengthening
- Creating a statutory system for long-term resilience rather than short-term relief

This change reflects global trends influenced by the Yokohama Strategy, Hyogo Framework, and later the Sendai Framework, all of which encouraged nations to integrate disaster risk reduction into governance structures.

### 3.3.5.1 Objectives of the Act

#### Institutionalisation of Disaster Governance

► Institutionalisation

A primary objective of the Act is to institutionalise disaster management through permanent bodies at national, state, and district levels. This ensures continuity, consistency, and long-term planning, regardless of government changes or administrative turnovers.

#### Coordination between Union, State, and Local Bodies

Disasters require multi-level governance. The Act formalises relationships between:

► Multilevel governance

- NDMA at the national level
- SDMAs at the state level
- DDMA at the district level

This hierarchical yet collaborative structure aims to eliminate duplication, improve information flow, and ensure timely mobilisation of resources.

#### Legal Mandate for Planning and Preparedness

For the first time in India, the Act provides a legal obligation

for National, State, and District Disaster Management Plans, Department-specific disaster plans, Periodic mock drills, training, and community awareness, Integration of disaster management into development processes, This legal mandate ensures accountability and uniform standards across the country.

### 3.3.5.2 Structure and Key Provisions

- **Authorities at All Levels: NDMA, SDMA, DDMA**

The Act establishes a three-tier institutional framework:

- NDMA → Apex national body chaired by the Prime Minister
- SDMA → State-level bodies chaired by Chief Ministers
- DDMA → District-level authorities chaired by District Collectors and co-chaired by the elected Zilla Parishad President

This structure ensures vertical integration and decentralisation, allowing each level to function within its jurisdiction while maintaining coordination.

- **Disaster Response Fund and Disaster Mitigation Fund**

The Act mandates the creation of National Disaster Response Fund (NDRF), State Disaster Response Fund (SDRF). These funds ensure the immediate availability of finances for relief and long-term mitigation measures without administrative delays.

- **Roles and Powers of Government Bodies**

The Act assigns specific roles and powers to each institution:

- NDMA: Policy formulation, national plans, guidelines, and coordination
- NEC: Executive implementation and inter-ministerial coordination
- SDMA: State policies, state plans, and departmental coordination
- DDMA: Local planning, response, evacuation, and relief operations

► Specific Roles



Each authority has defined responsibilities to ensure clarity and accountability.

► Legal obligation

- **Duties of Government Officials**

Government officials are legally obligated to prepare departmental DM plans, respond promptly during disasters, provide accurate information, comply with directions from NDMA, SDMA, and DDMA, participate in training and preparedness programmes.

Failure to fulfil these duties can invite disciplinary and legal consequences.

► Legal obligation

- **Penalties and Legal Responsibilities**

The Act includes provisions for penalties related to obstruction of disaster management operations, false claims or misuse of funds, failure to comply with lawful directions, negligence leading to increased disaster impacts. These provisions enhance compliance and protect the integrity of the disaster management system.

- **Special Powers during Disasters**

During a disaster, authorities are empowered to order evacuations, use private property for rescue or relief, regulate traffic, transport, and movement, deploy resources without procedural delays, issue binding directions to government agencies and private entities. These powers ensure rapid decision-making and effective response.

### **3.3.5.3 Institutional Mechanisms Created under the Act**

- **NDRF and Training Framework**

The Act formalised the National Disaster Response Force as a specialised search-and-rescue force. It also emphasised regular training, multi-hazard capabilities, standardised equipment, integration with state and district authorities. States have also raised their own forces, such as the SDRF (State Disaster Response Force).

- **Mandatory Disaster Management Plans at All Levels**

The Act makes it compulsory for National DM Plan, State

DM Plans, District DM Plans, Department-specific DM Plans. These plans must be periodically reviewed, updated, and integrated with mainstream development programmes.

- **Integration with Development Planning**

► Not merely as emergency response but as an essential dimension of governance

A major innovation of the Act is embedding disaster risk reduction into development activities. Departments such as health, agriculture, PWD, irrigation, education, and local governments must consider risk reduction in all projects. This ensures: resilient infrastructure, safer public buildings, sustainable land-use planning, better environmental management. The Act thus establishes disaster management not merely as emergency response but as an essential dimension of governance.

### **3.3.6 Role of Nodal Agencies in Disaster Management**

► Agencies with scientific, technical, and sector-specific expertise

In a multi-hazard, geographically diverse country like India, disaster management requires the involvement of specialised agencies with scientific, technical, and sector-specific expertise. The Disaster Management Act, 2005, emphasises coordination among these agencies to ensure that accurate, timely, and actionable information reaches the appropriate administrative levels. Nodal agencies perform the crucial task of monitoring hazards, issuing early warnings, conducting research, and supporting preparedness measures. Their role ensures that disaster administration is informed by reliable data, scientific evidence, and technological advances.

#### **3.3.6.1 Nodal Agencies for Specific Hazards**

- **India Meteorological Department (IMD) – Cyclones and Weather Hazards**

► Crucial for evacuation planning, activating response forces, and preparedness

The India Meteorological Department is the national nodal agency for: Cyclones, Heavy rainfall, Thunderstorms and lightning, Heatwaves and cold waves, Weather forecasting and climate monitoring. IMD operates specialised centres such as the Cyclone Warning Division and the Regional Meteorological Centres. It uses satellites, Doppler radars, automatic weather stations, and numerical weather prediction models. Its forecasts are crucial for evacuation planning, activating response forces, and preparedness at the district and community levels. IMD's cyclone alerts have significantly reduced casualties in coastal regions over the last decade.



- **INCOIS – Tsunami**

The Indian National Centre for Ocean Information Services (INCOIS) functions as the nodal agency for: Tsunami detection, Ocean-based hazards, High-wave and tidal alerts

► Strengthening India's coastal preparedness

The Indian Tsunami Early Warning Centre (ITEWC) under INCOIS is one of the world's most advanced systems, integrating: Seismic data, Sea-level gauges, Deep-ocean assessment buoys (DART buoys), Tsunami modelling systems It sends rapid alerts to NDMA, MHA, coastal states, and international bodies. INCOIS played a central role in strengthening India's coastal preparedness after the 2004 Indian Ocean Tsunami.

- **Central Water Commission (CWC) – Floods**

The Central Water Commission is the nodal agency for: riverine floods, reservoir water level monitoring, dam safety advisories, flood forecasting CWC operates an extensive hydrological network of: flood monitoring stations, river gauge systems, reservoir monitoring centres It issues forecasts to states, enabling them to prepare evacuation plans, regulate dam release, and activate flood response mechanisms.

- **Geological Survey of India (GSI) – Landslides**

► Geological assessment

The Geological Survey of India is responsible for: landslide hazard zonation, geological assessments, monitoring landslide-prone areas, advising state governments during slope failures GSI prepares hazard maps, conducts ground investigations, and provides scientific insights that help states identify high-risk zones, regulate construction, and strengthen hillside communities' preparedness.

- **Ministry of Health & Family Welfare**

The Ministry of Health serves as the nodal agency for: disease outbreaks, public health emergencies, biological hazards, pandemics Key institutions under the Ministry include: National Centre for Disease Control (NCDC), Integrated Disease Surveillance Programme (IDSP), Indian Council of Medical Research (ICMR) These bodies monitor disease trends, detect outbreaks, issue advisories, coordinate public health responses, and manage vaccination and treatment strategies. COVID-19 highlighted the importance of health-sector preparedness and inter-sectoral coordination.

► Epidemics and Biological Hazards



► Nuclear Accidents

- **Atomic Energy Regulatory Board (AERB)**

The AERB acts as the nodal authority for: nuclear safety, radiation incidents, hazardous exposure from nuclear facilities. It establishes safety standards, conducts inspections, and coordinates emergency responses with state agencies, NDRF, and specialised units during nuclear or radiological emergencies. Its role ensures public protection and strict adherence to international safety norms.

### 3.3.6.2 Coordination Mechanisms

Effective disaster management depends on seamless coordination among nodal agencies, government authorities, and local mechanisms. The DM Act, 2005 emphasises integrated information flow and clearly defined communication channels.

► Information sharing

- **Inter-agency Information Sharing**

Disaster response requires collaboration across: Scientific institutions, Administrative bodies, Police, health, fire, and emergency services, NDRF, SDRF, armed forces. Information sharing includes: Forecasts and warnings, Damage assessments, Search-and-rescue updates, Resource availability, Real-time field reports. Platforms such as the National Emergency Communication Network, NDMA's information systems, and State/District Emergency Operation Centres facilitate this integration.

► Communication and coordination hubs

- **Emergency Operation Centres (EOCs)**

Emergency Operation Centres function as the communication and coordination hubs during disasters. They operate at: National level (NEOC), State level (SEOC) & District level (DEOC). Their roles include receiving hazard alerts from IMD, CWC, INCOIS, GSI, NCDC, and others, disseminating warnings to local authorities and communities, coordinating resource mobilisation, supporting Incident Response Systems, maintaining real-time situation reports. States like Kerala have strengthened SEOC and DEOC systems through GIS platforms, river-monitoring dashboards, and communication networks connecting local bodies.

- **Role of Media and ICT Systems**

The media and ICT tools play an essential role in: Public warning dissemination, Spreading awareness and safety advisories, Countering misinformation, Broadcasting



► Receives timely, accurate, and actionable information

updates from government authorities, Supporting community mobilisation ICT innovations include: SMS-based alerts, Mobile apps, Social media platforms, Automated siren systems, GIS-based dashboards, Satellite communication during network failures. These mechanisms ensure that the “last mile” receives timely, accurate, and actionable information.

## Summarized Overview

This unit provided a comprehensive understanding of India’s disaster administration system, highlighting how the Disaster Management Act, 2005, transformed disaster governance from a reactive relief-based approach to a structured, prevention-oriented framework. The unit examined the roles and functions of institutions at the national, state, district, and local levels, as well as the legal and financial mechanisms that support coordinated action. It also explained the responsibilities of hazard-specific nodal agencies and the importance of early warning, preparedness, and inter-agency communication. Overall, the unit emphasised that effective disaster management is rooted in good governance, institutional clarity, and community participation.

## Self-Assessment

1. What is the primary purpose of the Disaster Management Act, 2005?
2. Who is the Chairperson of the National Disaster Management Authority (NDMA)?
3. Define the National Executive Committee (NEC).
4. What is the role of the District Disaster Management Authority (DDMA)?
5. Who chairs the State Disaster Management Authority (SDMA)?
6. Which agency is the national nodal body for cyclone warnings?
7. Which organisation provides tsunami early warnings in India?
8. Mention one way in which ICT tools help in disaster management.
9. What is the role of Panchayati Raj Institutions (PRIs) in local disaster management?
10. Mention one major lesson learned from the Gujarat earthquake (2001) or the Indian Ocean Tsunami (2004).

## Assignments

1. Examine the major shortcomings in India's earlier relief-centric disaster approach and explain how the Disaster Management Act, 2005, addressed these gaps.
2. Analyse the institutional structure established by the DM Act, 2005. How do NDMA, SDMA, and DDMA complement one another in multi-level disaster governance?
3. Discuss the importance of decentralisation in disaster administration. Use examples from district and local-level mechanisms to support your answer.
4. Evaluate the effectiveness of Emergency Operation Centres (EOCs) and ICT-based communication systems in ensuring timely warnings and coordinated action during disasters.
5. Using a recent disaster event (natural or man-made) in India, analyse how the institutional mechanisms created under the DM Act operated in practice. Identify strengths, weaknesses, and lessons learned.

## Reference

1. Government of India. (2005). *The Disaster Management Act, 2005*. Ministry of Law and Justice, Government of India.
2. National Disaster Management Authority. (2009). *National Policy on Disaster Management*. Government of India.
3. National Disaster Management Authority. (n.d.). *National Disaster Management Guidelines: National Disaster Management Information & Communication System (NDMICS)*. Government of India.
4. National Institute of Disaster Management. (n.d.). *Executive documentation on disaster management*. National Institute of Disaster Management (NIDM).
5. Kerala State Disaster Management Authority. (2016). *Kerala State Disaster Management Plan 2016*. Government of Kerala.
6. Kerala State Disaster Management Authority. (2019). *Orange Book of Disaster Management: Emergency Support Functions Plan & Standard Operating Procedures*. Government of Kerala.



## Suggested Reading

1. Murthy, D. B. N. (2008). Disaster management: Text and case studies. Deep & Deep Publication.
2. Sinha, P. C. (2006). Disaster management process: Laws, process and strategy. SBS Publishers & Distributors.
3. Singh, R. (2015). Handbook of disaster management (Vol. 1). Horizon Press.
4. Singh, R. (2015). Handbook of disaster management (Vol. 2). Horizon Press.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU







# **BLOCK 4**

## **Disaster Response and Rehabilitation**

# UNIT 1

## Disaster Preparedness and Risk Reduction

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ understand the basic concepts of disaster preparedness, risk reduction, and resilience.
- ▶ explain the roles of NDMA, NDRF, Armed Forces, NGOs, and local governments in disaster management.
- ▶ describe the importance of early warning systems and community participation in reducing disaster risks.
- ▶ assess the effectiveness of various preparedness strategies used by NDMA, NDRF, NGOs, and local bodies.

### Background

The study of environmental and disaster management progresses gradually across the earlier blocks of this course, helping learners build a strong conceptual foundation before approaching the applied dimensions covered in this unit. Block I introduced the idea of environmental management, environmental problems, and the global and national efforts to safeguard ecosystems. Block II examined India's environmental laws, constitutional provisions, and regulatory mechanisms that protect natural resources. Block III shifted the focus to disasters, their nature, classification, administrative frameworks, and the legislative foundations of disaster governance, especially the Disaster Management Act, 2005.

Building on these earlier discussions, this unit, Disaster Preparedness and Risk Reduction, moves learners from understanding what disasters are to exploring how societies can proactively prepare for them. As disasters become more frequent and severe due to environmental degradation, climate change, and rapid urbanisation,

preparedness emerges as a central pillar of modern public administration. This unit highlights why preparedness is vital: it reduces vulnerability, protects communities, and enables institutions to respond quickly and accurately.

This unit introduces learners to the national architecture of preparedness, especially the role of the National Disaster Management Authority (NDMA), the Armed Forces, the National Disaster Response Force (NDRF), and the vast network of governmental and non-governmental actors who work together before disasters strike. It stresses that preparedness is not merely an operational activity but a coordinated, multi-level effort involving early warning systems, local governments, community participation, mock drills, and inter-agency collaboration. By connecting the environmental principles from earlier blocks with the disaster administration structures discussed previously, this unit provides a holistic understanding of how preparedness and risk reduction contribute to building safer, more resilient communities. It encourages learners to view disaster management not as an isolated task but as an integral part of sustainable development and responsible governance.

## Keywords

Mitigation, Early Warning Systems, Inter-Agency Coordination, Community Resilience, Evacuation Planning

## Discussion

### 4.1.1 Introduction to Disaster Preparedness

#### Meaning and Concept of Disaster Preparedness

► Ready to respond effectively to potential disasters

Disaster preparedness refers to the set of systematic measures taken in advance to ensure that communities, institutions, and governments are ready to respond effectively to potential disasters. It is a proactive process aimed at strengthening the ability of individuals and systems to anticipate hazards, minimise their adverse effects, and recover more efficiently.

Preparedness is not simply about reacting to emergencies; rather, it is a continuous cycle of developing capacities to address disasters before they occur. Preparedness is an integral part of departmental and national disaster management plans, encouraging ministries and agencies to institutionalise multi-level planning, conduct regular mock drills, and improve readiness through standardised procedures. International

► Continuous cycle of developing capacities to address disasters before they occur

frameworks, particularly the Sendai Framework (2015–2030), view preparedness as a core priority for understanding and reducing disaster risk. UNDRR (United Nations Office for Disaster Risk Reduction) stresses that preparedness must be grounded in a clear understanding of hazard characteristics and vulnerability patterns so that risk information translates into actionable plans at the community and national levels. In essence, disaster preparedness encompasses knowledge, capacities, and systems that empower societies to effectively anticipate, respond to, and recover from hazardous events.

## Importance of Preparedness in Disaster Risk Reduction (DRR)

► Determines the speed and effectiveness of response and recovery

Preparedness is a fundamental pillar of Disaster Risk Reduction because it directly determines the speed and effectiveness of response and recovery. As noted in the Government of India's disaster management framework, timely preparedness reduces casualties, minimises economic losses, and stabilises communities during crises by ensuring that all actors understand their roles and responsibilities in advance.

### Preparedness contributes to DRR in several key ways:

► Preparedness as a preventive strategy

- **Minimising mortality and injuries:** Early warning systems, evacuation plans, and pre-positioned resources ensure rapid action, reducing the immediate impact of disasters.
- **Strengthening institutional coordination:** Preparedness promotes clarity in inter-agency responsibilities, enabling smoother coordination between central, state, district, and local institutions an aspect emphasised strongly in both NDMA guidelines and national crisis management mechanisms
- **Protecting livelihoods and essential services:** By identifying essential infrastructure and vulnerable populations in advance, preparedness helps safeguard critical facilities such as hospitals, schools, power systems, and transport networks.
- **Enhancing community resilience:** The Sendai Framework underscores that preparedness empowers communities through awareness, drills, and local action plans. UNDRR advocates for inclusive preparedness



strategies involving women, children, elderly persons, and persons with disabilities to ensure equitable protection

- **Reducing long-term recovery costs:** Well-prepared systems recover faster, reducing the financial burden associated with relief and reconstruction. This echoes international findings that preparedness investments yield high returns by preventing large-scale disruptions.

Thus, preparedness is not only a response measure, but it is a preventive strategy that strengthens overall societal and institutional resilience.

## Linkage between Preparedness, Mitigation, and Resilience

Preparedness is closely linked to the broader objectives of mitigation and resilience, forming an interconnected framework within modern disaster management.

Mitigation refers to long-term measures that reduce the underlying risk factors of disasters. Preparedness complements mitigation by ensuring that even if residual risks remain, communities and institutions are ready to act. For example, while mitigation may involve building flood-resistant infrastructure, preparedness ensures evacuation routes, warning systems, and shelters are functional.

### ► Preparedness and Mitigation

Resilience refers to the capacity of systems to absorb, withstand, and recover from shocks. Preparedness operationalises resilience by equipping communities with knowledge, early warning systems, and the capacity to respond swiftly.

### ► Preparedness and Resilience

Preparedness and mitigation are mutually reinforcing: mitigation reduces the severity of hazard impacts, and preparedness ensures readiness to manage the residual risks. Together, they enhance resilience by creating robust systems capable of bouncing back quickly after disasters. NDMA's 2024 guideline emphasises that resilient systems depend on both well-designed mitigation measures and well-coordinated preparedness actions embedded within each ministry's Disaster Management Plan

### ► A continuous cycle

In sum, preparedness forms a critical bridge between risk



reduction and resilience-building, making disaster management more anticipatory, inclusive, and effective.

### 4.1.2 National Disaster Management Authority (NDMA)

#### ► Disaster Management Act

The National Disaster Management Authority (NDMA) is the apex statutory body for disaster management in India. It was established under the Disaster Management Act, 2005, which laid the legislative foundation for a paradigm shift from a relief-oriented response system to a comprehensive disaster risk management framework. As highlighted in the *Disaster Management in India* report, the Act assigns the Prime Minister of India as the Chairperson of NDMA, reflecting the national importance attached to disaster governance.

#### ► Unified Institutional System

The Constitution of India does not explicitly list “disaster management” as a subject, but several related areas fall within the Union, State, and Concurrent Lists—allowing cooperative federalism in disaster governance. The DM Act operationalises this coordination by creating a unified institutional system across the central, state, and district levels. The Act mandates that NDMA formulate national policies, approve disaster management plans, and coordinate response and mitigation measures across ministries and states. NDMA’s establishment marks a transition from ad hoc disaster responses to a structured, legally backed system that prioritises preparedness, mitigation, and long-term resilience.

#### ► Build safer and resilient India

NDMA’s vision is to build a safer and disaster-resilient India by developing and institutionalising a holistic, proactive, and technology-driven strategy for disaster management. Its mission emphasises mainstreaming disaster risk reduction (DRR) into development planning and promoting a culture of preparedness across society.

NDMA’s mandate includes:

#### ► Vision, Mission, and Mandate

- Laying down policies, plans, and guidelines for disaster management at the national level.
- Coordinating enforcement and implementation of these guidelines across ministries, departments, and state governments.
- Ensuring comprehensive preparedness through risk assessments, early warning improvements, and community awareness.



- Promoting mitigation measures, including structural and non-structural interventions.
- Encouraging technology integration, such as GIS mapping, remote sensing, and information systems for early warning and decision-making.

## Institutional Structure and Key Functions

NDMA is chaired by the Prime Minister and includes up to nine members with designated areas of expertise. It is supported operationally by the National Executive Committee (NEC), comprising senior secretaries from key ministries, responsible for preparing the National Disaster Management Plan and ensuring implementation of NDMA's guidelines.

### Core components of NDMA's institutional structure:

- NDMA Headquarters: Coordinates policy, planning, and oversight activities.
- National Executive Committee (NEC): Implements NDMA's vision through ministries and technical agencies.
- State and District Authorities: Ensure localisation of national policies, reflecting the DM Act's decentralised structure.
- National Institute of Disaster Management (NIDM): Acts as the capacity-building and training arm of NDMA.

### Key Functions of NDMA:

- Preparing national-level policies, frameworks, and guidelines.
- Coordinating with central and state agencies for preparedness and mitigation.
- Approving disaster management plans of ministries.
- Overseeing early warning systems, forecasting agencies, and information networks.
- Promoting research, innovation, and technological solutions.
- Ensuring a uniform response structure through SOPs and incident response systems.

NDMA thus acts as both a policymaking and supervisory institution, ensuring coherence across India's vast disaster management system.

#### ► Institutional structure

#### ► Important functions

## NDMA Guidelines for Specific Hazards

NDMA has issued detailed guidelines for a range of hazards, providing a standardised approach for preparedness, mitigation, and response. These guidelines draw from scientific assessments, national experiences, and global frameworks.

Key guidelines include:

► Providing a standardised approach for preparedness, mitigation, and response

- **Cyclones:** Strengthening early warning systems (IMD), cyclone shelters, preparedness plans, and coastal zone management.
- **Earthquakes:** Promoting earthquake-resistant construction, retrofitting, capacity-building for search and rescue, and awareness programmes.
- **Floods:** Encouraging flood forecasting (CWC), river-basin management, embankment maintenance, and community-based alerts.
- **Landslides:** Hazard zonation mapping (GSI), slope stabilisation, early warning technologies, and relocation of high-risk settlements.
- **Heat Waves, Cold Waves, Industrial Accidents, Biological Emergencies, etc.**

These guidelines support uniform planning across ministries and states, ensuring that all preparedness and mitigation efforts are risk-informed.

## Preparedness Strategies Developed by NDMA

Preparedness is a cornerstone of NDMA's approach, reflected in national planning instructions and sector-specific guidelines.

Major preparedness strategies include:

### • Multi-level Disaster Management Plans

NDMA mandates the preparation of Disaster Management Plans (DMPs) at national, state, district, ministry, and departmental levels.

### • Strengthening Early Warning Systems

NDMA works with IMD, INCOIS, GSI, ISRO and others to develop accurate and timely forecasting systems for cyclones, tsunamis, floods, avalanches, and landslides.



► Preparedness strategies

- **Mock Drills and Simulation Exercises**

Regular drills, including school safety programmes and community simulations, are mandated to test readiness and identify gaps in response mechanisms.

- **Pre-positioning of Resources and Logistics**

Ensuring the availability of emergency supplies, equipped response teams, and communication systems before a disaster occurs.

- **Inter-agency Coordination Mechanisms**

NEOC, NCMC, NEC, and state/district control rooms form a seamless preparedness network. Through these strategies, NDMA strengthens readiness at every administrative level and enhances the country's capacity to absorb shocks.

### **National Crisis Management Committee**

The National Crisis Management Committee (NCMC) is a high-level body of senior officials of the Government of India, headed by the Cabinet Secretary. It continues to address major crises that have serious or nationwide implications. The Committee functions within the established legal and institutional framework for disaster and crisis management and receives operational support from the Crisis Management Groups (CMGs) of the relevant Central nodal Ministries. When necessary, it may also be assisted by the National Executive Committee (NEC). The Secretary of the National Disa

## **Capacity-Building and Community-Based Disaster Preparedness**

NDMA places significant emphasis on capacity development as a means to empower institutions and communities alike.

### **Institutional Capacity Development**

- **NIDM** conducts research, training programmes, and online modules for government officials, emergency responders, and community volunteers.
- **NDRF Trainings** focus on specialised rescue techniques, medical first response, CBRN emergencies, and urban search operations.
- **Ministries & Departments** receive technical guidance

► Empower Institutions

through the 2024 DMP guidelines to build preparedness capacities in their sectors.

### Community-Based Preparedness

#### ► Empower Communities

In alignment with global best practices advocated by UNDRR, NDMA promotes community awareness campaigns (school safety, mock evacuation drives), formation of village-level disaster management committees, inclusion of local knowledge and traditional coping mechanisms, Vulnerability mapping at the grassroots level, Special focus on vulnerable groups—children, the elderly, women, and persons with disabilities.

Together, these efforts contribute to building a culture of preparedness and enhancing India's overall resilience.

### 4.1.3 Role of the Armed Forces in Disaster Response

#### ► Act as one of the crucial pillar of national disaster management

India's Armed Forces play a pivotal role in disaster response. Owing to their discipline, organisational strength, rapid mobility, and specialised skills, they act as a crucial pillar of national disaster management. Their contribution spans search and rescue, medical support, infrastructure restoration, evacuation, and logistical support, often in challenging terrain and extreme conditions.

#### 4.1.3.1 Legal Framework for Deployment (Aid to Civil Authorities)

#### ► When the scale of a disaster overwhelms local capacities

The deployment of the Armed Forces during disasters is governed by the principle of "Aid to Civil Authorities", a long-established convention formalised through the Disaster Management Act, 2005. While disaster management primarily falls under the purview of civil administration, the Armed Forces step in when the scale of a disaster overwhelms local capacities. Their deployment is authorised by the Ministry of Defence based on requests from state governments or central agencies.

#### ► Coordination between civilian authorities and the Armed Forces

According to *Disaster Management in India*, military assistance is sought particularly in large-scale natural disasters where specialised capabilities, such as airlift, engineering, medical evacuation- are essential for immediate relief. The legal framework ensures coordination between civilian authorities and the Armed Forces while maintaining military





autonomy in tactical execution. The DM Act institutionalises this arrangement by making the Armed Forces a formal part of India's national response mechanism, responsible for assisting NDMA, NEC, SDMA, and district administrations during major emergencies.

#### 4.1.3.2 Key Divisions Involved (Army, Navy, Air Force)

##### a) Indian Army

###### ► Rapid mobilisation

The Army remains the most frequently deployed force for disaster response due to its widespread presence, high manpower strength, and engineering expertise. Army units are strategically located across the country and can be mobilised rapidly. They are particularly effective in post-earthquake rescue, flood relief, landslide management, and restoration of communication lines.

##### b) Indian Navy

###### ► Coastal disaster

The Navy leads response during coastal disasters such as cyclones, tsunamis, and maritime emergencies. It has specialised capabilities in diving operations, underwater rescue, hydrographic surveys, and large-scale evacuation. Naval ships are equipped with medical bays and the capacity to carry relief supplies over long distances.

##### c) Indian Air Force (IAF)

###### ► When ground access is restricted

The IAF provides aerial reconnaissance, transport of relief materials, air-dropping of supplies, casualty evacuation (CASEVAC), and rapid mobilisation of rescue teams. Helicopters and cargo aircraft are crucial during floods, landslides, and remote-area disasters where ground access is restricted.

Together, the Army, Navy, and Air Force form a highly coordinated tri-service network capable of responding to multi-hazard emergencies across India.

#### 4.1.3.3 Capabilities: Search & Rescue, Evacuation, Medical Aid, Engineering Support

The Armed Forces possess a broad spectrum of capabilities essential for effective disaster response:

► Broad spectrum of capabilities

- **Search and Rescue (SAR)**

- Specialised teams trained in high-altitude, underwater, and urban SAR.
- Use of advanced equipment such as thermal imaging, cutting tools, inflatable boats, and diving gear.
- Helicopter-based SAR missions by the IAF and Navy.

- **Evacuation Operations**

- Mass evacuation from flood zones, cyclone-affected areas, and earthquake-hit regions.
- Amphibious craft and naval ships used for coastal evacuations.
- Airlift of vulnerable populations from inaccessible areas.

- **Medical Assistance**

- Field hospitals and mobile medical units.
- Emergency trauma care, first aid, and disease-control support.
- Naval ships with onboard medical facilities for large-scale emergencies.

- **Engineering and Infrastructure Restoration**

- Clearing debris, repairing roads and bridges, restoring communication lines.
- Building temporary shelters and community facilities.
- Expertise in constructing improvised pathways in mountainous and remote regions.

These capabilities align with national guidelines that emphasise rapid, coordinated, and technology-enabled disaster response.

#### **4.1.3.4 Case Examples of Military-led Disaster Response in India**

The Armed Forces have played a decisive role in several major disasters. Examples include:



► Role in major disasters

- **2004 Indian Ocean Tsunami**

The Navy and Air Force mounted one of the most significant humanitarian operations in India's history, providing rescue support, medical care, evacuation, and international assistance. Naval ships served as floating hospitals, and the IAF conducted continuous airlifts.

- **2013 Uttarakhand Flash Floods**

Army units conducted extensive rescue operations in challenging terrain. The IAF carried out the largest helicopter-based rescue mission at that time, evacuating thousands of stranded pilgrims and residents.

- **2018 Kerala Floods**

All three services participated in massive evacuation missions. The Navy's Operation *Madad* and the Air Force's air-dropping of supplies and winching operations saved thousands of lives.

- **Cyclone Fani (2019)**

The rapid deployment of Army engineers, Navy ships, and IAF helicopters enabled swift clearance of debris, restoration of infrastructure, and the distribution of relief materials.

- **Cyclone Amphan (2020)**

During Cyclone Amphan in May 2020, which struck the West Bengal coast and affected parts of coastal Odisha, the Indian Armed Forces supported civil authorities within the national disaster management framework. Following early warnings from the India Meteorological Department (IMD), preparedness was reviewed at the highest levels of government, and military resources were kept ready in advance. The Indian Navy and the Indian Coast Guard deployed ships and helicopters to carry out search, rescue, and relief operations, especially in coastal and maritime areas. Army and Air Force units in the affected States were placed on standby to assist with evacuation, logistical support, and the restoration of essential services whenever required. These actions were carried out in close coordination with the Ministry of Home Affairs, NDMA, NDRF, and State Governments to enable timely evacuation, effective relief distribution, and a swift response.

These examples demonstrate the Armed Forces' unmatched capability to manage disasters with speed, scale, and professionalism.

#### 4.1.3.5 Coordination Between Military and Civil Authorities

Effective disaster response requires seamless coordination between the Armed Forces and civilian agencies. The structured coordination mechanism involving:

- **Multi-level Communication Channels**

Civil authorities request military assistance through standard protocols defined by the Ministry of Defence and NDMA. During operations, coordination takes place via control rooms at the national, state, and district levels.

- **Incident Response Structure**

The Incident Response System (IRS), as outlined in NDMA guidelines, provides a unified chain of command that integrates military units into civil-led response systems. This prevents duplication of efforts and ensures clear role delineation.

- **Joint Planning and Briefings**

Military representatives participate in planning meetings, reconnaissance missions, and discussions on resource allocation. Civil authorities rely on military intelligence, hazard assessments, and logistical insights.

- **Liaison Officers and On-ground Integration**

Liaison officers facilitate linkages between local administrations, NDRF/SDRF units, and the military. This ensures coordinated rescue operations, supply management, and evacuation planning.

► Seamless coordination between the Armed Forces and civilian agencies

#### 4.1.4 Role of National Disaster Response Force (NDRF)

The National Disaster Response Force (NDRF) is India's premier specialised force dedicated exclusively to disaster response. Over the years, it has emerged as one of the most professional and technologically advanced response forces in the world, known for its rapid mobilisation, scientific rescue techniques, and strong community engagement. Its presence

► Dedicated exclusively to disaster response



has significantly enhanced the country's preparedness and responsiveness to natural and human-induced disasters.

► Formation under the DM Act 2005

NDRF was established under the Disaster Management Act, 2005, which marked a structural shift in India's disaster management approach from reactive relief to proactive preparedness and specialised response. The Act mandated the creation of a dedicated multi-disciplinary force trained to deal with a wide range of disasters. The decision to create NDRF emerged from the need for a centralised, professional, and trained response force capable of handling complex emergencies such as earthquakes, floods, cyclones, building collapses, industrial accidents, and Chemical, Biological, Radiological, and Nuclear (CBRN) incidents. Over time, NDRF has become the backbone of India's national response mechanism.

### Structure and Specialised Units

► Multi-battalion force

NDRF operates as a multi-battalion force, each battalion drawn from different Central Armed Police Forces such as CRPF, BSF, CISF, ITBP, and SSB. These battalions are strategically located across the country to ensure swift deployment in any region. Each battalion consists of multiple teams trained for various rescue, relief, and specialised emergency operations.

Key structural features include:

- Team composition includes engineers, medical personnel, paramedics, dog squads, technicians, divers, and CBRN experts.
- Battalions are geographically distributed to reduce response time.
- A structured command hierarchy ensures operational clarity and swift decision-making.

This arrangement allows NDRF to respond efficiently to multi-hazard situations across India's diverse geographical terrain.

### Core Functions: Search, Rescue, Medical Assistance, CBRN Response

NDRF's core mandate includes a broad spectrum of life-saving functions:



► Life-saving functions

a) Search and Rescue Operations: NDRF is trained to conduct urban and rural search and rescue, including operations in collapsed structures, flooded regions, high-altitude zones, and confined spaces. Teams use advanced tools such as life detectors, cutting equipment, inflatable boats, and rope systems.

b) Rescue and Evacuation: During floods and cyclones, NDRF evacuates vulnerable populations, assists stranded individuals, and ensures safe movement to relief shelters. Their expertise in swift water rescue makes them essential during monsoon emergencies.

c) Medical First Response: NDRF teams include medically trained personnel who provide first aid, trauma care, and stabilisation of victims. They operate mobile medical units and support district health systems during emergencies.

d) CBRN Response: NDRF is a national-level force in India with dedicated CBRN response capabilities. Personnel are trained to detect, isolate, and neutralise chemical, biological, radiological, and nuclear hazards. They use specialised protection gear, detectors, and decontamination equipment.

Through these functions, NDRF delivers immediate life-saving support during emergencies of all scales.

### Community Outreach & Mock Drills

Beyond operational response, NDRF plays a major role in strengthening community resilience one of the core themes of modern disaster management.

- **Community-Based Disaster Risk Reduction (CBDRR)**

NDRF actively works with local communities to raise awareness, build local capacities, and promote a culture of preparedness. This includes village-level awareness campaigns, demonstrations on first aid, safe evacuation, and emergency communication and hazard-specific preparedness training in flood- and cyclone-prone areas

- **School Safety Programmes**

NDRF conducts mock drills and awareness sessions in schools to train students and teachers on safe evacuation, fire safety, earthquake response, and basic life support. These

► Strengthening community resilience



initiatives help instil preparedness at a young age.

### ● **Mock Drills with Local Authorities**

Regular mock drills are conducted in collaboration with district administrations, state emergency authorities, and other stakeholders. These drills help identify gaps in the response system and enhance coordination across agencies.

By engaging directly with communities, NDRF strengthens the grassroots foundation of disaster preparedness.

## **Training, Equipment, International Cooperation**

NDRF places strong emphasis on continuous skill enhancement, technological advancement, and collaboration with global agencies.

### **a) Training**

Personnel undergo rigorous training in:

- Collapsed structure search and rescue
- Rope rescue and high-angle techniques
- Flood rescue and boat operations
- Medical first response
- CBRN safety and response
- Communication and coordination during complex disasters

NDRF also collaborates with national institutes such as NIDM, IMD, GSI, and INCOIS for hazard-specific training.

### **b) Equipment and Technology**

NDRF uses modern equipment, including:

- Underwater search devices
- Thermal imaging cameras
- Communication gear
- Cutting and breaching tools
- Boats and life jackets

► Continuous skill enhancement, technological advancement, and collaboration

- CBRN protective suits and detectors

This advanced equipment enhances speed, precision, and safety during operations.

### c) International Cooperation

NDRF participates in international exercises and has been deployed for global humanitarian missions. It collaborates with agencies such as:

- UN agencies
- INSARAG (International Search and Rescue Advisory Group)
- Asia-Pacific disaster response networks

These partnerships help NDRF align with global best practices and contribute to regional and international disaster response efforts.

## 4.1.5 Role of Non-Governmental Organisations (NGOs)

► NGOs act as a bridge between communities and government institutions

Non-Governmental Organisations (NGOs) play a crucial role in strengthening India's disaster management system. Their presence at the grassroots level, flexibility, local credibility, and ability to mobilise resources quickly make them indispensable partners in disaster preparedness, response, and rehabilitation. When disasters strike, NGOs act as a bridge between communities and government institutions, ensuring that relief reaches vulnerable populations effectively and empathetically.

### 4.1.5.1 Importance of NGOs in Disaster Management

NGOs contribute significantly to all phases of the disaster management cycle. Their importance arises from several factors:

- **Grassroots presence:** NGOs often work closely with local communities, giving them first-hand knowledge of vulnerabilities, local needs, and coping capacities.
- **Speed and flexibility:** Unlike government systems, which involve formal protocols, NGOs can mobilise volunteers, materials, and information rapidly.



► Enhance the responsiveness and inclusiveness

- **Community trust:** NGOs often have long-standing relationships with communities, making their advice and interventions widely accepted.
- **Targeted support for vulnerable groups:** NGOs specialise in reaching populations that are often overlooked—such as women, children, elderly persons, persons with disabilities, and socio-economically marginalised groups.
- **Complementing the government:** They supplement government response by filling operational gaps, offering specialised services, and extending support in areas where state capacity is limited.

Overall, NGOs enhance the responsiveness and inclusiveness of the national disaster management framework.

#### 4.1.5.2 Pre-Disaster Awareness and Preparedness Initiatives

Preparedness is one of the strongest domains of NGO engagement. Before disasters strike, NGOs implement a range of awareness and capacity-building activities to strengthen community resilience.

Key initiatives include:

► Awareness and capacity-building activities

- **Awareness campaigns:** Conducting programmes on safe evacuation, first aid, fire safety, and hazard-specific behaviour (e.g., what to do during floods or cyclones).
- **School-based preparedness:** Training students and teachers on disaster drills, emergency assembly points, and safe behaviour during earthquakes or fires.
- **Community-Based Disaster Risk Reduction (CBDRR):**
  - Preparing community-level disaster management plans
  - Identifying local hazards and vulnerabilities
  - Forming task forces for first aid, search and rescue, and early warning
- **Early warning dissemination:** NGOs help ensure that warnings reach remote or vulnerable communities through volunteers, local networks, and digital platforms.

- Capacity-building workshops: Training community volunteers, women's groups, self-help groups, and youth clubs on emergency response and leadership.

Through these initiatives, NGOs foster a culture of awareness and preparedness at the grassroots level.

#### 4.1.5.3 Relief Activities: Food, Shelter, Medical Aid, Counselling

► Immediate relief and humanitarian support

Once a disaster occurs, NGOs play a pivotal role in delivering immediate relief and humanitarian support. Their interventions are often the first organised assistance received by affected communities.

Major relief activities include:

► First organised assistance

- **Food and Water Distribution:** NGOs set up community kitchens, distribute dry ration kits, and ensure safe drinking water through purification systems or supply chains.
- **Temporary Shelter Management:** They support the establishment of relief camps, arrange essential items (bedding, clothing, sanitation supplies), and ensure safety and dignity within shelters.
- **Medical Assistance:** NGOs deploy mobile medical teams, coordinate with local health services, provide first aid, and support management of communicable diseases in relief camps.
- **Psychosocial Counselling:** Recognising the emotional impact of disasters, NGOs offer counselling services, stress management sessions, and child-friendly spaces to help individuals cope with trauma.

NGOs' humanitarian approach ensures that relief reaches the affected population in a timely, compassionate, and sensitive manner.

#### 4.1.5.4 Rehabilitation Support and Livelihood Restoration

Beyond immediate relief, NGOs play a central role in long-term rehabilitation and recovery. Their initiatives help communities rebuild their lives and regain self-reliance.





Common rehabilitation activities include:

► Help communities rebuild their lives and regain self-reliance

- **Housing Reconstruction:** NGOs assist in rebuilding disaster-resistant homes, ensuring compliance with safety standards and local architectural standards.

- **Livelihood Restoration:** They provide livelihood kits, skill-development training, agricultural support, and financial assistance to help families recover their sources of income.

- **Support for Social Infrastructure:** Rebuilding schools, anganwadis, health centres, and community buildings forms part of their recovery programmes.

- **Social and Psychological Rehabilitation:** NGOs run community healing programmes, women's empowerment initiatives, and long-term psychosocial support services.

Their sustained engagement helps communities transition from relief to recovery while promoting resilience and self-sufficiency.

#### 4.1.5.5 Coordination Challenges and Best Practices

Despite their valuable contributions, NGOs often face coordination challenges during disaster operations:

► Challenges

- Overlapping roles when multiple NGOs operate in the same area.
- Variation in capacity, especially among smaller NGOs.
- Limited coordination with local governments due to inadequate communication channels.
- Resource constraints in reaching remote or severely affected regions.
- Lack of standardised procedures for needs assessment and reporting.

#### Best Practices for Effective Coordination

To overcome these challenges, several best practices strengthen NGO-government partnerships:

- Institutionalised coordination platforms, such as NGO task forces and Emergency Operation Centres.

### ► Overcoming Challenges

- Clear guidelines on roles, responsibilities, and reporting formats.
- Joint training programmes with district authorities and state disaster management agencies.
- Information sharing systems using digital tools and community-based networks.
- Adoption of standard operating procedures (SOPs) for relief distribution and camp management.
- Inclusive disaster governance, ensuring NGO representation in planning and review meetings.

When coordination is streamlined, NGOs significantly enhance the effectiveness and reach of disaster response and recovery efforts.

## 4.1.6 Inter-Agency Coordination in Preparedness and Risk Reduction

Effective disaster preparedness depends on strong coordination among institutions at the central, state, district, and local levels. Since disasters affect multiple sectors simultaneously, inter-agency cooperation ensures timely action, efficient resource use, and smooth communication across all administrative levels.

### Central, State, District-level Coordination Mechanisms

#### ► Central Level

National coordination is led by bodies such as NDMA, the National Executive Committee, and nodal ministries. They frame policies, issue guidelines, and support states with technical expertise, early warnings, and specialised resources.

#### ► State Level

State Disaster Management Authorities (SDMAs) and State Executive Committees guide preparedness efforts within each state. State Emergency Operation Centres coordinate communication and integrate plans of various departments such as health, power, water, and transport.

#### ► District Level

The District Disaster Management Authority (DDMA), chaired by the District Collector, manages ground-level preparedness. District Emergency Operation Centres coordinate warnings, resource mobilisation, and response activities, while



local line departments carry out field operations.

Local Self-Governments (Panchayats, Municipalities, Corporations) play a critical role because they work closest to communities. Their responsibilities include:

► Role of Local Self-Governments

- Identifying local hazards and preparing community-level disaster plans
- Conducting awareness activities and training programmes
- Maintaining local infrastructure such as drainage, roads, and shelters
- Supporting early warning dissemination through local networks
- Collaborating with community groups and NGOs for preparedness and evacuation

Their proximity ensures quicker action and better community participation.

### Use of Early Warning Systems and Communication Channels

Early warning systems enable timely action by providing accurate hazard forecasts and alerts. Warnings are generated by national scientific agencies and disseminated through:

► Enable timely action

- Mobile alerts and SMS
- Radio, TV, and digital platforms
- Local public address systems, sirens, and volunteers

Local authorities ensure last-mile connectivity so that warnings reach even remote or vulnerable communities. Effective communication turns early warnings into preventive action, significantly reducing disaster losses.

## Summarized Overview

This unit provides a comprehensive understanding of how societies can prepare for and reduce the risks associated with disasters. It explains the meaning and importance of preparedness and highlights the roles of key institutions, including NDMA, the Armed Forces, NDRF, NGOs, and local governments, in strengthening readiness. The unit also emphasises the value of community participation, early warning systems, and coordinated action across central, state, district, and local levels. By linking preparedness with mitigation and resilience, the unit helps learners appreciate how proactive planning can minimise impacts and support safer, more resilient communities.

## Self-Assessment

1. What is meant by disaster preparedness?
2. What is the role of the National Disaster Management Authority (NDMA) in preparedness?
3. Under which Act was the NDRF formed, and why was it created?
4. Mention any two key functions of the NDRF.
5. State two major roles of the Armed Forces during disasters.
6. Identify any two challenges in NGO coordination during disasters.
7. Who prepares the District Disaster Management Plan (DDMP)?
8. What is meant by inter-agency coordination in disaster management?
9. Why is community participation essential for disaster resilience?
10. Name any two specialised units within the NDRF.

## Assignments

1. Analyse the significance of disaster preparedness in the broader framework of disaster risk reduction. How does it contribute to minimising loss of life and enhancing community resilience?
2. Critically assess the involvement of NGOs in disaster management, focusing on preparedness, relief, and rehabilitation activities. What challenges do they face in coordination?
3. Using any recent disaster in India as a case study, critically analyse the effectiveness of preparedness measures and identify lessons for future planning and risk reduction.





## Reference

1. Ministry of Home Affairs. (2011). *Disaster management in India*. Government of India.
2. National Disaster Management Authority. (2024). *Guidelines for preparation of disaster management plan for Ministry/Department of Government of India*. Government of India.
3. United Nations Office for Disaster Risk Reduction. (2017). *Words into action guidelines: National disaster risk assessment—Governance system, methodologies, and use of results*. United Nations.
4. Government of India. (2005). *Disaster Management Act, 2005*. Government of India.
5. Sendai Framework for Disaster Risk Reduction 2015–2030.
6. United Nations Office for Disaster Risk Reduction. (2015). *Sendai Framework for Disaster Risk Reduction 2015–2030*. United Nations.

## Suggested Reading

1. Murthy, D. B. N. (2008). *Disaster management: Text and case studies*. Deep & Deep Publication.
2. Sinha, P. C. (2006). *Disaster management process: Laws, process and strategy*. SBS Publishers & Distributors.
3. Singh, R. (2015). *Handbook of disaster management* (Vol. 1). Horizon Press.
4. Singh, R. (2015). *Handbook of disaster management* (Vol. 2). Horizon Press.
5. Sinha, P. C. (2006). *Disaster relief, rehabilitation and emergency humanitarian assistance*. SBS Publishers & Distributors Pvt. Ltd.
6. Sinha, P. C. (2006). *Disasters, vulnerabilities and risks: Trends, concepts, classifications and approaches*. SBS Publishers & Distributors Pvt. Ltd.
7. Singh, B. K. P. (2010). *Disaster management: Psycho-social support and health services*. Sumit Enterprises.



## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU



## UNIT 2

# Disaster Management : Recovery and Rehabilitation

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ define the concept of post-disaster recovery and rehabilitation.
- ▶ identify the major types of rehabilitation: physical, social, and psychological.
- ▶ explain the importance of balancing economic and social needs during rehabilitation.
- ▶ analyse the impact of the 2004 Indian Ocean Tsunami on India and evaluate the response and rehabilitation efforts that followed.

### Background

Understanding recovery and rehabilitation is crucial for grasping the full cycle of disaster management. In earlier units, learners explored the meaning of disasters, the disaster management cycle, institutional arrangements under the Disaster Management Act, 2005, and India's overall preparedness and response framework. Having developed this foundation, this unit takes the next logical step by examining what happens after the immediate emergency has passed. Recovery and rehabilitation are the phases in which communities begin to rebuild their lives, restore essential services, and regain a sense of stability.

Disasters disrupt not only infrastructure but also the social and emotional fabric of communities. Homes are lost, livelihoods are damaged, and the psychological impact may linger long after physical structures are repaired. Rehabilitation, therefore, requires a holistic approach that addresses physical rebuilding, social restoration, and psychological well-being. National and international guidelines emphasise that recovery must be inclusive, people-centred, and sensitive to the needs of vulnerable groups. Concepts such as damage assessment, community participation, equitable resource distribution, and long-term planning guide the recovery process and help ensure that affected populations are not pushed into deeper cycles of vulnerability.

The Indian Ocean Tsunami of 2004, one of the most devastating disasters in recent history, illustrates the complexities of large-scale rehabilitation. Its long-term impact on coastal communities in India highlighted the need for structured recovery frameworks, stronger institutions, and systematic assessments of damage and needs. The lessons from such events continue to influence policies, funding mechanisms, and the roles of national, state, and district authorities in rehabilitation planning.

By exploring the principles, processes, and institutional structures related to recovery and rehabilitation, this unit helps learners understand how societies move from crisis to reconstruction and from vulnerability to resilience. It emphasises that successful rehabilitation is not merely about restoring what was lost, but about enabling communities to recover with dignity and emerge stronger than before.

## Keywords

Post-Disaster Recovery, Long-Term Recovery, Economic and Social Balance, Inclusive Rehabilitation, Livelihood Restoration, Infrastructure Restoration

## Discussion

### 4.2.1 Understanding Recovery and Rehabilitation

► Guides the gradual return to normalcy

Recovery and rehabilitation form the backbone of post-disaster management. While the immediate response phase focuses on protecting life and providing urgent assistance, the recovery phase guides the gradual return to normalcy. Rehabilitation, in this context, goes beyond physical rebuilding; it involves restoring social systems, livelihoods, emotional well-being, and the institutional capacities that support community life. Modern recovery frameworks including national guidelines and international practices such as “Build Back Better- view recovery not merely as a return to the past but as an opportunity to create safer, stronger, and more resilient communities.

#### Meaning and Scope of Post-Disaster Recovery

Post-disaster recovery refers to the set of activities undertaken after the emergency phase to restore and improve the living conditions of affected communities. It begins once immediate relief needs have been addressed and continues until



households, infrastructure, and public systems regain stability. The scope of recovery is broad and multi-dimensional. It includes:

► Set of activities undertaken to restore and improve the living conditions of affected communities

- Restoring essential services such as water, electricity, health care, and transportation
- Rebuilding homes and community infrastructure
- Reviving local economies and livelihoods
- Supporting vulnerable groups who may require long-term assistance
- Re-establishing social networks and community institutions
- Addressing psychological and emotional needs

Recovery should be inclusive, participatory, and sensitive to local contexts. It must recognise the varied needs of different groups and ensure that marginalised populations are not left behind. This comprehensive approach helps rebuild communities in ways that reduce future vulnerabilities and promote long-term stability.

### **Distinction between Relief, Rehabilitation, and Reconstruction**

Although these terms are often used together in disaster discourse, relief, rehabilitation, and reconstruction refer to distinct stages of post-disaster action.

#### **• Relief**

► Focuses on immediate needs

Relief constitutes the first stage after a disaster. It focuses on immediate needs such as search and rescue, medical care, food, temporary shelter, clothing, and essential services. Relief operations aim to reduce suffering and protect lives during the critical hours and days after a disaster.

#### **• Rehabilitation**

► Seeks to restore basic functioning

Rehabilitation takes place once the emergency stabilises. It seeks to restore basic functioning in society, helping individuals and communities rebuild their lives. This stage includes temporary housing, restarting schools and health centres, restoring livelihoods, and addressing social and psychological

needs. Rehabilitation bridges the gap between relief and reconstruction by enabling people to regain agency over their daily lives.

### ● Reconstruction

► Long-term efforts to rebuild

Reconstruction refers to long-term efforts to rebuild physical infrastructure and community assets in a safer and more resilient manner. It includes constructing permanent housing, rebuilding roads and public buildings, improving land use, and strengthening protective structures. Reconstruction reflects strategic planning and often incorporates hazard-resistant technology and enhanced standards.

Understanding these distinctions helps administrators plan systematically and allocate resources effectively across different phases of disaster management.

### Importance of Long-term Resilience

► Sustainable recovery

Long-term resilience is the foundation of sustainable recovery. It reflects the ability of communities, institutions, and systems to withstand future shocks while maintaining essential functions. Disasters do not merely expose existing vulnerabilities; they also offer opportunities to correct them. If recovery and reconstruction efforts replicate pre-disaster conditions, communities remain vulnerable to similar events in the future.

Building resilience requires:

► Resilience is not an additional component but a central objective of rehabilitation and reconstruction

- Risk-sensitive planning that integrates hazard knowledge into reconstruction
- Strengthening community capacities through participation, awareness, and empowerment
- Improving infrastructure quality by adopting disaster-resistant designs
- Diversifying livelihoods to reduce socio-economic vulnerability
- Ensuring inclusive recovery so that women, children, elderly persons, and marginalised groups benefit equally
- Embedding psychological and social well-being into recovery programmes

National and global recovery frameworks emphasise that





resilience is not an additional component but a central objective of rehabilitation and reconstruction. Efforts such as the Post-Disaster Needs Assessment (PDNA) and Recovery Frameworks underscore that recovery should reduce risk, restore dignity, and create conditions for safer development.

### 4.2.2 Types of Rehabilitation

► Guiding communities from immediate survival to long-term stability

Rehabilitation is a core element of post-disaster recovery, guiding communities from immediate survival to long-term stability. It reflects a transition from temporary arrangements to more sustainable forms of rebuilding, physically, socially, and psychologically. Disaster management literature emphasises that rehabilitation must be holistic, inclusive, and aligned with the principle of *Build Back Better*, ensuring that communities not only regain what was lost but also emerge stronger and safer than before. National recovery guidelines and international frameworks underscore that effective rehabilitation requires planning, participation, and a clear understanding of community needs across multiple dimensions.

#### Physical Rehabilitation

► Restoration of infrastructure, housing, and public utilities

Physical rehabilitation focuses on restoring the essential physical systems that support daily life. This includes rebuilding damaged houses, schools, hospitals, roads, bridges, and other public infrastructure. Guidelines for recovery emphasise that reconstruction must follow disaster-resistant standards and incorporate risk-sensitive design. For example, the NDMA's *Recovery and Reconstruction Guidelines* highlight the importance of using safer construction practices, appropriate land-use planning, and improved building materials to prevent future losses. Restoring water supply, electricity, sanitation, and communication networks is equally important, as these services enable communities to resume normal activities and support livelihood revival. Effective physical rehabilitation lays the structural foundation for long-term recovery.

#### Social Rehabilitation

► Rebuilding social networks, community institutions, and vulnerable groups

Social rehabilitation aims to rebuild the social fabric of disaster-affected communities. Disasters disrupt relationships, community institutions, and patterns of collective life. As documents on post-disaster community recovery indicate, restoring social networks is essential for reviving trust, cooperation, and mutual support. Social rehabilitation activities

include reopening schools and anganwadis, re-establishing community centres, strengthening local governance systems, and supporting civil society organisations that play key roles in recovery.

► Supporting vulnerable groups

A primary focus of social rehabilitation is supporting vulnerable groups such as women, children, the elderly, persons with disabilities, and economically marginalised communities—who often experience the most profound impacts. The Indian Red Cross Society’s report on the 2004 Tsunami highlights how inclusive rehabilitation efforts, such as providing livelihood assistance to widows and single-parent households, significantly improved social recovery outcomes. Overall, social rehabilitation ensures that communities regain their cohesion, dignity, and collective capacity to function.

### Psychological Rehabilitation

► Trauma counselling, mental health support, community healing

Disasters leave profound emotional and psychological scars. Psychological rehabilitation addresses these invisible impacts by providing trauma counselling, grief support, stress management, and community-based mental health services. Research on post-tsunami recovery, including studies by the Stockholm Environment Institute, shows that psychological effects such as fear, anxiety, depression, and loss of personal security can persist long after physical reconstruction is complete. Integrating mental health care into recovery initiatives is therefore essential.

► Working together to create safe spaces

Psychological rehabilitation involves trained counsellors, community volunteers, social workers, and health professionals working together to create safe spaces where survivors can express their emotions and rebuild a sense of normalcy. Activities such as group therapy, child-friendly spaces, community gatherings, and culturally meaningful rituals contribute to community healing. Long-term psychological support not only restores individual well-being but also strengthens community resilience, ensuring that people are emotionally equipped to rebuild their lives and face future challenges.

### 4.2.3 Guiding Principles of Post-Disaster Rehabilitation

Effective post-disaster rehabilitation must be guided by principles that ensure recovery is not only fast but also equitable, sustainable, and transformative. National and international recovery guidelines emphasise that rehabilitation is an



- Ensure recovery is not only fast but also equitable, sustainable, and transformative

opportunity to correct pre-existing vulnerabilities and rebuild communities in safer ways. It requires coordinated planning, scientific assessment, and inclusive participation so that all groups, especially the most vulnerable, benefit from recovery interventions. The following principles outline the foundation of sound rehabilitation practice.

#### 4.2.3.1 Balancing Economic and Social Needs

- Careful balance between restoring economic activity and addressing social needs

Rehabilitation must strike a careful balance between restoring economic activity and addressing social needs. Economic recovery such as reviving markets, agriculture, enterprises, and employment, is essential for enabling families to regain self-reliance. However, social needs such as housing, health care, education, and protection of vulnerable groups are equally significant. National recovery guidelines stress that focusing solely on economic revival may leave behind communities whose social support structures have collapsed. The World Bank's *Disaster Recovery Framework Guide* emphasises integrated planning that aligns livelihood recovery with improved housing, public services, and community infrastructure, ensuring that social and economic priorities move forward together.

#### 4.2.3.2 Damage and Needs Assessment

- Identify the scale of loss

A reliable damage and needs assessment is the backbone of effective rehabilitation planning. It helps identify the scale of losses, the needs of affected populations, and the resources required for recovery.

#### Rapid Assessment Techniques

- Identifying critical needs

Rapid assessments are conducted immediately after a disaster to gather quick, actionable information. They focus on identifying critical needs such as food, shelter, water, medical care, and immediate protection. According to the *Post-Disaster Needs Assessment (PDNA) Standard Operating Procedure*, rapid assessments rely on field visits, community interactions, and preliminary sectoral data to guide urgent relief and early recovery decisions.

#### Comprehensive Loss Estimation

Comprehensive assessment provides a detailed picture of the disaster's impact across sectors housing, infrastructure,

► Evidence based planning

agriculture, health, education, and the environment. The PDNA methodology, used globally and applied during major disasters in India, evaluates damage (physical impact), losses (economic disruptions), and recovery needs (financial requirements for medium-term restoration). This holistic approach ensures that rehabilitation planning is evidence-based and aligned with long-term development goals.

► Places affected people at the heart of rehabilitation

#### 4.2.3.3 Community-Centred and Inclusive Approaches

A community-centred approach places affected people at the heart of rehabilitation. Experience from the 2004 Indian Ocean tsunami, documented by the Indian Red Cross Society, shows that recovery outcomes improve when communities participate in decision-making, planning, and monitoring of rehabilitation activities. Inclusive recovery ensures that women, children, elderly persons, persons with disabilities, and marginalised groups receive targeted support that addresses their specific vulnerabilities. This principle also encourages the strengthening of community institutions such as local self-governments, cooperatives, and self-help groups. These institutions often serve as the backbone of recovery efforts, distributing resources, coordinating activities, and maintaining social cohesion.

► Design sustainable recovery

#### 4.2.3.4 Sustainable Recovery Frameworks (International Best Practices)

International best practices provide valuable insights for designing sustainable recovery frameworks. The *Disaster Recovery Framework Guide*, developed by the World Bank, outlines core principles such as:

- Build Back Better, ensuring safer reconstruction
- Risk-informed development, integrating hazard knowledge into planning
- Institutional coordination, linking national, regional, and local actors
- Inclusiveness, ensuring that all groups benefit from recovery
- Long-term sustainability, aligning recovery with development goals

Similarly, global experiences from countries affected by major disasters such as Japan, Indonesia, Chile, and the Philippines



highlight the importance of strong governance, transparent resource management, and community participation. These principles have been adapted into national guidelines to ensure that recovery efforts in India are both context-appropriate and globally informed.

#### 4.2.3.5 Building Resilient Communities

Resilience-building is a central objective of post-disaster rehabilitation. Rehabilitation must not recreate pre-disaster vulnerabilities; instead, it should improve safety, preparedness, and adaptive capacity. Guidelines on recovery and reconstruction highlight that resilient communities are characterised by strong social networks, risk-aware planning, robust infrastructure, diversified livelihoods, and responsive local institutions.

► Improve adaptive capacity

Key strategies for building resilience include:

- Promoting disaster-resistant construction techniques
- Integrating hazard information into land-use planning
- Strengthening local governance systems
- Enhancing community awareness and preparedness
- Supporting sustainable livelihoods that reduce economic vulnerability

The Stockholm Environment Institute's study on post-tsunami recovery notes that resilience is strongest when reconstruction efforts combine physical improvements with social empowerment and psychological well-being.

#### 4.2.4 Post-Disaster Case Study: Tsunami 2004

The Indian Ocean Tsunami of 2004 remains one of the most devastating natural disasters in modern history. It was triggered by a massive undersea earthquake off the coast of Sumatra, causing giant waves that struck several countries around the Indian Ocean. India was among the severely affected nations, with communities in Tamil Nadu, Kerala, Andhra Pradesh, and the Andaman and Nicobar Islands suffering widespread loss of life, displacement, and destruction. The scale of devastation made the 2004 tsunami a defining event that reshaped India's disaster management framework, including policies, institutional mechanisms, and community-based preparedness.

► Reshaping India's disaster management framework



► Absence of early warning system

On 26 December 2004, a 9.1 magnitude undersea earthquake occurred in the Indian Ocean, generating tsunami waves that travelled thousands of kilometres and struck coastal regions with little warning. India experienced a significant impact along its eastern coast and island territories. The Indian Red Cross Society's documentation of the event describes how waves up to 10–15 metres high inundated settlements, swept away infrastructure, and caused near-instant devastation. The suddenness of the disaster, combined with the absence of an effective early warning system at that time, contributed to high casualty figures and extensive displacement.

► Impact on India and Affected States

The tsunami caused catastrophic damage across several states. Tamil Nadu recorded the highest number of deaths, followed by the Andaman and Nicobar Islands, Andhra Pradesh, and parts of Kerala. Coastal villages lost homes, fishing boats, agricultural land, livestock, and essential public services. Key impacts included:

- Loss of life and injury on a massive scale
- Destruction of housing and community infrastructure
- Damage to the fishing sector, which was the primary livelihood for thousands
- Loss of agricultural land due to saltwater intrusion
- Psychological trauma among survivors, especially children and women

### **Government Response Mechanisms**

The Government of India's response combined immediate relief with medium- and long-term recovery efforts. Rescue operations were initiated by the Armed Forces, Coast Guard, and state agencies. Temporary shelters, relief camps, medical services, and food distribution systems were quickly established.

Efforts for recovery Major components of the government response included:

- Search and rescue operations led by the Armed Forces and coastal agencies
- Immediate relief distribution (food, water, shelter, medical care)



- Deployment of health and sanitation teams
- Damage assessments to guide resource allocation
- Restoration of essential services such as electricity, water supply, and transport

In the following months, the government launched rehabilitation programmes focusing on housing reconstruction, livelihood restoration, and support for vulnerable families. The PDNA methodology, later adopted in India, drew significantly from the experiences gained during this disaster.

### Role of NGOs and International Agencies

Non-governmental organisations, humanitarian groups, and international agencies played a crucial role in both relief and long-term rehabilitation. The Indian Red Cross Society, along with numerous national and international NGOs, conducted wide-ranging activities such as:

#### ► Relief and long-term rehabilitation

- Running relief camps
- Providing temporary shelters and family kits
- Supporting livelihood restoration for fishing and coastal communities
- Offering psychosocial counselling and child-friendly spaces
- Rebuilding schools, anganwadis, and community centres

International agencies, including UN bodies, the IFRC, and various global humanitarian organisations, collaborated with government departments to provide technical expertise, funding, and recovery tools. These partnerships demonstrated the importance of coordinated, multi-agency approaches in large-scale disasters.

### Long-term Rehabilitation Strategies

Long-term rehabilitation after the tsunami emphasised restoring normalcy while reducing future vulnerabilities. Key components included:

#### ● Permanent Housing Reconstruction

Rebuilding homes using safer, disaster-resistant designs became a priority. Settlement planning improved, and many

communities were relocated to safer sites.

- **Livelihood Recovery:** Large-scale programmes supported fishermen, farmers, small entrepreneurs, and women's groups. Many agencies provided boats, nets, livestock, equipment, and skills training.

- **Social and Community Rehabilitation:** Restoring schools, health centres, community halls, and public infrastructure helped communities regain stability.

► Reducing future vulnerabilities.

- **Psychological Support:** Counselling services, group therapy, and community activities helped address the emotional impact of the disaster. The IRCS report emphasises that psychosocial care was a vital pillar of recovery.

- **Strengthening Institutional Capacity:** Experiences from the tsunami accelerated policy reforms, contributing to the establishment and strengthening of national disaster management institutions, guidelines, and early warning systems.

Long-term strategies reflected the *Build Back Better* approach, emphasising resilience, sustainability, and community participation.

### Lessons Learned

The 2004 tsunami provided valuable lessons that shaped India's disaster management system:

► Improved resilience

1. **Early Warning Systems Are Critical:** The absence of timely alerts underscored the need for a robust early warning system, leading to the creation of the Indian Tsunami Early Warning Centre.
2. **Disaster-Resistant Infrastructure Is Essential:** Reconstruction highlighted the necessity of safe housing, planned settlements, and resilient public services.
3. **Community Participation Improves Outcomes:** Recovery was most successful where communities were involved in planning and decision-making.
4. **Livelihood Restoration Must Be Integrated:** Supporting livelihoods—particularly in fishing and agricultural sectors—proved vital for long-term resilience.
5. **Psychosocial Support Cannot Be Overlooked:** The di-



saster revealed the deep psychological impacts of trauma, making mental health and community healing central to future recovery efforts.

6. **Institutional Strengthening Is Necessary:** The tsunami, along with other early experiences of disasters, prompted major reforms, including the creation of NDMA (2005), NDRF, and improved coordination frameworks.

These lessons continue to inform India's recovery strategies and have significantly improved resilience across coastal and disaster-prone regions.

### 4.2.5 Funding Mechanisms

#### National Disaster Response Fund (NDRF)

- Supports relief and immediate rehabilitation

The NDRF is the primary national financial mechanism for providing financial assistance to states during severe disasters. It supports relief and immediate rehabilitation activities based on the severity of impacts. While its primary focus is on response, NDRF allocations often support temporary rehabilitation measures such as temporary housing, medical care, and restoration of essential services. The fund is operated under guidelines that outline admissible expenditures, ensuring that resources are used transparently and effectively.

#### State Disaster Response Fund (SDRF)

- Enables states to address pressing needs

The SDRF is the principal fund available to state governments for disaster response and short-term rehabilitation. It enables states to address pressing needs, such as repairing public infrastructure, providing temporary shelters, distributing essential items, and restoring utilities. SDRF allocations are shared between the central and state governments in predetermined ratios. When disasters exceed a state's coping capacity, additional financial support may be recommended from the NDRF.

- Long term rehabilitation

While NDRF and SDRF support early-stage recovery, long-term rehabilitation typically relies on state budgets, special reconstruction packages, and external funding. States often supplement these funds with sectoral schemes, international loans, and development programmes to support housing reconstruction, livelihood revival, and infrastructure development.

### ► Structured recovery

## International Agencies (UNDP, World Bank, ADB)

International agencies play a significant role in strengthening India's post-disaster rehabilitation by providing financial assistance, technical expertise, and introducing global best practices. Their involvement is particularly valuable in large-scale disasters where national resources need to be supplemented by specialised knowledge and structured recovery frameworks.

### United Nations Development Programme (UNDP)

UNDP's contribution to disaster rehabilitation in India is centred on capacity-building, governance support, and community-based recovery models. The organisation works closely with state governments to strengthen institutional preparedness and post-disaster coordination. UNDP has supported:

### ► Strengthen institutional preparedness and post-disaster coordination

- Post-Disaster Needs Assessments (PDNA) that help quantify damage and recovery needs.
- Resilient housing initiatives, especially in coastal and cyclone-prone regions, promoting safer construction designs.
- Livelihood restoration programmes, including training for vulnerable groups and support for micro-enterprise revival.
- Community-based disaster management, emphasising participation of women, local leaders, and marginalised groups.

UNDP's approach aligns closely with national frameworks by embedding inclusiveness, sustainability, and local participation into rehabilitation programmes. Through technical partnerships, it helps states integrate global recovery principles such as *Build Back Better* and risk-sensitive development into their long-term strategies.

### ► Large-scale reconstruction and institutional reforms

## World Bank

The World Bank has played a transformative role in India's long-term rehabilitation by supporting large-scale reconstruction and institutional reforms. A notable example is the Odisha Disaster Recovery Project, which demonstrates how international financing combined with technical expertise can





accelerate recovery in severely affected regions. The project contributed to: construction of cyclone-resilient permanent houses, restoration of roads, bridges, and public infrastructure, revival of livelihoods in agriculture and fisheries, Strengthening state institutions for disaster risk management

#### ► Structured approach

The World Bank's Disaster Recovery Framework Guide further provides a structured approach for planning recovery, linking immediate relief with medium- and long-term reconstruction. The guide emphasises: risk-informed planning, social and economic inclusion, transparent governance, integrated financing strategies By embedding these principles into state programmes, the World Bank supports recovery processes that are not only faster but also more resilient and development-oriented.

### Asian Development Bank (ADB)

The Asian Development Bank supports India primarily through emergency assistance loans, infrastructure rehabilitation, and risk-reduction planning. ADB-funded rehabilitation projects typically focus on:

#### ► Emergency assistance

- Rebuilding transport networks, including roads, bridges, and coastal protection structures
- Improving water supply and sanitation systems, which are often severely damaged during floods and cyclones
- Supporting urban resilience, particularly in rapidly growing cities
- Strengthening the capacity of state departments and urban local bodies to integrate disaster risks into infrastructure planning

ADB also promotes risk-sensitive urban development, ensuring that reconstruction projects incorporate hazard maps, climate risks, and long-term sustainability considerations. By coupling infrastructure support with technical guidance, ADB helps states design durable, climate-resilient rehabilitation programmes compatible with local development priorities.

## Summarized Overview

This unit offers a comprehensive understanding of how communities recover and rebuild after disasters. It explains the meaning and scope of post-disaster recovery and highlights the need to address physical damage, social disruption, and psychological trauma in an integrated manner. Learners gain insight into rapid and detailed damage assessments, the importance of balancing economic and social priorities, and the role of community participation in shaping effective rehabilitation. The experiences from the 2004 Indian Ocean Tsunami illustrate the challenges and possibilities of large-scale recovery. The unit also explores the institutional and financial frameworks supporting rehabilitation, as well as contributions from international agencies. Overall, the unit emphasises that sustainable recovery is a long-term, inclusive process that strengthens resilience and restores dignity to affected communities.

## Self-Assessment

1. What is meant by post-disaster recovery?
2. How does rehabilitation differ from relief?
3. Why is psychological rehabilitation important after a disaster?
4. What does it mean to balance economic and social needs during rehabilitation?
5. How did the 2004 Indian Ocean Tsunami impact India?
6. What types of livelihood restoration were undertaken after the 2004 Tsunami?
7. How do funding mechanisms such as NDRF and SDRF support recovery?
8. Why are international agencies like UNDP, World Bank, and ADB important for rehabilitation efforts?
9. How does the experience of the 2004 Tsunami illustrate the need for early warning systems?
10. Why is the concept of “Build Back Better” important in rehabilitation planning?



## Assignments

1. Critically examine the components of physical, social, and psychological rehabilitation. Illustrate how these dimensions collectively contribute to comprehensive recovery.
2. Using the 2004 Indian Ocean Tsunami as a case study, assess the impact of the disaster on India and examine the effectiveness of the rehabilitation measures adopted.
3. Critically evaluate the role of international agencies such as UNDP, the World Bank, and ADB in India's post-disaster rehabilitation. How do their interventions complement national efforts?
4. Discuss the institutional responsibilities of NDMA, SDMAs, and DDMA's in post-disaster rehabilitation. How do these institutions coordinate to support recovery at different administrative levels?

## Reference

1. NDMA. (2019). *Recovery and reconstruction guidelines*. Government of India
2. Larsen, R. K. (2008). *Vulnerability in the context of the 2004 Indian Ocean tsunami recovery*. Stockholm Environment Institute.
3. World Bank. (2021). *India: Odisha disaster recovery project (P148868)*. World Bank Group.
4. Indian Red Cross Society. (2005). *From relief to rehabilitation: Tsunami 2004 special report*. International Federation of Red Cross and Red Crescent Societies.
5. National Institute of Disaster Management. (2013). *Standard operating procedure for post-disaster needs assessment (PDNA)*. Government of India.
6. Global Facility for Disaster Reduction and Recovery, & World Bank. (2020). *Disaster recovery framework guide: Building back stronger, faster and more inclusively*. World Bank Group.

## Suggested Reading

1. Murthy, D. B. N. (2008). *Disaster management: Text and case studies*. Deep & Deep Publication.
2. Sinha, P. C. (2006). *Disaster management process: Laws, process and strategy*. SBS Publishers & Distributors.
3. Singh, R. (2015). *Handbook of disaster management* (Vol. 1). Horizon Press.
4. Singh, R. (2015). *Handbook of disaster management* (Vol. 2). Horizon Press.
5. Sinha, P. C. (2006). *Disaster relief, rehabilitation and emergency humanitarian assistance*. SBS Publishers & Distributors Pvt. Ltd.
6. Sinha, P. C. (2006). *Disasters, vulnerabilities and risks: Trends, concepts, classifications and approaches*. SBS Publishers & Distributors Pvt. Ltd.
7. Singh, B. K. P. (2010). *Disaster management: Psycho-social support and health services*. Sumit Enterprises.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.



SGOU



## UNIT 3

# Recent Trends and Social Dimensions in Disaster Management

### Learning Outcomes

Upon completion of this unit, the learner will be able to:

- ▶ understand the role of Information and Communication Technologies (ICT) in disaster management.
- ▶ explain how remote sensing and GIS support hazard mapping, early warning, and risk assessment.
- ▶ analyse the challenges created by climate change, rapid urbanisation, and administrative gaps in contemporary disaster management.

### Background

In the previous units, learners explored the foundations of disaster management, the importance of preparedness, and the processes that guide recovery and rehabilitation. Building on this understanding, Unit 3 shifts the focus toward the emerging trends and social realities that shape disaster management in the contemporary world. As disasters become increasingly complex due to climate variability, environmental degradation, rapid urban expansion, and changing socio-economic patterns, traditional approaches alone are no longer sufficient. Modern disaster management requires a combination of advanced technologies and deep awareness of social vulnerabilities.

Information and Communication Technologies (ICT) have transformed the way hazards are detected, monitored, and communicated. Tools such as remote sensing, satellite observations, GIS-based hazard mapping, and mobile-based early warning systems now form the backbone of preparedness and response. The integration of Artificial Intelligence (AI) further strengthens forecasting, risk prediction, real-time assessment, and rescue operations. These technologies enable faster decision-making, improve precision, and help institutions manage large-scale emergencies more efficiently.

At the same time, disasters continue to reveal profound social inequalities. The experiences of vulnerable groups; children, the elderly, women, persons with disabilities,



migrant workers, and economically marginalised households highlight the need for disaster strategies that recognise and address differential risks. Community participation, local knowledge, and social capital play a critical role in shaping resilience, ensuring that disaster response is not only technologically advanced but also socially inclusive.

This unit also examines the persistent challenges in contemporary disaster management. Climate change-induced hazards, unplanned urbanisation, administrative limitations, funding constraints, and the gap between policy and practice all influence the effectiveness of disaster governance. By understanding these challenges, learners gain insight into why disasters continue to have uneven impacts and how holistic approaches; combining technology, community participation, and policy reforms are essential for building resilient societies.

## Keywords

Remote Sensing, Satellite Monitoring, Artificial Intelligence (AI), Robotics in Disaster Response, Geographic Information Systems (GIS)

## Discussion

### 4.3.1 Introduction to Technological and Social Dimensions

#### ► Proactive and holistic strategies

Disaster management has undergone significant transformation in recent decades. Earlier approaches focused primarily on emergency response, but contemporary thinking recognises that disasters are shaped by a combination of physical hazards and complex social factors. Rapid technological advancement, along with changing climatic and socio-economic conditions, has expanded both the nature of risks and the methods available to manage them. Today, disaster management draws upon advanced technological tools such as geospatial systems, digital communication platforms, and intelligent data analytics while simultaneously emphasising the social dimensions of vulnerability, inclusion, and community resilience. This convergence marks a shift toward more proactive and holistic strategies for reducing disaster risk.

#### ► Evolving Nature of Disasters

The character of disasters has changed significantly due to global environmental, technological, and demographic trends. Climate-related hazards are becoming more frequent and intense. Urbanisation has increased the concentration of people

and infrastructure in high-risk areas, making even moderate hazards capable of causing extensive disruption. Additionally, technological innovations have introduced new categories of risk, such as industrial accidents, chemical spills, and failures in critical infrastructure.

#### ► Technological progress

At the same time, technological progress has transformed how disasters are monitored and analysed. Geospatial technologies like remote sensing and GIS provide detailed assessments of terrain, land-use patterns, and hazard exposure. These tools enable early identification of risk zones, support hazard mapping, and improve situational awareness during emergencies. Digital information systems and communication networks have strengthened early warning mechanisms, allowed more timely dissemination of alerts and facilitating coordination among agencies.

#### ► Social dimension

Alongside technological developments, greater attention is now given to the social dimensions of disasters. Research and field experience consistently show that the impact of disasters is unevenly distributed. Vulnerable groups such as women, children, the elderly, persons with disabilities, and economically marginalised communities often face deeper and longer-lasting consequences. These realities have broadened the understanding of disasters from isolated physical events to complex social processes influenced by inequality, preparedness, governance, and access to resources.

#### ► Reducing vulnerabilities

### **Shifting Focus: From Response to Prevention and Resilience**

Modern disaster management places growing emphasis on prevention, preparedness, and resilience rather than solely on post-event response. This shift reflects the recognition that reducing underlying vulnerabilities is more effective and sustainable than managing the consequences of disasters after they occur.

#### ► Preventive strategies

Preventive strategies are increasingly supported by sophisticated technological systems. Geospatial mapping, real-time monitoring, predictive modelling, and data-driven risk assessments help administrators identify threats early and plan accordingly. Technologies such as automated sensors, integrated communication platforms, and analytical tools enhance institutions' capacity to anticipate hazards, streamline preparedness measures, and coordinate rapid responses.



#### ► Resilience

Resilience has also emerged as a key principle guiding disaster management. Building resilience involves strengthening physical infrastructure, diversifying livelihoods, promoting social protection, and empowering local communities. Inclusive planning ensures that vulnerable populations are not left out of early warning systems, preparedness initiatives, or recovery programmes. Experiences from major disasters in India have shown that communities with stronger social networks, better public services, and greater access to information recover more quickly and better withstand future risks.

Together, these technological advancements and social insights reflect a fundamental shift in disaster management: from reacting to crises toward anticipating risks, reducing vulnerabilities, and creating stronger, more adaptive communities.

### 4.3.2 Role of ICT in Disaster Management

#### ► Strengthening Disaster Management Cycle

Information and Communication Technology (ICT) has become an indispensable component of modern disaster management. It enhances the ability of governments and communities to detect hazards, communicate warnings, coordinate responses, and plan recovery. With advances in geospatial systems, real-time communication networks, mobile applications, and artificial intelligence, ICT now plays a transformative role across all stages of the disaster management cycle. It strengthens decision-making, improves risk analysis accuracy, and increases response speed and efficiency, making it a cornerstone of contemporary disaster governance.

#### 4.3.2.1 Importance of ICT for Preparedness, Response, and Mitigation

#### ► Monitor environmental patterns

ICT enhances preparedness by enabling authorities to monitor environmental patterns, identify risk zones, and communicate warnings effectively. Coastal states, for instance, routinely use satellite-based cyclone tracking and digital forecasting models to predict storm paths several days in advance. These tools enable district administrations to plan evacuations, prepare shelters, stock essential supplies, and alert communities well ahead of landfall. Digital training platforms and simulation tools further strengthen readiness by allowing officials and volunteers to practise emergency procedures.

During response, ICT ensures rapid, reliable communication



► Ensures rapid, reliable communication

between agencies and the public. Real-time weather updates, location-based alerts, and status reports from emergency operations centres guide coordinated decision-making. For example, during major flood events, live data on river water levels and inundation patterns helps responders identify safe routes, prioritise rescue operations, and mobilise medical assistance efficiently. Integrated communication networks linking police, fire services, health departments, and local administrations significantly improve the speed and accuracy of emergency actions.

► Scientific analysis

ICT also contributes to mitigation, supporting long-term efforts to reduce disaster risk. Hazard modelling, remote sensing analysis, and GIS-based land-use planning help authorities understand exposure, assess environmental changes, and avoid construction in high-risk zones. In several states, digital terrain models and floodplain maps guide infrastructure planning and zoning regulations, helping communities minimize future losses. By embedding scientific analysis into policymaking, ICT strengthens both structural and non-structural mitigation strategies.

#### 4.3.2.2 Remote Sensing

► Provides essential information

Remote sensing provides essential information about hazards and environmental changes through satellite imagery, aerial observations, and drone-based mapping. It plays a vital role in early detection, continuous monitoring, and rapid assessment. Satellite monitoring provides detailed, frequent observations of weather systems, coastlines, vegetation, and river basins. These images are crucial during cyclones, when storm development in the Bay of Bengal and the Arabian Sea is continuously tracked. Satellite-based flood monitoring has become especially important in monsoon months, as radar imagery can capture inundation even under dense cloud cover.

► Real-time data collection

Remote sensing also supports real-time data collection, enabling authorities to assess hazard intensity and identify affected regions quickly. After major floods, for instance, satellite assessments help determine which villages are submerged, which roads are blocked, and where relief efforts should be focused. Similarly, thermal imaging sensors detect forest fire hotspots, allowing firefighting teams to act promptly.

In the Indian context, remote sensing forms the backbone of early warning systems when integrated with predictive models.





► Integrated with predictive models

Satellites such as RISAT (Radar Imaging Satellite) play a crucial role in flood monitoring by providing reliable data even through cloud cover. At the same time, INSAT-3D and INSAT-3DR are central to cyclone tracking and weather forecasting. Alerts for cyclones, floods, landslides, heatwaves, and storm surges are largely based on satellite-derived meteorological and oceanographic data. These space-based systems support timely warnings and evacuation planning, thereby significantly reducing loss of life and property damage.

### 4.3.2.3 GIS for Hazard Mapping and Risk Assessment

► Analysing spatial information

Geographic Information Systems (GIS) are indispensable for analysing spatial information, visualising risks, and supporting both planning and emergency operations. By integrating topography, population density, infrastructure networks, and historical hazard data, GIS enables a comprehensive understanding of vulnerabilities. GIS is widely used to map vulnerable zones, such as identifying flood-prone wards in major cities, marking landslide-prone slopes in hilly districts, and locating cyclone-exposed coastal stretches. These maps guide land-use decisions, influence building codes, and help determine safe locations for schools, hospitals, and shelters.

► Decision support

Through decision-support systems, GIS helps administrators simulate hazard scenarios and assess potential impacts. Flood forecasting dashboards, for example, combine rainfall data, river conditions, and digital elevation models to project inundation patterns and support timely evacuation planning. During landslides, GIS-based analysis of terrain stability helps authorities identify alternative routes for emergency transport and supplies.

► Transparent and responsive

GIS also strengthens resource allocation, enabling precise mapping of shelters, health centres, relief stockpiles, and transport networks. In the Indian context, platforms such as Bhuvan, ISRO's national geoportal, and the National Database for Emergency Management (NDEM) support this process by providing detailed spatial data to district and State administrations. After disasters, GIS layers generated by these systems help officials identify underserved areas that require urgent attention. This ensures that relief distribution is efficient, transparent, and responsive to community needs.

#### 4.3.2.4 Real-Time Communication Tools and Mobile Applications

- Bridging the information gap between institutions and communities

Timely communication is essential in disaster management, and digital platforms play a key role in bridging the information gap between institutions and communities. Mobile applications developed by national and state authorities disseminate hazard alerts, evacuation routes, helpline numbers, and safety instructions in real time. These platforms enhance two-way communication by allowing citizens to access verified information and authorities to monitor on-ground conditions.

- Strengthened situational awareness

Crowd-sourced reporting has further strengthened situational awareness. Citizens can share location details, photographs, and short updates on events such as local flooding, blocked roads, or damaged infrastructure. Such real-time inputs proved valuable during urban floods, where public updates helped responders identify safe passages, mobilise rescue teams more efficiently, and prioritise critical interventions. Digital communication thus ensures that disaster management is more responsive, inclusive, and community-informed, enabling authorities to adapt quickly to changing situations.

#### 4.3.3 Artificial Intelligence (AI) in Disaster Preparedness and Response

- Tools that help authorities reduce uncertainties and manage risks more effectively

Artificial Intelligence (AI) has emerged as a transformational force in disaster management. Its ability to analyse vast datasets, identify patterns, model hazard behaviour, and support rapid decision-making makes it invaluable for anticipating, responding to, and recovering from disasters. AI techniques, ranging from machine learning and predictive analytics to robotics, drones, and automated systems, enhance both the precision and speed of disaster-related operations. As hazards become more complex due to climate variability and socio-economic vulnerabilities, AI provides tools that help authorities reduce uncertainties and manage risks more effectively.

##### 4.3.3.1 AI for Early Warning and Forecasting

- Strengthening early warning system

AI significantly strengthens early warning systems by improving the accuracy and timeliness of hazard forecasts. Traditional forecasting relies heavily on human interpretation of meteorological and hydrological data. AI, however, can process massive volumes of satellite observations, weather parameters, and historical patterns to produce more precise predictions. In



the Indian context, artificial intelligence is increasingly used as a support tool in disaster forecasting rather than as a replacement for established prediction systems. Cyclone forecasting by the India Meteorological Department (IMD) continues to rely primarily on physics-based numerical weather prediction models, with AI and machine learning applied primarily for post-processing, pattern recognition, and decision support. These tools help refine estimates of cyclone intensity, probable landfall zones, and rainfall distribution.

► Improve real-time alerts

Similar supportive applications of AI are seen in flood forecasting, where machine learning complements hydrological models by integrating rainfall data, river discharge, soil moisture, and terrain information to improve real-time alerts. In drought monitoring, AI-based analysis of satellite data helps detect vegetation stress and climatic anomalies, thereby strengthening early warning systems for authorities. Through these functions, AI amplifies the effectiveness of early warning systems, giving communities more time to prepare and respond.

#### 4.3.3.2 Machine Learning for Risk Prediction

► Supports risk prediction

Machine learning (ML), a core subset of AI, supports risk prediction by identifying hidden patterns in complex datasets. ML models learn from historical disaster incidents, environmental trends, socio-economic indicators, and geospatial information to estimate the probability and severity of future events. In flood-prone regions, ML algorithms combine rainfall intensity, watershed characteristics, land-use change, and real-time river levels to predict the likelihood of inundation. For landslide-prone areas, machine learning systems assess slope stability using rainfall thresholds, soil type, vegetation cover, and terrain imagery. Similarly, ML-based wildfire risk models evaluate wind speed, temperature, fuel moisture, and past fire occurrences to warn authorities of potential ignition zones. These predictive tools allow administrators to prioritise high-risk regions, plan mitigation measures, pre-position resources, and strengthen community preparedness.

#### 4.3.3.3 AI-based Damage Assessment Post-Disaster

AI offers rapid, accurate tools for assessing damage after disasters an essential step in directing response efforts and planning rehabilitation. Automated image analysis systems can compare pre- and post-disaster satellite or drone imagery to identify structural collapse, inundated areas, blocked roads, and

#### ► Planning rehabilitation

affected settlements. Following major floods or cyclones, AI-driven classification techniques detect submerged buildings and estimate the extent of infrastructure damage with minimal human intervention. During earthquakes, object-detection algorithms analyse patterns in rubble to identify severely affected areas. These assessments not only speed up decision-making but also reduce the time and effort required for manual surveys, enabling quicker allocation of relief support and resources. AI-based assessment also supports long-term recovery by providing reliable data for needs estimation, insurance claims, and planning reconstruction.

### 4.3.3.4 Drones, Robotics, and Automation in Rescue Operations

Drones and robotics broaden the applications of AI in disaster response by improving mobility, safety, and operational efficiency in challenging environments.

#### ► Drones

Drones equipped with high-resolution cameras, thermal sensors, and LiDAR assist in mapping inaccessible or hazardous zones. During floods, drones help identify stranded individuals, assess breaches in embankments, and locate safe landing zones for helicopters or rescue boats. In landslide or earthquake scenarios, drones provide real-time visuals of blocked routes, collapsed structures, and potential secondary hazards.

#### ► Robotics

Robotics can play a vital role where human access is limited. Ground robots can navigate narrow spaces, detect survivors trapped under debris, and transport essential supplies. Automation also supports firefighting, chemical spill inspection, and monitoring of unstable structures. These technologies reduce responders' exposure to danger, enhance situational awareness, and improve the accuracy of rescue operations.



### New Integrated Disaster Management Platforms

In 2025, Government of India launched three new key initiatives, namely the Integrated Control Room for Emergency Response (ICR-ER), the NDEM Lite 2.0 Mobile App, and the Assam Flood Hazard Zonation Atlas, to strengthen disaster preparedness and response mechanisms in the country. The ICR-ER is a state-of-the-art, disaster-resilient facility designed to enable near real-time information reception, strategic monitoring, enhanced situational awareness, and effective decision-making for disaster preparedness and response. It is technologically supported by the National Database for Emergency Management (NDEM) version 5.0, developed by the Indian Space Research Organisation–National Remote Sensing Centre (ISRO-NRSC), which integrates data from forecasting agencies through APIs for real-time transmission of disaster-specific information and supports rescue operations, damage assessment, and disaster risk analysis on a 24×7 basis in coordination with States and Central agencies. The NDEM Lite 2.0 Mobile App, a lightweight version of the national emergency database developed by ISRO-NRSC, assists relief and rescue authorities and ground-level disaster management officials by providing near real-time operational information and disaster-specific alerts. Complementing these initiatives, the Assam Flood Hazard Zonation Atlas, developed by the Assam State Disaster Management Authority (ASDMA) in collaboration with NRSC, serves as a critical planning tool for flood mitigation by supporting land-use regulation in floodplains, crop insurance planning, flood control infrastructure development, and the identification of flood relief and rescue centres. The NDEM 5.0 Geoportal hosting these resources is openly accessible from the State to village level, and the Assam Flood Hazard Zonation Atlas is available for public download through the NDEM Geoportal or the ICR-ER.

#### 4.3.3.5 Ethical Concerns and Challenges in AI Deployment

While AI brings significant advantages, its deployment in disaster management raises important ethical, operational, and governance challenges.

##### ► Data privacy

One major concern is data privacy, as AI systems rely on sensitive information such as personal location, demographic details, and communication records. Ensuring that such data is protected from misuse is essential. Another challenge involves algorithmic bias—AI models trained on incomplete or unrepresentative data may misclassify hazard intensity or overlook vulnerable communities, leading to inequitable outcomes.

There are also technical challenges, such as poor data quality, limited interoperability between systems, and reliance on high-speed connectivity that may not be available in rural or disaster-



► Technical challenges

affected regions. Over-reliance on automated systems without adequate human oversight can create gaps in judgement, especially when dealing with complex social vulnerabilities.

These ethical and operational concerns highlight the need for transparent algorithms, robust data governance, skilled personnel, and policies that safeguard fairness and accountability in AI-driven disaster management.

#### 4.3.4 Social Dimensions of Disaster Management

► Consequences differ widely among communities and social groups

Disasters are not merely physical events; their impact is deeply shaped by social structures, cultural practices, and economic inequalities. Even when hazards affect a region uniformly, the consequences differ widely among communities and social groups. Understanding these social dimensions is therefore essential for designing disaster management strategies that are fair, inclusive, and effective. Socially sensitive disaster governance emphasises participation, local knowledge, equity, and protection of vulnerable groups—ensuring that interventions strengthen communities rather than deepen existing disparities.

► Complement scientific assessments

##### Community Participation and Local Knowledge

Community participation is a cornerstone of effective disaster management. Local communities often possess detailed knowledge of their environment such as traditional flood pathways, safe shelters, seasonal weather patterns, or early signs of landslides which can complement scientific assessments. This local knowledge helps in designing preparedness plans that are practical, culturally appropriate, and widely accepted. When communities actively participate in hazard mapping, preparedness training, mock drills, and committee-based decision-making, they become more confident and better equipped to act during emergencies. Experience from many disaster-prone regions of India shows that communities with well-organised local groups, such as village disaster management committees or self-help groups, mobilise faster and manage recovery more efficiently. Participation also creates a sense of ownership, ensuring that early warning messages, evacuation orders, and risk-reduction measures reach households effectively.

##### Vulnerable Groups: Children, the Elderly, Women, Persons with Disabilities

Vulnerability to disasters is unevenly distributed. Certain



- Vulnerability to disasters is unevenly distributed

groups face higher levels of risk due to age, health conditions, mobility limitations, social roles, or economic dependence. Recognising these differential vulnerabilities is central to designing inclusive disaster strategies. Children are highly vulnerable due to their dependence on adults for protection, nutrition, and emotional support. Schools need specific safety plans, child-friendly spaces, and continuity of education during disasters. Elderly persons face challenges such as reduced mobility, chronic illnesses, and difficulty accessing shelters or relief supplies. They require targeted health support, assisted evacuation, and continuous care during prolonged recovery periods.

- Equitable disaster governance

Women often carry the responsibilities of childcare, food preparation, and household management. They may also face heightened risks of violence, loss of livelihood, and limited access to decision-making spaces during disasters. Gender-sensitive policies, economic support, and protection mechanisms are therefore essential. Persons with disabilities (PwDs) experience unique barriers—such as inaccessible shelters, lack of sign-language warnings, or mobility constraints—making them one of the highest-risk groups. Disaster management must include accessible communication systems, priority evacuation, customised shelters, and support devices. Addressing the needs of these groups is both a humanitarian obligation and a requirement for equitable disaster governance.

### Social Capital and Community Resilience

- Networks, relationships, trust, and mutual support

Social capital refers to the networks, relationships, trust, and mutual support that exist within a community. It plays a decisive role in determining how communities cope with and recover from disasters. Communities with substantial social capital—where neighbours support each other, local institutions function effectively, and social ties are strong—tend to respond more cohesively during emergencies. Informal support networks help share food, shelter, information, and emotional support. Community groups such as youth organisations, women's collectives, and local councils often emerge as first responders long before external agencies arrive.

- Community resilience

Social capital also underpins community resilience—the ability of a community to adapt, reorganise, and rebuild after a disaster. Resilient communities exhibit collective problem-solving, shared responsibility, trust in institutions, and active engagement in preparedness planning. Strengthening social

capital through community-based programmes, participatory planning, and inclusive governance enhances long-term disaster resilience.

### Issues of Equity and Inclusion in Disaster Response

#### ► Social inequalities

Disaster response is often influenced by social inequalities, leading to uneven access to relief, rehabilitation, information, and long-term recovery opportunities. Issues of equity arise when vulnerable groups receive delayed support, face discrimination, or are excluded from decision-making processes.

#### ► Equitable disaster response

Equitable disaster response requires transparent distribution of relief materials, gender-sensitive shelters, disability-inclusive communication, and mechanisms to ensure that marginalised groups are not overlooked. It also involves addressing deeper social determinants—such as poverty, housing quality, land tenure, and access to education—that shape vulnerability long before a disaster occurs.

#### ► Inclusive disaster management

Inclusive disaster management ensures that diverse voices are represented in planning committees, community consultations, and training programmes. It promotes justice, dignity, and fairness, recognising that resilience cannot be achieved unless all groups have equal opportunities to prepare, respond, and recover.

### 4.3.5 Major Challenges in Contemporary Disaster Management

Despite advances in technology, policy reforms, and institutional strengthening, several challenges continue to affect the effectiveness of disaster management. These challenges arise from environmental transformations, rapid socio-economic changes, governance complexities, and persistent structural inequalities. Understanding them is essential for building more resilient systems capable of anticipating and responding to the growing scale and diversity of risks.

### Climate Change-Induced Hazards

#### ► Increased frequency of hazards

Climate change has intensified the frequency, severity, and unpredictability of many natural hazards. Coastal regions experience stronger cyclones and rising sea levels, while inland areas face erratic rainfall patterns, prolonged droughts, and extreme heatwaves. These shifting climatic conditions



place enormous pressure on existing early warning systems, infrastructure, agriculture, and water resources.

► Social inequalities

For instance, erratic monsoon behaviour has increased the likelihood of sudden urban flooding, while higher sea surface temperatures have contributed to more intense cyclonic storms in the Bay of Bengal and the Arabian Sea. Heatwaves have become longer and more dangerous, affecting millions of people in densely populated urban areas. These climate-driven hazards often interact with existing vulnerabilities, creating compound risks that are harder to predict and manage.

### Urbanisation and Disaster Vulnerability

► Unplanned urbanisation

Rapid and often unplanned urbanisation has significantly heightened disaster risk in growing cities. Large populations are concentrated in hazard-prone areas, such as riverbanks, coastal zones, unstable hillsides, and low-lying areas. Informal settlements lacking adequate drainage, sanitation, and stable construction materials are particularly vulnerable during floods, landslides, and storms.

► Need of integrated planning

Urban infrastructure roads, bridges, drainage networks, water supply systems, and electricity grids can be easily overwhelmed by extreme events. Overburdened services, encroachment on wetlands, and inadequate waste management contribute to recurrent urban flooding. High-rise buildings and dense settlements also complicate evacuation efforts and emergency response.

Urbanisation has thus created complex, multi-dimensional risks requiring integrated planning, resilient infrastructure, and strong local governance.

### Administrative and Coordination Challenges

► Multi-level coordination

Disaster management requires coordination across multiple institutions, sectors, and administrative levels. However, fragmentation of responsibilities and weak communication channels often hinder effective action. Delays in information sharing, unclear role divisions, and inadequate collaboration among national, state, and district authorities can affect preparedness and response.

During emergencies, challenges may arise in mobilising personnel, aligning departmental priorities, and coordinating



with external agencies such as NGOs, private institutions, and community groups. Local authorities may lack the technical capacity or resources needed to interpret early warnings or implement mitigation measures effectively. These administrative gaps can slow decision-making at critical moments, affecting the timeliness and impact of interventions.

### **Funding and Resource Limitations**

#### **► Financial constraints**

Adequate funding is essential for every stage of disaster management—from preparedness and mitigation to relief and rehabilitation. However, many disaster-prone regions face financial constraints that limit their ability to invest in resilient infrastructure, advanced technologies, and community awareness programmes.

#### **► Resource limitation**

Resource limitations are particularly evident in rural districts, where disaster management cells often operate with minimal staff and outdated equipment. Even in urban centres, competing developmental priorities can lead to underinvestment in drainage systems, embankments, early warning technologies, and emergency shelters. After major disasters, states may struggle to mobilise resources for rapid reconstruction, especially when losses exceed local capacities. Ensuring consistent, flexible, and timely funding remains a major challenge for effective disaster governance.

### **Gap Between Policy and Practice**

#### **► Implementation gap**

While India has developed robust policies, guidelines, and institutional frameworks for disaster management, the implementation gap between policy intention and field-level practice remains significant. National-level plans emphasise risk reduction, community participation, and resilient development, but these principles do not always translate into effective local action.

Several factors contribute to this gap: limited awareness among local communities, insufficient technical expertise in district administrations, delays in updating local disaster plans, and inadequate monitoring mechanisms. In some regions, early warning messages may not reach vulnerable populations in time, or land-use regulations may not be enforced effectively. Infrastructure projects may ignore hazard assessments, and community members may not be sufficiently involved in planning.





Bridging this gap requires sustained training, stronger accountability, improved communication systems, and the active participation of local institutions and communities.

## Summarized Overview

Throughout this unit, learners explored how ICT, remote sensing, GIS, and artificial intelligence are reshaping preparedness, forecasting, response, and damage assessment, enabling faster and more accurate decision-making. At the same time, the unit emphasised that technology alone is insufficient without recognising the social realities of disasters community participation, protection of vulnerable groups, social capital, and inclusive planning remain central to resilience.

The unit also highlighted the persistent challenges in the field, including climate-induced hazards and rapid urbanisation, as well as institutional gaps and resource limitations. By understanding these complexities, learners gain a holistic view of disaster governance that integrates scientific tools with human-centred strategies.

## Self-Assessment

1. What is the role of ICT in strengthening disaster preparedness?
2. How does satellite monitoring support early warning systems?
3. What is meant by artificial intelligence in disaster management?
4. State one challenge posed by climate change to disaster management.
5. Mention one ethical concern related to the use of AI in disaster settings.
6. How does GIS support decision-making during emergency response?
7. Mention one advantage of using AI-based forecasting in disasters.
8. How does poor urban planning contribute to disaster risks?
9. What is the purpose of integrating drones into disaster response operations?
10. What is the significance of early warning systems for reducing disaster impacts?

## Assignments

1. Critically evaluate the contribution of Artificial Intelligence (AI) to early warning, forecasting, and post-disaster assessment. Illustrate your answer with appropriate examples.
2. Analyse the administrative, institutional, and coordination-related challenges that hinder effective disaster governance in India.
3. Explain how GIS contributes to hazard mapping and risk assessment in disaster-prone regions.
4. Examine the role of ICT in strengthening preparedness and response mechanisms in disaster management.

## Reference

1. Assam State Disaster Management Authority. (n.d.). *ICT for disaster risk reduction: The Indian experience*. Government of Assam. <https://asdma.gov.in>
2. United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development. (2020). *Academy module on ICT for disaster risk management* (4th ed.). UN-APCICT.
3. Bari, R., Islam, M., Zaman, H., Huq, S., & Rahman, A. (2023). Potential use of artificial intelligence (AI) in disaster risk and emergency health management: A narrative review. *Health Services Insights*, 16(1), 1–12. <https://doi.org/10.1177/11786302231217808>
4. Budhiraja, R. (n.d.). *Disaster management and ICT*. Ministry of Home Affairs, Government of India.
5. International Telecommunication Union. (2022). *AI for modeling: Technical report of the Focus Group on AI for Natural Disaster Management*. ITU.
6. National Disaster Management Authority. (2019). *National disaster management guidelines: Post-disaster recovery and reconstruction*. Government of India.
7. Government of Odisha & World Bank. (2017). *Odisha disaster recovery project: Implementation report*. Government of Odisha.
8. United Nations Office for Disaster Risk Reduction. (2019). *Disaster risk reduction in India: Special report on national progress*. UNDRR.
9. National Disaster Management Authority. (2019). *Standard operating procedure for post-disaster needs assessment (PDNA)*. NDMA, Government of India.
10. World Bank & Global Facility for Disaster Reduction and Recovery. (2015). *Disaster recovery framework guide*. GFDRR/World Bank.



## Suggested Reading

1. Sinha, P. C. (2006). Disaster relief, rehabilitation and emergency humanitarian assistance. SBS Publishers & Distributors Pvt. Ltd.
2. Sinha, P. C. (2006). Disasters, vulnerabilities and risks: Trends, concepts, classifications and approaches. SBS Publishers & Distributors Pvt. Ltd.
3. Singh, B. K. P. (2010). Disaster management: Psycho-social support and health services. Sumit Enterprises.
4. Murthy, D. B. N. (2008). Disaster management: Text and case studies. Deep & Deep Publication.
5. Sinha, P. C. (2006). Disaster management process: Laws, process and strategy. SBS Publishers & Distributors.
6. Singh, R. (2015). Handbook of disaster management (Vol. 1). Horizon Press.
7. Singh, R. (2015). Handbook of disaster management (Vol. 2). Horizon Press.

## Space for Learner Engagement for Objective Questions

Learners are encouraged to develop objective questions based on the content in the paragraph as a sign of their comprehension of the content. The Learners may reflect on the recap bullets and relate their understanding with the narrative in order to frame objective questions from the given text. The University expects that 1 - 2 questions are developed for each paragraph. The space given below can be used for listing the questions.

SGOU





**MODEL QUESTION PAPER- SET- A**  
**SREENARAYANAGURU OPEN UNIVERSITY**

**QP CODE: .....**

**Reg. No : .....**

**Name : .....**

**SREENARAYANAGURU OPEN UNIVERSITY**

**M.A PUBLIC ADMINISTRATION**

**Semester IV - Discipline Core Course**

**M23PA11DC**

**Environment and Disaster Management**

**MODEL QUESTION PAPER - SET 1**

**Time: 3 Hours**

**Max Marks: 70**

**SECTION A**

Answer any ten questions in a word or a sentence. Each question carries one mark.

(10X1 = 10 Marks)

1. Define Environmental Management.
2. Which conference in 1972 marked a turning point in global environmental governance?
3. What is meant by ozone depletion?
4. Name one man-made environmental problem.
5. Mention one constitutional provision related to environmental protection in India.
6. What is the primary objective of the National Green Tribunal?
7. What is the first stage in the Disaster Management Cycle?
8. Give one example of a rapid-onset disaster.
9. In which year was the Disaster Management Act enacted in India?
10. What does GIS stand for in disaster management?
11. Name one agency involved in disaster response in India.
12. What is Environmental Impact Assessment (EIA)?
13. Identify one guiding principle of disaster rehabilitation.
14. What is Global Warming?
15. Expand SDGs.





## SECTION B

Answer any five questions in e. Each question carries two marks.

(5X2 =10 Marks)

16. Explain the significance of Environmental Ethics in governance.
17. Differentiate between natural and man-made environmental problems.
18. Briefly explain the role of the Central Pollution Control Board.
19. What are the major objectives of the Disaster Management Act, 2005?
20. Distinguish between rapid-onset and slow disasters.
21. What is the importance of Environmental Audit?
22. Explain the role of the National Disaster Management Authority (NDMA).
23. What is meant by Environmental Compensation Charge?
24. Briefly explain the concept of resilient communities.
25. What are the challenges in disaster management?

## SECTION C

Answer any five questions in one paragraph. Each question carries four marks.

(5X4 = 20 Marks)

26. Discuss the evolution of Environmental Management.
27. Analyse the causes and consequences of biodiversity loss.
28. Examine the constitutional and legislative framework for environmental protection in India.
29. Explain the Disaster Management Cycle with its components.
30. Analyse the role of UNO and its agencies in environmental protection.
31. Explain the classification of disasters with suitable examples.
32. Discuss the role of NDRF and Armed Forces in disaster response.
33. Analyse the importance of ICT in disaster risk reduction.



## SECTION D

Answer any three questions in two pages. Each question carries ten marks.

(3X10 =30 Marks)

34. Trace the evolution of global environmental protection from the Stockholm Conference (1972) to the Sustainable Development Goals.
35. Examine the environmental governance framework in India, highlighting major policies, institutions, and regulatory strategies.
36. Critically analyse the Disaster Management Act, 2005 and its administrative framework at Union, State, and Local levels.
37. Discuss the major environmental problems in the contemporary world and evaluate strategies for their management.
38. Analyse disaster preparedness and risk reduction strategies in India with reference to NDMA, NDRF, and non-governmental agencies.
39. Examine recent trends in disaster management, focusing on the role of ICT and Artificial Intelligence.



**MODEL QUESTION PAPER- SET- A**  
**SREENARAYANAGURU OPEN UNIVERSITY**

**QP CODE: .....**

**Reg. No : .....**

**Name : .....**

**SREENARAYANAGURU OPEN UNIVERSITY**

**M.A PUBLIC ADMINISTRATION**

**Semester IV - Discipline Core Course**

**M23PA11DC**

**Environment and Disaster Management**

**MODEL QUESTION PAPER - SET 1I**

**Time: 3 Hours**

**Max Marks: 70**

**SECTION A**

Answer any ten questions in a word or a sentence. Each question carries one mark.

(10X1 = 10 Marks)

1. What is Sustainable Development?
2. In which year was the Stockholm Conference on Human Environment held?
3. Name one objective of Environmental Management.
4. What is meant by ozone depletion?
5. Name one man-made environmental problem
6. Which Article of the Indian Constitution directs the State to protect and improve the environment?
7. Name one agency involved in disaster response in India.
8. What is Environmental Impact Assessment (EIA)?
9. Name one stage of the Disaster Management Cycle.
10. Give one example of a natural disaster.
11. Expand NDMA.
12. Expand NDRF.
13. Expand UNEMG
14. What is GIS used for in disaster management?
15. Expand CPCB.



## SECTION B

Answer any five questions in two or three sentences. Each question carries two marks.

(5X2 =10 Marks)

16. Define Environmental Ethics.
17. Explain the concept of Environmental Management
18. Write a short note on the Montreal Protocol.
19. What are the constitutional provisions for environmental protection in India?
20. Explain the functions of the Central and State Pollution Control Boards.
21. What are the major provisions of the Disaster Management Act, 2005?
22. What is Environmental Audit?
23. Differentiate between rapid-onset and slow disasters with examples.
24. Explain the role of the Ministry of Environment, Forest and Climate Change.
25. What is meant by damage assessment in disaster rehabilitation?

## SECTION C

Answer any five questions in one paragraph. Each question carries four marks.

(5X4 = 20 Marks)

26. Explain the scope and significance of Environmental Management.
27. Describe the evolution of environmental protection from the Stockholm Conference (1972) to the Rio Earth Summit.
28. Discuss the causes of environmental problems.
29. Explain the Wild Life Protection Act, 1972 and Biological Diversity Act, 2002.
30. Describe the Disaster Management Cycle.
31. Classify disasters with suitable examples.
32. Explain the role of NDMA in disaster preparedness and risk reduction.
33. Discuss the role of ICT in disaster management with reference to GIS and remote sensing.

## SECTION D

Answer any three questions in two pages. Each question carries ten marks.

(3X10 =30 Marks)

34. Discuss the meaning, evolution, objectives, and ethical foundations of Environmental Management.
35. Examine the environmental legislative and policy framework in India, including constitutional provisions and major Acts.
36. Explain the administrative framework of disaster management in India at Union, State, and Local levels.
37. Discuss disaster preparedness and the role of Army, NDRF, and non-governmental agencies in disaster response.
38. Explain the different types of rehabilitation in disaster recovery and their guiding principles.
39. Discuss recent trends in disaster management with reference to Artificial Intelligence and technological interventions.





## സർവ്വകലാശാലാഗീതം

വിദ്യാതൽ സ്വതന്ത്രരാകണം  
വിശ്വപൗരരായി മാറണം  
ഗ്രഹപ്രസാദമായ് വിളങ്ങണം  
ഗുരുപ്രകാശമേ നയിക്കണേ

കുരിശിൽ നിന്നു ഞങ്ങളെ  
സൂര്യവീഥിയിൽ തെളിക്കണം  
സ്നേഹദീപ്തിയായ് വിളങ്ങണം  
നീതിവൈജയന്തി പാറണം

ശാസ്ത്രവ്യാപ്തിയെന്നുമേകണം  
ജാതിഭേദമാകെ മാറണം  
ബോധരശ്മിയിൽ തിളങ്ങുവാൻ  
ജ്ഞാനകേന്ദ്രമേ ജ്വലിക്കണേ

കുരിപ്പുഴ ശ്രീകുമാർ

# SREENARAYANAGURU OPEN UNIVERSITY

## Regional Centres

### Kozhikode

Govt. Arts and Science College  
Meenchantha, Kozhikode,  
Kerala, Pin: 673002  
Ph: 04952920228  
email: rckdirector@sgou.ac.in

### Thalassery

Govt. Brennen College  
Dharmadam, Thalassery,  
Kannur, Pin: 670106  
Ph: 04902990494  
email: rctdirector@sgou.ac.in

### Tripunithura

Govt. College  
Tripunithura, Ernakulam,  
Kerala, Pin: 682301  
Ph: 04842927436  
email: rcedirector@sgou.ac.in

### Pattambi

Sree Neelakanta Govt. Sanskrit College  
Pattambi, Palakkad,  
Kerala, Pin: 679303  
Ph: 04662912009  
email: rcpdirector@sgou.ac.in

**DON'T LET IT  
BE TOO LATE**

**SAY  
NO  
TO  
DRUGS**

**LOVE YOURSELF  
AND ALWAYS BE  
HEALTHY**



**SREENARAYANAGURU OPEN UNIVERSITY**

The State University for Education, Training and Research in Blended Format, Kerala

# Environment and Disaster Management

COURSE CODE: M23PA11DC

SGOU



Sreenarayanaguru Open University

Kollam, Kerala Pin- 691601, email: [info@sgou.ac.in](mailto:info@sgou.ac.in), [www.sgou.ac.in](http://www.sgou.ac.in) Ph: +91 474 2966841

ISBN 978-81-998069-9-3



9 788199 806993