7.1 Introduction

In the earlier chapters, we have discussed the major economic issues faced by the Indian economy. While the economic development achieved so far has brought growth and progress, it has also come at a heavy price — the deterioration of environmental quality.

As we move into an era of globalisation that promises higher economic growth, it is essential to remember the adverse consequences of our past developmental path on the environment. We must now consciously choose a path that ensures **sustainable development**.

To understand the challenges of sustainable development, we must first examine the **significance and contribution of the environment** to economic growth. This chapter, therefore, is divided into three sections:

1. **Functions and Role of the Environment** – exploring its importance in economic development.
2. **State of India's Environment** – assessing current conditions and issues.
3. **Steps and Strategies for Sustainable Development** – identifying ways to balance growth with environmental protection.

7.2 Environment — Definition and Functions

Definition of Environment

The environment refers to the **total planetary inheritance** and the **totality of all resources**. It includes both **biotic** (living) and **abiotic** (non-living) factors that influence each other.

- **Biotic elements**: Birds, animals, plants, forests, fisheries, etc.
- **Abiotic elements**: Air, water, land, rocks, sunlight, etc.

Studying the environment involves understanding the **inter-relationship** between these biotic and abiotic components.

Functions of the Environment

The environment performs **four vital functions**:

1. **Supplies Resources**
    - **Renewable resources**: Can be used without risk of depletion (e.g., trees in forests, fishes in oceans).
    - **Non-renewable resources**: Get exhausted with use (e.g., fossil fuels).

2. **Assimilates Waste**
    - The environment absorbs the waste generated by human and natural activities.
3. **Sustains Life**
    - Maintains **genetic diversity** and **biodiversity** to support all forms of life.
4. **Provides Aesthetic Services**
    - Offers scenic beauty and other non-material benefits.

Carrying Capacity and Environmental Crisis

The environment can perform these functions **without interruption** as long as human demands stay **within its carrying capacity**.

- **Carrying capacity**: Resource extraction ≤ regeneration rate, and waste generation ≤ waste absorption capacity.
- If this balance is broken, life-sustaining functions fail, leading to an **environmental crisis**.

Current Scenario:

- Rapid population growth in developing nations and high consumption in developed countries have **stressed resources** and **exceeded absorptive capacity**.
- Many resources are **extinct**, and waste levels are beyond the environment's ability to absorb.
- Water has become an **economic commodity** due to overuse and pollution.
- Over-extraction of renewable and non-renewable resources has depleted reserves.
- Environmental degradation has led to **rising health costs** from diseases such as asthma (air pollution) and cholera (water pollution).
- Global environmental issues like **global warming** and **ozone depletion** have added to financial burdens.

Global Warming

- **Definition**: Gradual increase in Earth's lower atmospheric temperature due to the rise in greenhouse gases since the Industrial Revolution.
- **Causes**:

    - Burning fossil fuels (coal, petroleum) → CO_2, methane, nitrous oxide emissions.
    - Deforestation → Higher CO_2 levels.
    - Methane from animal waste and cattle production.
- **Impacts**:
    - Melting polar ice → Rising sea levels, coastal flooding.
    - Loss of drinking water sources dependent on snow melts.
    - Extinction of species.
    - More frequent tropical storms.
    - Spread of tropical diseases.
- **Statistics**:
    - CO_2 increased by 31%, CH_4 by 149% since 1750.
    - Average temperature rose by 0.6°C (1.1°F) in the last century.
    - Sea levels have risen several inches.
- **Kyoto Protocol (1997)**: International agreement to reduce greenhouse gas emissions by industrialised nations.

Are Environmental Problems New?

In earlier times—before rapid population growth and industrialisation—the demand for resources was **much lower than supply**, and pollution was **within the absorptive capacity** of the environment.
Today, the balance is broken, making environmental problems more severe and urgent.

Ozone Depletion

Meaning

Ozone depletion refers to the **reduction in the amount of ozone** present in the **stratosphere**.

Causes

The main cause is the presence of **high levels of chlorine and bromine compounds** in the stratosphere, primarily from:

- **Chlorofluorocarbons (CFCs)** — used as cooling agents in air conditioners and refrigerators, and as aerosol propellants.

- **Bromofluorocarbons (halons)** — used in fire extinguishers.
- Other ozone-depleting chemicals such as **carbon tetrachloride** and **trichloroethane** (methyl chloroform).

Effects

Depletion of the ozone layer allows **more ultraviolet (UV) radiation** to reach the Earth, leading to:

- **Human health impacts**: Skin cancer, eye damage.
- **Aquatic ecosystem damage**: Reduced phytoplankton production, affecting the entire aquatic food chain.
- **Terrestrial plant effects**: Disruption of plant growth.

Data: From 1979 to 1990, the ozone layer saw a reduction of approximately **5%**.

Global Response

The **Montreal Protocol** was adopted to ban:

- CFCs and other ozone-depleting substances.
- Carbon tetrachloride.
- Trichloroethane (methyl chloroform).
- Bromine compounds (halons).

Historical Context of Environmental Problems

In the **early stages of human civilisation**:

- Resource extraction was **less than** the rate of regeneration.
- Pollution was **within the absorptive capacity** of the environment.
- Environmental problems were minimal.

Post-Industrial Revolution:

- **Population explosion** and rapid **industrialisation** increased demand for resources.
- Extraction rates **exceeded regeneration rates**.
- Waste generation and pollution **overwhelmed** the environment's absorptive capacity.

Today:

- We face a **reversal of the supply-demand relationship** — high demand for environmental resources and services, but **limited supply** due to overuse and misuse.
- Waste generation and pollution have become **critical global issues**.

7.3 State of India's Environment

Abundant Natural Resources

India is endowed with rich natural resources, including:

- **Soil:** Fertile black soil of the Deccan Plateau, ideal for cotton cultivation, supporting the concentration of textile industries in this region.
- **Water Resources:** Hundreds of rivers and tributaries, along with vast stretches of the Indian Ocean.
- **Forests:** Lush green forests, though unevenly distributed, provide green cover for most of the population and habitat for wildlife.
- **Minerals:** Large deposits of iron ore (8% of the world's reserves), coal, and natural gas, as well as bauxite, copper, chromate, diamonds, gold, lead, lignite, manganese, zinc, and uranium.
- **Geographical Features:** The Indo-Gangetic Plains—one of the most fertile, intensively cultivated, and densely populated regions in the world, and diverse mountain ranges.

Environmental Challenges

While these resources have supported development, they have also faced growing **pressure from human activities**, leading to:

- **Poverty-induced degradation** (overuse of resources for survival)
- **Pollution from affluence and industrial growth**

Key environmental issues include:

1. **Air Pollution** – Especially vehicular pollution in urban areas
2. **Water Contamination** – Freshwater resource management challenges
3. **Soil Erosion** – Loss of fertile land
4. **Deforestation** – Decreasing forest cover and biodiversity

5. **Wildlife Extinction** – Loss of habitats and species

Priority Concerns

The following issues have been identified as priorities:

1. **Land degradation** – Resulting from unstable land use and poor management practices
2. **Biodiversity loss**
3. **Air pollution**, with emphasis on urban vehicular emissions
4. **Freshwater management**
5. **Solid waste management**

Chipko Movement

Chipko or Appiko — What's in a Name?

Background

- The **Chipko Movement** in the Himalayas aimed at protecting forests by physically preventing tree felling.
- In **Karnataka**, a similar initiative arose under a different name — **'Appiko'**, meaning *to hug*.

The Salkani Forest Incident (8 September 1983)

- Location: Salkani forest, Sirsi district, Karnataka.
- Action: 160 men, women, and children hugged trees to stop woodcutters from felling them.
- Duration: Volunteers kept watch over the forest for six weeks.
- Outcome: Forest officials assured that trees would be cut *scientifically* as per the district's working plan, after which the protest ended.
- Impact: The immediate action saved **12,000 trees**.

Spread and Motivation

- Trigger: Commercial felling by contractors damaged large areas of natural forests.
- Effect: Hugging trees gave people **hope and confidence** in protecting forests.
- Expansion: Within months, the movement spread to many adjoining districts.

Environmental Problems from Indiscriminate Felling

- **Loss of bamboo** in Uttar Kanara within 12 years of a paper mill being established.
- **Deforestation effects**:
    - Removal of broad-leaved trees → soil erosion → bare laterite soil → only weeds grow.
    - Rivers and rivulets dry up faster.
    - Rainfall becomes erratic.
    - New diseases and insect attacks on crops.

Demands of Appiko Volunteers

- Local consultation before marking trees for felling.
- No felling:
    1. Within **100 metres** of a water source.
    2. On slopes of **30° or above**.

Factors Responsible for Land Degradation in India

Land degradation in India is a serious environmental concern, caused by a variety of interrelated factors.

1. Direct Causes of Land Degradation

1. **Loss of Vegetation** – Occurs due to large-scale deforestation.
2. **Unsustainable Fuelwood and Fodder Extraction** – Excessive removal without allowing regeneration.
3. **Shifting Cultivation** – Traditional slash-and-burn practices leading to soil loss.
4. **Encroachment into Forest Lands** – Expansion of agriculture and settlements into protected forest areas.
5. **Forest Fires and Overgrazing** – Destruction of forest cover and grasslands.
6. **Non-adoption of Adequate Soil Conservation Measures** – Lack of contour ploughing, terracing, etc.
7. **Improper Crop Rotation** – Continuous monocropping reducing soil fertility.
8. **Indiscriminate Use of Agro-chemicals** – Excessive fertilisers and pesticides harming soil structure.

9. **Improper Planning and Management of Irrigation Systems** – Leading to salinity and waterlogging.
10. **Over-extraction of Groundwater** – Depleting resources and lowering water tables.
11. **Open Access Resource Use** – Unregulated exploitation of common lands.
12. **Poverty among Agriculture-dependent People** – Forcing unsustainable farming practices.

2. Pressure on Land Resources

- Competing uses of land for forestry, agriculture, pastures, human settlements, and industries put **enormous pressure** on India's finite land resources.
- **Per capita forest land** in India is only **0.06 hectare** against the requirement of **0.47 hectare** to meet basic needs.
- This shortfall results in **excess felling of about 15 million cubic metres of forests** over the permissible limit annually.

3. Soil Erosion and Nutrient Loss

- Estimates show that **soil is being eroded at a rate of 5.3 billion tonnes per year** for the entire country.
- As a result, India loses approximately **0.8 million tonnes of nitrogen**, **1.8 million tonnes of phosphorus**, and **26.3 million tonnes of potassium** annually.
- According to the Government of India, the **total nutrient loss** due to erosion ranges from **5.8 to 8.4 million tonnes per year**.

4. Population Pressure

- India supports **17% of the world's human population** and **20% of the livestock population**, but has only **2.5% of the world's geographical area**.
- This **high density of population and livestock** further accelerates land degradation and resource depletion.

Here's a **well-arranged and structured version** of the content you provided, with smooth flow, clear headings, and preserved details.

Pollution Control Boards

To address two major environmental concerns in India—**water pollution** and **air pollution**—the government established the **Central Pollution Control Board (CPCB)** in 1974. Subsequently, each state set

up its own **State Pollution Control Board (SPCB)** to deal with environmental issues at the regional level.

Functions of CPCB and SPCBs

The CPCB and SPCBs perform a wide range of activities, including:

1. **Regulation and Standard-Setting**
    - Laying down standards for **sewage and trade effluent treatment**.
    - Setting limits for **emissions** from industries.
    - Assessing **air quality** for industrial siting and town planning.
2. **Technical and Research Support**
    - Providing technical assistance to governments for **cleaning streams and wells**.
    - Preventing, controlling, and abating **water and air pollution**.
    - Sponsoring and conducting research on pollution problems and their solutions.
3. **Inspection and Monitoring**
    - Regular inspections by district-level officials to check adequacy of pollution control measures in industries.
    - Monitoring **water quality** in **125 rivers** (including tributaries), wells, lakes, creeks, ponds, tanks, drains, and canals.
4. **Awareness and Education**
    - Organising **mass awareness programmes** through newspapers, radio, television, and billboards.
    - Publishing **manuals, codes, and guidelines** for waste treatment and disposal.
5. **Data Collection and Dissemination**
    - Collecting and sharing **technical and statistical data** on water and air pollution.
    - Providing **background environmental data** to guide planning.

Industrial and Vehicular Pollution

- **Vehicular Emissions:**
    - A major contributor to air pollution, especially in urban areas.
    - Motor vehicles increased from **3 lakh in 1951** to **30 crore in 2019**.
    - In 2016, **personal transport vehicles** (two-wheelers and cars) formed **85%** of total registered vehicles, significantly adding to pollution.
- **Industrial Pollution:**
    - India's industrial growth has brought **unplanned urbanisation**, pollution, and accident risks.
    - CPCB has identified **17 categories** of large and medium-scale industries as **significantly polluting**.

Sustainable Development Link

The environmental challenges faced by India can only be addressed if development is pursued **sustainably**. The **United Nations Conference on Environment and Development (UNCED)** defined sustainable development as:

Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.

Key aspects:

- **Needs:** Linked to the fair distribution of resources.
- **Future Generations:** Ensuring long-term ecological and economic stability.

Edward Barbier further emphasised that sustainable development should focus on **improving the material living standards of the poor**—measured by **income, education, health care, sanitation, and water supply**—while minimising resource depletion and environmental harm.

Conclusion

While the **Ministry of Environment**, CPCB, and SPCBs have initiated several measures, success depends on a **collective shift towards sustainable practices**.

- Development driven only by present needs, ignoring the future, will **deplete resources** and **damage the environment**, leading to crises.

- A **concern for future generations** is the foundation for long-lasting development.

7.4 Sustainable Development

Environment–Economy Interdependence

Environment and economy are **interdependent** and cannot be separated. Development that ignores its **environmental repercussions** will destroy the very base that sustains life. What is needed is **sustainable development**—development that allows **all future generations** to enjoy at least the same quality of life as the present generation.

Definition and Key Concepts

The concept of sustainable development was emphasised by the **United Nations Conference on Environment and Development (UNCED)**. It is defined as:

Development that meets the needs of the present generation without compromising the ability of the future generation to meet their own needs.

Catch Phrases in the Definition

- **Need:** Linked to the **fair distribution** of resources.
- **Future Generations:** Ensuring the **long-term availability** of resources and environmental stability.

The seminal report *Our Common Future* further explained it as:

Meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life.

Meeting the needs of all requires **redistribution of resources**, making it a **moral issue**.

Alternative Perspective: Edward Barbier

Edward Barbier defined sustainable development as one which is directly concerned with **increasing the material standard of living of the poor at the grassroots level**—measurable in terms of:

- Increased income and real income
- Better education
- Health care
- Sanitation
- Water supply

This approach aims to:

- Reduce **absolute poverty**
- Provide **lasting and secure livelihoods**
- Minimise **resource depletion**, environmental degradation, cultural disruption, and social instability

Broader Goals of Sustainable Development

In essence, sustainable development seeks to:

- Meet basic needs of **all people**, particularly the poor majority, for **employment, food, energy, water, housing**
- Promote **agriculture, manufacturing, power, and services** to meet these needs

The **Brundtland Commission** emphasised our **moral obligation** to:

- Leave future generations a better environment
- Maintain or improve the stock of *quality of life* assets we have inherited

Principles for Sustainable Development

The present generation should promote development compatible with:

1. **Conservation** of natural assets
2. **Preservation** of the regenerative capacity of ecosystems
3. **Avoidance** of added costs or risks for future generations

Herman Daly's Guidelines

According to environmental economist **Herman Daly**, achieving sustainable development requires:

1. **Population Control** – Maintain population within the **carrying capacity** of the environment (like a *Plimsoll line* for ships marking the load limit).
2. **Efficient Technology** – Technological progress should be **input-efficient**, not input-consuming.
3. **Sustainable Resource Use** – For **renewable resources**, the **rate of extraction** should not exceed the **rate of regeneration**.
4. **Non-renewable Resource Management** – **Rate of depletion** should not exceed the **rate of creation** of renewable substitutes.

5. **Pollution Management** – Correct inefficiencies arising from pollution.

Global Commitment: UN Sustainable Development Goals (SDGs)

In **2015**, the United Nations formulated **17 Sustainable Development Goals (SDGs)** to be achieved by **2030**, addressing poverty, inequality, climate change, and environmental degradation.

Link to Indian Environmental Challenges

The **Ministry of Environment**, the **Central Pollution Control Board (CPCB)**, and **State Pollution Control Boards (SPCBs)** have adopted measures to tackle environmental problems. However, these measures will not be fully effective unless we consciously adopt a **path of sustainable development**.

Without a **concern for future generations**, resource depletion and environmental degradation will lead to **environmental and economic crises**.

7.5 Strategies for Sustainable Development

Sustainable development requires adopting practices and technologies that reduce environmental damage while meeting human needs. The following strategies can help India move towards a cleaner and greener future.

1. Use of Non-Conventional Sources of Energy

India is heavily dependent on **thermal** and **hydropower plants** to meet its energy requirements.

- **Thermal Power Plants:**
    - Emit large quantities of **carbon dioxide**, a greenhouse gas.
    - Produce **fly ash**, which, if not properly utilised, can pollute water bodies, land, and other environmental components.
- **Hydroelectric Projects:**
    - Inundate forests.
    - Disrupt the natural flow of water in **catchment areas** and **river basins**.

Alternative Sources:

- **Solar energy** and **wind power** are clean and renewable.

- In recent years, efforts have been made to **tap these resources** to reduce environmental harm.

Class Activity: Collect details of a solar or wind energy unit set up in your area, if any, and discuss in class.

2. LPG and Gobar Gas in Rural Areas

Rural households often use **wood, dung cakes, or other biomass** as fuel.

- **Problems:**
    - Deforestation and reduction of green cover.
    - Wastage of cattle dung (which could be used as fertiliser).
    - Household air pollution.

Solutions:

- **Subsidised LPG:**
    - A clean fuel that reduces indoor air pollution.
    - Minimises energy wastage.
- **Gobar Gas Plants:**
    - Operate by feeding cattle dung into the plant.
    - Produce gas for cooking fuel.
    - Leave behind slurry, which is an excellent **organic fertiliser** and **soil conditioner**.
    - Provided through **easy loans and subsidies**.

3. CNG in Urban Areas

- In **Delhi**, the use of **Compressed Natural Gas (CNG)** in public transport has significantly reduced air pollution, making the air cleaner.
- Many other Indian cities have also started adopting **CNG fuel** for public and private transport.

4. Wind Power

- Ideal for areas where **wind speed is consistently high**.
- **Windmills** convert wind energy into electricity without any adverse impact on the environment.

- Although the initial installation cost is high, **long-term benefits** outweigh the cost.

5. Solar Power through Photovoltaic Cells

India is naturally endowed with abundant **solar energy** in the form of sunlight, which we use in various ways — drying clothes and grains, warming ourselves in winter, and enabling plants to perform **photosynthesis**.

With **photovoltaic cells**, solar energy can be directly converted into electricity. These cells:

- Use special materials to capture sunlight.
- Convert solar energy into electrical energy without pollution.
- Are especially useful in **remote areas** where power supply through grids is difficult or costly.

India's Initiatives:

- Increasing power generation through solar technology.
- Leading the **International Solar Alliance (ISA)**, a global body promoting solar energy use.

6. Mini-Hydel Plants

In mountainous regions, perennial streams are abundant. **Mini-hydel plants**:

- Use the stream's energy to turn small turbines.
- Generate electricity for **local use** without changing land use patterns.
- Avoid large transmission towers, cables, and transmission losses.
- Are largely environment-friendly and meet local electricity demands effectively.

7. Traditional Knowledge and Practices

Historically, Indians lived **in harmony with nature**—their agriculture, healthcare, housing, and transport systems were eco-friendly.

- **Medicinal Plants:** India has around **15,000 plant species** with medicinal properties, of which **8,000** are in regular use across **Ayurveda, Unani, Tibetan, and folk systems**.
- These systems are regaining popularity, especially for **chronic health problems**.

- Modern herbal-based cosmetics (hair oils, toothpaste, creams, lotions) are in demand due to their eco-friendliness, minimal side effects, and reduced industrial chemical processing.

8. Biocomposting

Over the last five decades, the shift from **organic compost** to **chemical fertilisers** has:

- Damaged large tracts of fertile land.
- Contaminated water bodies, including groundwater.
- Increased irrigation demands.

Return to Composting:

- Farmers are increasingly using compost made from **organic waste**.
- In some areas, cattle are kept primarily for **dung production**, an excellent fertiliser and soil conditioner.
- **Vermicomposting** (using earthworms) speeds up composting and benefits civic authorities by reducing waste volume.

9. Biopest Control

The Green Revolution saw excessive use of **chemical pesticides**, leading to:

- Contamination of food products.
- Pollution of soil, surface water, and groundwater.
- Contamination of animal products like milk, meat, and fish.

Eco-friendly Pest Control Measures:

- Plant-based pesticides, such as those from **neem**, which provide effective pest control.
- **Mixed cropping** and **crop rotation** to naturally reduce pest build-up.
- Encouraging the presence of natural predators:
    - **Snakes** (control rats, mice, and other pests)
    - **Birds** like **owls** and **peacocks** (prey on vermin and insects)
    - **Lizards** (consume insect pests)

Sustainable Development – A Paradigm Shift

Sustainable development is now a **key guiding principle** in development planning. Though interpreted in multiple ways, it ensures:

- **Lasting development**
- **Non-declining welfare** for all
- Preservation of the environment for future generations

7.6 Conclusion

Economic development, aimed at increasing the production of goods and services to meet the needs of a growing population, inevitably puts **greater pressure on the environment**.

In the early stages of development, the **demand for environmental resources** was lower than their supply. However, today the world faces a situation where demand has **surpassed supply** due to **overuse** and **misuse** of these resources.

Sustainable development seeks to promote a form of growth that:

- **Minimises environmental problems**
- **Meets the needs of the present generation**
- **Does not compromise the ability of future generations** to meet their own needs

This approach ensures that development and environmental conservation go hand in hand, securing long-term well-being for both people and the planet.