
UNIT 3 ENVIRONMENTAL ISSUES

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3.1 INTRODUCTION

Many global and local environmental problems had been identified by the United Nations Environment Programme (UNEP) that poses a big challenge for national and international organizations (UNEP, 2016). For example, ozone layer depletion, photochemical pollution in the air, desertification, water pollution, microplastics, soil erosion and, municipal and industrial wastewater, acid rain events, population growth and urbanization, deforestation and biodiversity loss, climate change are some environmental issues that threaten our natural resources and human health. This unit deals with environmental issues at local, regional, and global levels and rising environmental problems like global warming, climate change, ozone depletion, and acid rain. The students would be able to learn about major environmental issues as well as pollution problems. After studying this unit, they will understand water scarcity, degradation of natural resources, and the reasons responsible for them, like deforestation and soil erosion. The social problems like urban sprawl, traffic congestion, and socio-economic status are also discussed in this unit.

3.2 OBJECTIVES

After reading this unit, you should be able to:

- identify environmental issues at local, regional, and global levels;
- discuss rising environmental problems like global warming, climate change, ozone depletion, and acid rain;
- discuss water scarcity, degradation of natural resources, and the reasons responsible for them, like deforestation and soil erosion; and
- describe social problems like urban sprawl, traffic congestion etc.

3.3 GLOBAL, REGIONAL, AND LOCAL ENVIRONMENTAL ISSUES

Global environmental issues are the environmental problems that affect the whole world, and the co-operation and participation of all countries are required to overcome these issues. For example, global warming, climate change, ozone depletion, and biodiversity conservation are such kind of global environmental issues.

National issues are the problems of a country that have to be addressed by the nation itself.

1. Land use pattern and degradation of soil: Agriculture is the major economy of India and provides a push to the GDP growth rate. However, due to soil degradation, the agricultural share in GDP is declining in the country. The main reasons behind soil degradation are extensive agriculture and excessive use of fertilizers and pesticides in the agricultural fields.
2. Water crisis: It is predicted that about 3.5 billion people will face the problem of water crisis by the year 2025. This problem is more pronounced in India because of unsustainable water management systems (World Bank, 2005).
3. Air pollution: In India, the problem of air pollution persists in urban as well as rural areas. Nitrogen Oxide (NO_x), Suspended Particulate Matter (SPM), Carbon Monoxide (CO), Sulphur Dioxide (SO₂), Carbon Dioxide (CO₂) are the major pollutants observed.
4. Waste disposal: An increasing population and urbanization lead to the production of a huge amount of municipal and hazardous waste. The management of waste is a big task in front of the Indian government. There are many types of waste, such as physical (paper, rags, plastic, glasses, metals, etc.), chemical waste, and other biological substances.

Local environmental issues include those problems which affect a particular local area. According to the Ministry of Information and Broadcasting (2004), the local environmental problems common in India are:

- Deforestation
- Pollution
- Desertification
- Degradation of common property
- Resources like pastures, villageponds, and tanks, wetlands, etc.
- Freshwater and marine ecosystems

3.4 DEGRADATION OF NATURAL RESOURCES

Natural resources are a very precious gift provided by mother nature to us. Natural resource degradation refers to the loss of the environment and biodiversity in an area. Nowadays, degradation occurs rapidly, and environmental resources are not getting much time to regenerate themselves. The main reason behind this degradation is the increasing demands of the rising population (Gogoi, 2013).

Renewable resources obtained from nature proved to be an essential commodity for poor communities. If properly managed, these resources can create many job opportunities and provide income to people who are completely dependent on their livelihoods. However, the continuous degradation of the resources has increased human vulnerability and posed many environmental challenges (World Bank, 2019).

Climate change enhances the degradation rate of resources. Resource degradation increases the chances of exposure to climatic changes (World Bank, 2018).

3.4.1 Factors Responsible for the Depletion of Natural Resources

1. **Overpopulation and over-exploitation:** The population of the world is about 7 billion and is increasing continuously. To fulfill the needs of such a huge number of people, natural resources are over-exploited. Resources are required to support industrialization and urbanization. As a result, it disturbs the environment and reduces its regenerative capacity.
2. **Poor farming:** Our farming practices also affect soil quality. For example, poor irrigation and poor management of soil along with heavy equipment disturb the soil structure. Moreover, the excessive use of pesticides and herbicides kills many beneficial microbes that help maintain soil nutrients.
3. **Deforestation:** From 1990 to 2016, the net loss of forest cover was reported as 1.3 million km² (World Bank, 2016). Forests are cleared mainly for agricultural land to fulfill the needs of the growing population.
4. **Pollution:** Increasing population and lifestyle has added many pollutants to the environment such as harmful gases, plastic, sewage, and many toxic chemicals contaminating our air, land, water, and soil.

3.4.2 Effects of Resource Degradation

The depletion of natural resources by human beings can cause many drastic impacts on the environment and wildlife. Some of these are discussed below:

1. **Depletion of water resources:** The poor irrigation practices, as well as pollution, will cause water shortage, which further leads to drought and food insecurity.
2. **Forest loss:** About 7.3 million hectares of forest cover are destroyed each year (National Geographic Society, 2016). Previous studies indicate that deforestation has also increased the amount of greenhouse gases in the atmosphere.
3. **Species Extinction:** Due to over-exploitation of resources and forest degradation, many useful and rare species of plants and animals will get extinct.
4. **Depletion of mineral resources:** To complete the needs of a growing population, many useful minerals like copper, zinc, and phosphorus will get depleted due to over-exploitation.

3.4.3 Solutions to Control Resource Degradation

Our resources are required for development as well as to fulfill the basic needs. Therefore, some steps need to be taken to stop the degradation of our resources.

1. **Reducing deforestation:** Some initiatives should be taken to conserve the forest and wildlife habitats. For example, REDD (Reducing Emissions from Deforestation and Forest Degradation) formulated by the World Bank is aimed to check deforestation.
2. **Use of alternate resources:** We should rely more on renewable resources such as wind power and solar energy to minimize the pressure on non-renewable resources.
3. **Reducing consumption of minerals:** As minerals cannot be replenished very fast in nature so their use should be minimized, and over-exploitation should be reduced.

4. **Awareness:** People should know about the depletion of our natural resources, and it could be done through awareness programs. The public should be encouraged to reduce their use and dependency on resources and conservation of resources.

3.5 POLLUTION OF AIR, WATER AND SOIL

Pollution is any undesirable change in the physical, chemical, and biological properties of air, water, or soil that adversely affect the health of plants and animals. Pollutants are substances that cause pollution and are added to the environment through human activities. These pollutants can accumulate in water, soil, and air and negatively affects their quality.

3.5.1 Air Pollution

The foreign substances that adversely affect air quality are known as air pollutants. Some of the air pollutants are:

- oxides of carbon (CO and CO₂)
- oxides of sulphur (SO₂ and SO₃)
- oxides of nitrogen (NO, NO₂ and N₂O)
- volatile organic compounds (VOCs) such as hydrocarbons (propane, methane, etc.), mainly released from the burning of fuels
- chlorofluorocarbons
- suspended particulate matter (PM₁₀ and PM_{2.5}) including dust, smoke, soot
- hazardous pollutants like carbon tetrachloride and benzene
- radioactive substances
- other microscopic droplets

Corrective actions to control air pollution

- Use of unleaded petrol to prevent the release of lead in the air.
- Special filters to be adopted by the industries and factories to reduce gaseous emissions.
- Alternative energy sources (hydropower and wind energy) should be preferred to minimize the use of fossil fuels.
- Strict laws to prevent the release of CFCs and nitrogen oxides into the air
- Electric vehicles should be used more to reduce the emissions of CO₂ and CO into the atmosphere.
- Public transport systems should be made more efficient to reduce traffic congestion.

3.5.2 Water Pollution

The pollution caused by the excess concentration of some physical, chemical, or biological substances alters the quality of water and makes it unfit for drinking and other purposes.

Sources of water pollution:

- Biological pollutants are mainly microbes like bacteria, viruses, and protozoa, which cause water-borne diseases. They can reach to surface and groundwater

and cause major infections like typhoid, cholera, hepatitis, etc.

- Chemical pollutants include fertilizers, pesticides, and heavy metals (lead, mercury, cadmium, chromium, etc.)
- Persistent organic pollutants (POPs) are the toxic chemicals released from pesticides and other industrial processes. For example, DDT, Polychlorinated biphenyls (PCBs) and aldrin, etc.

Corrective actions to control water pollution

- ? Community education to teach them about the recycling of substances.
- ? Provision of containers to recycle materials such as paper and glass.
- ? Enforcement of large fines for the illegal dumping into rivers.
- ? Proper removal of sewage from settlement by the municipality.
- ? Strict laws to prevent the dumping of wastes into seas, rivers, dams, and streams.
- ? Large penalties and strict laws for oil companies when oil tankers sink, leak, or spill oil.
- ? Encourage people to use organic fertilizers and manure.
- ? Encourage farmers to adopt integrated pest management.

3.5.3 Soil Pollution

The presence of some harmful particles in the soil, which reduces its fertility, is known as soil pollution. Some kinds of solid and liquid waste and toxic chemicals affect soil quality and percolate up to groundwater.

Sources of soil pollution

- Industrial and chemical waste
- Municipal and solid waste
- Open defecation
- Leakage from storage containers
- Open dumping
- Insecticides such organophosphates and carbamates etc.
- Fungicides like Capton and Sovran etc.

Corrective actions to reduce soil pollution

- Education and awareness among people to follow the principle of reducing, re-use and recycle
- Enforcement of legal actions and strict fines for prevention of dumping in unauthorized areas.
- Afforestation programs and use of indigenous trees.
- Crop rotation in fields by farmers.
- Provision of settlements with proper waste management.
- Provision of dustbins in towns and cities by local government
- Formation of action committees to clean up polluted areas.

3.6 PERSISTENT ORGANIC POLLUTANTS (POPS)

POPs are the chemicals that can persist in the environment for longer (many years) and magnify and accumulate in the organisms, and causes adverse health impacts on human health. One can get exposed to these chemicals by eating contaminated food, breathing in polluted air, and other exposed areas or accidents. They are easily found in items like surfactants and flame retardants, added to improve their characteristics.

3.6.1 Characteristics of POPs

- Stays intact for longer periods
- Get widely distributed in the environment through air, water, and soil
- Can travel to far distances, away from original resources
- Not soluble in water
- Readily absorbed in fatty tissues and can get magnified up to 70,000 times (UNEP, 2020)
- Found in higher concentration at the top level of the food chain
- Toxic to wildlife and humans

For example, organochlorine pesticides like DDT, polycyclic aromatic hydrocarbons (PAHs), organometallic compounds like tributyltin (TBT), chemicals from industries such as PCBs and other industrial by-products like dibenzofurans (PCDF), and polychlorinated dibenzo-p-dioxins (PCDD) mostly referred to as 'dioxins' (WHO, 2020).

A convention on POPs was held in Stockholm on 17 May 2004. It was a global treaty aimed to protect the environment from adverse impacts of POPs. The control measures were provided in the convention to reduce and eliminate the release of POPs in the environment. Many POPs (mainly 26) were listed in the annexures of the convention in 2004, and some were added later in 2010, and six were added later on. The list of these POPs is given in table 3.1

Table 3.1: POPs listed in Stockholm Convention (Source: UNEP Stockholm Convention, 2019)

Sl.	POPs (added in 2004)	POPs (added in 2010)	Added later on
1	Dieldrin	Hexabromobiphenyl	Toxaphene
2	Polychlorinated biphenyls (PCB)	Hexabromodiphenyl ether and heptabromodiphenyl ether ('commercial octabromodiphenyl ether)	Tetrabromodiphenyl ether and pentabromodiphenyl ether
3	Chlordane	Lindane	Technical endosulfan
4	Endrin	Pentachlorobenzene	Short-chain chlorinated paraffins (SCCPs)

5	Toxaphene	Tetrabromodiphenyl ether and pentabromodiphenylether ('commercial pentabromodiphenyl ether')	Polychlorinated naphthalenes
6	Mirex	Perfluorooctane sulfonic acid, its salts, and perfluorooctane sulfonyl fluoride (PFOS)	Perfluorooctanoic acid (PFOA) and its related compounds
7	Aldrin	Chlordecone	---
8	Hexachlorobenzene (HCB)	Beta hexachlorocyclohexane	---
9	Heptachlor	Alpha hexachlorocyclohexane	---
10	Furans	---	---
11	Dioxins	---	---
12	DDT	---	---

Very low-level exposure to POPs can:

- Lead to death
- Cause allergies
- Increased risk of cancer and other reproductive disorders
- Cause neurobehavioral impairment
- Affect the immune system
- Cause disruption in the endocrine system
- Increase the chances of congenital disabilities.

3.7 WATER SCARCITY

Water covers about 70% of the earth's surface. However, the freshwater is only 3%, and two-third is present in the frozen form that is unavailable for our use [World Wildlife Fund (WWF), 2020].

Water scarcity occurs when water is not available enough to meet the demands due to physical or shortage of water or infrastructure failure to meet the water supply for people's regular water demands [United Nations (UN), 2020]. Scarcity of water is an issue that has affected every continent of the world. Around 1.2 billion people are living in areas of physical water scarcity. Almost 1.6 billion people have faced the economic water shortage globally [United Nations Department of Economic and Social Affairs (UNDESA), 2014]. They are residing in countries with the appropriate infrastructure to extract water from various sources. The main reason behind this scarcity is overuse and wastage of water. In the last century, water use is double the level of the rising population.

Water is enough to sustain seven billion people on planet earth. However, it is unevenly distributed, and a lot of water gets wasted, overexploited, and not managed sustainably.

About 1.8 billion people will be facing absolute water scarcity in different countries of the world. Moreover, 2/3rd population in the world would be living under water-stressed conditions (UNDESA, 2014).

3.7.1 Causes of Water Scarcity

There are many factors responsible for water scarcity in the world. Some important causes of water scarcity are discussed below:

Pollution: The use of pesticides and fertilizers in the field, as well as the discharge of wastewater from the industries, pollutes the water bodies. Sometimes the pollution also reaches the groundwater and makes it unfit for various uses.

Agriculture: Around 70% of the world's freshwater is used up in agriculture, and 60% of it get wasted due to inefficient application and inappropriate irrigation system and cultivation of thirsty crops. It creates pressure on our water resources, and the river, lakes, and underground aquifers are getting dried.

Population growth: The human population has grown twice in the last 50 years. This fast-growing population, along with industrialization and urbanization, has created stress on water resources. Nowadays, 41% of the population lives in water-stressed river basins globally (WWF, 2020).

Action be taken: Individual countries have to take immediate steps to avoid critical water stress in the near future. Water needs to be treated as a scarce resource. All the countries should follow integrated water resources management by managing the available water resources according to the number of people sustainably.

3.8 SOIL EROSION AND LAND DEGRADATION

Soil is an essential component of land, and it takes thousands of years for its formation. The top layer of soil is equipped with many nutrients for crop growth and is also at a higher risk of wind and water erosion. When this top fertile layer is removed due to any agent, it is known as soil erosion. Currently, the global rate of soil erosion is higher than its formation [World Resources Institute (WRI), 2020].

Soil erosion is a major problem in regions with a higher population, agricultural land, and urbanization (Ding et al., 2015). The watersheds of India, Indonesia, the Philippines, and many more have the highest risk of soil erosion (WRI, 2020). The erosion of soil hinders plant growth, affects agricultural production, recreation, and water quality. It occurs naturally on land and is a key reason for land degradation (Ding et al., 2015; Bai et al., 2010).

3.8.1 Factors Responsible for Soil Degradation

Soil erosion occurs when soil is exposed to high winds or raindrops. The other sources of erosion are discussed below:

1. **Rainfall:** Heavy rainfalls disperses the material of soil and carry it along with runoff. It carries away silt, organic matter of soil, and finer particles also and sometimes large particles are also affected depending on the severity of rainfall.

2. **Agricultural activities:** Unsustainable agriculture and intensive farming affect soil structure and organic matter content, making it more vulnerable to erosion. For example, the tillage of lands breaks the soil structure and contributes to soil erosion.
3. **Vegetation cover:** The land areas with less natural vegetation cover are more susceptible to soil erosion as flora protects soil structure.
4. **Wind:** High blowing winds facilitate erosion, especially when it is loose in structure. The sandy or lighter soils are more affected as they can be easily blown away.
5. **The land's slope:** The land with a higher slope is more vulnerable to rain erosion as water moves faster down the hill, and the water percolation rate is also very low (Nenadovi et al. 2013).

3.8.2 Impacts of Soil Erosion

The process of soil erosion causes a lot of land degradation and other impacts, which are discussed below:

1. **Affects people's livelihood:** About 52% of the agricultural land is severely affected by soil erosion due to removing trees from the landscape and increasing food insecurity (IUCN, 2017).
2. **Climate mitigation:** The annual sequestration rate of CO₂ by the world's forests is about 2.4 billion tonnes. The destruction of forests emits more CO₂ into the air and annual emission of 4.3–5.5 GtCO₂eq/yr. Hence conservation of soil and forests is essential to mitigate climate change.
3. **Biodiversity loss:** More than 80% of global terrestrial biodiversity is present in the forests. The survival of many species is threatened due to forest degradation and erosion.
4. **Economic loss:** The economic loss faced by the world due to soil erosion is around eight billion dollars. It is due to reduced fertility of the soil, less crop production, and overuse of water. For example, in Indonesia, soil erosion is a reason for 2 percent loss in the agricultural gross domestic product (GDP) (Sartori et al. 2019). In another study from Sleman (Indonesia), erosion costs 17% of the net income of an average farmer per hectare of land (Möller and Ranke, 2006).

3.8.3 Solutions to Prevent Soil Erosion

1. **Good agriculture practices:** Some soil friendly practices should be followed in agriculture, such as:
 - Terrace farming in hilly areas to prevent water and soil loss
 - Intercropping system with plantation of two crops together, for example, soybean or maize crop between oil-palm trees
 - Alternate growth of shallow-rooted and deep-rooted crops to improve soil structure
 - Agroforestry system
 - Application of organic manure to improve nutrients in the soil

2. **Sustainable land management practices with incentives:** The methods to prevent soil erosion should be adopted by farmers, and they should be supported financially by the government and banks. The approximate cost of anti-erosion methods is about 500 dollars per hectare, higher for a small farmer (WRI, 2020).
3. **Rehabilitation and prevention:** The land which is already damaged should be rehabilitated, and preventive measures should be adopted to stop soil erosion.

3.9 DEFORESTATION

Deforestation is converting forested land to non-forest use, such as agricultural land and for construction purposes. It leads to the forests' degradation, and they lose their capacity to provide essential goods and services.

Deforestation and the degradation of the forests are the biggest threat nowadays. Since the 1960s, more than half of the tropical forests have been destroyed globally and affected the livelihood of about 1.6 billion people [International Union for Conservation of Nature (IUCN), 2017].

3.9.1 Causes of Deforestation

The main reason behind deforestation is expanding and extensive agriculture with poorly planned infrastructure and unsustainable practices. Moreover, illegal logging is responsible for major forest degradation (WWF, 2020). Deforestation has alarmingly devastated the tropical rain forests, and these are home to a lot of biodiversity in the world. For example, in the Amazon rainforest, in the last 50 years, about 17% of the forest area has been lost due to forest conversion for cattle ranching (WWF, 2020).

Another major cause of deforestation is forest fires. The fires are a natural element, but when they are at the wrong place and at the wrong time, they can cause huge destruction. Millions of acres of forested land are degraded by forest fires annually. These fires destroy the forests, threaten biodiversity, open the forest for invasive species, and affect soil fertility.

3.9.2 Impacts of Deforestation

- **Increased greenhouse gas emissions (GHGs):** The forests act as carbon sinks and mitigate climate change. The tropical forests can sequester 228 to 247 gigatons carbon, which equals seven times the annual anthropogenic emissions. Although deforestation and degradation of forests are alone responsible for 15% emissions of GHGs.
- **Disruption in the water cycle:** The trees maintain a balance between land and atmosphere. Due to deforestation, the precipitation and water cycles become unregulated and disturbed.
- **Soil erosion:** Large trees hold the soil firmly, and after deforestation, the soil easily gets exposed and eroded. The fertility of soil also gets reduced due to erosion.

- **Affects livelihoods of people:** About 750 million lives in and around forests, and around 1.25 billion people in the world are dependent on the forest for their shelter, food, water, and livelihood. Deforestation affects these people with devastating consequences on their lives.

3.9.3 Solutions to Reduce Deforestation

Many solutions are available to control and minimize deforestation as described here:

- **Conservation agriculture:** The expansion of agriculture should be performed responsibly, along with the conservation of forests. The organizations and governments should remain committed to forest conservation along with agriculture.
- **Alternate and sustainable energy sources:** Humans are relying on forests for fuel for thousands of years ago. To reduce our reliance on the forest, we should go for energy from waste, scraps, and residues.
- **Creation and management of conservation areas:** Many forests are declared protected areas, but they are not managed properly. The funds can be collected from the public and private sectors to conserve these natural resources.
- **Forest landscape restoration (FLR):** The FLR can come out as an important solution for reversing the impacts of forest degradation and deforestation (IUCN, 2017). It will also help regain the social, climatic, ecological, and economic benefits from the forests.

FLR includes multiple programs like erosion control, agroforestry, and regeneration of the natural forest. It also monitors the possible causes responsible for forest loss. It also provides knowledge about sustainable agricultural methods to the farming communities living in and nearby forest areas.

For example, the countries and other organizations are working with FLR through “the Bonn Challenge.” It’s an effort launched by IUCN and Germany in 2011 at a global level to perform the restoration of 150 million hectares of deforested and degraded land by the year 2020 and 350 million hectares by 2030. This challenge has generated pledges from international organizations and governments to restore over 156 million hectares of land so far.

3.10 EMERGENCE OF AIR, WATER AND SOIL BORNE DISEASES

3.10.1 Airborne Diseases

Airborne diseases are those that can infect a person only by breathing or inhaling some pollutants or particles. The infection can spread through sneezing, cough, or talking. Some bacteria and viruses can stay in the air and on surfaces for many hours. Sometimes, they contact an infected person or from droplets in the air, such as Coronavirus disease-19 (COVID-19). The other common examples of air-borne illnesses are the common cold, influenza, mumps, measles, chickenpox, whooping cough, diphtheria, etc.

Symptoms of airborne diseases

Each disease has its particular symptoms. However, the major symptoms among which one or more is common in airborne diseases are sneezing, congestion, running nose, coughing, swollen glands, sore throat, fever, loss of appetite and fatigue etc.

Treatment for common airborne diseases: Some common treatment methods can be applicable for airborne diseases. These are:

- Plenty of fluids intake and rest
- Antiviral drugs in case of common flu
- Use of antibiotics and hospitalization if needed
- Special care on detection of a specific illness

3.10.2 Waterborne Diseases

These diseases are caused by various micro-organisms present in water or drinking contaminated water such as diarrhea, cholera, typhoid, hepatitis, dysentery, meningitis, or other gastrointestinal problems. The water can get contaminated through various sources like industrial effluents, household waste, human and animal waste, untreated sewage, and other chemical effluents.

The water can also be contaminated with bacteria like *E. coli* and many viruses such as hepatitis. The consumption of such kind of water can lead to gastrointestinal diseases. Direct contact with unclean water can also cause many skin infections and eye diseases such as trachoma. The risk of infection remains high among infants, children, and older people.

An outbreak of disease can occur mostly after severe rainfall or flood as they boost the growth of bacteria and viruses. Climate change and extreme weather events also support the spread of many microbes. The disease can spread from any water source. However, its surveillance and diagnosis are required to control disease spread [National Institute of Environment and Health Sciences (NIH), 2017].

Symptoms: Some common symptoms related to the waterborne disease are diarrhea and vomiting, sometimes skin, ear, eye, and respiratory infections are also associated depending on the specific disease.

Prevention of waterborne diseases: Some precautionary measures can prevent the spread of waterborne illnesses. These are discussed below:

- Water should be purified at the household level to make it potable
- Water should be clean and dirt-free, visibly
- Where the risk of infection is high, bathing water should be used by adding some antiseptic liquid.
- Hand hygiene should be followed while eating, cooking, and using toilets
- Food should be washed thoroughly
- Vaccinations should be followed for diseases such as polio, typhoid, and hepatitis A, etc.

3.10.3 Soil-borne Diseases

The organisms responsible for soil-borne diseases can be found in gardens, agricultural fields, and warm areas where the climate is favourable for their growth. The organisms live in the soil and infect human beings as their host. These diseases sometimes are infectious, and one person can get infected by another person. Some examples of soil-borne diseases include amoebiasis, ascariasis, hookworm, enterobiasis, Q fever, lime disease, giardiasis, salmonellosis, shigellosis, tetanus, etc. (Jeffery and Putten, 2011).

Common symptoms: The cause of infection can be direct ingestion of contaminated food from soil, direct inoculation, or inhalation. The symptoms of soil-borne infections are wounds, skin problems, gastrointestinal infections, and respiratory tract diseases. For example, tetanus, botulism, and anthrax, Some fungal infections from the soil are life-threatening, especially in people with a weak immunity (Baumgardner, 2012).

Prevention and treatment of soil-borne infections: Some preventive and treatment measures can minimize the spread of soil-borne diseases. These include:

- Prompt diagnosis of the disease
- Intensive care and support to patients
- Application of antitoxin and antibiotic therapies
- Investigation about the source of infection to prevent its further spread
- Public health measures in disease-prone areas, like after a flood or heavy rainfall and other disasters.

3.11 GLOBAL WARMING GASES

Greenhouse gases (GHGs) or global warming gases absorb heat in the atmosphere and trap the solar radiations, which causes warming of the earth. The major GHGs are Carbon-dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and some fluorinated gases like chlorofluorocarbons (CFCs), Sulfur hexafluoride, and hydrochlorofluorocarbons (HCFCs) [United States Environment Protection Agency (USEPA), 2020].

Carbon-dioxide: The sources of CO_2 in the atmosphere are from the open burning of solid waste and fossil fuels along with trees other biological and agricultural waste.

Methane: CH_4 is naturally released from the decomposition of organic waste in landfills, from livestock, and during the production of fossil fuels like coal, oil, and natural gas.

Nitrous oxide: This gas is emitted through industrial and agricultural activities like excess use of fertilizers, burning of fossil fuels, and wastewater treatment.

Fluorinated gases are mainly emitted from industrial sources as they are used as coolants and propellants.

According to USEPA (2020) report, the total emissions of GHGs in 2018 were 6,677 Million Metric Tons of CO_2 equivalent. Two main properties determine the power of gas to cause the greenhouse effect. These are:

- **Global warming potential (GWP):** Various GHGs have different heat-trapping capacities known as GWP. It measures the radiative impact of each molecule of gas over a specified time. For example, N₂O is 264 times more potent than carbondioxide for a 100-year timescale.
- **Atmospheric lifetime:** It measures the lifetime of gas in the atmosphere before removal through any chemical reaction.

A gas with more GWP and more life span in the atmosphere will cause more earth warming. Table 3.2 depicts the GWP and atmospheric life span of major GHGs. These values are taken from the Fourth Assessment Report (AR4) of IPCC from 2007, referred mostly to in international reporting.

Table 3.2: GWP and atmospheric lifetime of major GHGs[Source: Fourth Assessment Report of Intergovernmental Panel on Climate Change (IPCC), 2007].

GHG	Chemical formula	GWP (100-year time horizon)	Atmospheric Lifetime (in years)
Carbon Dioxide	CO ₂	1	100
Methane	CH ₄	25	12
Nitrous Oxide	N ₂ O	298	114
Chlorofluorocarbon-12 (CFC-12)	CCl ₂ F ₂	10,900	100

3.12 CLIMATE CHANGE

Climate change is the rising issue of the present time. It addresses the complex shifts in the weather of planet earth and climate systems. It includes global warming and other extreme weather events, rising sea levels, extinction of species and shift in wildlife populations, habitat destruction, and many other impacts. These shifts in weather threaten food production and the rising sea level increases the risk of flooding.

The earth’s temperature is rising nearly twice the rate as it was 50 years ago. The GHGs emitted by human activities are mainly blamed for this continuous warming of the earth. Although GHGs are essential as they keep the earth liveable by stopping some radiations from reflecting back. However, due to rapid industrialization, intensive agriculture, and deforestation, the concentration of these GHGs has risen to record levels in the last three million years [United Nations (UN), 2020]. Hence, we need drastic action now to combat climate change in the present and future.

Many global efforts are made so far to reduce the impacts of climate change, and the recent was the Paris agreement in 2015. However, global warming continues and hit its record levels in 2018. Some organizations and agreements related to climate change are discussed below:

Intergovernmental Panel on Climate Change (IPCC): The UN IPCC was formulated by the World Meteorological Organization (WMO) and the United Nations Environment Programme for providing a source of scientific information regarding climate change. According to AR5 of IPCC (2013):

- Human activities are responsible for climate change
- The average global temperature has risen about 0.85°C from 1880 to 2012.
- The average global sea level rose by 19 cm from 1901 to 2010, and it is predicted to rise 40–63 cm by 2100 and 24–30 cm by 2065 in relation to the reference period of 1986–2005
- If the present conditions persist and the concentration of GHGs keep rising, then the global mean temperature will rise continuously above the pre-industrial level by the end of this century

United Nations Framework Convention on Climate Change (UNFCCC): The ‘Earth Summit’ produced UNFCCC in 1992 to address climate change, and it is ratified by 197 countries.

Kyoto protocol: For a global response to climate change, the countries formulated the Kyoto protocol in 1995. It aimed to set the emission reduction targets and to bind the developed countries legally with them. It has 192 parties, and its first commitment period was from 2008 to 2012, and the second began in 2013 and will end up in 2020.

Paris Agreement: It was adopted in the 21st conference of parties (COP) in 2015 in Paris. Its goal was to combat climate change and fasten the actions and initiatives needed for a low carbon future and sustainable living. Now 186 countries have ratified the Paris agreement (UN, 2020).

Climate Action Summit 2019: The Secretary-General of the UN convened a Climate Summit on 23rd September 2019. Its goal was to bring the world’s leading countries, the civil society, and the private sector to support the initiatives to mitigate climate change.

3.13 OZONE DEPLETION

3.13.1 Ozone

Ozone with chemical formula O_3 is a colorless and active gas. It is the present near-surface of earth. It can cause rubber cracking, damage to the lungs, and affects plant life also. However, in the stratosphere (15-30 km from earth’s surface), ozone forms a protective covering and prevents the harmful ultraviolet (UV)-B radiations from entering the earth’s atmosphere [National Aeronautics and Space Administration (NASA), 2020]. The thickness of the ozone layer is measured through Dobson’s Unit (DU).

3.13.2 Ozone Hole

Some chemical reactions are causing rapid and severe destruction of ozone in the southern polar region, and the main reactants are chlorine and bromine from the past few decades. That depleted part of ozone is known as the ozone hole. In 1974, two scientists from the University of California had first detected the threat to the ozone layer from CFCs. The ozone hole was first discovered in Antarctica in 1985. The hole in the area in the stratosphere with extremely low concentrations of ozone molecules. Around 100,000 ozone molecules can be destroyed by one atom of chlorine (USEPA, 2018). Hence eradication of ozone from the atmosphere is more rapid than its replacement.

Figure 3.2 shows that the grey shading is for minimum and maximum values since 1979, and the red numbers indicate the lowest and highest values.

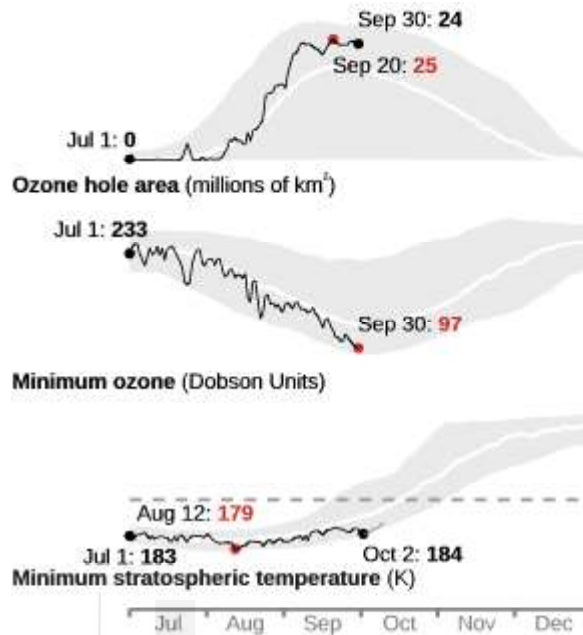


Fig 3.2: Progress of ozone hole in 2020 (Source: NASA, 2020)

3.13.3 Ozone-depleting Substance (ODS)

The substances which release ozone on exposure to UV light in the stratosphere are known as ODS. Chlorine-releasing ODS includes CFCs, HCFCs, methyl chloroform, etc., whereas methyl bromide and halons release bromine. ODS is very stable and cannot be easily dissolved by rain. These ODS substances are mainly used as propellants, refrigerators, fire suppressors and foam insulators, etc. Some natural processes like volcanic eruptions also affect ozone concentration in the stratosphere as they can release some aerosols, which increases chlorine's effectiveness in destroying ozone molecules. For example, a volcanic eruption in Mt. Pinatubo's 1991 (USEPA, 2018).

3.13.4 Health Impacts of Ozone Depletion

The depletion of ozone will increase the harmful UV-B radiations on earth, which can cause skin cancer, immune deficiency disorders, and eye cataracts in humans. It can alter plant growth and can affect the food chain and ecosystems.

3.13.5 Montreal Protocol

In 1987, the Montreal Protocol was a landmark agreement signed by 197 countries to phase out the ozone-depleting substances that is CFCs. After more than 30 years of Montreal protocol, NASA scientists have found the recovery of ozone in the Antarctic region for the first time. A 20 percent decline is observed in the depletion of ozone since 2005. The UN has projected that it would heal completely by the 2030s in the Northern Hemisphere, by 2050s in Southern Hemisphere, and by 2060s in the polar regions.

3.14 ACID RAIN

It is rain with low pH due to contamination with acids like sulphuric acid (H_2SO_4) and nitric acid (HNO_3). The major source of these acids is emissions of sulphur and nitrous oxide from fossil fuels' combustion, increasing their concentration in the atmosphere. The vehicular exhaust also releases oxides of nitrogen into the air. The pH of acid rain can range from 5.0 to 5.5 and sometimes 4 in highly industrialized areas [USGS (United States Geological Survey), 2020].

Deposition of acid is classified into two categories: a) wet deposition like acid rain, snow, and fog b) dry deposition like smoke, dust, and deposition as a particulate matter.

The oxides of nitrogen and sulphur can travel a long way through winds before coming in contact with water vapours to form acid rain [SDWF (Safe Drinking Water Foundation), 2017]. Hence if sulphur and nitrogen oxides are emitted from urban industrial areas, the acid rain can fall in some nearby rural areas. Fig 3.3 describes the path traveled by sulphur and nitrogen oxides before falling as acid rain.

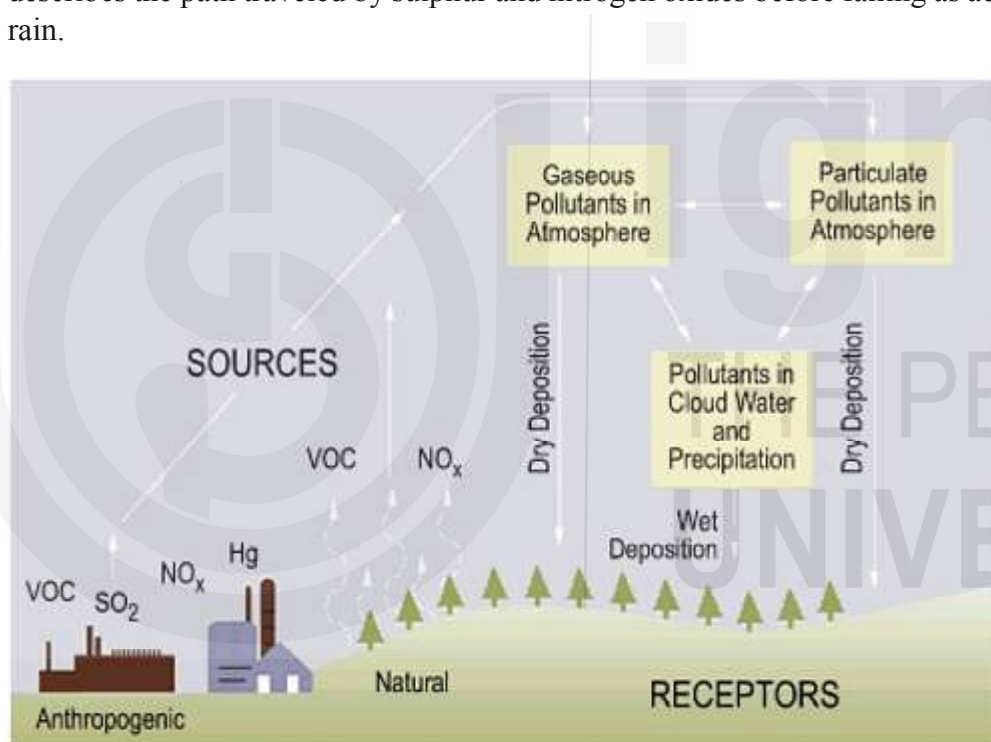


Fig 3.3: Formation of acid rain (Source: SDWF, 2017)

3.14.1 Impacts

Acid rain can decrease the pH of aquatic ecosystems (Singh and Shishodia, 2007). It causes foliar injury, discoloration and reduces plant growth. It also reduces pollen germination and fruit formation in plants. Vital nutrients in the soil get decreased due to acid rain (Mohajan, 2018). Dry deposition can affect the heart and lungs in humans. Acid rain also affects buildings and monuments by causing discoloration and marble cracking.

3.14.2 Control of Acid Rain

Acid rain can be controlled by minimum emissions of sulphur and nitrous oxides into the atmosphere. The industries and factories should reduce their emissions,

and alternative fuels should be used in place of fossil fuels. Moreover, we can minimize energy use by conserving it and using energy-efficient appliances, vehicle maintenance, car-pooling, etc.

3.15 BIODIVERSITY LOSS

Biodiversity is the variety of different species present on the earth. The species of plants and animals are disappearing rapidly, mainly due to anthropogenic activities like pollution, land use patterns, and climate change. This is known as biodiversity loss (European Parliament, 2020). According to a UN (2019) report, one million species out of an estimated eight million are threatened with extinction.

Biodiversity is very important for our planet. It has many values, such as:

- It provides food, pharmaceuticals, and fuel
- Forests act as carbon sinks and reduce global warming
- Pollination occurs due to biodiversity
- It helps in ecosystem regulation
- Many optional values are provided due to the variety of plants and animals
- Our cultural and social values are also related to biodiversity

Hence, we need to protect our biodiversity as it has great importance. The reasons responsible for biodiversity loss are:

- Deforestation
- Urbanization
- Intensive agriculture
- Hunting
- Over-exploitation
- Climate change
- Pollution
- Alien or invasive species

Since 1900, the average distribution of native species has decreased to 20%. The list of threatened organisms includes about 40% of amphibian species, more than 33% of reef-forming corals, about 10% insects, and around 1/3rd of marine mammals. More than 680 species of vertebrates have been extinct since the 16th century. At least 9% of all domesticated mammals had become extinct by 2016, which were used for food and agriculture, and around 1,000 more breeds of these mammals are still threatened (UN, 2019).

The conservation measures are adopted to protect the biodiversity at various levels, such as ex-situ and in-situ conservation. Along with conservation methods, we need to minimize human activities and exploitation, like land-use changes, pollution, hunting, and equitable sharing of sustainable development resources.

3.16 ELECTRICAL AND ELECTRONIC WASTE

Electrical waste or E-waste includes discarded electronic appliances such as the keyboard, monitors, motherboards, mobile phones, laptops, chargers, headphones,

televisions, and air conditioners, etc (Down To Earth, 2019). According to a report of Global E-Waste Monitor 2017, India generates around two million tonnes (MT) of E-waste per year, and India's ranking is at 5th among countries producing e-waste, after the US, China, Japan, and Germany. As per the report of UN (2019), only 20% of global e-waste is recycled. E-waste is composed of many kinds of materials, which are briefly mentioned in table 3.

Table 3.3 Composition of E-waste

Material	Percentage in E-waste
Iron and steel	50%
Non-ferrous metal	13%
Plastic	21%
Mercury, arsenic. Lead etc.	Traces

In the recent past, the use of electrical and electronic equipment (EEE) has grown. However, their life span is becoming shorter day by day. The disposal of E-waste is a critical issue in the 21st century. Most of the developing countries lack the infrastructure needed for proper disposal and recycling of E-waste. Many disorders are linked with E-waste, such as cancer, respiratory and neurological disorders, and congenital disabilities (Davis, 2006).

Moreover, a well-established system is not available for collecting, separation, storage, transportation, and disposal of e-waste. Also, E-waste has a complex nature and hence is somewhat complicated in handling and disposal. In addition to this, no effective enforcement of laws and regulations is implemented to E-waste disposal and management (Bhutta et al. 2011).

3.17 URBAN SPRAWL

Definition: Urban sprawl is referred to as another term for urbanization. It is defined as the migration or movement of people from populated or crowded towns towards low-density areas or rural lands. It results in the spreading of a town or city into more and more suburbs over rural areas.

3.17.1 Characteristics of a Sprawl

There are some common characteristics for a sprawl, mentioned below:

- Availability of a large lot of land for single-family dwellings
- Large distances are created among dwellings, and they depend on private automobiles for short trip distances also
- Sprawls have dispersed development or leapfrog development patterns, and people are located on lands adjacent to one another
- Community distinctiveness declines in urban sprawl
- People's desire for more residential amenities leading to urban sprawl

3.17.2 Impacts of Urban Sprawl

- It causes more energy use and pollution

- Dispersion of communities to long distances
- Destruction and fragmentation of wildlife habitats
- Traffic congestion

According to a report of the European Environment Agency (2002), between 1980 and 2000, the footprint of built-up areas increased by 20% whereas the population increase observed was only 6%. From another study of the United Nations population division, in the 1950s, only 29% of people lived in urban areas globally, whereas it increased to 49% in the late 2000s. In India, the urban population was 17% in the 1950s. However, it increased to 29% in the year 2007.

3.18 TRAFFIC CONGESTION

The traffic congestion results from the increased number of traffic on roads and its consequences are long travel times and higher emissions which affects air quality. In other words, the higher number of cars, trucks, and buses on roads and a greater number of pedestrians on sidewalks describes the scene of congestion.

Traffic congestion can be of many types depending on the reason for congestion. These are described below:

1. Environment: If the weather is rainy or foggy, it results in halted traffic on roads. Sometimes extreme snowstorms and other disasters can lead to prolong traffic on roads
2. Mechanical: If any vehicle is slipped on-road or has any accident, it can cause traffic congestion. Broken roads and unmaintained vehicles can also stop traffic in the long run. Some mechanical fallings of the building or other accidents such as landslides can cause traffic to stop. Sometimes the traffic control devices and toll taxes also cause congestion of traffic.
3. Human causes: A drowsy or drunken driver can be very dangerous not only for the traffic but also for the lives of people. Sometimes an untrained driver can lead to a traffic halt.
4. Infrastructure: Some traffic problems are caused by inadequate infrastructure, which is although a human-made cause. Some potholes cause slowdown of the traffic, and some bottleneck roads also lead to traffic problems.

The other causes responsible for traffic congestion include increasing population and urbanization. Due to this, people demand their personalized vehicles for movements, and its outcomes are traffic congestion. According to the 2011 census, India's urban population increased to 377 million in 2011, whereas it was 290 million in 2001. The urban people cover around 30% of the total population in India (Alam and Ahmed, 2013).

The governments frame some policies from time to time to minimize traffic congestion. For example, from a report of the Ministry of Urban Development, Government of India (2007), it was found that the average speed of journey in Delhi was around 16 km per hour, and a slightly higher was observed in Mumbai (Wilbur Smith Associates, 2008). Delhi's Master Plan 2021 was formulated to attract 80% of travel on the road to public transport by 2020. According to an estimate, Delhi's travel demand will rise to 27.9 million passengers in 2021 compared to 13.9 million trips in the year 2001 (Alam and Ahmed, 2013).

Some other steps that can be taken to control traffic congestion are:

- Reforms in Urban planning and urban development policies
- Promotion of public transports
- Intelligent transport systems such as Bus Rapid Transit (BRT) System

3.19 SOCIO-ECONOMIC PROBLEMS

The socio-economic factors influence a person’s economic activities, such as education, food, and employment. Socio-economic problems include lack of education, scarcity of food, unemployment, cultural discrimination, corruption, etc.

Lower socio-economic status is associated with many health problems such as cancer, arthritis, low birthweight, and hypertension (Pamuk et al. 1998)). Moreover, it increases mortality rates also, and more disparities are found in middle adulthood or the age of 45-65 years (Mare, 1990).

3.19.1 Components of Socio-economic Status

1. Education: The earning potential of a person and his future opportunities are dependent directly on his education status. It helps in getting good social behaviour, better health, and good income also.
2. Income: A good income helps make good health and nutrition, better lifestyle including housing, schooling, and other recreational activities.
3. Occupation: It is believed that an employed person would have better health than an unemployed one as long-term unemployment increases job insecurity and anxiety (Ross and Mirovsky, 1995).

3.19.2 Environmental Exposure and Socio-economic Status

People with lower socio-economic status are more prone to work in a worse environment, like more polluted and unhygienic conditions. People in the low poverty line have their house locations in industrial areas, near highways, or toxic waste sites because of cheaper land availability. They also experience more noise and crowding. Higher noise levels sometimes increase hypertension in adults and poor memory in children (Evans, 1997). Chronic stress due to overcrowded housing and long working hours are also consequences of lower socioeconomic status.

Check Your Progress a

Note: a) Write your answer in about 50 words.

b) Check your progress with possible answers given at the end of the unit.

1. Give some examples of air-borne and water-borne diseases.

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2. Elaborate the following terms:
a) ODS b) POPs c) GWP

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3. What is the composition of E-waste?

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4. What are the factors responsible for the degradation of natural resources?

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3.20 LET US SUM UP

This unit has discussed major global environmental issues such as climate change, global warming, ozone depletion, and regional and local issues like pollution, forest degradation, and water scarcity. This knowledge helps us understand various causes and impacts of different environmental problems and their solutions and contribute to environmental conservation.

3.21 KEY WORDS

Forest Landscape Restoration (FLR): The actions taken for the recovery and rehabilitation of a forest.

Urban Sprawl: Unrestricted growth in urban areas resulting in movement of people to outer areas of town.

POPs: Persistent organic pollutants are resistant and can not be degraded and persist in the environment for a long time.

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3.23 ANSWERS TO CHECK YOUR PROGRESS

Answers to Check Your Progress 1

1. a) Airborne diseases: common cold, influenza, mumps, measles, chickenpox, whooping cough, etc.

- b) Water-borne diseases: diarrhea, cholera, typhoid, hepatitis, dysentery, etc.
- 2. ODS: Ozone-depleting Substances
POPs: Persistent Organic Pollutants
GWP: Global Warming Potential
- 3. E-waste is mainly composed of steel, plastic, iron, and some heavy metals.
- 4. Some factors responsible for natural resource degradation are over-population, pollution, deforestation, etc.



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