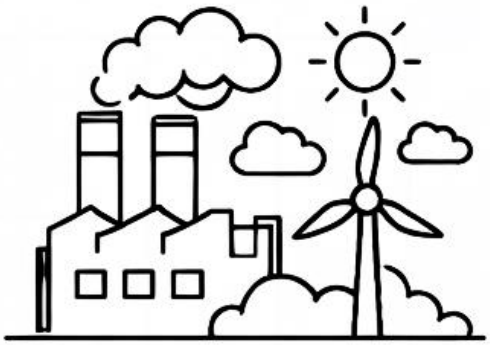
MVS FOUNDATION

FREE NOTES

ENVIRONMENTAL SCIENCE (333)

CHAPTERWISE NOTES



Environmental Science

Sl. No.	Module	Chapters (Public Examination)	Marks
1	**Module 4 : Contemporary Environmental Issues**	L-10 Environmental Pollution L-11 Environment and Health L-13 National Environmental Issues L-14 Global Environmental Issues	15
2	**Module 5 : Environmental Conservation**	L-15 Biodiversity Conservation L-18 Water and Energy Conservation	14
3	**Optional Module 8A : Water Resource Management**	L-29A Fresh Water Resources L-30A Methods of Water Harvesting L-31A Water Conservation at Different Levels	12

Component	Details	Marks
Public Exam (Selected Modules 4, 5, 8A)	Total Chapters : 9	41
Practical Exam	Practical	20
TMA	Tutor Marked Assignment	16
Final Possible Marks		**77 Marks**

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Environmental Pollution

Introduction

Due to human activities, many types of pollutant substances get mixed into the environment, which has an adverse effect on air, water, soil, and living organisms. Industrialization, transport, and domestic activities are the main causes of pollution. In this chapter, the types, causes, effects, and control measures of pollution are studied.

Pollution And Pollutants

- **Pollution:** The **accumulation of unwanted substances in the environment** due to human activities is called pollution.
- **Pollutants:** Those **physical, chemical, or biological substances** that contaminate the environment
- Human activities such as:
  - **Vehicle emission**
  - **Industrial waste**
  - **Domestic garbage**
  - **Chemical fertilizers and pesticides**

Affected by these are: **Air, water, soil, sea, and human health**

Types Of Pollution

Mainly the following types of pollution are found in the environment:

- **Air pollution**
- **Noise pollution**
- **Water pollution**
- **Soil (land) pollution**

- **Thermal pollution**
- **Radiation pollution**

Air Pollution

- Industrial activities and domestic work are the main causes of air pollution.
- Air pollution occurs when **harmful gases or particles** get mixed in the air in large quantities.
- It causes damage to **humans, animals, plants, and property.**

Main Sources of Air Pollution

- Vehicles
- Factories and industries
- Thermal power plants
- Mining and construction work
- Burning of fuel

Particulate pollutants

- Dust and soot
- Fly ash
- Particles of metals (lead etc.)

Effects

- Reduction in visibility
- Lung diseases
- Asthma and cancer
- Plant growth affected

Gaseous pollutants

Main gases:

- Carbon monoxide **(CO)**
- Carbon dioxide **(CO_2)**
- Sulphur dioxide **(SO_2)**
- Nitrogen oxide **(NOx)**
- Hydrocarbons

Effects

- Respiratory diseases
- Acid rain
- Reduction in plant productivity
- Greenhouse effect

Prevention and control of air pollution

(i) Indoor air pollution

Causes:

- Faulty design of buildings
- Smoke from domestic fuel
- Paints, furniture, and chemicals

Effects:

- Cough, difficulty in breathing
- Irritation in eyes and throat

Control

- Use of clean fuel (biogas, electricity)
- Proper ventilation
- Smokeless chullahs

- Correct disposal of waste

(ii) Prevention and control of industrial pollution

- Use of cleaner fuels
- Installing pollution control devices

Main equipment:

- Filters
- Electrostatic precipitators (ESP)
- Scrubbers
- Inertial collectors

(iii) Control of vehicular pollution

- Regular checkup of vehicles (PUC certificate)
- Use of CNG
- Lead-free petrol
- Correct maintenance of vehicles

Ozone Hole

- The ozone layer in the stratosphere protects the earth's surface from excessive ultraviolet (UV) radiation from the Sun.
- **CFC** gases cause damage to ozone layer.
- Thinning of the ozone layer can cause skin cancer, eye disease, and crop loss.
- To stop this, the Montreal Protocol was implemented.

Global Warming And Greenhouse Effect

- **Greenhouse gases:**
  - CO_2
  - Methane

  - Nitrous oxide
  - Water vapour
- These gases trap the out-going **infrared radiation** from the earth.

Results

- Increase in global temperature
- Melting of polar ice caps
- Increase in sea level
- Increase in storms

Noise Pollution

Unwanted sound is called noise pollution.

Unit of measurement: Decibel (dB)

Sources: Industry, vehicles, loudspeakers, aircraft, machines

Sources of noise pollution

Indoor sources: Radio, television, generators, home appliances

Outdoor sources: Vehicles, industries, aeroplanes, market place, and social functions

Effects of noise pollution

- High blood pressure
- Disturbance in sleep
- Mental stress
- Reduction in work efficiency

Prevention and control of noise pollution

- Proper maintenance of vehicles
- **Limited use of loudspeakers**

- **Development of green belt**
- Installing sound proofing equipment in industries

Water Pollution

Addition of **undesirable substances in water** is called water pollution.

Causes

- Industrial waste
- Domestic sewage
- Agricultural chemicals
- Pesticides and fertilizers

Sources of water pollution

- Industrial effluents
- Sewage
- Agricultural runoff
- Solid waste

Effects

- Water born diseases
- Death of aquatic organisms
- Reduction in transparency of water

Groundwater Pollution

- Groundwater is a main source for drinking and agriculture.
- **Causes:**
  - Sewage leakage
  - Chemical fertilizers

- Industrial waste

Eutrophication

- Due to excess of **nutrients in water, excessive growth of plants** and algae occurs.
- Due to this, **dissolved oxygen decreases and aquatic organisms** start dying.

TOP 5 QUESTIONS

Q-1. What is pollution?

Answer- The accumulation of unwanted substances in the environment due to human activities is called pollution. It causes harm to air, water, soil, and living organisms and also affects human health.

Q-2. What are the main sources of air pollution?

Answer- The major sources of air pollution are vehicle emissions, industrial smoke, thermal power plants, mining work, and burning of fuel. Due to these, harmful gases and particles get mixed in the air.

Q-3. What is the greenhouse effect?

Answer- Greenhouse effect is that process in which CO_2, methane, and other gases trap the out-going infrared radiation from the earth, due to which the global temperature increases. This is considered the main cause of global warming.

Q-4. Write two effects of noise pollution.

Answer- Due to noise pollution, high blood pressure, disturbance in sleep, mental stress, and reduction in work efficiency occur. Listening to high noise for a long time can also cause loss of hearing.

Q-5. What is eutrophication?

Answer- The excessive growth of algae and aquatic plants due to the excess of nutrients in water is called eutrophication. Due to this, dissolved oxygen in water decreases and a threat is created for aquatic organisms.

2

ENVIRONMENT AND HEALTH

Introduction

Environment and human health are deeply interconnected. Polluted air, water and food cause many diseases. In this chapter, the **effects of environment on health, sanitation, water-borne diseases** and the effects of pollutants are studied.

Health and Various Influences on It

Health: Health is the result of the **interaction** of various influences on the body.

Factors Affecting Health

- **Genetic influences:** Traits received from parents affect health
- **Behavioural influences:** Smoking, intoxication, wrong eating habits affect health
- **Environmental influences:** Physical, chemical, biological, social and psychological factors affect health

Sanitation and Other Problems in Habitations

- Unplanned urbanization
- Improper disposal of waste
- Lack of toilets
- Lack of clean drinking water
- Poor drainage system

Village

- Main problem: **Lack of clean drinking water**
- **Causes:** Use of contaminated water, open defecation, inadequate cleanliness
- **Effects:** Increase in diseases, rise in infant mortality rate

- **Other problems:** Poor ventilation, smoke-filled houses

Town or Small City

- Poor drainage system
- Accumulation of dirty water
- Animal excreta
- Bad roads and traffic
- **Result:** Increase in pollution and health problems

City

- Unplanned development
- Problem of slums
- Lack of clean water and sanitation
- Industrial pollution
- Traffic pollution

(A) Slums

- Overcrowding
- Lack of ventilation
- Smoke and dirt
- Water-borne diseases (diarrhoea, dysentery)

(B) Industrial Areas

- Air, water and soil pollution
- Heavy metals and toxic substances

(C) Residential and Commercial Areas

- Crowding and traffic

- Noise pollution
- Accumulation of waste

(D) Traffic

- Smoke and dust from vehicles
- Increase in air pollution

Causes Due to Pathogens, Vectors and Chemical Pollutants

- Diseases spread through contaminated water
- 80–90% sewage goes into water without treatment
- Vectors like mosquitoes spread diseases

Modes of Spread of Diseases

- By contact
- By medium (water, food)
- By vector (Vector)

Example: Malaria, Dengue, Filaria (by mosquito)

Water-borne Diseases, Their Spread and Consequences

Water-borne diseases

- Typhoid
- Cholera
- Diarrhoea
- Hepatitis

Effects

- Death of children
- Digestive system problems

- Skin and eye diseases
- **Causes:** Contaminated drinking water, poor sanitation

Air Pollutants Associated with Agriculture, Industry, Mining and Urban Areas

- Air pollution is a serious threat to health
- **Effects:**
  - Cough, asthma, headache
  - Lung diseases

Air Pollution from Agricultural Activities

- Pesticides
- Burning of crop residues
- Gases from diesel pumps and tractors

Industrial

- Smoke
- Carbon dioxide (CO_2)
- Sulphur dioxide (SO_2)
- **Others:** Toxic gases from chemical industries

Mining Areas

- Dust particles (Particulates)
- Sulphur and nitrogen oxides
- **Diseases:**
  - Silicosis
  - Asbestosis
- **Heavy metals and radioactive elements are** also found

Pollution in Urban Areas

- **Main pollutants:** Dust particles, vehicle emissions, **SO_2, NOx, CO**
- **Sources:**
  - Traffic
  - Industries
  - Diesel vehicles

Cancer Causing (Carcinogens) Environmental Substances and Their Control

- **Cancer:** A disease caused by **uncontrolled growth** of cells
- **Carcinogens:** Substances that cause cancer

Tobacco

- **Cause of 85% cancer deaths**
- **Effects:** Cancer of lungs, mouth, throat
- Risk decreases by quitting smoking

Ultraviolet (UV) Radiation

- Rays coming from the sun
- **Effects:** Skin cancer, damage to skin
- **Prevention:** Protection from sunlight, wearing clothes

Ionizing Radiation

- **Sources:** X-ray, radioactive substances
- **Effects:** Leukemia, other cancers

Chemicals and Other Elements

- Pesticides, industrial chemicals, heavy metals
- **Effects:** Cell changes, cancer

Methods of Control

- Limited use of chemicals
- Safety measures
- Avoidance of tobacco
- Pollution control
- Clean environment

Toxicity of Heavy Metals and Its Prevention Measures

- **Heavy metals:** Accumulate in the body and cause harm

Main metals: Lead, mercury, arsenic, cadmium

Effects

- Nervous system affected
- Kidney/liver damage
- Skin diseases
- Cancer

Prevention: Clean water, pollution control, industrial waste management

Occupational Health Hazards

- **Occurring at workplace:**
  - Injury
  - Respiratory diseases
  - Cancer
  - Mental diseases

Heavy Physical Work

- **Work:** Mining, construction, agriculture

Effects: Muscle disorders, injury, disability

Black Lung Disease

- **Cause: Coal dust**
- **Effect: Lungs affected**

Noise

- More than 80–90 dB is harmful

Effects

- Psychological
- Hearing (deafness)
- Communication barrier, irritability,

Chemicals and Biological Agents (Agents)

Chemical Agents

- **Workers in many industries:** come in contact with various chemicals
- **These chemicals:** are hazardous, toxic, carcinogenic

Main industries where impact is more

- Textile mills
- Cement industry
- Construction industry

Main harmful substances: Enzymes, chromium, zinc, lead (Lead)

Diseases caused by them

- Lung cancer
- Bladder cancer
- Skin cancer

- Mesothelioma
- Liver cancer

Prevention:

- Initial safety measures necessary
- **Workers** should be protected from chemicals
- **Special attention:** protection from carcinogenic substances

Workplace related hazards:

- Occupational dust
- Lack of ventilatio
- Particles of construction material

All these: are harmful to workers' health

Special facts

- **Before 1947:** Silicosis was less found in coal mines
- **Later:** Silicosis increased as a hazard

Other major diseases

- Silicosis
- Pneumoconiosis
- Byssinosis

These diseases especially: are found in mine and textile mill workers

TOP 5 QUESTIONS

Q-1. Describe the factors affecting health.

Answer- Health is affected by three main factors – genetic, behavioural and environmental. Genetic traits are inherited from parents, behavioural factors include lifestyle and environmental factors include air, water, food and social conditions.

Q-2. What are water-borne diseases? Write their causes and effects.

Answer- Diseases spread by consumption of contaminated water are called water-borne diseases. Their causes are dirty water, poor sanitation and sewage. Effects include diarrhoea, cholera, typhoid, digestive system problems and death of children.

Q-3. Write the sources and effects of air pollution.

Answer- Sources of air pollution are vehicles, industries, agricultural activities and mining. It causes cough, asthma, lung diseases and headache. Long-term exposure has serious effects on health.

Q-4. What are carcinogens? Write their types.

Answer- Carcinogens are substances that cause cancer. Their main types are- tobacco, ultraviolet radiation, ionizing radiation and chemical substances. They increase uncontrolled growth of body cells.

Q-5. What are occupational health hazards? Explain with examples.

Answer- Health problems caused by hazards present at the workplace are called occupational health hazards. Example- silicosis in mining, byssinosis in textile industry and deafness due to noise. These are caused by dust, chemicals and noise.

3

NATIONAL ENVIRONMENTAL ISSUES

Introduction

Constant changes are occurring in the environment due to human activities, which have a negative impact on air, water and soil. Increasing industrialization, transportation and urbanization are making pollution more serious. In this chapter, we will understand the types of pollution, its causes, effects and control measures in a simple way, so that the importance of environmental conservation can be better known.

Land And Forests Of India

India is the seventh largest country in the world, which is only 2.42% of the world's total area. Its total **land is 32,87,263 sq km.**

Land:

Northern Plains: This is made of alluvial soil and is the "granary" of the country.

Peninsular Plateau: This is rich in minerals and is called the "storehouse of minerals".

Coastal Areas: These are important for fishing and marine activities.

Forests:

About 49,000 species of plants and 81,000 species of animals are found in India.

Major Forests: Tropical rain forests, tropical deciduous forests, temperate broadleaf forests, coniferous forests and alpine/tundra vegetation.

Only 11.48% of India's geographical area comes under dense forests.

Population Growth

Human population poses a threat in two ways: the increasing number of people and the impact of each individual on the environment.

Main Epochs of Human Population Growth:

There have been four main periods of population growth in history: Hunter/gatherer period, agricultural growth period, industrial revolution and the present period (rapid growth in developing countries).

Demographic Characteristics:

Size: According to the 2001 census, India's population was 102.7 crore.

Growth Rate (g): It is calculated based on the difference between birth rate and death rate

Migration: Youth going abroad for better opportunities is 'emigration', while moving from one region to another within the country is called 'internal immigration'.

Exponential Growth Curve: When growth increases in a fixed proportion, a J-shaped curve is formed.

Population Structure

Density:

Number of individuals per unit area. High density decreases per capita income and increases pressure on natural resources.

Dispersion: People are not uniformly distributed; only one-third of the total land is inhabited by humans.

Age Structure: It helps in estimating the work force (15-59 years) and future education/health needs.

Sex Ratio: Number of females per 1000 males. In 2001, India's sex ratio was 933, which is constantly falling.

Human Population And Environment

Impact on Environment: Humans have changed the environment through agriculture, housing and control over diseases. However, as a result, we have to face disasters like famine, inadequate shelter and tsunami/earthquakes.

Standards of Living: It is measured by infant mortality rate (low), per capita income (high), literacy and balanced consumption of resources.

Urbanization And Environmental Problems

Urbanization and Limited Energy Resources: India is the sixth largest energy consumer in the world. 75% of our energy comes from thermal sources.

Urbanization and Water Scarcity: There is only 3% freshwater on Earth. The main causes of water crisis in cities are carelessness, lowering of water table and pollution (nitrate, chemicals, sewage).

Floods and Drought: Deforestation and heavy rainfall cause floods, while less than average rainfall causes drought.

Decline In Natural Resources

Due to urbanization and unsustainable development, issues like deforestation, desertification and loss of biodiversity are interconnected.

TOP 5 QUESTIONS

Q-1. What are the main features of India's land and forests?

Answer- India is the seventh largest country in the world, which has 2.42% of the world's total land. Its Northern Plains are called "granary" due to fertile alluvial soil, while the Peninsular Plateau is the "storehouse" of minerals. Diverse types of forests from tropical rain forests to alpine vegetation are found in the country.

Q-2. What does the 'exponential growth curve' of population growth show?

Answer- When the growth rate of a population is such that it increases rapidly in a fixed proportion at all times, it is called exponential growth. The growth graph of human population forms a 'J-shaped' curve. It shows that as the population increases, the pressure on resources increases even more rapidly.

Q-3. What is the impact of increase in population density on society and environment?

Answer- Due to increase in population density, per capita income decreases and there is a scarcity of natural resources like water, land and fuel. As a result, prices of essential items increase and pressure on health services and education increases. Simultaneously, there is a heavy increase in air, water and soil pollution.

Q-4. Explain the situation of water crisis and pollution due to urbanization.

Answer- Due to increasing urbanization, the water table is falling and water pollution is increasing by discharging untreated sewage into rivers. This spreads diseases like cholera, dysentery and jaundice. It is estimated that by the year 2050, we will need three times more water compared to current availability.

Q-5 What is the current status of energy resources in India and what are the future challenges?

Answer- India is the world's sixth largest energy consumer, where energy demand is increasing by 3.6% annually. 75% of our electricity comes from thermal, 21% from hydroelectric and only 4% from nuclear sources. Due to increasing population, the demand for electricity will cross 9,50,000 MW by 2030.

4

GLOBAL ENVIRONMENTAL ISSUES

Introduction

We live in a world where there are many reasons for the beauty of nature, but our human activities are changing the environment that provides us life. In this lesson we will study those global problems and their solution plans that are affecting the entire earth.

Major Global Environmental Issues

- Urbanization and industrialization have seriously affected the life supporting system.
- **Main global issues:**

(1) Green house effect and global warming,

(2) Loss of biodiversity,

(3) Desertification,

(4) Depletion of ozone layer,

(5) Acid rain,

(6) Oil spill,

(7) Disposal of hazardous wastes.

Green House Effect and Global Warming

What is Green House Effect?

- **Basic information**: A 'green house' is a glass chamber in which plants are grown by trapping solar energy.

- **Process:** Sunlight enters through the glass, but the heat (infrared radiation) produced from it cannot go out, due to which the chamber remains warm.

Global Warming and Green House Effect

- **Basic information:** It is a natural phenomenon which has been occurring for millions of years and makes life possible on earth.
- **Average temperature:** Due to this, the average temperature of the earth remains 15°C; without it, it would be -17°C.
- **Main gases and sources:**
  - **Carbon dioxide (CO_2):** Burning of fossil fuels, deforestation.
  - **Chlorofluorocarbons (CFCs):** Refrigeration (AC/Fridges), solvents, aviation fuel.
  - **Methane (CH_4):** Paddy cultivation, cattle, termites, landfills.
  - **Nitrogen oxides (N_2O):** Fertilizers, burning of wood and crop residues.

Effect on Living Beings

Increasing amount of CO_2 increases photosynthesis in plants, but the number of weeds and harmful pests also increases.

Strategies to cope with 'Green House' Effect

- Increase fuel efficiency of vehicles.
- Find alternatives of non-fossil fuels like solar energy.
- Reduce deforestation and promote **afforestation.**

Biodiversity

Basic information: The composition of plants and animals of a region is called biodiversity.

Classification

- **Species:** Total number of biological species (more than 2 lakh in India).
- **Genetic:** Genetic variation within the same species.

- **Ecosystem:** Lakes, deserts, mangroves, coral reefs etc.

Reasons for loss of biodiversity

(1) Loss of natural habitats: Deforestation for agriculture, dams and settlements.

(2) Pollution: Changing environment due to global warming is making species extinct.

(2) Pollution: Changing environment due to global warming is making species extinct.

(4) Exotic species: Invasion of foreign weeds like Parthenium, Argemone and Lantana.

(5) Environmental degradation: Effect of oil spill, nuclear radiation and UV-rays.

Desertification

- **Basic information:** Destruction of the biological potential of land which turns it into desert.
- **Main factors:** Over cultivation, overgrazing, deforestation and salt accumulation due to irrigation.

(A) Over cultivation

Ploughing disturbs the soil and increases erosion (cutting) by wind and water.

(B) Overgrazing

Hooves of animals loosen the land surface, due to which soil becomes unprotected.

(C) Deforestation

Roots of plants bind the soil; cutting of forests makes the land barren.

(D) Salinization due to irrigation

After evaporation, salt of irrigation water accumulates in soil making it unsuitable for agriculture.

Depletion of Ozone Layer

Structure of ozone layer

- Ozone O_3 in the stratosphere acts as a filter to block harmful ultraviolet (UV) radiations from the sun.

Causes of ozone layer depletion

- **Natural:** Hydrogen oxides, methane and volcanic eruptions.

- **Human made:** Use of chlorofluorocarbons (CFCs) in refrigeration (AC/Fridges). One chlorine atom can destroy 1,00,000 ozone molecules.

Effects of O_3 layer depletion

- **Human:** Skin cancer, cataract, DNA damage and weakening of immune system.
- **Others:** Stopping of plant growth, destruction of plankton and breaking of plastics.

Measures to prevent depletion of ozone layer

Ban on CFCs under the **Montreal Protocol** and the use of HCFCs as a temporary alternative.

Acid Rain

Basic information: Rain which is more acidic than normal due to SO2 and NOx gases.

Harmful effects of acid rain

(i) Aquatic life: Due to low pH, eggs of fish and frogs get destroyed.

(ii) Terrestrial life: Yellowing of leaves and leaching of fertile metals from soil.

(iii) Effect on forests: Destruction of vegetation.

(iv) Buildings: Damage to stone (marble) of monuments like Taj Mahal.

Policies to deal with acid rain

- Use of low sulphur fuels or natural gas.

Nuclear Disasters

- Leakage of radioactive materials from nuclear plants.

Impact of nuclear disasters on environment

- **Immediate effect:** Massive destruction like Japan (Hiroshima-Nagasaki).
- **Slow effect:** Blood cancer (leukemia), miscarriage, infant mortality and radioactivity in food chain (milk).

Oil Spill

Definition: Spreading of layers of oil on water bodies, which is a severe form of marine pollution.

Causes of oil spill

- Accident of marine tankers, leakage in supply lines or oil discharge from motor boats.

Impact of oil spill on marine life

- Suffocation of fishes and plankton; reduction of oxygen in water.

Impact of oil spill on terrestrial life

- Adverse effect on coastal cities, tourism, swimming and hotel business.

Hazardous Waste

- **Basic information:** Substances which are highly harmful for public health and environment.
- **Characteristics:** Toxicity, inflammability, corrosive and reactive (explosive).
- **Disposal problems** : Toxic gases from burning of plastic, and cancer risk from agricultural waste (nitrogen).

TOP 5 QUESTIONS

Q-1. Name any four gases responsible for global warming.

Answer- Carbon dioxide (CO2), methane (CH4), nitrogen oxides (N2O) and chlorofluorocarbons (CFCs) are mainly responsible for global warming. These gases trap the heat coming from the earth in the atmosphere.

Q-2. How is irrigation responsible for desertification?

Answer- Salts (salt) are dissolved in irrigation water. When water evaporates, salt keeps accumulating in the soil. Due to excessive accumulation of salt, the land becomes unsuitable for agriculture and ultimately turns into desert.

Q-3. What is the importance of ozone layer for us?

Answer- Ozone layer prevents harmful ultraviolet (UV) radiations coming from the sun from reaching the earth's surface. It works like a filter, without which diseases like skin cancer, cataract and DNA damage may increase.

Q-4. How does acid rain affect historical monuments?

Answer- Acid present in acid rain reacts chemically with marble and limestone. Due to this, the layers of stone gradually start dissolving and falling off, due to which monuments like Taj Mahal of Agra are getting damaged.

Q-5. What are the main characteristics of hazardous waste?

Answer- The four main characteristics of hazardous waste are:

(1) Toxicity - it is poisonous;

(2) Inflammability - it can easily catch fire;

(3) Corrosive - it can corrode metals; and

(4) Reactive - it can explode.

5

BIODIVERSITY CONSERVATION

Introduction

Extraordinary diversity is found on Earth, ranging from microorganisms to large animals and plants, which makes this planet beautiful. This diversity is spread from mountains to the depths of the sea, but due to increasing population it has been seriously threatened. In this lesson we will study the importance of biodiversity, its causes of loss and conservation efforts.

What is Biodiversity

All kinds of living organisms found on earth collectively are called **biodiversity.** It has three main levels:

- **Genetic diversity:** It shows variation at the level of genes within species, which helps them to adapt to changing environment.
- **Species diversity:** It shows the number of species and their varieties in a geographical area. It is measured in terms of 'species richness' (number) and 'species abundance' (expected number).
- **Ecosystem diversity:** It shows the presence of different types of ecosystems (such as desert, rainforest, coral reef).

Hot Spots of Biodiversity

- **Definition:** Areas which are extremely rich in biodiversity but are under threat are called **hot spots** or "mega diversity regions".
- **Criteria:** The area should have more than 1500 endemic species and 70% of its original habitat should have been destroyed.

- **Hot spots in India:** Out of the 25 hot spots of the world, 2 are in India: **Western Ghats** and **Eastern Himalayas.**

Why Biodiversity is Important

The benefits of biodiversity can be divided into three categories:

Ecosystem Services

- **Water and soil conservation:** Vegetation maintains the water cycle and prevents soil erosion.
- **Nutrient cycling:** Microorganisms and earthworms convert dead matter into manure and make the soil fertile.
- **Reduction in pollution:** Wetlands absorb pollutants and purify water.
- **Climate stability:** Dense forests help in maintaining rainfall and controlling temperature.

Biological Resources of Economic Importance

- **Food and medicine:** About 7000 plant species are used for medicinal purposes (Ayurveda).
- **Industrial materials:** Wood for furniture, bamboo for paper and cotton/jute for fibres are used.
- **Crop improvement:** Genes of wild species are used to increase yield and resistance of crops.

Social Benefits

- **Recreation:** National parks, ecotourism and photography are valuable.
- **Cultural values:** Plants like Tulsi, Peepal and Khejri are worshipped.

Research, Education and Monitoring

Natural areas act as living laboratories for the study of ecology and development.

Uniqueness of Indian Biodiversity

- India is only **2.4%** of the world's land area but **7-8%** of the world's **living species** are found here.

- There are more than 45,000 species of plants and 81,000 species of animals here.
- **Regional specificity:** North-east India is famous for orchids, bamboo and banana, while endangered 'Great Indian Bustard' is found in the grasslands of Gujarat.

Causes of Biodiversity Loss

The main causes of destruction are as follows:

- **Habitat destruction:** Homes of organisms are being destroyed due to deforestation, mining and road construction.
- **Introduction of exotic species:** Exotic species like Parthenium (Congress grass) and Lantana are destroying local plants.
- **Pollution:** Acid rain, water pollution and oil spills in sea are destroying aquatic life.
- **Population growth and poverty:** Over-exploitation of resources is causing damage to biodiversity.
- **IUCN Red List:** It is the list of endangered species. In India, 18 animals and 44 plant species are 'critically endangered'.

Conservation of Biodiversity

Conservation is the planned management of natural resources so that the needs of present and future generations can be fulfilled. Its two main objectives are: to save species from extinction and to prevent destruction of ecosystem.

Conservation Strategies

It is divided into two categories:

In-situ Methods (Conservation in natural habitat)

- **National parks and sanctuaries:** There are 96 national parks and 500 wildlife sanctuaries in India. **Example:** Jim Corbett (Uttarakhand), Kanha (MP), Gir (Gujarat).
- **Biosphere Reserve**: It has three zones:

- **Core zone:** Fully protected, human activity is prohibited here.
- **Buffer zone:** Limited human use is allowed.
- **Transition zone:** The outermost part, settlements and agriculture are allowed here.

Species-oriented Projects:

When special and directed efforts are needed to save some species from extinction, 'species-oriented projects' are run. Its main examples are as follows:

Project Tiger

- **Objective:** To conserve tiger population and save them from extinction.
- **Start:** It was started in 1973.
- **Status:** In 1970 the number of tigers had decreased from 40,000 to only 1200. With the help of the project, by 1990 it increased to 3500, however in the 2008 census it again decreased to 1411.
- **Strategy:** Complete ban on trade of tiger products and extensive management plans have been made to improve their habitats.

Project Elephant

- **Objective:** To protect the population of elephants and their habitats for long term.
- **Start:** It was started in February 1992.
- **Area:** It is currently implemented in 12 states of India (such as Assam, Karnataka, Kerala, Uttarakhand, West Bengal etc.).

Crocodile Breeding and Management Project

- **Objective:** To save three endangered species of crocodiles (freshwater, saltwater and gharial).
- **Start:** It was started in 1976 with the cooperation of FAO-UNDP.
- **Technique:** In this, 'captive breeding' (Capture Breeding) technique was used, where eggs were collected from the forest, reared at centres and then released back into the forest.

- **Conservation:** For this, 11 sanctuaries have been declared, among which 'National Chambal Sanctuary' of Madhya Pradesh is prominent.

Ex-situ Conservation

- **Botanical gardens and zoos:** Artificial breeding and propagation of endangered species.
- **Gene banks and seed banks:** Collection of genetic material of crops and domesticated animals.
- **Cryopreservation:** Preserving samples at -196°C in liquid nitrogen.
- **Legal measures:** Prevention of illegal hunting and trade through Wildlife Protection Act (1972) and Biological Diversity Act (2002).

TOP 5 QUESTIONS

Q-1. Describe the different levels of biodiversity.

Answer- There are three main levels of biodiversity:

- **Genetic diversity:** Variation found at the level of genes within the same species, which helps organisms to adapt to changing environment.
- **Species diversity:** Total number of different species and their varieties found in a geographical area.
- **Ecosystem diversity:** Presence of different types of ecosystems (such as desert, rainforest, lake) in an area.

Q-2. What is the difference between In-situ and Ex-situ conservation methods?

Answer- The main difference between these two methods is as follows:

- **In-situ conservation:** In this, plants and animals are conserved in their natural habitats (such as national parks, wildlife sanctuaries).
- **Ex-situ conservation:** In this, species are kept in safe places outside their natural habitat (such as zoos, botanical gardens, gene banks).

Q-3. What do you understand by 'Hot Spots' of biodiversity? Write the names of two hot spots of India.

Answer- Hot spots are those areas which are extremely rich in biodiversity but are under threat of destruction. It is necessary to have at least 1500 endemic species here. Two main hot spots of India are: (1) Western Ghats and (2) Eastern Himalayas.

Q-4. What are the main causes of biodiversity loss?

Answer- The main causes of biodiversity destruction are as follows:

- **Habitat destruction:** Deforestation for agriculture, industries and roads.
- **Introduction of exotic species:** External species destroying local species (such as Congress grass and water hyacinth).
- **Over-exploitation:** Excessive hunting of organisms for food, medicine and skin.
- **Pollution:** Loss of aquatic and terrestrial life due to water, air and marine pollution.

Q-5. Explain the three 'zones' of Biosphere Reserve.

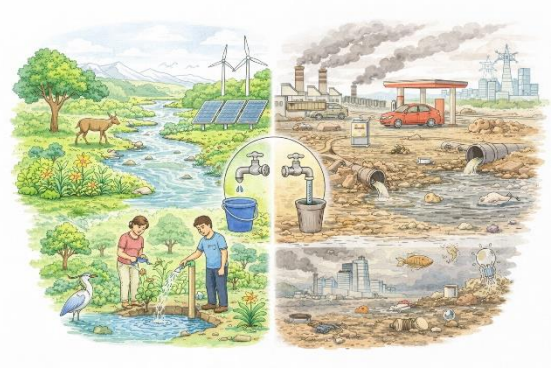
Answer- A biosphere reserve has three main parts:

- **Core Zone:** It is the innermost and fully protected area where human activities are prohibited.
- **Buffer Zone:** The area around the core zone where only research and education are allowed.
- **Transition Zone:** The outermost part where local people can make settlements and carry out economic activities like agriculture.

6

WATER AND ENERGY CONSERVATION

Introduction



All living organisms require both water and energy to survive. Human beings have reduced the availability of water by excessive exploitation of water resources and have polluted natural water bodies. The increasing problem of two basic resources like water and energy can be solved only by wise use and effective conservation.

Water as a Natural Resource

- **Definition:** Water is a very important natural resource because without it life is not possible.
- About three-fourths of the earth is covered with water, but less than **1% of it is fresh water** which is suitable for human use.
- According to the United Nations, by the year 2025 about two-thirds of the world's population will face a severe problem of shortage of drinking water.

Causes Responsible for Increasing Demand of Water

The following are the main factors behind the increasing demand of water:

(A) Expansion of irrigation: India is an agricultural country. In the year 2000, 81% of the total water used was used for irrigation.

(B) Industrial use of water: A large amount of water is used in industries during manufacturing processes and for cooling machines.

(C) Increasing demand of growing population: After independence, the population of India has increased three times, due to which the demand for drinking and domestic use of water has increased.

(D) Changing lifestyle: A large amount of water is spent on washing machines, dishwashers and entertainment places like water parks.

Various Methods of Water Conservation

The following methods can be adopted for water conservation:

(i) Afforestation: Plants play an important role in the water cycle through **transpiration** and maintain water balance.

(ii) Recycling of water: Industrial or domestic wastewater can be recycled for irrigation or municipal use.

(iii) Reuse of wastewater: 'Grey water' (water from bathing/washing clothes) can be used for watering plants.

(iv) Water harvesting: The process of collecting rainwater and using it or sending it into the ground.

(v) Recharge of groundwater: Flood water can be sent underground through aquifers or deep pits.

Management of Water Resources

There are two main strategies for efficient management:

Reduction in wastage of water

- Creating public awareness (through TV, radio, street plays).
- Installing water meters and immediate repair of leaking pipes.
- Use of low water toilet flush and shower.

Storage and recharge

- Collection of rainwater and recharge of underground water.
- Removing pollutants from polluted water and making it usable.

National River Conservation Plan

There are two main schemes to make the rivers of India pollution free:

1. **Ganga Action Plan (GAP):** Its first phase was completed in 1993 for cleaning the Ganga river.
2. **Yamuna Action Plan (YAP):** Started in April 1993, its objective is to remove pollutants from Yamuna and clean it.

Energy Conservation

- **Definition:** The capacity to do work is called energy (Energy).
- Energy can neither be created nor destroyed, it can only be converted from one form to another.

Use of Energy by Society

- The human body gets energy in the form of ATP (Adenosine Triphosphate).
- Energy is used in cooking, electrical appliances, transport (CNG/petrol), industrial processes and agriculture.

Conventional and Non-conventional Sources of Energy

- **Conventional sources:** These are **fossil fuels** such as coal, oil (petroleum), and natural gas. Thousands of years are required for their formation.
- **Non-conventional sources:** These are inexhaustible sources.
    - **Solar energy:** Obtained from the sun, pollution-free energy.
    - **Wind energy:** Generation of electricity by windmills.
    - **Hydropower:** Electricity (Hydel power) from water stored in dams.
    - **Biomass:** Energy obtained from plants and animal waste (biogas).
    - **Bio-diesel:** Fuel obtained from oil of plants like Jatropha (Ratanjot).

Development in Energy Efficiency

- Save electricity in homes (switch off when not in use).
- Use fuel efficient stoves and solar cookers.
- Use **car pool** in transport and use public vehicles.
- Switch off the engine of vehicle when stopping at traffic signals.

Promotion of Solar Energy in India

- **MNRE (Ministry of New and Renewable Energy):** Provides subsidy and easy loans for the use of solar energy.
- **CFL (Compact Fluorescent Lamps):** These consume 95% less electricity than traditional bulbs.
- **BEE rating:** Star rating (1 to 5 stars) is given on electrical appliances by Bureau of Energy Efficiency (BEE). 5-star appliances save the most energy.
- **Transport:** Hydrogen fuel cells and hybrid vehicles are being developed to save energy.

Methods of Energy Conservation and Better Use of Fuel:

1. It is necessary to increase **energy efficiency** to save energy.

2. Energy can be saved by increasing the fuel efficiency of motor vehicles.

3. **Hybrid, electric and fuel cell** vehicles cause less pollution and are more efficient.

4. Small size vehicles and public transport reduce energy consumption.

5. Use of biofuels and renewable energy should be increased instead of petroleum.

TOP 5 QUESTIONS

Q-1. What are the main causes of increasing demand of water?

Answer- The main causes are increasing population, expansion of irrigation, industrial use and changing lifestyle (such as use of washing machines and showers). Due to these, water consumption is continuously increasing.

Q-2. What is the difference between conventional and non-conventional energy sources?

Answer- Conventional sources (such as coal, oil) are non-renewable and available in limited quantity. Non-conventional sources (such as solar energy, wind energy) are renewable, do not cause pollution and will never get exhausted.

Q-3. What is the objective of National River Conservation Plan (GAP and YAP)?

Answer- The main objective of these schemes (Ganga Action Plan and Yamuna Action Plan) is to remove pollutants and sewage discharged by cities and industries into rivers and to clean and conserve rivers.

Q-4. What is BEE star rating system and what is its benefit?

Answer- BEE star rating shows the energy efficiency of electrical appliances from 1 to 5 stars. The more the stars, the less electricity the appliance will consume, which will save both energy and money.

Q-5. Write any three incentives given by the government to promote the use of solar energy in India.

Answer- Answer- The three incentives given by the government to promote the use of solar energy in India are as follows:

(1) Provides subsidy and easy loans on purchase of solar equipment,

(2) Provides concession in duty on import of raw materials, and

(3) Provides financial assistance to supply electricity in rural areas through solar pumps and solar photovoltaic systems.

7

FRESH WATER RESOURCES

Introduction

Fresh water is essential for life on earth. Although a large part of the earth is covered with water, the amount of usable fresh water is extremely limited. In this lesson we will study in detail the sources of water, its distribution and the measures to maintain its quality.

Distribution of Fresh Water

- **Total availability:** Only **2.7%** of the total water on earth is fresh water.
- **Storage:** A large part of it is in **glaciers**, ice caps and clouds.
- **Accessible sources:** Only **0.5%** of water is available for use in the form of lakes, rivers and groundwater.
- **Condition of rivers:** Only **0.1%** of the total available fresh water is in rivers.

Distribution of Water Resources in India

- **Rainfall level:** The average annual rainfall in India is **1170 mm**, which provides about 4000 BCM water.
- **Monsoon:** Most of the rainfall (about 3/4 part) occurs between **June to September.**
- **Surface water:** Due to geographical limitations, out of 1800 BCM surface water only **700 BCM** is usable.
- **Groundwater:** The amount of replenishable groundwater in the country is about **600 BCM.**
- **Features:**
    - **Rivers:** Their flow is in one direction and velocity (0.1 to 1 meter/second) is high.
    - **Lakes:** Their flow is very slow and in many directions.
    - **Groundwater:** It flows very slowly under the layers of soil.

Water Collection

- **Use:** Water is mainly collected for **domestic**, agricultural and industrial purposes.
- **Natural purity:** Groundwater seeps through soil, therefore it has fewer harmful microorganisms.

Water Treatment

- **Definition:** Improving the quality of water so that it can be safe for specific use.
- **Objective:** To protect people's health by removing harmful bacteria and toxic chemicals from water.

Methods of Water Treatment

- **Clarification:** Making water transparent by removing impurities.
- **Disinfection:** Destroying microorganisms.

(A) Purification or Sedimentation: Allowing heavy impurities to settle down by gravity.

- **Coagulation and flocculation:**
  - **Alum i**s added to remove colloidal particles.
  - Particles combine to form large flocs and settle down.
- **Filtration:** Passing water through layers of sand or gravel. Use of **rapid sand filter** is common.

(B) Disinfection:

- **Chlorination:** It is the most effective and cheapest method.
- **Ozone:** It is a powerful oxidant but unstable and expensive.
- **Ultraviolet radiation:** Electricity is required to kill microorganisms.

Traditional Methods of Water Purification

- Since ancient times (2000 BC), there has been a tradition of **boiling**, filtering and storing water in copper vessels.
- **Robert Koch** established the scientific importance of disinfection.

Other Methods of Water Treatment

- **Removal of fluoride:**

- **Fluorosis:** Excess fluoride causes disease of teeth and bones.
- **Limit:** Safe level is **1.5 mg/litre.**
- **Nalgonda technique:** Removal of fluoride using alum and lime.

- **Domestic defluoridation:**
  - Water can be purified in a 60 litre bucket.
  - **Process:** Alum, lime/sodium carbonate and bleaching powder are mixed in water.
  - **Mixing time:** Mixed for about 20 minutes and then left for a few hours.
  - **Result:** Clear water from above is taken for drinking, impurities at the bottom are removed.
  - **Community method:** Nalgonda Technique is used on large scale.
- **Removal of iron:** Excess iron in hand pumps spoils taste and colour.
  - **Treatment:** Use of aeration and **lime stone** filter.
- **Removal of arsenic:**
  - It is highly toxic and causes cancer (especially in West Bengal).
  - **Limit:** Acceptable amount is **0.05 mg/litre.**

Standard of Water Quality for Domestic, Industrial and Agricultural Use

- **Domestic:** Drinking water should be free from microorganisms and odour (BSI standard).
- **Industrial:** Water hardness should be low for protection of machines.
- **Agricultural:** Salinity in irrigation water should be controlled.

Requirement of Water Quality for Different Uses

- Due to industrialization and increasing population, the demand for water and its use area has expanded.
- **Main uses:** Water supply, recreation, fisheries, wildlife conservation, irrigation, cooling in power plants, and navigation.
- Drinking water should be the purest, whereas any type of water can be used for disposal of waste.

Ecological Water Requirements

- **Ecosystem:** A river has its own ecosystem along its flow which includes various organisms and seasons.
- **Importance of floods:** Flood water cleans impurities and renews by depositing new stones/sand.
- **Dilution:** Dilution of water is an important factor for solving pollution. In India, the concept of 10 times dilution is accepted.
- **Reduction in flow:** Due to withdrawal of water from rivers, their flow has decreased, making them "ecologically dead".

Major Water Quality Issues of India

The main problems related to water quality in India are as follows:

1. Water scarcity: Uneven distribution of rainfall and over-exploitation are the main causes.

Solution: Rainwater harvesting, recycling, and afforestation.

2. Pathogenic pollution: The most important issue in India. It occurs due to poor management of wastewater and its discharge into water bodies without treatment.

3. Oxygen depletion: Due to oxidation of domestic and industrial waste (organic matter), dissolved oxygen in water decreases, threatening aquatic life.

4. Eutrophication: Excess growth of algae occurs due to phosphates and nitrates from wastewater and agricultural residues, which disturbs the ecosystem.

5. Salinity: Salt content in surface and groundwater is increasing due to irrigation activities, industrial waste and intrusion of sea water in coastal areas.

6. Toxic pollution: Due to chemicals and industrial waste, water bodies are becoming poisonous and unfit for use.

7. Ecological health: Sensitive areas and rare species require special protection.

Use of Water in India

It is divided into two categories:

1. Abstractive use of water

- **Domestic supply:** 85% of India's population depends on groundwater. About 14 BCM water is used annually for this purpose.
- **Irrigation:** The **largest use of water in India (about 84%)** is for irrigation. About 460 BCM water is used annually.
- **Industrial use:** About 30 BCM water is used annually for cooling in thermal power plants.

2. Use as stream flow

- **Hydropower:** Its total capacity in India is estimated at 84,000 megawatt.
- **Fisheries:** India is the seventh largest fish producing country in the world.
- **Navigation:** 'Central Inland Water Transport Corporation' (IWTC) operates transport through rivers.
- **Community bathing:** Rivers are used for bathing on religious and cultural occasions (such as Kumbh Mela).

TOP 5 QUESTIONS

Q-1. Write the names of the main sources of fresh water.

Answer- The main sources of fresh water are rivers, lakes and underground water (groundwater). Only 2.7% of the total water available on earth is fresh water, most of which is stored in glaciers and ice caps.

Q-2. Describe the various stages of water treatment in sequence.

Answer- The main stages of water treatment are:

(1) Sedimentation (settling of heavy impurities),

(2) Filtration (filtering through sand filters), and

(3) Disinfection (killing germs by chlorine or ozone).

Q-3. Why is it necessary to ensure the quality of drinking water?

Answer- Pure drinking water is necessary to protect the health of the community. Unclean water spreads infectious diseases like cholera and dysentery, and toxic elements like arsenic can cause serious diseases like cancer.

Q-4. What are the harmful effects of excess fluoride and arsenic in drinking water?

Answer- Excess fluoride causes a disease of bones and teeth called 'fluorosis'. Excess arsenic can cause skin disorders, dark spots and serious diseases like cancer.

Q-5. Explain any three main issues of water quality in India.

Answer- Pathogenic pollution: Due to poor management of wastewater, the risk of water-borne diseases increases.

Oxygen depletion: Due to organic waste, dissolved oxygen in water decreases, causing death of aquatic organisms.

Eutrophication: Excess nutrients (phosphates/nitrates) cause excessive growth of algae, which disturbs the ecosystem.

8

METHODS OF WATER HARVESTING

Introduction

"Water is the nectar of life," but do you know that for every 50,000 grams of sea water, we have only 1 gram of potable water available? This chapter tells us that between increasing population and decreasing water levels, 'water harvesting' is not just an option, but an essential wisdom for the existence of our present and future generations.

Need for Water Conservation

- **Limited resources:** Only **2.7%** of the total water on earth is fresh water, most of which is in glaciers and clouds.
- **Uneven distribution:** Despite being the wettest country in the world, India faces water crisis because the average number of rainy days here is only **40** and the distribution is highly uneven (20 cm in Rajasthan and 13 meters in the North-East).
- **Increasing crisis:** Due to industrialization, urbanization and increasing demand of irrigation in agriculture, excessive exploitation of groundwater is taking place, due to which the water table is declining.
- **Future warning:** It is estimated that by 2050, half of India's urban population will face severe water scarcity.

Traditional Methods of Water Harvesting

- **Historical importance:** The history of water harvesting is 4,000 years old. The Indus Valley Civilization (Harappa and Mohenjodaro) had an excellent system of water supply and sewage.

- **Dholavira:** This city located in the Rann region of Gujarat was famous for its well-planned water harvesting system.

Ancient examples:

- Reservoirs made by cutting mountains in **Naneghat** near Pune provided water to traders.
- Water was collected on the rooftops of houses in Rajasthan and **stored in underground tanks.**
- Reservoirs and ponds made by cutting stones in forts like Raigad still exist today.

Modern Methods of Water Harvesting

Modern techniques are mainly divided into two parts:

A. Recharge of groundwater

- **Pits:** Pits 1-2 meter wide are made for shallow aquifers.
- **Trenches:** When rocks are at shallow depth, trenches 0.5-1 meter wide are made.
- **Recharge Shaft:** Shafts of 0.5 to 3 meter diameter which are 10-25 meter deep.
- **Existing wells and hand pumps:** These can be used by installing filters to recharge aquifers.

B. Storage of surface water

- In urban areas, rainwater is collected on rooftops and stored in underground tanks.
- This not only increases water supply but also raises the water table level.

Water Harvesting in Agriculture

- In dry areas, local people have reduced the demand for water by simple techniques.
- **Khadin:** Large reservoirs used in Rajasthan.
- **Local names:** 'Talai' in Uttar Pradesh, 'Haveli system' in Madhya Pradesh and 'Atar' in Bihar.

- **Success story:** Near the Ruparel river of Rajasthan, women revived a dry river by building 'Johad' (ponds) and dams.

Four Main Components of Water Harvesting at Household Level

1. **Collection:** Surface such as roof or courtyard from where water is collected.
2. **Storage:** Storing water in drums or underground tanks through gutters and pipes.
3. **Distribution:** Supplying water to plants through pipes or 'drip' irrigation.
4. **Maintenance:** Regular cleaning of gutter screens and tanks.

Benefits of Water Harvesting

- Reduction in water bill and conservation of valuable groundwater.
- Protection from flood and soil erosion in urban areas.
- Reduction in salinity, nitrate and fluoride content.
- Availability of good quality water for gardens.

TOP 5 QUESTIONS

Q-1. Why is there an urgent need for water conservation in India?

Answer- India is one of the wettest countries in the world, but the distribution of rainfall here is highly uneven in terms of time and space. Due to increasing population, urbanization and industrialization, the demand for water has increased. More water is also required for irrigation for food production, therefore conservation of water and prevention of misuse is essential.

Q-2. Describe any two evidences of water harvesting in ancient India.

Answer- Indus Valley Civilization: There was a well-planned system of water supply and sewage in Mohenjodaro and Harappa.

Naneghat (Western Ghats): Many reservoirs were carved in rocks here, which provided drinking water to ancient traders.

Q-3. Explain 'Recharge Pits' and 'Trenches' under modern water harvesting.

Answer- Recharge pits: These are made 1-2 meter wide and 1-1.5 meter deep to recharge shallow aquifers, which are filled with sand and gravel.

Trenches: These are made when permeable rocks are at shallow depth. These can be 0.5-1 meter wide and 10-20 meter long.

Q-4. What are the main benefits of rainwater harvesting?

Answer- Rainwater harvesting has many important benefits:

- It increases water availability and controls the declining groundwater level (water table).
- It is environment friendly and helps in dilution of elements like fluoride and nitrate.
- It protects from soil erosion and sudden floods in urban areas.

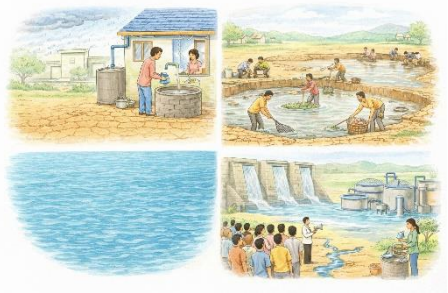
Q-5. What is the 'Khadin' and 'Johad' system of water harvesting in Rajasthan?

Answer- In low rainfall areas like Rajasthan, water harvesting is the basis of agriculture. Here 'Khadin' refers to large reservoirs and 'Johad' are earthen dams, which are used to stop water flow and collect it. After monsoon, this water is used for irrigation of crops.

9

WATER CONSERVATION AT DIFFERENT LEVELS

Introduction



Water is important for the existence of all living beings, but the availability of usable water is decreasing. In this lesson, we will learn about the methods of water conservation and the role of individuals, community and government.

Various Methods of Water Conservation

Conservation and management

- India has only **40 days** of rainfall and then a long period of dry season.
- Due to increasing population and increase in food production, excessive use of water is taking place.
- Water conservation is essential for the economic, social and cultural development of India.

Conservation techniques

(A) Conservation of surface water by storage: Collecting water by constructing reservoirs is the oldest method.

(B) Conservation of rain water: Techniques like contour farming control moisture and soil erosion.

(C) Underground conservation: Groundwater is less sensitive to pollution and a more reliable source.

(D) Catchment area protection (CAP): In hilly areas, check dams are constructed to allow water to seep into the ground.

(E) Inter-basin transfer of water: Transferring excess water of rivers like Ganga to water deficient areas through projects like Ganga-Cauvery link.

(F) Adoption of drip sprinkler irrigation: Drip irrigation saves 80% water. Sprinkler method reduces water consumption by 50% to 70%.

(G) Management of crop growing methods: Selecting crops with short duration and deep roots.

(H) Reducing evapotranspiration: Preventing water loss by applying mulching or plastic cover on soil

(I) Reducing evaporation from various water bodies: Installing wind breaks at the edges of reservoirs.

(J) Recycling of water: Reusing industrial and domestic wastewater after treatment for irrigation and industries

Conservation of water in domestic use

- Reducing leakage in pipes (in Delhi about 35-40% water is wasted in leakage).
- Using low flush toilets.
- Washing vegetables and utensils in a bowl instead of running tap.

Reducing water scarcity

- **Mulching:** Use of organic or inorganic materials to improve soil moisture and prevent evaporation.
- **Desalination:** Techniques like Reverse Osmosis to purify saline water.

Reuse of wastewater

- Wastewater contains nutrients like nitrogen, phosphorus and potash which are good for agriculture.
- Its reuse reduces both the demand for fresh water and water pollution.

Watershed management

- Watershed is the area from which a water body (river, lake) gets water.
- Forests prevent soil erosion and act as 'sponges' and 'filters' for water.

- **Single stem harvesting:** Cutting only one tree at a time so that forest cover is maintained.

Role of individual and community in overcoming water scarcity

Examples for individuals and community

- **Gandhigram (Kutch):** Villagers formed 'Gram Vikas Mandal', built a check dam and irrigated 400 hectares barren land.
- **Bhavnagar:** Students and employees dug a percolation tank which increased groundwater level of nearby wells.

Artificial recharge of groundwater

Recharge can be done in urban areas through pits, trenches and rooftop rainwater harvesting.

Government efforts on water conservation

- **National Water Policy 2002:** Emphasizes conservation and efficient use of water.
- Proposal of interlinking of rivers and making rainwater harvesting mandatory.

Revisiting traditional solutions

- **'Chipko Movement'** led by Sunderlal Bahuguna gave message of saving trees and water sources.

Some simple methods to save water

- Use bucket instead of pipe for washing car.
- Use water used for washing vegetables and rice for plants.

Case Study: Tarun Bharat Sangh (TBS)

- Under the leadership of **Rajendra Singh,** vegetation was grown on barren hills and 'Johad' were built.
- As a result, dry rivers (like Aravari) started flowing again and income from animal husbandry and agriculture began.
- **Social fencing:** Collective agreement by villagers to not cut trees and not allow grazing for a certain period.

TOP 5 QUESTIONS

Q-1. Why are drip and sprinkler irrigation better than traditional irrigation?

Answer- In surface irrigation, a large amount of water is wasted due to evaporation and seepage. Drip irrigation saves up to **80%** water by supplying water directly to the roots of plants, whereas sprinkler irrigation saves **50-70%.** These techniques are life-saving for water scarce areas.

Q-2. What is the importance of forests in watershed management?

Answer- Forests and their soil act like 'sponges' and 'filters', due to which the water coming out is pure. Forests prevent soil erosion and reduce the risk of floods. Also, the air above forests remains moist and cool, which helps in rainfall at local level.

Q-3. How did 'Tarun Bharat Sangh' revive rivers in Rajasthan?

Answer- Under the leadership of Rajendra Singh, villagers built traditional 'Johad' (ponds) and check dams. Villagers adopted 'social fencing' by mutual agreement, which stopped cutting of trees. Due to these efforts, dry rivers like Aravari and Ruparel started flowing again.

Q-4. Suggest any four measures to save water in domestic use.

Answer- Four measures to save water in domestic use:

- Repair leakage (dripping) in pipes and taps immediately.
- Do not keep tap open while brushing teeth or shaving.
- Install strainers in wash basin taps to save up to 50% water.
- Use leftover water after washing vegetables for irrigation of plants.

Q-5. What are the benefits of recycling wastewater?

Answer- Wastewater is not just waste but a resource containing nutrients like nitrogen and phosphorus. Its reuse reduces the demand for fresh water and decreases water pollution. It can be used for industrial cooling, irrigation of parks and flushing toilets.