BAOU
Education for All

Dr. Babasaheb Ambedkar
Open University
(Established by Government of Gujarat)

NAAC ACCREDITED A++ GRADE 3.55/4

BBA/DBA
SEMESTER - 1
BBAVAC107
DBAVAC107
Environmental Science

Message for the Students

Dr. Babasaheb Ambedkar Open (University is the only state Open University, established by the Government of Gujarat by the Act No. 14 of 1994 passed by the Gujarat State Legislature; in the memory of the creator of Indian Constitution and Bharat Ratna Dr. Babasaheb Ambedkar. We Stand at the seventh position in terms of establishment of the Open Universities in the country. The University provides as many as 54 courses including various Certificate, Diploma, UG, PG as well as Doctoral to strengthen Higher Education across the state.

On the occasion of the birth anniversary of Babasaheb Ambedkar, the Gujarat government secured a quiet place with the latest convenience for University, and created a building with all the modern amenities named 'Jyotirmay' Parisar. The Board of Management of the University has greatly contributed to the making of the University and will continue to this by all the means.

Education is the perceived capital investment. Education can contribute more to improving the quality of the people. Here I remember the educational philosophy laid down by Shri Swami Vivekananda:

> ***"We want the education by which the character is formed, strength of mind is Increased, the intellect is expand and by which one can stand on one's own feet".***

In order to provide students with qualitative, skill and life oriented education at their threshold. Dr. Babaasaheb Ambedkar Open University is dedicated to this very manifestation of education. The university is incessantly working to provide higher education to the wider mass across the state of Gujarat and prepare them to face day to day challenges and lead their lives with all the capacity for the upliftment of the society in general and the nation in particular.

The university following the core motto 'स्वाध्यायः परमम् तपः' does believe in offering enriched curriculum to the student. The university has come up with lucid material for the better understanding of the students in their concerned subject. With this, the university has widened scope for those students who
are not able to continue with their education in regular/conventional mode. In every subject a dedicated term for Self Learning Material comprising of Programme advisory committee members, content writers and content and language reviewers has been formed to cater the needs of the students.

Matching with the pace of the digital world, the university has its own digital platform Omkar-e to provide education through ICT. Very soon, the University going to offer new online Certificate and Diploma programme on various subjects like Yoga, Naturopathy, and Indian Classical Dance etc. would be available as elective also.

With all these efforts, Dr. Babasaheb Ambedkar Open University is in the process of being core centre of Knowledge and Education and we invite you to join hands to this pious *Yajna* and bring the dreams of Dr. Babasaheb Ambedkar of Harmonious Society come true.

Prof. Ami Upadhyay
Vice Chancellor,
Dr. Babasaheb Ambedkar Open University,
Ahmedabad.

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BBA/DBA

SEMESTER - 1

BBAVAC107

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ENVIRONMENTAL SCIENCE

BLOCK-1

BLOCK-2

BBA SEMESTER-1
ENVIRONMENTAL SCIENCE
BLOCK: 1

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Publisher's Name: Registrar,
Dr. Babasaheb Ambedkar Open University,
'JyotirmayParisar', opp. Shri Balaji Temple,Chharodi, Ahmedabad, 382481,
Gujarat, India.

Edition: 2024-25 (First Edition)

ISBN: **978-93-5598-783-9**

978-93-5598-783-9

UNIT-1 OVERVIEW OF ENVIRONMENTAL STUDIES

1.0 Concept

Environment can be defined as a sum total of all the living and non-living elements and their effects that influence human life. While all living or biotic elements are animals, plants, forests, fisheries, and birds, non-living or abiotic elements include water, land, sunlight, rocks, and air.

The environment is the natural and human-made surroundings that affect and sustain life on Earth. The environment is composed of various physical, chemical, and biological components that interact with each other and with human activities. The environment is also influenced by social, economic, political, and cultural factors that shape human values, attitudes, behaviors, and institutions. Environmental studies are the academic field that systematically studies the environment and its issues from a multidisciplinary and holistic perspective. Environmental studies integrate knowledge from the natural sciences, the humanities, and the social sciences to understand, analyze, evaluate, and address the causes, consequences, and solutions of environmental problems.

Weather is basically the way the atmosphere is behaving, mainly with respect to its effects upon life and human activities. The difference between weather and climate is that weather consists of the short-term (minutes to months) changes in the atmosphere. Most people think of weather in terms of temperature, humidity, precipitation, cloudiness, brightness, visibility, wind, and atmospheric pressure, as in high and low pressure. Whereas, the climate is the description of the long-term pattern of weather in a particular area. Some scientists define climate as the average weather for a particular region and time period, usually taken over 30-years. It's really an average pattern of weather for a particular region. When scientists talk about climate, they're looking at averages of precipitation, temperature, humidity, sunshine, wind velocity, phenomena such as fog, frost, and hail storms, and other measures of the weather that occur over a long period in a particular place. For example, after looking at rain gauge data, lake and reservoir levels, and satellite data, scientists can tell if during a summer, an area was drier than average. If it continues to be drier than normal over the course of many summers, than it would likely indicate a change in the climate. There is very thin line of understanding between all these concepts. The key difference between Atmosphere and Environment is that, Atmosphere is the layer of gases around the Earth and Environment is the living or non-living things around us.

1.1 Meaning and Definitions- What is Environmental Studies?

We can define Environmental studies in different ways, depending on the context and perspective of the field. However, some of the common elements that are shared by most of the definitions are the multidisciplinary, holistic, and human-oriented nature of environmental studies. Here are some examples of how environmental studies can be defined:

"Environmental studies are an interdisciplinary field that seeks to understand the interactions between human and natural systems, and to develop strategies for managing and conserving natural resources in a way that sustains the health and well-being of both humans and the planet." – E.O. Wilson, biologist and conservationist

"Environmental studies are not just about studying the environment; it's about changing the world. It's about recognizing that we are part of the natural world, not separate from it, and that our actions have consequences for the health and well-being of the planet and all its inhabitants." – David Suzuki, scientist and environmental activist

https://jgu.edu.in/blog/2024/03/07/what-is-environmental-studies/

1.2 Scope of Environmental Studies

The scope of environmental studies in India is vast and growing rapidly due to increasing concerns about environmental degradation, climate change, and the sustainable use of natural resources. Environmental studies encompass a multidisciplinary field, integrating natural sciences, social sciences, and policy-making to address complex environmental challenges. In the Indian context, the scope includes opportunities in education, research, government policy, corporate sustainability, and grassroots activism.

- Academic and Research Opportunities

  Higher Education: Many Indian universities and institutes offer undergraduate, postgraduate, and doctoral programs in environmental science and studies. Fields such as ecology, environmental chemistry, biodiversity conservation, environmental law, and sustainable development are key areas of study.

  Research and Innovation: India is home to a growing number of research institutes focused on environmental challenges, such as the Indian Institute of Science (IISc), Indian Institutes of Technology (IITs), and the Centre for Science and Environment (CSE). Research opportunities exist in fields like climate change adaptation, pollution control, waste management, water conservation, and renewable energy.

  Interdisciplinary Studies: Environmental studies also open the door to interdisciplinary research that combines science, economics, sociology, and policy analysis to solve pressing environmental issues.

- Government Policy and Regulatory Roles

  Environmental Policy and Planning: There is significant demand for professionals in government agencies like the Ministry of Environment, Forest and Climate Change, Pollution Control Boards, and other public institutions. These roles focus on policy-making, regulatory compliance, and implementation of environmental laws and policies.

  Environmental Impact Assessment (EIA): Environmental studies graduates can work in conducting and reviewing EIAs, which are critical for large-scale development projects in India. This role helps ensure that projects comply with environmental regulations and minimize their ecological footprint.

  Wildlife Conservation and Forestry: Agencies such as the Indian Forest Service (IFS) and various wildlife departments recruit professionals for the protection and management of forests, wildlife, and biodiversity. Conservation efforts in national parks, sanctuaries, and other protected areas are key parts of this work.

- Corporate Sustainability and Environmental Consulting

  Corporate Environmental Responsibility: In the context of increasing corporate social responsibility (CSR) requirements in India, businesses are focusing on sustainability. Environmental studies professionals are needed in industries to manage corporate sustainability programs, waste management, energy efficiency, and pollution control.

  Green Business Practices: Companies are also looking for ways to reduce their carbon footprint, manage resources sustainably, and develop environmentally friendly products and services. Environmental managers and consultants help corporations design strategies for greener operations.

  Environmental Auditing and Consulting: Consulting firms specializing in environmental compliance, audits, and certification (e.g., ISO 14001 standards) offer career opportunities. These roles involve advising businesses on environmental laws, waste management, and energy conservation.

- Non-Governmental Organizations (NGOs) and Advocacy

  Environmental Advocacy: Numerous Indian NGOs focus on environmental protection, advocacy, and activism, addressing issues such as deforestation, air and water pollution, climate change, and wildlife conservation. Prominent NGOs like Greenpeace India, TERI (The Energy and Resources Institute), and WWF India offer opportunities for advocacy, public awareness, and policy lobbying.

  Community-Based Conservation: NGOs also work on grassroots-level environmental projects, including community-based conservation, water resource management, and sustainable agriculture. These initiatives aim to empower local communities to manage natural resources sustainably.

- Sustainable Development and Green Technology

  Renewable Energy Sector: With the Indian government's push towards renewable energy (solar, wind, hydropower), there is significant demand for professionals skilled in environmental studies to develop sustainable energy solutions. The sector provides jobs in research, project management, policy advocacy, and field implementation.

  Green Technology Innovation: The scope of environmental studies also extends to technological innovations that aim to mitigate environmental damage, such as waste-to-energy technologies, sustainable agriculture, smart cities, and green building technologies.

  Urban Planning and Sustainable Infrastructure: As cities in India grow rapidly, professionals in environmental studies are needed to develop sustainable urban plans, focusing on green buildings, public transportation, and waste management systems that reduce environmental degradation.

- Climate Change and Disaster Management

  Climate Change Mitigation and Adaptation: India, being highly vulnerable to climate change, offers numerous roles for environmental scientists and policymakers in climate mitigation, adaptation strategies, and research. Opportunities exist in climate modeling, carbon footprint reduction, and promoting climate-resilient infrastructure.

  Disaster Management: Environmental studies professionals play a critical role in disaster preparedness and response, particularly in the context of climate-related disasters such as floods, droughts, and cyclones. Professionals in this field work with governmental and international bodies to develop disaster risk reduction strategies.

- Environmental Law and Advocacy

  Environmental Law: With the rise in environmental litigation and the need for stronger enforcement of environmental regulations in India, there is a growing demand for lawyers specializing in environmental law. This includes areas like environmental justice, wildlife protection laws, and litigation against polluting industries.

  Public Interest Litigation (PIL): Environmental activists and lawyers can file PILs in the Indian courts to challenge violations of environmental rights. Several landmark cases in Indian environmental law, such as the Ganga River pollution case, have been driven by public interest litigations.

- Public Awareness and Education

  Environmental Education: Educational institutions are incorporating environmental studies into their curricula at various levels, from schools to universities. Professionals with expertise in environmental science can work as educators, researchers, and curriculum developers, contributing to raising awareness about environmental sustainability.

Media and Communication: Environmental journalism and media roles are critical in raising public awareness about environmental issues. Professionals with a background in environmental studies can work in print, online, and broadcast media, reporting on issues such as climate change, pollution, and conservation efforts.

- International Environmental Cooperation

  Global Environmental Organizations: India's role in international agreements like the Paris Climate Agreement, biodiversity treaties, and the Sustainable Development Goals (SDGs) creates opportunities for environmental professionals to work with international organizations such as the United Nations, World Bank, and International Union for Conservation of Nature (IUCN).

  Cross-border Environmental Challenges: Issues like transboundary air pollution, water sharing (e.g., Indus Water Treaty), and regional biodiversity conservation offer scope for international collaboration. Environmental studies professionals can work on projects that address these cross-border environmental concerns.

The field of environmental studies encompasses a wide range of scopes, which are not only important for children but also for individuals of all ages. These scopes can be summarized as follows:

1.2.1 Resource Awareness

Environmental studies foster awareness about both renewable and nonrenewable resources in a particular region. This involves assessing the available resources, their utilization patterns and the need to maintain a balance for future generations.

1.2.2 Ecological Understanding

It imparts knowledge about ecological systems and the cause-and-effect relationships within them.

1.2.3 Biodiversity Awareness

Environmental studies provide essential information about the richness of biodiversity and the potential threats to plant, animal and microbial species in the environment.

1.2.4 Disaster Preparedness

This field helps individuals understand the causes and consequences of natural and human-induced disasters, such as floods, earthquakes, landslides, cyclones and various types of pollution. It also explores measures to minimize their effects.

1.2.5 Decision-Making

Environmental studies equip individuals with the ability to evaluate alternative responses to environmental issues before deciding on a course of action.

1.2.6 Environmental Literacy

It enables individuals to become environmentally literate citizens by providing knowledge of environmental laws, rights, rules and regulations. This knowledge empowers them to make informed judgments and decisions for the protection and improvement of the Earth.

1.2.7 Social Issues

Environmental studies shed light on societal problems like overpopulation, public health and hygiene. It also emphasizes the role of arts, science and technology in addressing these challenges.

1.2.8 Eco-Friendly Technologies

The field identifies and promotes the development of appropriate, indigenous and eco-friendly skills and technologies to address various environmental issues.

1.2.9 Sustainable Resource Use

It educates citizens about the importance of sustainable resource utilisation, emphasising that these resources are inherited from our ancestors and must be passed on to future generations without compromising their quality.

1.2.10 Practical Application

Environmental studies bridge the gap between theoretical knowledge and practical application, demonstrating the multiple uses and benefits of a well-managed environment.

1.3 Importance of Environmental Studies

The study of the environment is crucial for a country like India due to its unique ecological, economic, and social conditions. Here are several reasons why environmental studies are particularly important for India:

- **Biodiversity Hotspot**

  India is home to rich biodiversity, including unique flora and fauna. Protecting these natural resources is essential not just for conservation but also for sustaining ecosystems that provide essential services like clean water, air, and fertile soil.

- **Population Pressure**

  With a population of over 1.4 billion, India faces significant challenges in managing environmental resources. Rapid urbanization and industrialization put enormous pressure on land, water, air, and forests. Environmental studies help in planning sustainable development to balance human needs and environmental protection.

- **Agriculture Dependency**

  A large portion of India's population relies on agriculture, which is highly sensitive to environmental factors such as soil health, water availability, and climate. Studying the environment helps in managing natural resources and addressing issues like soil erosion, deforestation, and over-extraction of groundwater.

- **Climate Change Vulnerability**

  India is particularly vulnerable to climate change impacts, such as rising temperatures, shifting rainfall patterns, droughts, and floods. Environmental studies help in understanding these risks and formulating strategies for adaptation and mitigation, especially in vulnerable regions.

- **Water Scarcity**

  Despite having some of the largest river systems, many regions in India face acute water shortages due to pollution, inefficient usage, and over-extraction of groundwater. Environmental studies contribute to water conservation efforts, pollution control, and sustainable water management policies.

- **Air Pollution**

  Air quality in major cities like Delhi, Mumbai, and Kolkata often ranks among the worst in the world. Understanding the sources and impacts of air pollution is key to implementing effective regulations and technologies to improve air quality.

- **Energy Demand and Sustainable Development**

  As a growing economy, India has increasing energy demands. Environmental studies emphasize the importance of transitioning to renewable energy sources, such as solar and wind, to reduce dependency on fossil fuels and limit greenhouse gas emissions.

- **Disaster Management**

  India is prone to natural disasters like floods, cyclones, landslides, and earthquakes. Environmental studies contribute to better disaster preparedness and management strategies by helping authorities understand ecological patterns and vulnerabilities.

- **Sustainable Urbanization**

  With rapid urbanization, Indian cities face issues related to waste management, housing, transportation, and pollution. Environmental studies provide insights into creating sustainable cities through better infrastructure, green spaces, and eco-friendly policies.

- **International Commitments**

  India is a signatory to many international environmental agreements, such as the Paris Climate Accord. Understanding the environment helps in meeting these commitments and shaping India's global role in environmental governance.

Environmental studies raise awareness about the critical importance of safeguarding and conserving our planet, as well as the detrimental effects of pollution on the environment. Challenges stemming from population growth, industrialization and other factors have made the task of survival increasingly difficult.

Numerous environmental issues have grown in scale, progressively complicating the global system and endangering humanity's existence on Earth. The significance of environmental studies can be attributed to the following reasons:

1.3.1 Global Nature of Environmental Issues

It is widely acknowledged that environmental problems, such as global warming, ozone depletion, acid rain, marine pollution and biodiversity loss, transcend national boundaries. Consequently, addressing these issues requires international collaboration and concerted efforts.

1.3.2 Development and Its Environmental Impact

The development brings about urbanization, industrial expansion, advanced telecommunications and transportation systems, high-tech agriculture and housing, among other advancements. However, it has often come at the cost of environmental degradation.

Some developed regions have shifted polluting industries to developing nations, contributing to environmental challenges. The environmental consequences of development are not limited to specific regions but affect the entire world.

1.3.3 Escalating Pollution Levels

The world's population is on the rise and India, for instance, is home to a significant portion of the global population.

This puts immense pressure on natural resources, including land. Soil health problems, such as nutrient deficiencies, soil salinity and degradation, have been recognised by agricultural experts.

1.3.4 The Need for Alternative Solutions

Particularly in developing countries, there is a pressing need to chart alternative pathways towards sustainable development.

This involves setting goals for development that are environmentally responsible and sustainable. Such a goal should be universal, transcending the division between the developing and over-consumptive developed world.

1.3.5 Preserving Humanity

It is of utmost importance to prevent the potential extinction of humanity due to activities that harm the environment in the name of development. Striking a balance between development and environmental protection is essential.

1.3.6 Wise Development Planning

Survival and sustenance rely on the availability of resources. Therefore, any development plan should be ecologically sound and synchronised with the natural cycles of the environment. Planning should priorities environmental sustainability alongside economic development.

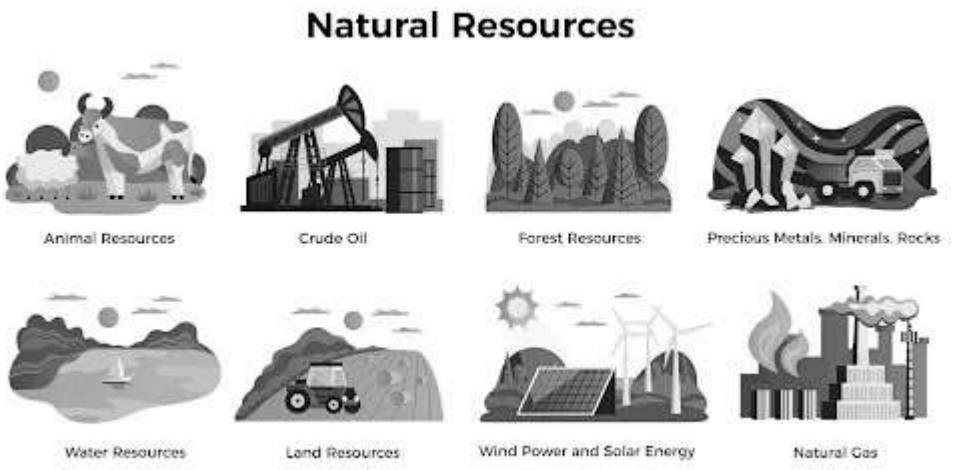
1.4 What are Resources?

Resources refer to all the materials present in our environment which are used by living beings. Resources are considered to be very useful raw materials found in the environment. These are known as materials that are found in nature. They are beneficial to every individual in a variety of ways.

Define Natural Resources

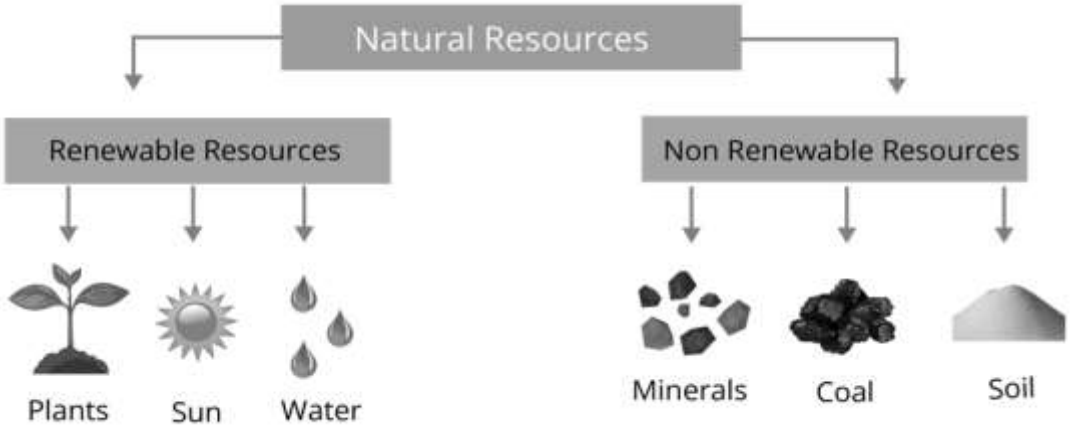
Natural resources are crucial because they form the backbone of human survival and economic development. They provide the raw materials needed for basic necessities like food, water, shelter, and energy. Natural resources such as minerals, forests, water, and fossil fuels drive industries, agriculture, and technological advancements. Additionally, they support ecosystems and biodiversity, which are vital for environmental balance and human well-being. Sustainable management of these resources is essential to prevent depletion and ensure future generations can also benefit from them. Without natural resources, economic growth and human progress would be severely limited.

Humans require many useful things available in nature to live on this planet. These are referred to as natural resources. Air, water, woods, animals, and minerals are some examples. When humans use natural things to make a new thing that increases its value, it is known as a man-made resource.



1.4.1 Types of Natural Resources

Natural resources are important for living beings. There are many ways of classifying natural resources. The most general category is the number of resources available for human consumption. There are two types of energy resources: renewable and non-renewable energy resources.



1.4.2 What is a Renewable Resource?

Renewable resources are incredibly important for several reasons. Unlike non-renewable resources, which are finite and can be depleted over time, renewable resources are naturally replenished and can be sustainably managed. These resources, such as solar energy, wind power, and biomass, offer a continuous supply of energy and materials without the risk of exhaustion. Their use helps to reduce dependence on fossil fuels, which are associated with environmental issues like pollution and climate change. By harnessing renewable resources, we can mitigate the impacts of global warming, reduce greenhouse gas emissions, and promote long-term environmental sustainability. Additionally, renewable resources often contribute to energy security and economic stability by diversifying energy sources and creating jobs in emerging industries

Renewable resources are those that cannot be depleted. They are always available and thus could be reused. The various types of Renewable resources are given below:

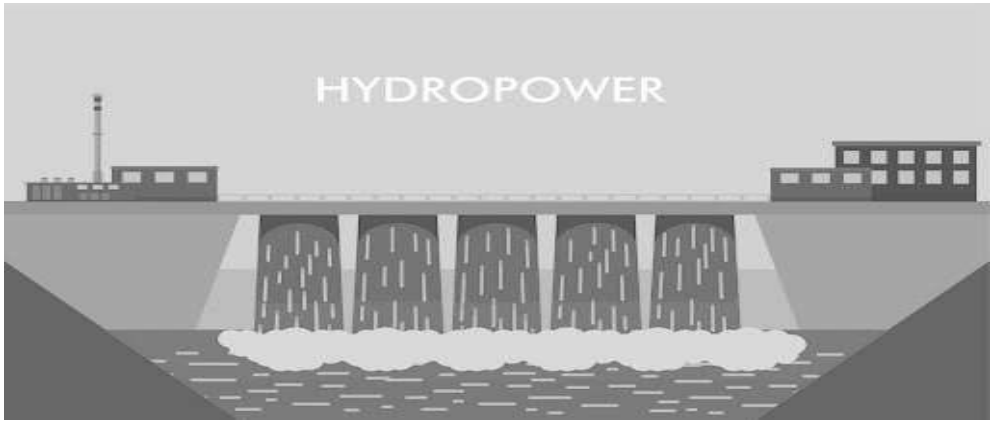
Renewable Resources: Examples

*** Sun** - The energy obtained from sunlight is solar energy. The sun is the ultimate natural resource for all living beings on the earth. Plants utilize solar energy and make their own food through photosynthesis.

*** Wind** - It is an important renewable resource required for the survival of living organisms. Air is important to carry out photosynthesis (the process by which green plants turn carbon dioxide and water into food using energy from sunlight) and respiration (the inhaling of oxygen and the exhaling of carbon dioxide) in plants and animals, respectively. The energy that is obtained from wind is termed as wind energy.

*** Water** - Water is required for survival. Humans use water for a variety of reasons, including drinking, washing, cooking, and cultivating crops. Hydro energy is generated by water flowing into a river or water held in a dam. Hydro energy is power that is generated from moving water such as rivers.

Converting hydro energy into electrical energy is a simple way to utilise it. Electrical energy is a specific form of energy that is the result of an electric charge. Electrical energy is a specific form of energy that is the result of an electric charge.



*** Soil**- Soil is a valuable resource as it is the layer in which plants grow. Living beings require food to live. Plants produce most of the food that is required by living organisms.

*** Biogas**- Biogas is a form of fuel that is a mixture of gases such as methane, carbon dioxide, hydrogen, and other gases produced by the breakdown of animal and plant wastes such as animal dung in the presence of water with the help of microorganisms. It is commonly used as a fuel for gas stoves, particularly in rural regions.

1.4.3 What is a Non-renewable Resources?

Natural resources that are limited in quantity are referred to as non-renewable resources. These resources cannot be supplied or regenerated in a short duration of

time. These resources cannot be reused. The various types of nonrenewable resources are as follows.

Non-renewable Resources: Examples

* **Fossil Fuels-** Fossil fuels are non-renewable energy sources. This means that they will ultimately be finished, which is why energy prices are rising. Fossil fuels consist of coal, natural gas and petroleum.

* **Coal-** Coal is used as a fuel, to generate electricity, and in factories and steam engines.

* **Natural gas-** Natural gas, often known as compressed natural gas, is an excellent alternative to petrol and diesel. It burns quickly and generates a large amount of heat. It's an excellent source of hydrogen.

* **Petroleum-** Mineral oil or crude oil are other names for petroleum. Petrol, diesel, cooking gas, and kerosene are all made from this liquid mineral. It can be found deep within the earth.

* **Nuclear energy-** This energy source involves use of radioactive material that is found in nature. Uranium is primarily used to make nuclear reactor fuel rods. Heat is generated when neutrons (neutral particles present in the atom) hit with the fuel rods. This converts water to steam, which is used to move turbines. As a result, it generates electricity.

Non-renewable resources are particularly important in India for several reasons:

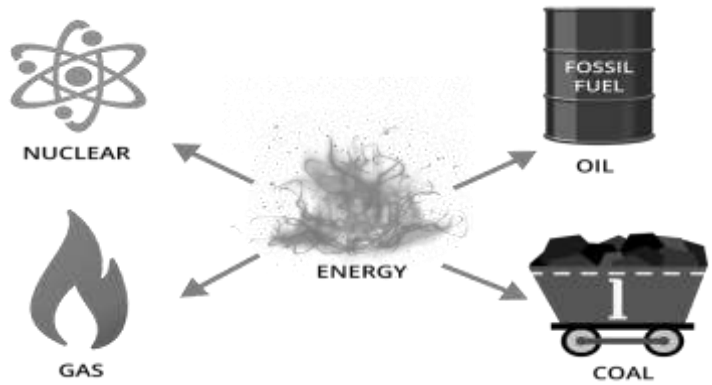
Energy Needs: India’s rapid economic growth and large population create a high demand for energy. Non-renewable resources like coal, oil, and natural gas are critical for generating electricity and fueling industries, which are essential for economic development and improving living standards.

Economic Development: The extraction and use of non-renewable resources contribute significantly to India’s economy. Industries such as coal mining, oil refining, and metal production are major sources of employment and economic activity, supporting millions of livelihoods.

Infrastructure and Industrialization: Non-renewable resources provide raw materials for infrastructure development and industrialization. Metals and minerals are crucial for constructing buildings, roads, and bridges, as well as manufacturing various products and machinery.

Energy Security: Non-renewable resources play a key role in ensuring India’s energy security. As a growing economy, India relies on these resources to meet its energy demands and reduce dependence on imported energy sources.

Strategic Importance: Control over and access to non-renewable resources can enhance India's strategic positioning. It influences global trade dynamics and geopolitical relationships, affecting national security and economic interests.



Difference Between Renewable and Non-renewable Resources

Renewable Resources	Non-renewable Resources
1. Can be replaced by natural processes in a short duration of time or can be recycled.	1. These are natural resources that either cannot be replaced or may take millions of years to be replaced by natural processes like coal and oil.
2. It can be reused or recycled and used multiple times.	2. It cannot be reused or recycled.
3. Some of the examples are: wind energy, solar power, hydroelectricity, geothermal.	3. Some of the examples are: petrol, coal, Natural gas, nuclear energy, fossil fuels.
4. There is no harm to the environment by using renewable resources.	4. Huge harm done to the environment because of the harmful emissions.

- **issues and challenges of renewable and non-renewable in India**

India faces a range of issues and challenges related to both renewable and non-renewable energy sources:

Renewable Energy:

- **Infrastructure and Technology**: While India has made significant strides in renewable energy, there are still challenges related to infrastructure development and the need for advanced technology. Integration of renewable sources like solar and wind into the grid requires upgrading and expanding infrastructure.
- **Intermittency and Storage**: Renewable energy sources such as solar and wind are intermittent and depend on weather conditions. Developing efficient and cost-effective energy storage solutions is crucial for balancing supply and demand.
- **High Initial Costs**: The initial capital required for setting up renewable energy projects can be high. Although costs are decreasing, financing remains a barrier, particularly for smaller players and rural areas.

- **Land and Resource Use**: Large-scale renewable projects, especially solar farms, require significant land, which can lead to land-use conflicts and affect local agriculture or communities.

- **Regulatory and Policy Framework**: Despite supportive policies, there can be inconsistencies or delays in implementation. Streamlining regulatory processes and ensuring clear, long-term policies are essential for fostering growth in the sector.

- **Skilled Workforce**: There is a need for skilled professionals in the renewable energy sector. Training and education programs are necessary to build a workforce capable of supporting and advancing renewable technologies.

❖ **Non-Renewable Energy:**

- **Environmental Impact**: Non-renewable energy sources like coal, oil, and natural gas have significant environmental impacts, including air and water pollution, greenhouse gas emissions, and habitat destruction.

- **Health Issues**: Pollution from non-renewable energy sources contributes to respiratory and cardiovascular diseases, affecting public health and increasing healthcare costs.

- **Resource Depletion**: Non-renewable resources are finite and will eventually be depleted. Continued reliance on these sources poses long-term sustainability challenges.

- **Energy Security**: India depends heavily on imported oil and gas, which can affect energy security and price stability. Diversifying energy sources and increasing domestic production are critical for reducing this dependency.

- **Economic Disparities**: The benefits of non-renewable energy often accrue to a limited number of stakeholders, leading to economic disparities. Transitioning to more equitable and sustainable energy systems is a challenge.

- **Transition Costs**: Shifting from non-renewable to renewable energy can involve significant transition costs, including retrofitting existing infrastructure, which can be economically challenging.

1.5 Equitable use of resources for sustainable lifestyles

Equitable use of resources for sustainable lifestyles in a country like India involves several dimensions:

Resource Management: Ensuring that natural resources like water, land, and energy are managed in a way that meets the needs of the present without compromising future generations. This includes sustainable agricultural practices, efficient water use, and the promotion of renewable energy sources.

Social Equity: Addressing disparities in resource access and usage among different socio-economic groups. In India, this means focusing on inclusive development that

provides equitable access to resources for marginalized and economically disadvantaged communities.

Economic Policies: Implementing policies that promote sustainability while supporting economic growth. This includes incentivizing green technologies, promoting sustainable industries, and investing in education and innovation for sustainability.

Environmental Protection: Balancing economic development with the need to protect natural ecosystems. Efforts include combating deforestation, reducing pollution, and conserving biodiversity.

Cultural and Traditional Practices: Integrating traditional knowledge and practices that support sustainable living. Many communities in India have long histories of sustainable resource use that can be leveraged in modern practices.

Public Awareness and Education: Raising awareness about sustainable practices and the importance of resource conservation through education and public campaigns.

1. Resource Allocation

- **Equity vs. Equality:** Equitable resource use means distributing resources in a way that considers the needs and capabilities of different communities, rather than providing the same amount to everyone.

- **Needs-Based Distribution:** Prioritizing resources for those who need them most, such as marginalized or under-resourced communities, helps ensure that everyone can achieve a sustainable lifestyle.

2. Sustainable Development Goals (SDGs)

- **SDG 10 (Reduced Inequality):** This goal focuses on reducing inequality within and among countries, which is integral to achieving equitable resource use.

- **SDG 12 (Responsible Consumption and Production):** This goal emphasizes sustainable resource use and production processes that minimize environmental impact and support equitable access.

3. Fair Trade and Ethical Consumption

- **Supporting Fair Trade:** Purchasing products that are certified as fair trade helps ensure that producers in developing countries receive fair compensation and work under decent conditions.

- **Ethical Choices:** Consumers can influence resource use by choosing products and services that are sustainably sourced and ethically produced.

4. Community-Based Resource Management

- **Local Knowledge:** Indigenous and local communities often have traditional knowledge about sustainable resource management that can be integrated into modern practices.

- **Participatory Management:** Engaging communities in decision-making processes helps ensure that resource management strategies reflect local needs and conditions.

5. Technological and Policy Innovations

- **Green Technologies:** Advancements in technology can help optimize resource use and reduce environmental impact, but these technologies must be accessible to all, not just affluent communities.

- **Inclusive Policies:** Governments and organizations should create policies that promote equitable resource distribution and address disparities in access to resources.

6. Education and Awareness

- **Promoting Sustainability Literacy:** Educating individuals about sustainable practices and resource management can empower people to make informed choices and advocate for equitable resource use.

- **Public Awareness Campaigns:** Raising awareness about the importance of fairness in resource use can drive collective action towards sustainability.

7. Global and Local Perspectives

- **Global Challenges:** Addressing global issues such as climate change and resource depletion requires international cooperation and commitment to equitable resource distribution.

- **Local Actions:** Implementing local solutions that consider the specific needs and contexts of communities can lead to more effective and equitable outcomes.

8. Monitoring and Evaluation

- **Assessing Impact:** Regularly evaluating the impact of resource use and management strategies helps ensure that they are achieving their intended goals and making a positive difference.

- **Feedback Mechanisms:** Establishing feedback systems allows communities and stakeholders to voice concerns and suggest improvements, fostering continuous progress towards equity and sustainability.

Sustainable Development Goals (SDGs) are crucial for India for several reasons:

- **Economic Development**: India is one of the world's fastest-growing economies, but it faces significant challenges such as poverty, inequality, and inadequate infrastructure. The SDGs provide a framework for inclusive and sustainable economic growth, helping to address these challenges while promoting economic development.

- **Environmental Sustainability**: India is home to diverse ecosystems and a high population density, making environmental sustainability a critical issue.

The SDGs focus on addressing climate change, conserving natural resources, and protecting biodiversity, which are essential for India's environmental health and resilience.

- **Social Equity**: India has a large and diverse population with significant social and economic disparities. The SDGs emphasize reducing inequality and ensuring access to quality education, healthcare, and social services for all, which aligns with India's efforts to improve social equity and quality of life.

- **Health and Well-being**: The SDGs address global health challenges, including maternal and child health, infectious diseases, and mental health. For India, improving healthcare systems and outcomes is a priority, and the SDGs provide guidelines and targets to enhance health and well-being.

- **Economic Opportunities**: Achieving the SDGs can drive new economic opportunities and innovation. For instance, investments in renewable energy, sustainable agriculture, and technology can create jobs, stimulate economic growth, and enhance India's global competitiveness.

- **International Commitments**: As a member of the United Nations, India has committed to the global agenda of the SDGs. Aligning national policies and strategies with these goals helps India contribute to global efforts and improve its standing in the international community.

- **Resilience and Stability**: The SDGs aim to build resilient communities and promote peace and justice. For India, addressing issues like disaster risk reduction, governance, and rule of law is essential for national stability and long-term prosperity.

- **Citizen Engagement**: The SDGs encourage citizen participation and community involvement in development processes. This approach supports India's democratic values and helps ensure that development efforts are inclusive and responsive to the needs of all citizens.

❖ **Long Question: -**

1. Write an Overview of Environmental Studies

❖ **Short Question: -**

1. Concept of Environmental Studies with its Scope and Importance

❖ **Short Note: -**

1. Renewable and Non-Renewable Resources,
2. Equitable use of resources for sustainable lifestyles

❖ **Fill Ups: -**

1. Sun is _____ Resource
2. Nuclear Energy is _____ Resource

UNIT-2 NATURAL RESOURCES AND ASSOCIATED PROBLEMS

2.1 Forest resources

Definition of Forests

Forests are complex land ecosystems that support a wide variety of plants, trees and animals. It provides a lot of resources like fruits, timber, firewood, honey, herbal medicines etc. The forests also provide several raw materials for different manufacturing industries. There are whole communities that depend entirely on forest resources for their survival.

1. It is generally understood as a wild habitat, where socio-political rules don't play any part.
2. Humans are generally not included in this layman definition of forests. But any serious discussion on forests cannot exclude the presence and dependence of indigenous communities on these ecosystems.
3. In the recent past, the effects of mindless economic development on the quantum of forest resources have been a significant issue.

2.1.2. Structure of a Forest

1. Forest structure refers to the different layers of horizontal and vertical distribution of forests depending on their age and location.
2. Even Aged structure means that the tree cover is at the same height. It generally points to less diversity of tree species. Artificial forests and plantations are good examples of even aged structures.
3. Two aged stands refer to two layers of vegetation, one usually a well developed one and the other in the state of growth (sapling stage or plant stage). It might be due to a new afforestation drive.
4. An uneven structure of more than three layers indicates that there are trees of multiple age classes in the forest. It also points to a wide variety of species in the forest.

2.1.3 The different components of the forest structure are listed below-

- **Emergent Layer**

The topmost layer of the forest is called the emergent layer and the trees may be as tall as 60 meters. They protrude over the general canopy. The trees should be able to overcome high temperatures and strong winds. Waxy leaves enable these trees to retain more water for drier temperatures. Bats and wind help pollination at these heights.

- **Canopy**

The canopy layer with its dense foliage and branches acts like a cover on the forest. It can be around 20-35 m high in rainforests. Winds, rain, and sunlight are all blocked by the canopy. As the weather is humid below the tree cover, leaves have pointed tips to keep excess water away. Pollination is done by animals as the seeds are usually inside fruits.

- **Understory Layer**

The understory, which is several metres below the canopy, is a humid habitat. The trees in this layer have larger leaves to absorb the minimum exposure to sunlight. These trees have flowers with a pungent smell to ensure that pollinators are attracted. Many animals make use of the low light in the understory to stay away from predators.

- **Forest Floor Layer**

There are fewer trees and more shrubs and plants in this layer. Plant growth is extremely difficult as sunlight is nearly absent in this layer. Leaves and organic matter from the vegetation is quickly turned into nutrients by the decomposers. Most of the animals live in this layer as both carnivores and herbivores find enough food sources.

2.1.4 Significance of Forest Resources

- **Economic Significance**

Forests are the largest renewable source of food, fodder and fuel. They provide important goods and services to the market economy. The timber from the woods can be used for a wide variety of uses like constructing homes, tools, boats etc. The forests' flora and wildlife provide important constituents of medicines, natural insecticides etc. Several manufacturing industries like furniture and paper make use of the forest resources.

- **Ecological Significance**

Forests help to maintain biodiversity while also improving conditions for agriculture. It performs several functions that stabilise the natural environment-

1. Conservation of biodiversity- Forests provide optimum circumstances for the sustenance of living organisms. It hosts a plethora of flora and fauna and is the

most diverse terrestrial ecosystem. There are complex food webs that function sustaining the ecological balance of forests.

2. Sustains the Natural World- The deep and shallow roots in the soil increase the stability of soil and prevent soil erosion. Forests prevent landslides and other disturbances on the surface of earth. They act as the lungs of the world by absorbing toxic gases. They play a huge role in suppressing and recycling carbon dioxide. It safeguards watersheds and ensures a constant supply of fresh water in the water bodies.
3. Controls the World's Climate- Their absorption and generation of rainfall, as well as their exchange of atmospheric gases, regulate local and worldwide weather. They absorb more heat than barren land. They directly affect the levels of carbon dioxide, which is a greenhouse gas, in the atmosphere. Forests are carbon sinks, and hence a key entity in fighting global warming and climate change. Afforestation drives are necessary to ensure that the quantity of forests doesn't decline.

- **Social Significance**

Forests are not just resources in a materialistic sense. Even while the forest resources have immense economic and ecological value, they also hold a huge socio-cultural value to indigenous communities. Many consider forests their home. It is even embedded in their religious beliefs when they worship their surroundings. Forests also hold an aesthetic value for bird watchers, occasional picnickers and conservationists.

2.2 Water Resources

Water resources refers to natural resources of water that are potentially useful as a source of water supply. About 97% of the water on the Earth is mainly salt water and only around 3% is fresh water; approximately around two thirds of this is frozen in glaciers and polar ice caps. The remaining unfrozen freshwater can be found mainly as groundwater, only a small fraction is present above the ground or in the air. Natural sources of fresh water comprises surface water, under river flow, groundwater and frozen water. Artificial sources of fresh water might include treated wastewater (reclaimed water) and also desalinated seawater.

2.2.1 Use of Water Resources

Water resources can be used for agricultural, industrial, domestic, recreational, and environmental activities. Majority of the users need fresh water.

However, around 97% of water found on the earth is salt water and only around 3% is fresh water. Around two-thirds of the available fresh water is frozen in glaciers and polar ice caps. The remaining freshwater can be found usually as groundwater and a negligible portion of it is present on the ground or in the air.

Following are a brief account of how water is used in different sectors.

- **Agricultural Use**

Agriculture consumes over 69 percent of all water in agricultural economies such as India. As a result, agriculture is the world's largest consumer of accessible freshwater.

Agriculture's global water demand is expected to rise by 19 percent by 2050 due to irrigation needs. Increased irrigation demand is projected to place undue strain on water reserves. It's also unclear whether further irrigation development, as well as increased water withdrawals from rivers and groundwater, will be doable.

- **Use in Industry**

The industry's lifeblood is water. It's utilised as a cooling for raw materials, a solvent, a transport agent, and an energy source. Manufacturing accounts for a significant portion of total industrial water usage. Water is used extensively in industries such as agriculture, allied products, chemicals, and primary metals. The industry represents around 19% of overall consumption worldwide. Industry, on the other hand, consumes more than half of the water available for human use in developed countries.

- **Domestic Use**

It encompasses drinking, cleaning, personal hygiene, gardening, cooking, clothing, dishwashing, and vehicle maintenance, among other things. People have been moving out of the countryside and into ever-expanding cities since the end of World War II. This tendency will have a significant impact on our water resources. To distribute water to expanding populations and industry, the government and towns have had to start developing major water-supply systems. Domestic water use accounts for around 12% of global water consumption.

- **Use for Hydropower Generation**

Hydropower is electricity generated by water. Hydropower is the world's most widely used renewable energy source. It generates around 16 percent of the world's total electricity. There are several hydropower development prospects all throughout the world. China, the United States, Brazil, Canada, India, and Russia are the world's top hydropower producers now.

- **Use for Navigation and Recreation**

Watercourses that have been or may be used for interstate or international commerce are known as navigable waterways. In many parts of the world, agricultural and commercial items are transported by water on a vast scale. Recreational activities such as boating, swimming, and sporting activities are all done on the water. These activities disrupt the water's quality and thus, pollute it. While allowing such operations in reservoirs, lakes, and rivers, the highest priority should be given to public health and drinking water quality.

- **Natural sources of freshwater**

Natural sources of fresh water comprise surface water, under river flow, groundwater and frozen water.

- **Surface Water**

Water in a river, lake, or freshwater wetland is known as surface water. Precipitation refills surface water, while discharge to the oceans, evapotranspiration, evaporation, and groundwater recharge deplete it. Although precipitation within a watershed is the only natural input to any surface water system, the overall amount of water in that system at any given time is influenced by a variety of other factors. Storage capacity in lakes, marshes, and artificial reservoirs, permeability of the soil underlying these storage bodies, runoff characteristics of the land in the watershed, precipitation timing, and local evaporation rates are among these aspects. All of these elements have an impact on water loss proportions.

- **Under river flow**

The total volume of water delivered downstream by a river is typically a combination of visible free water flow and a significant contribution flowing via rocks and sediments that lay beneath the river and its floodplain, known as the hyporheic zone. This invisible component of flow may substantially exceed the visible flow for many rivers in big valleys. The hyporheic zone is a dynamic interface that exchanges flow between rivers and aquifers that are either fully charged or depleted. This is especially true in karst environments, which are prone to potholes and subsurface rivers.

- **Groundwater**

Groundwater is a type of freshwater that is found in the pore space of soil and rocks under the surface. It also includes water that flows beneath the water table in aquifers. It's occasionally helpful to distinguish between surface water-associated groundwater and deep groundwater in an aquifer (sometimes referred to as "fossil water").

Inputs, outputs, and storage are generally the same for groundwater as they are for surface water. The crucial difference is that, due to its slow turnover rate, groundwater storage is often substantially bigger (in volume) than surface water storage when compared to inputs. Because of this disparity, humans can utilise groundwater in an unsustainable manner for an extended period of time without suffering serious effects. Nonetheless, the average rate of seepage above a groundwater source represents the upper bound for typical water intake from that source over the long run. Seepage from surface water is a natural source of groundwater input. Natural groundwater outflows include springs and seepage into the oceans.

- **Frozen Water**

Several strategies to use icebergs as a water source have been proposed, however this has only been done for research purposes so far. Surface water is

referred to as glacier runoff. The Himalayas, dubbed “The Roof of the World,” are home to some of the world’s most vast and rugged high-altitude terrain, as well as the world’s largest glaciers and permafrost outside of the poles. Ten of Asia’s greatest rivers originate there, and more than a billion people rely on them for survival. To make matters worse, temperatures in the area are rising faster than the world average. Over the last decade, the temperature in Nepal has risen by 0.6 degrees Celsius, while the Earth has warmed by about 0.7 °C globally.

- **Artificial Sources of Water**

Treated wastewater (reclaimed water) and desalinated seawater are two examples of artificial fresh water sources. However, the economic and environmental consequences of these technologies must be considered.

2.2.2 The Four Sources of Freshwater

The main sources of water are rain, groundwater, ice, rivers, lakes, streams, and natural reservoirs. We derive water for daily use through these sources. Let us now learn about each of these sources of water in detail.

- **Rain**

An important source of freshwater that is often overlooked is stormwater. This is the product of earth's water that has evaporated into the atmosphere and turned into rain. Making the most of an unlimited supply of freshwater that is sometimes taken for granted, rainwater harvesting is a technology that was employed by ancient civilizations and is currently commonly used in many rural places.

- **Groundwater**

Beneath the surface of the earth lies a great source of freshwater. Groundwater is the largest source of freshwater on the planet and the second largest source of water, along with that present in the oceans. Like the salt water of the sea, most of it cannot be consumed by people or animals. However, a percentage of the groundwater is fresh and can be desalinated and refined in order to provide safe drinking water for the population.

- **Ice**

A major topic of debate surrounding the earth's climate change issues is the melting of the polar ice caps and the shrinking of ice shelves throughout the Arctic. Along with groundwater, ice makes up the second largest source of freshwater on the planet, accounting for just under 2 percent of earth's water. Some of the freshwater preserved in ice, especially in the Antarctic ice sheets, is thousands of years old. As with groundwater and seawater, it is also difficult to use ice water as a source of drinking water, but it is possible.

- **Rivers, Lakes, Streams, and Natural Springs**

As the only natural source of freshwater on earth, rivers, lakes, streams, and natural springs are referred to as surface water sources (0.0014 per cent). Despite the fact that there are millions of freshwater lakes and many kilometres of rivers and streams on the planet, these water sources represent an almost insignificant amount of

freshwater. However, they remain vitally important: A large amount of our drinking water comes from them.

2.2.3 Main Uses of Water in Human Life

The importance of water for human beings is not only in its daily use such as washing dishes, personal hygiene, watering plants, etc. There are activities in which water plays a very important role and also becomes an economic and industrial resource. These various uses of water reflect its importance in the development and growth of the human being in all its areas. The below image shows the **uses of water for kids** to learn.

- **Uses of Water**

Human consumption: Water is used for drinking, to make the different beverages that man consumes, to prepare food, and in factories where food is processed.

Personal hygiene: Personal hygiene activities are where water is most wasted: people tend to waste thousands of litres of water when bathing and brushing their teeth. Pisciculture: This is an activity that refers to the cultivation of fish, that is, their breeding and reproduction. In it are also shellfish and, in general, any aquatic animal.

Agriculture: The importance of water for this set of activities created by man is fundamental, it is where fruits, vegetables, and grains are grown for human consumption. The land is treated so that it is fertile and can provide food for people and animals.

Industry: There are different sectors in which the function of water is important. It can be from a technological point to the textile sector that is responsible for the creation of fabrics.

2.3 Mineral Resources

Almost all Earth materials are used by humans for something. We require metals for making machines, sands and gravels for making roads and buildings, sand for making computer chips, limestone and gypsum for making concrete, clays for making ceramics, gold, silver, copper and aluminum for making electric circuits, and diamonds and corundum (sapphire, ruby, emerald) for abrasives and jewelry.

In this discussion, we hope to answer the following questions:

1. What constitutes a mineral resource and an ore?
2. What determines whether or not a mineral source is economical to exploit?
3. By what processes do ores form?
4. How are mineral resources found and exploited?
5. What happens when a mineral resource become scarce as a result of human consumption?
6. What are the adverse effects of exploiting mineral resource.

Mineral resources can be divided into two major categories - Metallic and Nonmetallic. Metallic resources are things like Gold, Silver, Tin, Copper, Lead, Zinc,

Iron, Nickel, Chromium, and Aluminum. Nonmetallic resources are things like sand, gravel, gypsum, halite, Uranium, dimension stone.

A mineral resource is a volume of rock enriched in one or more useful materials. In this sense a mineral refers to a useful material, a definition that is different from the way we defined a mineral back in Chapter 5. Here the word mineral can be any substance that comes from the Earth.

Finding and exploiting mineral resources requires the application of the principles of geology that you we have discussed or will discuss throughout this course. Some minerals are used as they are found in the ground, i.e. they require no further processing or very little processing. For example - gemstones, sand, gravel, and salt (halite). Most minerals must be processed before they are used. For example:

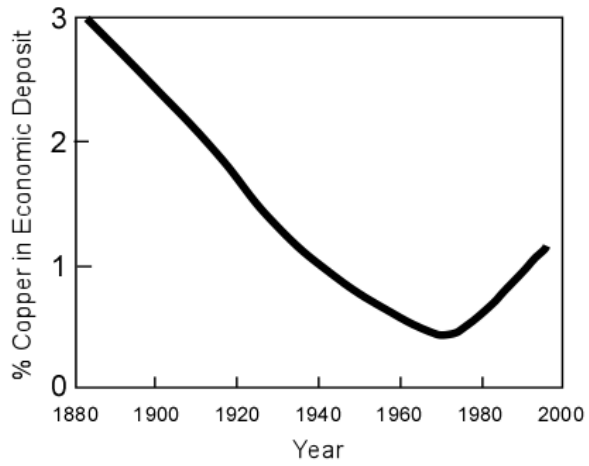
- Iron is the found in abundance in minerals, but the process of extracting iron from different minerals varies in cost depending on the mineral. It is least costly to extract the iron from oxide minerals like hematite (Fe_2O_3), magnetite (Fe_3O_4), or limonite [Fe(OH)]. Although iron also occurs in olivines, pyroxenes, amphiboles, and biotite, the concentration of iron in these minerals is less, and cost of extraction is increased because strong bonds between iron, silicon, and oxygen must be broken.
- Aluminum is the third most abundant mineral in the Earth's crust. It occurs in the most common minerals of the crust - the feldspars ($NaAlSi_3O_8$, $KalSi_3O_8$, & $CaAl_2Si_2O_8$, but the cost of extracting the Aluminum from these minerals is high. Thus, deposits containing the mineral gibbsite [$Al(OH)_3$], are usually sought. This explains why recycling of Aluminum cans is cost effective, since the Aluminum in the cans does not have to be separated from oxygen or silicon.

Because such things as extraction costs, labor costs, and energy costs vary with time and from country to country, what constitutes an economically viable deposit of minerals varies considerably in time and place. In general, the higher the concentration of the substance, the more economical it is to mine. Thus we define an ore as a body of material from which one or more valuable substances can be extracted economically. An ore deposit will consist of ore minerals, that contain the valuable substance. Gangue minerals are minerals that occur in the deposit but do not contain the valuable substance.

Since economics is what controls the grade or concentration of the substance in a deposit that makes the deposit profitable to mine, different substances require different concentrations to be profitable. But, the concentration that can be economically mined changes due to economic conditions such as demand for the substance and the cost of extraction.

Examples:

- The copper concentration in copper ore deposits has shown changes throughout history. From 1880 to about 1960 the grade of copper ore showed a steady decrease from about 3% to less than 1%, mainly due to increased efficiency of mining. From about 1960 to 1980 the grade increased to over 1% due to increasing costs of energy and an abundant supply produced by cheaper labor in other countries.



- Gold prices vary on a daily basis. When gold prices are high, old abandoned mines re-open, when the price drops, gold mines close. The cost of labor is currently so high in the U.S. that few gold mines can operate profitably, but in third world countries where labor costs are lower, gold mines that have ore concentrations well below those found in the U.S. can operate with a profit.

For every substance we can determine the concentration necessary in a mineral deposit for profitable mining. By dividing this economical concentration by the average crustal abundance for that substance, we can determine a value called the ***concentration factor***. The table below lists average crustal abundances and concentration factors for some of the important materials that are commonly sought. For example, Al, which has an average crustal abundance of 8%, has a concentration factor of 3 to 4. This means that an economic deposit of Aluminum must contain between 3 and 4 times the average crustal abundance, that is between 24 and 32% Aluminum, to be economical

Substance	Average Crustal Abundance	Concentration Factor
Al (Aluminum)	8.0%	3 to 4
Fe (Iron)	5.8%	6 to7
Ti (Titanium)	0.86%	25 to 100
Cr (Chromium)	0.0096%	4,000 to 5,000
Zn (Zinc)	0.0082%	300
Cu (Copper)	0.0058%	100 to 200
Ag (Silver)	0.000008%	~1000
Pt (Platinum)	0.0000005%	600
Au (Gold)	0.0000002%	4,000 to 5,000
U (Uranium)	0.00016%	500 to 1000

Note that we will not likely ever run out of a useful substance, since we can always find deposits of any substance that have lower concentrations than are currently economical. If the supply of currently economical deposits is reduced, the price will increase and the concentration factor will increase

Origin of Mineral Resources

Mineral deposits can be classified on the basis of the mechanism responsible for concentrating the valuable substance.

- Magmatic Ore Deposits - substances are concentrated within a body of igneous rock by magmatic processes like crystal fractionation and crystal settling.

Magmatic process such as partial melting, crystal fractionation, or crystal settling in a magma chamber can concentrate ore minerals containing valuable substances by taking elements that were once widely dispersed in low concentrations in the magma and concentrating them in minerals that separate from the magma.

Examples:

  - ***Pegmatites*** - During fractional crystallization water and elements that do not enter the minerals separated from the magma by crystallization will end up as the last residue of the original magma. This residue is rich in silica and water along with elements like the Rare Earth Elements (many of which are important for making phosphors in color television picture tubes), Lithium, Tantalum, Niobium, Boron, Beryllium, Gold, and Uranium. This residue is often injected into fractures surrounding the igneous intrusion and crystallizes as a rock called a pegmatite that characteristically consists of large crystals.

  - Crystal Settling. As minerals crystallize from a magma body, heavy minerals may sink to the bottom of the magma chamber. Such heavy minerals as chromite, olivine, and ilmenite contain high concentrations of Chromium, Titanium, Platinum, Nickel, and Iron. These elements thus attain higher concentrations in the layers that form on the bottom of the magma chamber.

- ***Hydrothermal Ore Deposits*** - Concentration by hot aqueous (water-rich) fluids flowing through fractures and pore spaces in rocks.

Hydrothermal deposits are produced when groundwater circulates to depth and heats up either by coming near a hot igneous body at depth or by circulating to great depth along the geothermal gradient. Such hot water can dissolve valuable substances throughout a large volume of rock. As the hot water moves into cooler areas of the crust, the dissolved substances are precipitated from the hot water solution. If the cooling takes place rapidly, such as might occur in open fractures or upon reaching a body of cool surface water, then precipitation will take place over a limited area, resulting in a concentration of the substance attaining a higher value than was originally present in the rocks through which the water passed.

Examples:

- ***Massive sulfide deposits*** at oceanic spreading centers. Hot fluids circulating above the magma chambers at oceanic ridges can scavenge elements like Sulfur, Copper, and Zinc from the rocks through which they pass. As these hot fluids migrate back toward the seafloor, they come in contact with cold groundwater or sea water and suddenly precipitate these metals as sulfide minerals like sphalerite (zinc sulfide) and chalcopyrite (Copper, Iron sulfide).

- ***Vein deposits*** surrounding igneous intrusions. Hot water circulating around igneous intrusions scavenges metals and silica from both the intrusions and the surrounding rock. When these fluids are injected into open fractures, they cool rapidly and precipitate mainly quartz, but also a variety of sulfide minerals, and sometimes gold, and silver within the veins of quartz. Rich deposits of copper, zinc, lead, gold, silver, tin, mercury, and molybdenum result.

- ***Stratabound ore deposits*** in lake or oceanic sediments. When hot groundwater containing valuable metals scavenged along their flow paths enters unconsolidated sediments on the bottom of a lake or ocean, it may precipitate ore minerals in the pore spaces between grains in the sediment. Such minerals may contain high concentrations of lead, zinc, and copper, usually in sulfide minerals like galena (lead sulfide), sphalerite (zinc sulfide), and chalcopyrite (copper-iron sulfide). Since they are included within the sedimentary strata they are called stratabound mineral deposits.

- ***Sedimentary Ore Deposits*** - substances are concentrated by chemical precipitation from lake or sea water.

Although clastic sedimentary processes can form mineral deposits, the term sedimentary mineral deposit is restricted to chemical sedimentation, where minerals containing valuable substances are precipitated directly out of water.

Examples:

- ***Evaporite Deposits*** - Evaporation of lake water or sea water results in the loss of water and thus concentrates dissolved substances in the remaining water. When the water becomes saturated in such dissolved substance they precipitate from the water. Deposits of halite (table salt), gypsum (used in plaster and wall board), borax (used in soap), and sylvite (potassium chloride, from which potassium is extracted to use in fertilizers) result from this process.

Iron Formations - These deposits are of iron rich chert and a number of other iron bearing minerals that were deposited in basins within continental crust during the Proterozoic (2 billion years or older). They appear to be evaporite type deposits, but if so, the composition of sea water must have been drastically different than it is today

- ***Placer Ore Deposits*** - substances are concentrated by flowing surface waters either in streams or along coastlines.

The velocity of flowing water determines whether minerals are carried in suspension or deposited. When the velocity of the water slows, large minerals or minerals with a higher density are deposited. Heavy minerals like gold, diamond, and magnetite of the

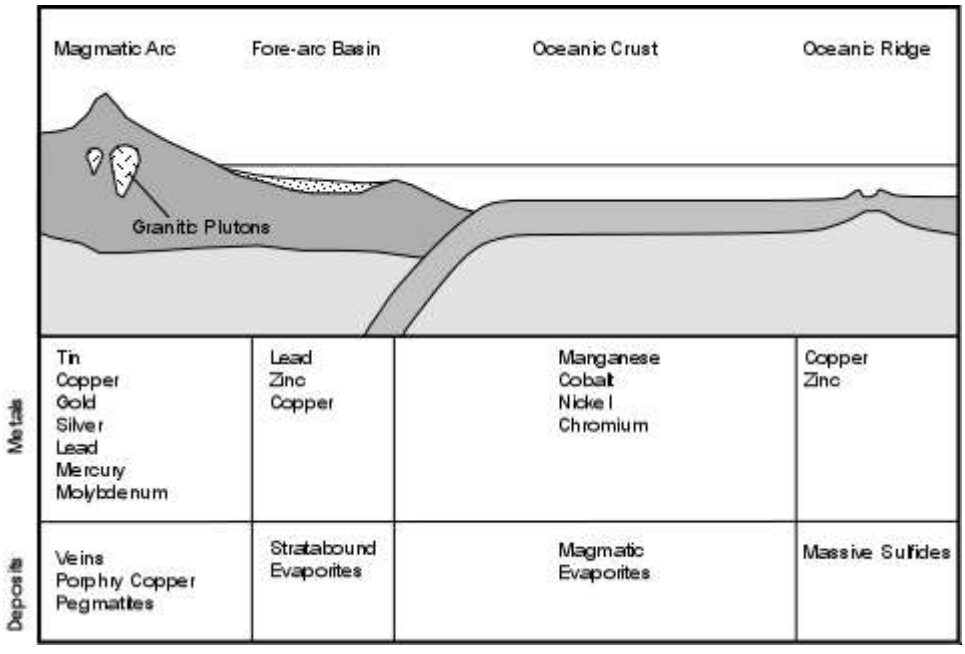
same size as a low density mineral like quartz will be deposited at a higher velocity than the quartz, thus the heavy minerals will be concentrated in areas where water current velocity is low. Mineral deposits formed in this way are called placer deposits. They occur in any area where current velocity is low, such as in point bar deposits, between ripple marks, behind submerged bars, or in holes on the bottom of a stream. The California gold rush in 1849 began when someone discovered rich placer deposits of gold in streams draining the Sierra Nevada Mountains. The gold originally formed in hydrothermal veins, but it was eroded out of the veins and carried in streams where it was deposited in placer deposits.

- ***Residual Ore Deposits*** - substances are concentrated by chemical weathering processes.

During chemical weathering and original body of rock is greatly reduced in volume by the process of leaching, which removes ions from the original rock. Elements that are not leached form the rock thus occur in higher concentration in the residual rock. The most important ore of Aluminum, ***bauxite***, forms in tropical climates where high temperatures and high water throughput during chemical weathering produces highly leached lateritic soils rich in both iron and aluminum. Most bauxite deposits are relatively young because they form near the surface of the Earth and are easily removed by erosion acting over long periods of time.

In addition, an existing mineral deposit can be turned in to a more highly concentrated mineral deposit by weathering in a process called ***secondary enrichment***.

Mineral Deposits and Plate Tectonics



Because different types of mineral deposits form in different environments, plate tectonics plays a critical role in the location of different geological environments. The diagram to the right shows the different mineral deposits that occur in different tectonic environments

- **Mineral Exploration and Production**

Ores are located by evidence of metal enrichment. Geologists look for hints in rocks exposed near the surface, for example, the enrichment process often results in discoloration of the soil and rock. When such hints are found, geophysical survey's involving measuring gravity, magnetism, or radioactivity are conducted. Geochemical surveys are conducted which analyze the composition of water, sediment, soil, rocks, and sometimes even plants and trees.

Once it is determined that a valuable material could be present, the deposit is assessed by conducting core drilling to collect subsurface samples, followed by chemical analysis of the samples to determine the grade of the ore If the samples show promise of being economic to mine, then plans are made to determine how it will me mined.

If the ore body is within 100 meters from the surface, open-pit mines, large excavations open to the air.are used to extract the ore before processing. Open pit mines are less expensive and less dangerous than tunnel mines, although they do leave large scars on the land surface. If the ore body is deeper, or narrowly dispersed within the non-ore bearing rock tunneling is necessary to extract the ore from underground mines. Mine tunnels are linked to a vertical shaft, called and adit. Ores are removed from the walls of the tunnels by drilling and blasting, with the excavated ores being hauled to the surface from processing. Underground mines are both more expensive and dangerous than open pit mines and still leave scares on the landscape where non-ore bearing rock is discarded as tailings. .

- **Global Mineral Needs**

Because the processes that form ores operate on geologic time scales, the most economic mineral resources are essentially nonrenewable.New deposits cannot be generated in human timescales. But, as mentioned previously, as the reserves of materials become depleted it is possible to find other sources that are more costly to exploit. Furthermore, mineral resources are not evenly distributed.

Some countries are mineral-rich; some are mineral-poor. This is a particular issue for strategic mineral resources. These strategic metals are those for which economical source do not exist in the U.S., must be imported from other potentially non-friendly nations, but are needed for highly specialized applications such as national security, defense, or aerospace applications. These metals include, Manganese, Cobalt, Platinum, and Chromium, all of which are stockpiled by the U.S. government in case supplies are cut off.

How long current mineral resources will last depends on consumption rates and reserve amounts.

Some mineral resources will run out soon, for example global resources of Pb, Zn, and Au? will likely run out in about 30 years. U.S. resources of Pt, Ni, Co, Mn, Cr less than 1 year. Thus, continued use of scarce minerals will require discovery of new sources, increase in price to make hard-to-obtain sources more profitable, increased efficiency, conservation, or recycling, substitution of new materials, or doing without.

- **Environmental Issues**

Extraction and processing has large environmental impacts in terms of such things as air quality, surface water quality, groundwater quality, soils, vegetation, and aesthetics. Acid mine drainage is one example, Sulfide minerals newly exposed to Oxygen and water near the surface create sulfuric acid. Rainwater falling on the mine tailings becomes acidified and can create toxic conditions in the runoff. This can mobilize potentially dangerous heavy metals and kill organisms in the streams draining the tailings.

2.4 What Is Energy?

The classical description of energy is the ability of a system to perform work, but as energy exists in so many forms, it is hard to find one comprehensive definition. It is the property of an object that can be transferred from one object to another or converted to different forms but cannot be created or destroyed. There are numerous sources of energy. In the next few sections, let us discuss the about different sources of energy in detail.

2.4.1 Sources Of Energy

Sources of energy can be classified into:

- Renewable Sources
- Non-renewable Sources

Renewable sources of energy are available plentiful in nature and are sustainable. These resources of energy can be naturally replenished and are safe for the environment.

Examples of renewable sources of energy are: Solar energy, geothermal energy, wind energy, biomass, hydropower and tidal energy.

A non-renewable resource is a natural resource that is found underneath the earth. These type of energy resources do not replenish at the same speed at which it is used. They take millions of years to replenish. The main examples of non-renewable resources are coal, oil and natural gas.

Examples of non-renewable sources of energy are: Natural gas, coal, petroleum, nuclear energy and hydrocarbon gas liquids.

2.4.2 Natural Sources of Energy

During the stone age, it was wood. During the iron age, we had coal. In the modern age, we have fossil fuels like petroleum and natural gas. So how do we choose the source of energy?

❖ **Good sources of energy should have the following qualities:**

- Optimum heat production per unit of volume/mass used
- Easy to transport
- Least Polluting

- Economical

❖ Types of Natural Sources of Energy

There are two types of natural sources of energy classified by their popularity and use,

- Conventional Sources of Energy
- Non-Conventional Sources of Energy

In this article, you learned about natural resources, energy sources, and what makes a good source of energy. Explore more such articles at BYJU'S, which provides detailed solutions to the questions of NCERT Book for the energy source so that one can compare their answers with the sample answers given for this chapter.

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2.5 Land Resources

❖ Introduction

Resources that we get from nature and that exist without any interference from humankind are called natural resources. Sunlight, water, air, and landform altogether form the essential ecosystem in which all organisms live. Over time humans have progressed, and to do that they have exploited all the natural resources, but the land resource has been the one that has been exploited most.

We have a limited amount of resources but human needs are unlimited. For human beings land has many needs: it functions as an asset, produces food, stores water, has minerals for plant growth, and more. The land resource is not a renewable resource, as the demand for land increases with the increase of population, the amount of land will remain the same. Many measures and techniques have been adapted to preserve the land that we have and we need to understand how to manage the land.

❖ Land Use Pattern

Land use pattern is the layout or arrangement of the uses and purposes of the land. Climate, soil, the density of population, technical and socio-economic features determine the land use pattern. Forests, wasteland, cultivation, and civilization are the most important types of land use. Land use in civilization is the most exploited, roads, transport routes, housing, industries, and human settlement.

Fallow land is the land that has not been in use for more than 3 to 5 years and the neglected or unused urban areas like an empty lot or a playground is called Wasteland. Wasteland is the type of land which has lost its capacity for vegetation and nor is in use for civilization. Whereas crops can be cultivated on Fallow land, it still has not loose fertility but no cultivation has been done on it for years. Physical, economic, and political cause the problem of land resources.

❖ Land Degradation

The process in which the value of the biophysical environment is affected by a combination of humankind and natural hazards is called land degradation. Land degradation is a serious issue that affects the environment and has an indirect impact on food production. The continued degradation of land leads to a decline in the productivity of the land capacity of vegetation.

❖ Causes Of Land Degradation

Deforestation: Forest is very important for maintaining the fertility of the soil. Roots of trees hold on to soil thus preventing washing away of soil by rain, flood, or wind.

Overgrazing: Farmers take their cattle and livestock for grazing, but they mostly don't do rotation. Due to this the grass and another type of vegetation do not get a chance to grow thus causing land degradation.

Water-logging: In the agriculture field when proper irrigation is not done or maintenance the drainage system lacks, then excessive waterlogging can happen. If this happens then the surface water and the groundwater gets mixed which will bring salt from the groundwater level, thus ruining the fertility of the land.

Desertification: In arid, dry sub-humid, and semi-arid regions due to natural and human activities desertification happens. Desertification is when land becomes desert-like.
Soil erosion: When the wind and water cause the displacement or washes away the top layer of soil it is called soil erosion. The loss of the top layer of soil causes degradation of the quality of land, then it will not be able to provide minerals to plants. It will reduce the crop yielding potential of land, the groundwater level will go down, and can cause sinkholes.

❖ Conservation of land resources

Steps and measures that should be taken to conserve land resources are afforestation, proper grazing and maintaining irrigation, regulating pesticides and fertilizers for agriculture, properly using wasteland and fallow land.

2.6 Role of individual in conservation of natural resources

Individuals play a crucial role in the conservation of natural resources. While large-scale policies and initiatives are vital, individual actions can collectively make a significant impact. Here are several ways individuals contribute to conservation efforts:

1 Reducing Consumption:

By consuming less and choosing products that are sustainably sourced, individuals help reduce the demand for resources. This includes reducing water usage, cutting down on energy consumption, and minimizing waste.

2 Recycling and Reusing:

Properly recycling materials and reusing items helps to reduce the need for new resources and decreases waste in landfills.

3 Supporting Sustainable Practices:

Individuals can support companies and products that practice sustainable resource management, such as those using renewable energy or eco-friendly materials.

4 Conserving Water:

Simple actions like fixing leaks, using water-efficient fixtures, and being mindful of water use can significantly reduce water consumption and help protect aquatic ecosystems.

5 Reducing Energy Use:

Using energy-efficient appliances, turning off lights when not in use, and opting for renewable energy sources help conserve energy resources and reduce greenhouse gas emissions.

6 Participating in Local Conservation Efforts:
Engaging in local clean-up events, planting trees, and supporting community conservation projects can have a direct positive impact on local environments.

7 Educating Others:

Sharing knowledge about conservation practices and raising awareness about environmental issues can inspire others to take action and foster a culture of sustainability.

8 Advocating for Policy Changes:

Individuals can influence conservation efforts by advocating for stronger environmental policies and supporting legislation that aims to protect natural resources.

9 Choosing Sustainable Transportation:

Opting for public transportation, biking, walking, or driving fuel-efficient or electric vehicles helps reduce fossil fuel consumption and lowers carbon emissions.

10 Being Mindful of Wildlife:

Respecting wildlife and their habitats, such as by not disturbing animals in their natural environment and supporting wildlife protection initiatives, helps maintain biodiversity.

❖ **Exercise**

- **Long Question:-**

1. Expalin forest and Water Resource and its Importance

- **Short Question**

What is Mineral Resoucres?

- **Short Notes:-**

1. Write a note on Energy and land Resources
2. What is Role of individual in conservation of natural resources?

- **Fill ups**

1. River and pond are _____ type of resource.

UNIT-3 ECOSYSTEM

3.1 introduction:

Ecology is a combination of two words Oikos which means house and Logos which means study. It is a study of relationships between organisms with their environment. All the living organisms and geographical area reveals interspecific and intraspecific relationships and dependency on each other for survival. All the living community in an environment which satisfies its material and energy requirements of each other's. Hence, we can say that living organisms and physical environment are in an attached or close relationship. This type of relationship establishes different ecosystems in the environment. so, we can say that ecosystem is the function of nature.

3.2 Meaning and Concept of Ecosystem:

Sir Arthur Tansley was the pioneer of the term ecosystem. He was the first person who recognized the term ecosystem, it means a self-sustained nature and environment in which living and non- living components functions together and dependent on each other.

Ecosystem diverges in size from a small forest or pond to large forest or sea. Ecologists relate the whole environment as a global ecosystem, which is a composition of all local ecosystems of the Earth and which is naturally formed not created by man or not man-made. The entire ecosystems or environments can be divided into two main

categories i.e., the terrestrial ecosystems and the aquatic ecosystems. The terrestrial ecosystems are related to the ecosystems which belongs to earth and it is divided into three categories such as Forest, grassland and desert while aquatic ecosystems are connected with sea or water related aspects and it is divided into different categories such as pond, wetland, river, bay and sea. Man-made ecosystems are those types of ecosystems which are created by man not naturally formed such as Crop fields, an aquarium, orchards and gardens may be considered.

3.3 Structure and function of Ecosystem:

Individual biotic and abiotic factors and their surroundings are affected each other. Both the components impacted each other and resultant the flow of energy takes place inside these components of the ecosystem or environments. The physical structure is created with the Interaction of biotic and abiotic components which is called the main characteristic for each ecosystem. Identification and enumeration of plant and animal species of an ecosystem gives its composition of each and every plant and animal species. Vertical distribution of different species at different levels is called stratification. i.e., Trees hold a first place of top vertical strata or first layer of a forest, shrubs hold the second layers or place and herbs and grasses hold the bottom place or layers.

The components of the ecosystem to function as a unit from the following four components or factor such as Productivity, Decomposition, Energy flow and Nutrient cycling.

Now, understand the character of an aquatic ecosystem of simple and complex interactions between the different factor and let's take an example of a small pond which is a self-sustainable element that exist in an aquatic ecosystem. A pond is a low water body in which all of the above stated four components or elements of an ecosystem are well displayed. The abiotic component present in the pond is the water with all other the dissolved inorganic and organic substances. The rich soil deposit at the bottom of the pond.

The solar effort, day- night length, cycle of temperature and other climatic conditions adjust the rate of function of the entire pond. The autotrophic elements or factor include the phytoplankton, algae and the moving, submerged and peripheral plants found at the edges of the pond. The consumers are characterized by the zooplankton in the free swimming and bottom dwelling forms. The fungi, flagellates and bacteria especially abundant at the bottom of the pond are called decomposers. This structure performs all the functions of ecosystem and of the biosphere i.e., alteration of inorganic into organic material with radiant energy of the sun by the autotrophs; consumption of the autotrophs by heterotrophs; decomposition and mineralisation of the dead substance to release them back for reprocess by the autotrophs, these events are consistently repeated again and again.

This is called as a unidirectional drive of energy towards the advance trophic levels and its dissipation and loss as heat to the environment.

3.4 Components or factors of Structure and function of Ecosystem:

There are four factor which is discussed below:

3.4.1 Productivity:

A constant input of solar energy is needed for any ecosystem to function properly and sustain. Primary production is the amount of biomass or organic matter produced per unit area by plants during photosynthesis. It is denoted through the weight (gm–2) or energy (kcal m–2). The rate of biomass production known as productivity. It is denoted as gm–2 yr–1 or (kcal m–2) yr–1.

Productivity categories into gross primary productivity (GPP) and net primary productivity (NPP). Gross primary productivity known as the rate of production of organic matter during photosynthesis. A significant amount of GPP is used by plants is called as respiration. Gross primary productivity minus respiration losses is called the net primary productivity (NPP).

$$GPP - R = NPP$$

Net primary productivity is the obtainable biomass for the consumption to herbivories and decomposers. Secondary productivity is known as the rate of creation of new organic matter by consumers. Primary productivity depends on the plant species, environmental factors, availability of nutrients and photosynthetic capacity of plants. The annual net primary productivity of the entire environment is approx. 170 billion tons of organic matter and holds about 70 % of the surface whereas the productivity of the oceans are only 55 billion tons. Remaining is on land.

3.4.2 Decomposition:

Earthworm is known as the farmer's friend because they help in the breakdown of composite organic substance and loosening of the soil. In the same way, decomposers breakdown the composite organic substance into inorganic substances i.e., water, carbon dioxide and nutrients, this entire process is called decomposition. Raw material or inputs of decomposition includes Dead plant substance such as bark, leaves, flowers and dead animal's substances such as constitute detritus and fecal matter. The significant steps of decomposition include fragmentation, leaching, catabolism, humification and mineralisation.

fragmentation means the process of break-down detritus into smaller elements by Detritivores or earthworm. Water- soluble inorganic nutrients fall into the soil horizon and get precipitated as unobtainable salts through the process of leaching. Catabolism means the process of destroying detritus into inorganic substances or components by Bacterial and fungal enzymes.

Humification and mineralisation occur during decomposition which leads to gathering of a dark-coloured amorphous substance known as humus that is highly resistant to microbial action and undertakes decomposition at an extremely slow rate in

the soil. Mineralisation is the process of the further degradation of humus by microbes and release of inorganic nutrients. Decomposition needed oxygen in the entire process and the rate is controlled by chemical composition of detritus and climatic factors. The Rate of decomposition is slower if detritus is rich in lignin and chitin and quicker if detritus is rich in nitrogen and water-soluble substances like sugars.

The climatic factors like Temperature and soil moisture that regulate decomposition through their effects on the activities of soil microbes. Warm and moist environment favour decomposition whereas low temperature and anaerobiosis prevent decomposition subsequently in buildup of organic materials.

3.4.3 Energy flow and Nutrient cycling:

On the Earth, despite of the sea hydro-thermal ecosystem, sun is the main source of energy for all ecosystems. occasionally solar radiation less than 50 % of it is photosynthetically active radiation (PAR). Plants and photosynthetic bacteria hit Sun's radiant energy to make food from inorganic constituents. Plants capture small amount (2-10 %) of PAR energy to sustains the entire living world and how the solar energy took by plants flows over the different organisms of an ecosystem. Directly or indirectly all the organisms are dependent on producers for their food and that's called unidirectional flow of energy from the sun to producers and then taken by consumers. Is this a first law of thermodynamics?

In addition, ecosystems are impacted from the Second Law of thermodynamics because They require a constant supply of energy to synthesise the molecules, to respond the universal tendency toward increasing chaos.

The green plant is known as producers in the ecosystem. In a terrestrial ecosystem the major producers are herbaceous and woody plants. In the same way, various species like phytoplankton, algae and higher plants are called as a producer in an aquatic ecosystem. The food chains and webs are Starting from the plants food chains or rather webs are formed such as animal feeds on a plant or on another animal and in turn is food for another that exist in nature. The chain or web is formed because of this interdependency on each other on ecosystems. No energy is remains in organism forever. The energy is captured by the producer and passed to a consumer or the organism dies. Death of organism or creature is the opening of the detritus food chain or web.

All animals directly or indirectly depend on plants for their food requirements are hence called consumers and also heterotrophs. If they feed on the producers or the plants are called primary consumers and animals eat other animals which eat the plants are called secondary consumers. Similarly tertiary consumers and the primary consumers will be herbivores such as insects, birds and mammals in terrestrial ecosystem and mollusks in aquatic ecosystem. The consumers that feed on these herbivores are primary carnivores or secondary consumers. Those animals that depend on the primary carnivores called as secondary carnivores. In grazing food chain (GFC), Grass called Producer, Goat called Primary Consumer and Man Secondary consumer.

The detritus food chain (DFC) starts with dead organic substance and made up of decomposers which are heterotrophic organisms such as fungi and bacteria. Saprotrophs means that which is degrading dead organic substance or detritus for fulfill their energy and nutrient requirements. Decomposers stash digestive enzymes that breakdown dead and waste substance into inorganic constituents subsequently absorbed by them.

GFC is the major channel for energy flow in an aquatic ecosystem. In a terrestrial ecosystem energy flow through the detritus food chain despite of the GFC. Detritus food chain is linked with the grazing food chain at some levels in a natural ecosystem and some animals such as cockroaches and crows are called as omnivores. These natural interconnection of food chains called as a food web.

Organisms holds a place in the natural surroundings in a community depending upon their feeding relationship with other organisms. Organisms holds a specific place in the food chain Based on the source of their nutrition or food is known as trophic level. Producers is the first trophic level; herbivores are the primary consumer to the second and carnivores is the secondary consumer to the third. It is significant that the amount of energy decreases at successive trophic levels. When any organism dies and resultant converted into detritus or dead biomass which is the source of an energy for decomposers. Organisms at each trophic level depend on the lower trophic level for satisfying their energy requirement.

The standing crop means that a certain mass of living material at a particular time in Each trophic level. The standing crop is measured as the mass of living organisms or biomass and Measurement in terms of dry weight. In the grazing food chain, the number of trophic levels is restricted as the transfer of energy follows 10 % low and only 10 % of the energy is transferred to each trophic level. In nature, it is possible to have so many levels such as producer, herbivore, primary carnivore, secondary carnivore in the grazing food chain.

3.5 Types of Ecosystems:

There are various types of ecosystems but when we categories them, it can be of three types on the basis of geographical: 1) territorial Ecosystems which is sub divided into three parts Forest, grassland and desert Eco Systems, 2) Aquatic Ecosystems which also can be categorized into several types such as Freshwater ecosystems, Pond Ecosystems, Lake ecosystems, and Stream ecosystems. 3) Man-made ecosystems such as grass field and garden.

3.5.1 Territorial Ecosystems: it includes the Forest, grassland and desert Ecosystems because it belongs to earth or territory. Which is described as follows:

3.5.1.1 Forest Ecosystems: It is a composite system of living and non-living components that interact with each other in a nature or forest environment. It includes the interaction of a diverse array of plant and animal species, dense canopy of trees and a rich soil ecosystem in the forest.

Components that are parts of a Forest Ecosystem in the environment such as Biotic Factors which includes the following:

- different species of Trees, understory, scrubs and saplings.

- Shrubs and herbaceous plants and floras

- different Animals such as mammals, birds, microorganisms and insects

Abiotic Factors which include or present in the Forest Ecosystem in the environment are following:

- Water, soil, Light and temperature

- Topography, climate, Nutrients and minerals

Structure of a Forest Ecosystem have five layers includes the following:

1. Canopy Layer: The highest or topmost layer of the forest created/framed by the leaves and branches of trees known as the highest or Canopy Layer.
2. Understory Layer: The layer lower than the canopy and which covering of smaller trees, shrubs, and herbaceous plants are known as the Understory Layer.
3. Shrub Layer: A layer of shrubs and small trees that grows below the understory layer is known as the Shrub Layer.
4. Herbaceous Layer: The layer of plants that cultivates on the forest floor such as grasses, ferns and wildflowers.
5. Forest Floor: The lowest or bottom layer of the forest which including of leaf litter, branches, and other organic substance.

Processes in a Forest Ecosystem includes the following: Photosynthesis, Decomposition, Nutrient Cycling, Food Web and Succession. Which is discussed such as Photosynthesis is the process of producing energy or food through photosynthesis by Trees and plants. Decomposition is the process of break down the Microorganisms into organic matter and resultant releasing nutrients. Nutrient Cycling means a process of exchanging Nutrients between living and non-living components. Food Web is a composite network of predator-prey relationships between animals. Succession is the procedure of forest regeneration and growth after disturbances.

Types of Forest Ecosystems: there are five types of forests ecosystems which are discussed in details.

1. Tropical Rainforests: it is a Rainforests where the environment or geographical condition of the earth is very Hot and humid with dense vegetation and diverse species such as Amazon Rainforest known as Tropical Rainforests.
2. Temperate Rainforests: it is a such types of Rainforests where the environment or geographical condition of the earth is Mild climate with cone-bearing trees and high rainfall like Pacific Northwest condition known as Temperate Rainforests.

3. Boreal Forests: it is a type of Rainforests where the environment or geographical condition of the earth is Cold and subarctic with coniferous trees and limited vegetation like Taiga, known as Boreal Forests.
4. Deciduous Forests: it is a Rainforests where the environment or geographical condition is Temperate with trees that shed leaves seasonally like Eastern North, America known as Deciduous Forests.
5. Cloud Forests: it is a Rainforests where the environment or geographical condition is High-altitude with misty and humid conditions such as Andes Mountains, known as Cloud Forests

Importance of Forest Ecosystems:

1. Biodiversity: Forests support a vast array of plant and animal species.
2. Climate Regulation: Forests influence climate through carbon sequestration and weather patterns.
3. Water Cycle: Forests play a crucial role in regulating water cycles and maintaining soil quality.
4. Human Livelihoods: Forests provide timber, fuel, and other resources for human communities.

Threats to Forest Ecosystems:

1. Deforestation: Widespread clearance of forests for agriculture, urbanization, and logging.
2. Climate Change: Rising temperatures and altered weather patterns impact forest ecosystems.
3. Invasive Species: Non-native species can outcompete native species and alter ecosystem processes.
4. Overexploitation: Excessive harvesting of forest resources can deplete stocks and harm ecosystems.

3.5.1.2 Grassland Ecosystem: This type of ecosystems is a temperate region with the grasses and herbaceous plants, few trees and a diverse array of wildlife known as Grassland Ecosystem.

Characteristics of Grassland Ecosystem:

1. Temperate Climate: Grasslands Ecosystem have a modest climate with warm summers and cold winters in the nature or environment.
2. Grasses and Herbaceous Plants: this ecosystem includes Grasses, wildflowers, and other herbaceous plants are the leading flora in the nature or environment.
3. Limited Tree Cover: these types of ecosystems have scarce or absent Trees because the factors like climate, soil and human activity.
4. Diverse Wildlife: Grasslands sustenance have a wide range of animals which includes insects to large mammals.

Components that are parts of a Grassland Ecosystem in the environment such as Biotic Factors which includes the following:

- Various types of species of Grasses such as tallgrass or shortgrass.

- wildflowers, clover and Herbaceous plants.

- insects, mammals, reptiles and birds

Abiotic Factors which include or present in the Grassland Ecosystem in the environment are following:

- Water, soil, Light and temperature

- Topography, climate, Nutrients and minerals

Structure of a Grassland Ecosystem have three layers includes the following:

1. Vegetation Layer: It includes the layer of herbaceous plants and grasses that grows above the soil.
2. Soil Layer: This soil layer helpful for plant to growth and stores nutrients.
3. Understory Layer: This layer is the lower layer which includes the vegetation containing of smaller plants and animals.

Processes in a Grassland Ecosystem includes the following: Photosynthesis, Decomposition, Nutrient Cycling and Food Web.

Types of Grassland Ecosystems: There are four types of Grassland ecosystems which are discussed in details.

1. Prairies: which is mostly seen in North America such as Temperate grasslands with tallgrass and wildflowers.
2. Steppes: which is mostly seen in Eurasia and includes Temperate grasslands with shortgrass and limited vegetation.
3. Savannas: which is normally seen in Africa and Australia and containing Grasslands with scattered trees and a warm climate.
4. Pampas: which is mostly seen in South America which includes Temperate grasslands with tallgrass and wildflowers.

Importance of Grassland Ecosystems:

1. Biodiversity: it supports Grasslands with a wide range of plant and animal species in the nature.
2. Soil Conservation: it helpful in maintaining soil quality and prevent erosion in the Grasses and other vegetation.
3. Livestock Grazing: Grasslands provide food or energy for living habitat like livestock and support agriculture.
4. Carbon Sequestration: It have a capacity to store carbon in soils and vegetation.

Threats of Grassland Ecosystems:

1. Habitat Fragmentation includes the Human activities like agriculture and urbanization fragment grassland habitats.
2. Invasive Species includes the Non-native species can obtainable from native species and alter ecosystem processes.
3. Climate Change includes the Changes in temperature and rainfall patterns which impact grassland ecosystems.
4. Overgrazing or Excessive by livestock and resultant grazing can degrade grassland ecosystems.

3.5.1.3 Desert Ecosystem:

It is a unique and fascinating ecosystem and which is characterized by low rainfall, limited vegetation and high temperatures.

Characteristics of Desert Ecosystem includes the followings:

1. Low Rainfall: in the Deserts areas always receive little rainfall and which is often less than 25 centimeters per year.
2. High Temperatures: Deserts are known for their extreme heat and there is always a high temperature in these types of regions with temperatures often reaching 45°C (113°F) or more.
3. Limited Vegetation: Desert plants are adapted or capable to survive with less water and vegetation is very sparse and limited. These types of areas have a very little greenery.
4. Specialized Wildlife: Desert animals also adoptable or capable to survive in this harsh and high temperature environment.

Components that are parts of a Desert Ecosystem in the environment such as Biotic Factors which includes the following:

- Cacti and succulents

- Desert shrubs and trees such as palo Verde, and mesquite.

- ants, beetles and other Insects.

- camels, rats, dessert snakes, kangaroo and other desert Animals.

Abiotic Factors which includes the following:

- scarce Water, Light and temperature

- sandy Soil and rocky Soil

- Topography such as dunes, plateaus and canyons.

Structure of a Desert Ecosystem have three layers includes the following:

1. Vegetation Layer is the layer of plants that cultivates above the soil and often sparse and limited.

2. Soil Layer is the layer of soil that supports plant to growth and helpful in storing water.
3. Understory Layer is the layer below the vegetation and consisting of smaller plants and animals.

Processes of a Desert Ecosystem includes the following:

1. Photosynthesis is the process of producing energy by Plants through photosynthesis.
2. Water is scarce and desert plants have a capability and adaptability to conserve water this process is known as Water Cycle.
3. Nutrient Cycling is the process of exchanging Nutrients between living and non-living components.
4. Food Web is a composite network of predator-prey relationships between animals.

Types of Desert Ecosystems: There are four types of desert ecosystems which is given below:

1. Hot Deserts which is Characterized by high temperatures and low rainfall Like Sahara and Mojave.
2. Cold Deserts is Characterized by cold temperatures and low rainfall Like Gobi and Patagonia.
3. Coastal Deserts is Characterized by cool temperatures and fog such as Atacama and Namib.
4. Monsoon Deserts is Characterized by seasonal rainfall and high temperatures Like Sonoran and Thar.

Importance of Desert Ecosystems:

1. Biodiversity: Deserts support a unique range of plant and animal species.
2. Water Conservation: Desert plants and animals have evolved efficient water conservation strategies.
3. Economic Importance: Deserts are often rich in natural resources like as minerals and oil.
4. Cultural Significance: Deserts have spiritual and cultural significance for many communities.

Threats of Desert Ecosystems:

1. Habitat Fragmentation: Human activities like urbanization and agriculture fragment desert habitats.
2. Climate Change: Changes in temperature and precipitation patterns impact desert ecosystems.
3. Overexploitation: Overgrazing and over-extraction of resources can degrade desert ecosystems.
4. Invasive Species: Non-native species can outcompete native species and alter ecosystem processes.

3.5.2 Aquatic ecosystems:

It is a community of living and non-living substances that interact in a body of water such as a lake, river, ocean, or wetland. **Aquatic ecosystems can be classified into two parts 1) Freshwater ecosystems**: which can be sub divided into three parts such as Pond ecosystems, Lake ecosystems and Stream ecosystems. **2) Salt water ecosystems: which can be sub categorized into three parts such as** Wetland ecosystems, Estuarine ecosystems and Marine ecosystems.

Types of Aquatic Ecosystems: it includes three types of ecosystems.

1. Freshwater Ecosystems includes the rivers, lakes, wetlands, and ponds with low salt concentrations. These types of ecosystems interact with freshwater environment.
2. Marine Ecosystems includes the Oceans, seas, and coral reefs with high salt concentrations. These types of ecosystems interact with saltwater environment.
3. Brackish Ecosystems includes the Estuaries, mangroves, and salt marshes with mixtures of fresh and saltwater.

Components that are parts of an Aquatic Ecosystem in the environment such as Biotic Factors which includes the following:

- microscopic plants and Phytoplankton

- microscopic animals and Zooplankton

- seagrasses, water lilies and Aquatic plants

- dolphins, whales, Fish and other aquatic animals

Abiotic Factors which includes the following:

- Water temperature, pH and oxygen levels

- Light, sediment composition, Salinity and nutrient concentrations.

Structure of the Aquatic Ecosystem have three layer includes the following:

1. These types of Aquatic Ecosystem includes the Open water in which phytoplankton and zooplankton thrive known as Pelagic Zone.
2. These types of Aquatic Ecosystem which includes Seafloor or lakebed where aquatic plants and animals live called as Benthic Zone.
3. Littoral Zone is known as the Shallow water near the shore with a mix of aquatic and terrestrial species.

Processes of the Aquatic Ecosystem includes the following: Photosynthesis, Decomposition, Nutrient Cycling and Food Web.

Importance of the Aquatic Ecosystem:

1. Biodiversity: Aquatic ecosystems support a vast array of plant and animal species.
2. Food Source: Aquatic ecosystems provide food for humans and other animals.

3. Water Regulation: Aquatic ecosystems help regulate water cycles and quality.
4. Recreation: Aquatic ecosystems offer opportunities for recreation and tourism.

Threats of the Aquatic Ecosystem:

1. Pollution: Chemical and waste pollution harm aquatic life.
2. Overfishing: Excessive fishing depletes fish populations and disrupts food webs.
3. Habitat Destruction: Human activities like coastal development and dredging harm aquatic habitats.
4. Climate Change: Changes in temperature and precipitation patterns impact aquatic ecosystems.

3.5.3 Man-made Ecosystems

It is known as artificial or constructed Ecosystems. It is human created environment that helpful for living and non-living components of the society. It includes aquaculture, Greenhouse, Artificial wetlands, urban ecosystem and space ecosystem.

Types of Man-made Ecosystems:

1. Aquaculture Ecosystems includes Fish farms, ponds and other man-made systems for raising aquatic animals.
2. Greenhouses Ecosystems involving the Controlled environments for growing plants and using hydroponics or aeroponics.
3. Artificial Wetlands Ecosystems means that which is Constructed wetlands for water filtration, recreation and wildlife habitat.
4. Urban Ecosystems includes the Cities and towns which can be considered man-made ecosystems due to their high level of human influence.
5. Space Stations Ecosystems is known as the Artificial environments for human habitation and research in space.

Characteristics of Man-made Ecosystems:

1. Human Design: Man-made ecosystems are intentionally designed by humans for personal use.
2. Controlled Conditions: Man-made ecosystems have controlled condition such as temperature, lighting and nutrient levels.
3. Limited Biodiversity: Man-made ecosystems have lesser species than natural ecosystems.
4. Dependence on Human Input: Man-made ecosystems depends on human maintenance and management.

Importance of Man-made Ecosystems:

1. Food Production: Man-made ecosystems increase food production such as aquaculture and greenhouses.
2. Environmental Remediation: Artificial wetlands and other man-made ecosystems useful in cleaning polluted water.

3. Research and Development: Man-made ecosystems helpful in scientific research and technological innovation such as space stations.
4. Recreation and Tourism: Man-made ecosystems offer entertainment and education such as theme parks and aquariums.

Challenges of Man-made Ecosystems:

1. Environmental Impact: Man-made ecosystems can have unintentional significances on surrounding natural ecosystems.
2. Resource Intensity: Man-made ecosystems require significant resources consisting energy and water.
3. Maintenance and Management: Man-made ecosystems involve regular maintenance to function.
4. Cost and Accessibility: Man-made ecosystems is very expensive to create and maintain with limiting access to benefits.

3.6 Role of individuals in sustaining the ecosystems:

- By Maintaining biodiversity, regulating the climate, and supporting human well-being can help in Conservating and sustaining of forest ecosystems.
- By Maintaining biodiversity, soil quality, and ecosystem services supports in Conservation of grassland ecosystems.
- By Maintaining biodiversity, water resources, and ecosystem services helpful in Conservation and sustaining of desert ecosystems.
- By Conservation and sustaining of aquatic ecosystems are critical for maintaining biodiversity, food security, and ecosystem services.
- Individuals play a vital role in sustaining ecosystems through Conservation, Sustainable Living, Education and Awareness, Environmental Stewardship and Community Involvement.
- Through Reduce, Reuse and Recycle strategy which Minimize waste, reuse substances when possible, and recycle to reduce landfill waste.
- Use water decently, fix leaks, and install low-flow fixtures and Use Eco-Friendly Products.
- Use Public Transport or Carpool which can Reduce carbon emissions.
- Use Energy-Efficient Appliances at homes and offices such as bulbs with LED bulbs.
- Support Renewable Energy through using and investing in solar panels or renewable energy.
- Plant Trees, Gardens and vegetables to support local biodiversity and reduce carbon emissions.
- Reduce Food Waste through using Plan meals and compost food waste to reduce landfill waste.
- Participate in local clean-ups, join conservation organizations, and advocate for environmental policies.
- Educate yourself and society about local ecosystems, species and conservation issues.

- Share knowledge with others and encourage sustainable practices.
- Support Environmental Education which includes Donation to organizations that promote environmental education.
- Participate in community gardening initiatives to promote local food production.
- Join local conservation organizations and participate in projects that protect and restore ecosystems.
- Advocate for Environmental Policies through sign petitions and participate in advocacy campaigns.
- Choose products with minimal packaging and made from sustainable materials.

❖ **Exercises:**

- **Answers the following MCQ.**

1. The importance of ecosystem lies in ----------
   (1) Flow of energy
   (2) Cycling of materials
   (3) Both (1) and (2)
   (4) None of these
   Answers: (3) Both (1) and (2)

2. Energy stored at the consumer level is known as ----------
   (1) Net primary productivity
   (2) Gross primary productivity
   (3) Secondary productivity
   (4) None of these
   Answers: (3) Secondary productivity

3. Find out the correct sequence of the food chain ------
   (1) grass → insect → bird → snake
   (2) grass → wolf → deer → buffalo
   (3) bacteria → grass → rabbit → wolf
   (4) None of these
   Answers: (1) grass → insect → bird → snake

4. Man made Ecosystems includes:
   (1) Crop fields
   (2) Aquaria
   (3) Gardens
   (4) All of these
   Answers: (4) All of these

5. Ecosystem involves ----------
   (1) Producers
   (2) Decomposers
   (3) Consumers
   (4) All of these
   Answers: (4) All of these

6. The second trophic level in a lake is called as:
   (1) Phytoplankton
   (2) Zooplankton
   (3) Both (1) and (2)
   (4) All of these
   Answers: (2) Zooplankton

7. The first primary producers in a lake is called as:
   (1) Phytoplankton
   (2) Zooplankton
   (3) Both (1) and (2)
   (4) All of these
   Answers: (1) Phytoplankton

8. Secondary producers are called as ----
   (1) Herbivores
   (2) Producers
   (3) Carnivores
   (4) None of the above
   Answers: (1) Herbivores

- **Answers the following short and long Questions:**

1. Explain the Meaning and Concept of Ecosystem in brief.
2. Explain the Structure and Function of Ecosystem in brief.
3. Explain the Components or factors of Structure and function of Ecosystem in brief.
4. Explain the Types of Ecosystems in details.
5. Explain the Territorial Ecosystems in details.
6. Explain the Forest Ecosystems in details.
7. Explain the Grassland Ecosystems in details.
8. Explain the Desert Ecosystems in details.
9. Explain the Aquatic Ecosystems in details.
10. Define Man-made Ecosystems.
11. Explain the Role of individuals in sustaining the ecosystems in brief.
12. Write a short note on Productivity.
13. Write a short note on Decomposition.
14. Write a short note on Energy flow and Nutrient cycling.

UNIT-4 BIODIVERSITY

4.1 Introduction

Biodiversity describes the richness and variety of life on earth. It is the most complex and important feature of our planet. Without biodiversity, life would not sustain. The term biodiversity was coined in 1985. It is important in natural as well as artificial ecosystems. It deals with nature's variety, the biosphere. It refers to variabilities among plants, animals and microorganism species.

Biodiversity includes the number of different organisms and their relative frequencies in an ecosystem. It also reflects the organization of organisms at different levels. Biodiversity holds ecological and economic significance. It provides us with nourishment, housing, fuel, clothing and several other resources. It also extracts monetary benefits through tourism. Therefore, it is very important to have a good knowledge of biodiversity for a sustainable livelihood.

Biodiversity is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems. Biodiversity forms the foundation of the vast array of ecosystem services that critically contribute to human well-being. Biodiversity is important in human-managed as well as natural ecosystems. Decisions humans make that influence biodiversity affect the well-being of themselves and others.

- **Meaning**

Biodiversity is the foundation of ecosystem services to which human well-being is intimately linked. No feature of Earth is more complex, dynamic, and varied

than the layer of living organisms that occupy its surfaces and its seas, and no feature is experiencing more dramatic change at the hands of humans than this extraordinary, singularly unique feature of Earth. This layer of living organisms the biosphere through the collective metabolic activities of its innumerable plants, animals, and microbes physically and chemically unites the atmosphere, geosphere, and hydrosphere into one environmental system within which millions of species, including humans, have thrived. Breathable air, potable water, fertile soils, productive lands, bountiful seas, the equitable climate of Earth's recent history, and other ecosystem services are manifestations of the workings of life. It follows that large-scale human influences over this biota have tremendous impacts on human well-being. It also follows that the nature of these impacts, good or bad, is within the power of humans to influence.

Biodiversity includes all ecosystems managed or unmanaged. Sometimes biodiversity is presumed to be a relevant feature of only unmanaged ecosystems, such as wildlands, nature preserves, or national parks. Managed systems like plantations, farms, croplands, aquaculture sites, rangelands, or even urban parks and urban ecosystems have their own biodiversity. Cultivated systems alone now account for more than 24% of Earth's terrestrial surface, it is critical that any decision concerning biodiversity or ecosystem services address the maintenance of biodiversity in these largely anthropogenic systems.

In spite of many tools and data sources, biodiversity remains difficult to quantify precisely. But precise answers are seldom needed to devise an effective understanding of where biodiversity is, how it is changing over space and time, the drivers responsible for such change, the consequences of such change for eco sysstem services and human well-being, and the response options available.

Ideally, to assess the conditions and trends of biodiversity either globally or sub-globally, it is necessary to measure the abundance of all organisms over space and time, using taxonomy such as the number of species, functional traits, For example, the ecological type such as nitrogen-fixing plants like legumes versus non-nitrogen-fixing plants, and the interactions among species that affect their dynamics and function means predation, parasitism, competition, and facilitation such as pollination, for instance, and how strongly such interactions affect ecosystems.

- **Definition**

"Biodiversity is the variation among living organisms from different sources including terrestrial, marine and desert ecosystems, and the ecological complexes of which they are a part."

Biodiversity is defined as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." The importance of this definition is that it draws attention to the many dimensions of biodiversity. It explicitly recognizes that every biota can be characterized by its taxonomic, ecological, and genetic diversity and that the way these dimensions of diversity vary over space and time is a key feature of biodiversity. Thus only a multidimensional assessment of biodiversity can provide insights into the relationship between changes in biodiversity and changes in ecosystem functioning and ecosystem services.

4.2 Types of Biodiversity

The following are three different types of biodiversity:

1) Genetic Biodiversity
2) Species Biodiversity
3) Ecological Biodiversity

1) Species diversity

Species diversity refers to the variety of different types of species found in a particular area. It is the biodiversity at the most basic level. It includes all the species ranging from plants to different microorganisms. No two individuals of the same species are exactly similar. For example, humans show a lot of diversity among themselves.

2) Genetic diversity

It refers to the variations among the genetic resources of the organisms. Every individual of a particular species differs from each other in their genetic constitution. That is why every human looks different from each other. Similarly, there are different varieties in the same species of rice, wheat, maize, barley, etc.

3) Ecological diversity

An ecosystem is a collection of living and non-living organisms and their interaction with each other. Ecological biodiversity refers to the variations in the plant and animal species living together and connected by food chains and food webs.It is the diversity observed among the different ecosystems in a region. Diversity in different ecosystems like deserts, rainforests, mangroves, etc., include ecological diversity.

4.3 Importance of Biodiversity

Biodiversity and its maintenance are very important for sustaining life on earth. A few of the reasons explaining the importance of biodiversity are:

- ✓ **Ecological Stability**

Every species has a specific role in an ecosystem. They capture and store energy and also produce and decompose organic matter. The ecosystem supports the services without which humans cannot survive. A diverse ecosystem is more productive and can withstand environmental stress.

- ✓ **Economic Importance**

Biodiversity is a reservoir of resources for the manufacture of food, cosmetic products and pharmaceuticals. Crops livestock, fishery, and forests are rich sources of food. Wild plants such as Cinchona and Foxglove plant are used for medicinal purposes. Wood, fibres, perfumes, lubricants, rubber, resins, poison and cork are all derived from different plant species.

The national parks and sanctuaries are a source of tourism. They are a source of beauty and joy for many people. In Context to Ethical Importance, All species have a right to

exist. Humans should not cause their voluntary extinction. Biodiversity preserves different cultures and spiritual heritage. Therefore, it is very important to conserve biodiversity.

4.4 Biodiversity in India

India is one of the most diverse nations in the world. It ranks ninth in terms of plant species richness. Two of the world's 25 biodiversity hotspots are found in India. It is the origin of important crop species such as pigeon pea, eggplant, cucumber, cotton and sesame. India is also a centre of various domesticated species such as millets, cereals, legumes, vegetables, medicinal and aromatic crops, etc.

India is equally diverse in its faunal wealth. There are about 91000 animal species found here. However, diversity is depleting at a drastic rate and various programmes on biodiversity conservation are being launched to conserve nature.

Biodiversity constitutes the most important working component of a natural ecosystem. It helps to maintain ecological processes and deals with the degree of nature's variety in the biosphere. The term biodiversity was first coined by Water & Rosen in 1985. Biodiversity refers to the variability among living organisms and constitute terrestrial, marine, aquatic ecosystems and the ecological complexes. It reflects the number, variety & variability of living organisms and includes diversity within species (genetic diversity), between species (species diversity) and between ecosystems (ecosystem diversity).

India is a mega diverse country having only 2.4% of the world's land area but accommodates 7-8% species of flora and fauna. It includes more than 45,000 species of plants and 91,000 species of animals. It is situated at the tri-junction of the Afro-tropical, Indo-Malayan and Palearctic realms, all of these support rich biodiversity. India is a diverse nation, which has 10 biogeographic zones. A comparison of status of biodiversity between Indian and World scenario is depicted in Table 1.

Table 1: Comparison between the Number of Species in India & the World

Group	Number of Species in India	Number of Species in the World	(%) India
Mammals	350	4627	7.6
Birds	1224	9702	12.6
Reptiles	408	6550	6.2
Amphibians	197	4522	4.4
Fishes	2546	21,730	11.7
Flowering Plants	15,000	2,50,000	6

(Source: Centre for Ecological Sciences, Indian Institute of Science)

India is also a recognized center of crop diversity and produces hundreds of varieties of crop plants such as rice, maize, millets etc. The diverse physical features

and climatic conditions of India are responsible for a variety of ecosystems such as forests, grasslands, wetlands, deserts, coastal and marine ecosystems.

- The majority of these natural ecosystems have been overused or misused by humans. Mangroves have been cleared for fuelwood and prawn farming, resulting in a reduction in the habitat required for marine fish breeding.

4.5 Threats to biodiversity

- The main threats to biodiversity include the wilderness habitats, particularly in the super-diverse tropical forests and coral reefs.

- Scientists estimate that by 2050, human activities will have wiped out approximately 10 million species. Approximately 1.8 million species of plants and animals, both large and small, are currently known to science.

- However, the number of species is likely to be multiplied by at least ten. Plants and insects, as well as other forms of life previously unknown to science, are constantly being discovered in the world's diverse "hotspots."Unfortunately, at the current rate of extinction, about 25% of the world's species will perish relatively quickly. This could happen at a rate of tens of thousands of species per year, a thousand to ten thousand times faster than the natural rate!

- Within the next twenty or thirty years, human actions could obliterate 25% of the world's species. Human population growth, industrialization, and changes in land-use patterns are all contributing to this mass extinction. Tropical forests, wetlands, and coral reefs will account for a significant portion of these extinctions. Rapid global biodiversity destruction is exacerbated by the loss of wild habitats as a result of rapid human population growth and short-term economic development.

- Human activity has so far had the greatest impact on island flora and fauna with high endemism in small isolated areas surrounded by sea, which has already resulted in the extinction of many island plants and animals. Man's introduction of species from one area to another disrupts the balance of existing communities, resulting in habitat loss. Many local species have been wiped out as a result of the intentionally or accidentally introduced organisms.

- Species extinction occurs as a result of the destruction of natural ecosystems, whether as a result of conversion to agriculture or industry, over-exploitation of resources, or pollution of the air, water, and soil. Forests and grasslands in India are constantly being converted to agricultural land.

- Encroachments have been legalized on several occasions. Natural wetland systems have also been drained to make way for croplands, resulting in the extinction of aquatic species. Grasslands that were once sustainably used by a smaller number of people and their cattle are now either converted to other uses or degraded due to overgrazing.

4.6 Biodiversity with a view point of National and Local level

- There are at present 1.8 million species known and documented by scientists in the world. However, scientists have estimated that the number of species of plants and animals on earth could vary from 1.5 to 20 billion!

- Thus, the majority of species are yet to be discovered. Most of the world's bio-rich nations are in the South, which are the developing nations. In contrast, the majority of the countries capable of exploiting biodiversity are Northern nations, in the economically developed world. These nations however have low levels of biodiversity. Thus the developed world has come to support the concept that biodiversity must be considered to be a 'global resource'.

- However, if biodiversity should form a 'common property resource' to be shared by all nations, there is no reason to exclude oil, or uranium, or even intellectual and technological expertise as global assets. India's sovereignty over its biological diversity cannot be compromised without a revolutionary change in world thinking about sharing of all types of natural resources. Countries with diversities higher than India are located in South America such as Brazil, and South East Asian countries such as Malaysia and Indonesia. The species found in these countries, however, are different from our own. This makes it imperative to preserve our own biodiversity as a major economic resource. While few of the other 'Mega Diversity Nations' have developed the technology to exploit their species for biotechnology and genetic engineering, India is capable of doing so.

4.7 India as a Mega diversity nation

The biodiversity is not only genes, species, population, community and ecosystem only but also it refers to productivity, nutritional status, biocontrol, biofertilizers, bioenergy, breeding strategies, livelihood, lifestyle, endogenous knowledge with ex-situ and in-situ conservation. We have a lot of endogenous species of flora and fauna in all ecosystems. They are part of traditional biodiversity.

Though many crops like rice sugarcane, mango, jute, citrus, banana, bazra, jwar etc, arose in India and spread throughout the world, a large proportion of the Indian biodiversity is still unexplored. Today the field of ethnobotany requires a variety of skills: botanical training for the identification and preservation of plant specimens.

A great deal of information about the traditional uses of plants is still intact with tribal people and they are not ready to share it with outsiders so the knowledge of wild plants for food, medicine, and fibers, among others, was left out of the picture, resulting in a distorted view of which plants were actually important to them. They use forest plants, weeds, fruit plants, vegetables, spices, ornamental plants, ferns and many others as traditional medicine and preparing agricultural implements.

To collect proper information, we have to develop a long-term commitment and genuine relationship with the tribals. India being a mega biodiversity country fulfills all the requirements of tribal people including problems of nutrition, health

care and life support system, social customs, mythological association or faith in plants, cottage industries, economic upliftment, conservation of biodiversity and sustainable use of plant resources.

The year 2010 was declared as the 'International Year of Biodiversity' and the theme for this year's environment day was "Biodiversity: Connecting with Nature" Mega bio diverse country is one that contains majority of living species found on the earth. The main criterion for mega diverse countries is endemism at the level of species, genera and families. A mega diverse country must have at least 5,000 species of endemic plants and must border marine ecosystems

(1) India is known for its rich heritage of Biological diversity. The greater the multidiversity of species, greater is the contribution to biodiversity
(2) The large species richness and abundance are due to immense variety of climatic and altitudinal condition in country. These vary from the humid tropical Western Ghats to the hot desert of Rajasthan, from cold desert of Ladakh and the icy mountain of Himalayas to the warm cost of peninsular India and Afro-tropical, Indo-Malayan and Paleo-Arctic realms, and therefore, has characteristic elements these includes ecosystem diversity is highest in the world, India is situated at the tri-junction of three realms from each of them. India is a remarkably diverse country having linguistic, genetic and cultural diversity
(3) The country is recognized as one of the eight Vavilovian centers of origin and diversity of crop plants having more than 300 wild ancestors which are closely related to cultivated plants.

There are 25 clearly defined areas in the world called 'Hot spots' that support about 50,000 endemic plant species, comprising 20 per cent of the world's total flora. India's defined location of 'hot spots' is the Western Ghats and the Himalaya regions. Approximately 65 per cent of the total geographical area has been surveyed so far. Based on this, over 46,000 species of plants and 81,000 species of animals have been described by the Botanical Survey of India (BSI) established in 1890. The forests India have been classified into 16 types and 251 subtypes by climatic and edaphic conditions. On the basis of vegetation India has ten zones.

There are number of climatic and edaphic factors that make India a mega diverse region.

1) Location- India is located in south Asia, between latitude 60 and 380 N and longitudes 690 and 970 E. The Indian landmass extending over a total geographical area of about 3029 million hectares is bounded by Himalayas in the north, the Bay of Bengal in east, the Arabian Sea in the west, and Indian Ocean in the south.
2) Rain fall - The annual rainfall varies from less than 37 cm in Rajasthan to 1500m in Cherapunji. The country experiences three different seasons in winter, summer, and monsoons.
3) Sunlight- The days in summer are long and in winter short. With up to approximately 14 hours the longest days are in June. On the other hand the longest dark nights happen in winter in the southern hemisphere it is the other way around. In December a night in New Delhi last almost 14 hours.

4) Forests: Different types of Forest are found in India. In tropical region climatic forests having luxuriantly growing lofty trees which are more than 45 metres in height. The shrubs, lianas (woody climbers) and epiphytes are abundant because of high rainfall. These forests are found in Andaman and Nicobar Islands, Western coasts and parts of Karnataka.

4.8 Conservation of Biodiversity

Biodiversity conservation is the protection and management of biodiversity to obtain resources for sustainable development.

Biodiversity conservation has three main objectives:

- To preserve the diversity of species.
- Sustainable utilization of species and ecosystem.
- To maintain life-supporting systems and essential ecological processes.

The following are the different biodiversity conservation methods explained below.

Biodiversity and its Conservation Methods

Biodiversity refers to the variability of life on earth. It can be conserved in the following ways:

1) **In-situ Conservation**

2) **Ex-situ Conservation**

1) In-situ Conservation

In-situ conservation of biodiversity is the conservation of species within their natural habitat. In this method, the natural ecosystem is maintained and protected. The in-situ conservation has several advantages. Following are the important advantages of in-situ conservation: It is a cost-effective and convenient method of conserving biodiversity.A large number of living organisms can be conserved simultaneously.Since the organisms are in a natural ecosystem, they can evolve better and can easily adjust to different environmental conditions.Certain protected areas where in-situ conservation takes place include national parks, wildlife sanctuaries and biosphere reserves.

- **National Parks**

These are small reserves maintained by the government. Its boundaries are well demarcated and human activities such as grazing, forestry, habitat and cultivation are prohibited. For eg., Kanha National Park, and Bandipur National Park.

- **Wildlife Sanctuaries**

These are the regions where only wild animals are found. Human activities such as timber harvesting, cultivation, collection of woods and other forest products are allowed here as long as they do not interfere with the conservation project. Also, tourists visit these places for recreation.

- **Biosphere Reserves**

Biosphere reserves are multi-purpose protected areas where the wildlife, traditional lifestyle of the inhabitants and domesticated plants and animals are protected. Tourist and research activities are permitted here.

2) Ex-situ Conservation

Ex-situ conservation of biodiversity involves the breeding and maintenance of endangered species in artificial ecosystems such as zoos, nurseries, botanical gardens, gene banks, etc. There is less competition for food, water and space among the organisms.

Ex-situ conservation has some advantages like,The animals are provided with a longer time and breeding activity. The species bred in captivity can be reintroduced in the wild. Genetic techniques can be used for the preservation of endangered species.

Strategies for Biodiversity Conservation

Following are the important strategies for biodiversity conservation:

1. All the varieties of food, timber plants, livestock, microbes and agricultural animals should be conserved.
2. All the economically important organisms should be identified and conserved.
3. Unique ecosystems should be preserved first.
4. The resources should be utilized efficiently.
5. Poaching and hunting of wild animals should be prevented.
6. The reserves and protected areas should be developed carefully.
7. The levels of pollutants should be reduced in the environment.
8. Deforestation should be strictly prohibited.
9. Environmental laws should be followed strictly.
10. The useful and endangered species of plants and animals should be conserved in their nature as well as artificial habitats.
11. Public awareness should be created regarding biodiversity conservation and its importance.

Why should you conserve Biodiversity?

It is believed that an area with higher species abundance has a more stable environment compared to an area with lower species abundance. We can further claim the necessity of biodiversity by considering our degree of dependency on the environment. We depend directly on various species of plants for our various needs. Similarly, we depend on various species of animals and microbes for different reasons.

Biodiversity is being lost due to the loss of habitat, over-exploitation of resources, climatic changes, pollution, invasive exotic species, diseases, hunting, etc. Since it provides us with several economic and ethical benefits and adds aesthetic value, it is very important to conserve biodiversity.

4.9 Biodiversity hotspot

A Biodiversity Hotspot is a geographical area with a high level of diverse endemic species that is not found anywhere else in the world.
In simple words, a biodiversity hotspot is a region where a significant number of threatened or endangered species live together.

According to the British biologist Norman Myers, a biodiversity hotspot must contain at least 1500 species of endemic vascular plants that have lost around 70% of their original habitat. The marine hotspots, fish, snails, lobsters, and coral reefs are also considered biodiversity hotspots.

Biodiversity Hotspots are biogeographic regions that have the richest and the most threatened reservoirs of plant and animal life on earth. These regions have been identified as some of the world's most important ecosystems that are home to a high number of endemic species that also provide crucial ecosystem services for the benefit of humans.

4.9.1 Origin of the concept

The concept of biodiversity hotspot was first proposed by the British Ecologist - Norman Myers says in his article - "The Environmentalist", which was published in 1988, identified 10 tropical forest "hotspots" as conservation priorities, which were characterized by an extraordinarily large number of endemic plant species found in relatively smaller areas, besides facing serious threats of habitat loss.

4.9.2 Criteria for determining a hotspot

According to Conservation International, to be recognized as a biodiversity hotspot, a region must meet two strict criteria. These are:

1. The number of Endemic Species: The region must comprise over at least 0.5% or 1,500 endemic vascular plant species. It has been found that these vascular plants are critical for the ecosystem's sustainability since they allow the circulation of photosynthetic products, water, and minerals.
2. Degree of threat: The region must have lost at least 70% or more of its original habitat.

However, many hotspot regions exceed these two criteria. For example, both the Tropical Andes and the Sundaland Hotspot regions have more than 15,000 endemic plant species; and over 95% of primary vegetation has also been lost in some hotspot areas.

As estimated by Conservation International, a total of 36 areas around the world meets the above two criteria and are therefore are considered to be biodiversity hotspots. These hotspots support nearly 60% of the world's flora and fauna.

4.9.3 Biodiversity Hotspots

Rank	Name	Location
1	California Floristic Province	California, USA
2	Caribbean Islands	East of Central America
3	Madrean Pine-Oak Woodlands	Southern USA
4	Mesoamerica	Central Mexico, Belize, Guatemala, Nicaragua, and Northern Costa Rica
5	Atlantic Forest	Parts of Brazil, Argentina, and Paraguay
6	Cerrado	Central Brazil
7	Chilean Winter Rainfall-Valdivian Forests	Central northern Chile to Argentina's western regions
8	Tumbes-Chocó-Magdalena	Pacific coast of South America and Galapagos Islands
9	Tropical Andes	Part of the Andes Mountains in South America
10	Caucasus	Border between Europe and Asia, separating Caspian and Black seas
11	Irano-Anatolian	Parts of Iran, Azerbaijan, Turkey, Armenia, Iraq, Turkmenistan
12	Mediterranean Basin	Surrounding the Mediterranean Sea
13	Mountains of Central Asia	Central Asia region including parts of Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan, China, and Afghanistan
14	Cape Floristic Region	South Africa's southern tip
15	Coastal Forests of Eastern Africa	Eastern coast of Africa
16	Eastern Afromontane	Mountainous parts of Eastern Africa
17	Guinean Forests of West Africa	Coastal West Africa
18	Horn of Africa	Northeastern Africa
19	Madagascar	Island of Madagascar in the southeast African coast
20	Indian Ocean Islands	Comoros, Seychelles, Mauritius
21	Maputaland-Pondoland-Albany	Southeastern coast of South Africa
22	Succulent Karoo	Coastal region of South Africa
23	Eastern Himalayas	Parts of India, China, Bhutan, Tibet, and Myanmar
24	Indo-Burma	Parts of India, Bangladesh, China, Myanmar, Cambodia, Vietnam, Laos, Thailand, and Malaysia
25	Western Ghats and Sri Lanka	Western part of the Indian Peninsula and country of Sri Lanka
26	East Melanesian Islands	Islands of Melanesia to the Northeast of Australia
27	New Caledonia	New Caledonia islands in Southwest Pacific Ocean
28	New Zealand	New Zealand islands in Southwest Pacific Ocean
29	Philippines	Philippines Southeast Asia
30	Polynesia-Micronesia	Islands in Southern Pacific Ocean
31	Southwest Australia	Southwest tip of Australia
32	Forests of East Australia	Eastern Australian coast

Rank	Name	Location
33	Sundaland	Parts of Southeast Asia including Borneo, Java, and Sumatra islands, the Malay Peninsula, and some small islands
34	Wallacea	Eastern Indonesia
35	Japan	Northern Pacific Ocean
36	Mountains of Southwest China	Tibet, parts of China and Myanmar

4.10 Threats to the biodiversity hotspots

The biodiversity hotspots around the world are facing severe threats from several anthropogenic activities like deforestation, forest fires, climate change, and poaching. Large swathes of forests have also been cleared for the expansion of agriculture, exploitation of natural resources, construction of roads, railways, dams, and housing for the burgeoning human population. This loss of large forest areas results in the alteration of the natural landscape, habitat loss, and extreme fragmentation of wildlife habitats, eventually leading to the rapid decline in the number of endemic species harbored in the hotspot region. Some of the invasive floral and faunal species that have been introduced due to human activities in different habitats subsequently eliminate the native species, thereby harming the ecosystem. The effects of anthropogenic climate change, urban tourism, and other recreational activities also put tremendous pressure on these fragile ecosystems.

4.11 Main causes of loss of diversity

The Biological Diversity of the earth is decreasing rapidly. There are four major causes of the loss of diversity also known as The Evil Quartet.

1. **Habitat Loss and Fragmentation**: this is the main cause of loss of diversity. Fragmentation of crops and conversion to grassland for beef cattle has resulted in decreased species of plants and animals. Earlier, the rain forest were covering about 14% of the total land area of earth but now the area has reduced to only 6%. Cleaning up the forest for crops and cattle destroyed the natural habitat of migratory birds too.
2. **Overexploitation**: overexploitation of natural resources by human beings has resulted in a loss of biodiversity. Overuse of natural resources like water bodies, soil resources, and forest areas has led to the degradation of natural habitats. Human-caused pollution is the biggest reason for the degradation of biodiversity.
3. **Invasion of Alien Species:** When alien species knowingly or unknowingly are introduced to natural habitat, some of them become invasive and compete with the endangered indigenous species. For example, the introduction of African catfish for aquaculture purposes has led to the extinction of some indigenous species.
4. **Co-extinction:** this is a type of existence where one where species is completely dependent on the other for its survival. Co-extinction is a threat to our biodiversity as the extinction of a single species may lead to the extinction of a whole community.

❖ **Exercise**

Q1. Biodiversity means _____

(a) Diverse kinds of plants and vegetation.
(b) Diverse kinds of animals.
(c) Diverse kinds of plants and animals in a particular area.
(d) Diverse kinds of exotic plants and animals.

Q2. The most significant aspect of biodiversity is_____

(a) Food
(b) Drug
(c) Industrial Use
(d) Maintenance of ecosystem

Q3. The destruction of biodiversity is due to_____

(a) The lack of natural habitats of the organism
(b) Environmental pollution
(c) Destruction of forests
(d) All the above

Q4. The main reason for the decrease in biodiversity is_____

(a) Habitat pollution
(b) Introduction of exotic species
(c) Over exploitation
(**d) Natural habitat destruction**

Q5. Which of the following is NOT an example of in-situ conservation strategy?
(a) Biosphere reserve
(b) Botanical garden
(c) National Park
(d) Sacred groves

Q6. The World Biodiversity Day is observed on _____

(a) March, 22
(b) May, 22
(c) June, 23
(d) April, 16

Q7. Which of the following is considered a 'hot-spot' of biodiversity in India?

(a) Aravalli hills
(b) Indo-Gangetic plain
(c) Eastern Ghats
(d) Western Ghats

Q8. India aims to achieve land degradation neutrality by the year_____

(a) 2025
(b) 2030
(c) 2035
(d) 2040

Q9. “Red Data Book” is published by _____

(a) USEPA
(b) IUCN
(c) WWF
(d) IG-BP

Q10. ‘Red Data Book’ contains data of _____

(a) Exotic species
(b) Endangered species
(c) Economically important species
(d) All plant and animal species

Q11.Which one of the following is an important strategy for the conservation of biodiversity?

(a) Biosphere Reserves
(b) Botanical Gardens
(c) National Parks
(d) Wild Life Sanctuaries

Q12. The maximum biodiversity is found in_____

(a) Tropical rainforest
(b) Temperate forest
(c) Coniferous forest
(d) Arctic forest

Q13. In which of the following types of forests maximum plant diversity is found?

(a) Tropical moist deciduous forests
(b) Sub-tropical mountain forests
(c) Temperate moist forests
(d) Tropical evergreen forests

Q14. ‘Silent Valley’ is located in _____

(a) Uttarakhand
(b) Kerala
(c) Arunachal Pradesh
(d) Jammu & Kashmir

Q15. ‘Valley of Flowers’ is situated in _____

(a) Kerala
(b) Jammu & Kashmir
(c) Uttarakhand
(d) Himachal Pradesh

Q-2 Give the answer in details.

1) Explain the Types of Biodiversity.

2) Write the Importance of Biodiversity

3) Describe Biodiversity in India.

4) Write the Threats to Biodiversity.

5) Explain the Bio Diversity at National level.

6) Explain India as a Mega diversity nation.

7) Write a note on Conservation of Biodiversity.

8) Explain Biodiversity hotspot.

9) Explain Threats to the biodiversity hotspots.

10) State and explain the Main causes of loss of diversity.

BBA SEMESTER-1

ENVIRONMENTAL SCIENCE

BLOCK: 2

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Publisher's Name: Registrar,
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Edition: 2024-25 (First Edition)

ISBN: **978-93-5598-783-9**

978-93-5598-783-9

UNIT-5 ENVIRONMENTAL POLLUTION

5.1 Introduction

By environment, we mean our surroundings, which have an impact on our lives. It is the sum total of the surroundings and resources, including both biotic resources i.e., living creatures such as plants and animals and abiotic resources i.e., non-living things, such as air, water and land that effect our existence and quality of life. However, because of the rapid increase in population and industrialisation, the excessive use of resources has resulted in their degradation and depletion. Environmental pollution is one of the most serious problems facing humanity and other life forms on our planet today. The different agents that cause environmental pollution are called pollutants. Pollutants can be chemicals, biological materials, or physical things that get added into the environment by accident that are directly or indirectly harmful to people and other living things.

Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. Pollution is the presence of substances or materials in the environment that cause direct or indirect adverse effects on human health and living beings in general. This phenomenon occurs when ecosystems are unable to absorb and eliminate the toxic substances introduced into them, resulting in their accumulation and subsequent environmental degradation.

The effects of environmental pollution may be severe and long-lasting, impacting not only humans but also plant and animal life, as well as soil and water quality. These effects may be observed either directly or indirectly, and may vary in magnitude from minor environmental issues to the death of plant and animal species. Moreover, pollution may have negative economic impacts such as reduced agricultural production, lower tourism activity, and the degradation of natural resources.

5.2 Meaning and Definition

Meaning: Environmental Pollution is not a new phenomenon, yet it remains one of the greatest threats to the health and well-being of humanity and one of the major environmental causes of death and morbidity. For example, substances such as plastic materials, heavy metals, etc., once released into the atmosphere. By natural processes, it cannot be degraded and are harmful to living organisms.

In environmental pollution, pollutants originate from a source, are transported by air or water, and are dumped into the soil by human beings.

The long-term impacts of pollution are still being felt despite global attention to the issue. Day by day, our atmosphere is becoming more and more polluted due to anthropogenic activities. It is usually due to the pollutants released into the air, water, soil, etc., through many human activities.

Definition: Environmental pollution is defined as "the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected". Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of any substance (solid, liquid, or gas) or energy (such as radioactivity, heat, sound, or light).

5.3 Solid Waste Management

Solid waste results from human or animal activities when they discard unwanted and useless materials. This waste is commonly generated from industrial, residential, and commercial activities in a specific area and can be managed in various ways. Waste classification is based on its composition, such as paper, plastic, glass, metal, and organic waste. Proper solid waste disposal is essential for ensuring environmentally responsible practices. Effectively managing solid waste is crucial for maintaining environmental cleanliness and should be integrated into overall environmental planning. Solid waste management encompasses the entire process of collecting, treating, and disposing of solid wastes. This process involves gathering waste from different sources, transporting it, treating it, analysing it, and ultimately disposing it safely. Strict adherence to regulations and guidelines is necessary to ensure the effectiveness of the waste management process and minimise its impact on the environment.

5.3.1 Features of Solid Waste Management

1. Due to rapid urbanisation, industrialisation, and a significant population increase in India, effectively managing solid waste will pose a major challenge for local municipal bodies as well as state governments, in the 21st century.
2. Ensuring proper solid waste management is essential for safeguarding the health and well-being of urban residents.
3. The urban poor, who often reside in informal settlements with limited or no access to solid waste collection, and in proximity to open landfills, are particularly susceptible to the consequences of inadequate waste management.
4. The 'Swachh Bharat Abhiyan' was established to address these waste management issues and create public awareness about appropriately handling solid waste. Since its implementation, the concept of waste management has gained considerable traction.

5.3.2 Types of Solid Wastes

1) **Household waste/ Municipal waste:** This comprises household waste, debris from construction and demolition, sanitation residue, and waste from streets. Such waste mainly emanates from residential and commercial complexes. Due

to increasing urbanisation, lifestyle changes, and altered food habits, the volume of municipal solid waste has been rising rapidly, causing changes in its composition.

Over recent years, the consumer market has witnessed significant growth, resulting in using non-biodegradable materials such as cans, aluminium foils, and plastics for packaging. These items have severe environmental consequences.Some municipal areas in India have effectively banned the use of plastics, and the success of such measures can be observed in the Ladakh district, where plastic has been absent since a ban was imposed in 1998. Other states should follow this region's example and prohibit using environmentally harmful items.

2) Industrial waste / Hazardous waste:

Industrial and hospital waste is considered hazardous due to its potential inclusion of toxic substances. Certain types of household waste can also be hazardous.Hazardous wastes may pose severe threats to humans, animals, and plants, displaying corrosive, highly flammable, or explosive properties and reacting adversely when exposed to specific elements, such as gases.

India generates approximately 7 million tonnes of hazardous waste each year, with a significant concentration in four states: Andhra Pradesh, Uttar Pradesh, Bihar and Tamil Nadu. Examples of household waste categorised as hazardous waste include old batteries, paint tins, old medicines, shoe polish and medicine bottles.

3) Biomedical waste/ Infectious waste:

Hospital waste is produced during the diagnosis, treatment, immunisation of humans or animals, research activities in these fields, or the production and testing of biologicals. It may include sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical waste, etc. This waste consists of disposable syringes, swabs, bandages, body fluids, human excreta, etc. It poses significant infectious risks and can seriously threaten human health if not managed in a scientific and discerning manner. Rough estimates suggest that out of the 4 kg of waste generated in a hospital, at least 1 kg could be infectious.

5.3.3 Disposal of Waste

Waste handling and disposal methods vary across different countries. In India, the processes are tailored according to the source of solid waste and can be categorised as follows:

- **Municipal Solid Waste (MSW):** This encompasses biodegradable, recyclable, and hazardous domestic wastes. Biodegradable waste consists of decomposable materials like spoiled food, vegetable peels, and wet kitchen waste. Recyclable waste includes items such as plastic, while hazardous waste comprises items like bulbs and batteries.

- **Hazardous Solid Waste:** This refers to waste generated by industries, chemical factories, and medical facilities. Special procedures are required for the disposal of these hazardous wastes.

Regardless of the region, effective solid waste management is crucial for safe waste disposal, reducing environmental pollution, and preventing potential health hazards. Landfills are the most used method for solid waste disposal. Modern landfills are designed with consideration of various environmental factors and waste types to minimise pollution and health risks associated with waste disposal.

5.3.4 Effects of Poor Solid Waste Management

Improper handling of solid waste, especially by waste management entities, leads to the accumulation of waste, causing environmental and public concerns.

Large-scale dumping of garbage leads to the decay and decomposition of biodegradable materials under uncontrolled and unhygienic conditions, creating breeding grounds for disease-carrying insects and infectious organisms within a short period. This situation results in foul odours and impacts the area's aesthetic appeal.

Industries generate solid waste containing toxic metals, chemicals, and hazardous materials, which, when released into the environment, pose biological and physicochemical problems. These chemicals can leach into the soil, contaminating groundwater and affecting soil productivity. In some instances, hazardous waste may get mixed with regular waste and other combustible materials, complicating the disposal process and posing additional risks.
Burning paper and other scraps alongside hazardous waste produce dioxins and toxic gases, leading to health issues such as chronic diseases, skin infections, and cancer. The adverse effects of improper solid waste management include:

- Air pollution
- Water pollution
- Soil contamination
- Spread of diseases
- Impact on biodiversity
- Unpleasant waste odours
- Emission of toxic gases
- Degradation of natural landscapes

5.4 Earthquake, Tsunami, Cyclone, Floods, landslides, Drought

➢ Earthquake

Earthquake is one of the most destructive natural hazards. They may occur at any time of the year, day or night, with sudden impact and little warning. They can destroy buildings and infrastructure in seconds, killing or injuring the inhabitants. Earthquakes not only destroy the entire habitation but may de-stabilize the government, economy and social structure of the country. So the earthquake is the sudden shaking of the earth crust. The impact of an earthquake is sudden and there is hardly any warning, making it impossible to predict. Earthquakes can be described by the use of two distinctively different scales of measurement demonstrating magnitude and intensity. Earthquake magnitude or amount of energy released is determined by

the use of a seismograph' which is an instrument that continuously records ground vibration. The scale was developed by a seismologist named Charles Richter. Although some scientists claim ability to predict earthquakes, the methods are controversial. Accurate and exact predictions of such sudden incidents are still not possible.

- **Tsunami**

The term Tsunami has been derived from a Japanese term Tsu meaning 'harbor' and nami meaning 'waves'. Tsunamis are popularly called tidal waves but they actually have nothing to do with the tides. These waves which often affect distant shores, originate by rapid displacement of water from the lake or the sea either by seismic activity, landslides, volcanic eruptions or large meteoroid impacts. What ever the cause may be sea water is displaced with a violent motion and swells up, ultimately surging over land with great destructive power. The effects of a tsunami can be unnoticeable or even destructive. The geological movements that cause tsunamis and fault movements on the sea floor, accompanied by an earth-quake. They release huge amount of energy and have the capacity to cross oceans. The degree of movement depends on how fast the earthquake occurs and how much water is displaced.

Tsunami differs from ordinary ocean waves, which are produced by wind blowing over water. The tsunamis travel much faster than ordinary waves. Compared to normal wave speed of 100 kilometers per hour, tsunami in the deep water of the ocean may travel the speed of a jet airplane - 800 kilometers per hour! And yet, in spite of their speed, tsunami increases the water height only 30-45cm and often passes unnoticed by ships at sea. Contrary to the popular belief, the tsunami is not a single giant wave. It is possible for a tsunami to consist of ten or more waves which is then termed as 'tsunami wave train'. The waves follow each other 5 to 90 minutes apart.

Tsunami normally causes flooding as a huge wall of water enters the main land. Local tsunami events or those less than 30 minutes from the source cause the majority of damage. The force of the water can raze everything in its path. It is normally the flooding affect of the tsunami that causes major destruction to the human settlements, roads and infrastructure thereby disrupting the normal functioning of the society. Withdrawal of the tsunami causes major damage. As the waves withdraw towards the ocean they sweep out the foundations of the buildings, the beaches get destroyed and the houses carried out to sea.

Damage to ports and airports may prevent importation of needed food and medical supplies. Apart from the physical damage, there is a huge impact on the public health system. Deaths mainly occur because of drowning as water inundates homes. Many people get washed away or crushed by the giant waves and some are crushed by the debris, causes.

There are very few evidences which show that tsunami flooding has caused large scale health problem. Availability of drinking water has always been a major problem in areas affected by a disaster. Sewage pipes may be damaged causing major sewage disposal problems. Open wells and other ground water may be contaminated by salt water and debris and sewage. Flooding in the locality may lead to crop loss, loss of livelihood like boats and nets, environmental degradation etc.

- **Cyclone**

Cyclone is a region of low atmospheric pressure surrounded by high atmospheric pressure resulting in swirling atmospheric disturbance accompanied by powerful winds blowing in anticlockwise direction in the Northern Hemisphere and in the clockwise direction in the Southern Hemisphere. They occur mainly in the tropical and temperate regions of the world.

General Characteristics: Cyclones in India are moderate in nature.

Some of the general characteristics of a cyclone are as follows:

1. Strong winds
2. Exceptional rain
3. Storm surge

Cyclones are generally accompanied by strong winds which cause a lot of destruction. In some cases it is accompanied by heavy downpour and also the rise in the sea which intrudes inland there by causing floods. Cyclones are known by different names in different parts of the world:

- Typhoons in the Northwest Pacific Ocean west of the dateline
- Hurricanes in the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean.
- Tropical cyclones - the Southwest Pacific Ocean and Southeast Indian Ocean.
- Severe cyclonic storm" (the North Indian Ocean)
- Tropical cyclone (the Southwest Indian Ocean)
- Willie-Willie in Australia.

- **Floods**

Flood is a state of high water level along a river channel or on the coast that leads to inundation of land, which is not usually submerged. Floods may happen gradually and also may take hours or even happen suddenly without any warning due to breach in the embankment, spill over, heavy rains etc. There are different types of floods namely: flash flood, riverine flood, urban flood, etc. Flash floods can be defined as floods which occur within six hours of the beginning of heavy rainfall, and are usually associated with cloud bursts, storms and cyclones requiring rapid localized warnings and immediate response to reduce damage.

Wireless network and telephone connections are used to monitor flood conditions. In case of flash floods, warnings for timely evacuation may not always be possible. from region to region. The causes may vary from a rural area to an urban area. Some of the major causes are: a. Heavy rainfall b. Heavy siltation of the river bed reduces the water carrying capacity of the rivers/stream. c. Blockage in the drains lead to flooding of the area. d. Landslides blocking the flow of the stream. e. Construction of dams and reservoirs f. In areas prone to cyclone, strong winds accompanied by heavy down pour along with storm surge leads to flooding The most important consequence of floods is the loss of life and property.

Structures like houses, bridges; roads etc. get damaged by the gushing water, landslides triggered on account of water getting saturated, boats and fishing nets get damaged. There is huge loss to life and livestock caused by drowning. Lack of proper drinking water facilities, contamination of water (well, ground water, piped water supply) leads to outbreak of epidemics, diarrhoea, viral infection, malaria and many other infectious diseases. Flooding also leads to a large area of agricultural land getting inundated as a result there is a huge crop loss. This results in shortage of food, and animal fodder. Floods may also affect the soil characteristics. The land may be rendered infertile due to erosion of top layer or may turn saline if sea water floods the area. Flood forecasting and warning has been highly developed in the past two decades. With the advancement of technology such as satellite and remote-sensing equipments flood waves can be tracked as the water and Water Resources Department. CWC maintains close liaison with the administrative and state engineering agencies, local civil authorities to communicate advance warning for appropriate mitigation and preparedness measures

- **Drought**

Drought is either absence or deficiency of rainfall from its normal pattern in a region for an extended period of time leading to general suffering in the society. It is interplay between demand that people place on natural supply of water and natural event that provides the water in a given geographical region. The state of Kerala which receives more than 3000 mm of rainfall every year is declared drought affected as it is insufficient to have two good crops. The more the imbalance in supply the higher is the drought. Drought is a slow on-set disaster and it is difficult to demarcate the time of its onset and the end. Any unusual dry period which results in a shortage of useful water.

Drought is a normal, recurrent feature of climate. Climate is expected to show some aberrations and drought is just a part of it. Drought can occur by improper distribution of rain in time and space, and not just by its amount. Drought is negative balance between precipitation and water use (through evaporation, transpiration by plants, domestic and industrial uses etc) in a geographical region. The effects of drought accumulate slowly over a considerable period of time. Though drought is basically caused by deficit rainfall, which is a meteorological phenomenon, it manifests into different spheres because of various vulnerability factors associated with them.

Some of these factors are human induced. Though drought is a natural disaster, its effects are made worst in developing countries by over population, over grazing, deforestation, soil erosion, excessive use of ground and surface water for growing crops, loss of biodiversity. In general, all those elements that are primarily dependent on water are most affected. It affects the rainfed crops and then slowly creeps into the irrigated crops. People who are dependent on agriculture and areas where the other livelihood opportunities are least developed are greatly affected. The herdsman, landless labourer, subsistence farmers, women, children and farm animals are the most vulnerable groups.

Drought, different from any other natural disaster, does not cause any structural damages. As the meteorological drought turns into hydrological drought, the impacts start appearing first in agriculture which is most dependant on the soil

moisture. Irrigated areas are affected much later than the rainfed areas. However, regions surrounding perennial rivers tend to continue normal life even when drought conditions are prevailing around. The impacts slowly spread into social fabric as the availability of drinking water diminishes, reduction in energy production, ground water depletion, food shortage, health reduction and loss of life, increased poverty, reduced quality of life and social unrest leading to migration.

- **Landslides**

The term' landslide' includes all varieties of mass movements of hill slopes and can be defined as the downward and outward movement of slope forming materials composed of rocks, soils, artificial fills or combination of all these materials along surfaces of separation by falling, sliding and flowing, either slowly or quickly from one place to another. Although the landslides are primarily associated with mountainous terrains, these can also occur in areas where an activity such as surface excavations for highways, buildings and open pit mines takes place. They often take place in conjunction with earthquakes, floods and volcanoes. At times, prolonged rainfall causing landslide may block the flow of river for quite some time. The formation of river blocks can cause havoc to the settlements downstream on its bursting.

There are several causes of landslide. Some of the major causes are as follows:

1. Geological Weak material: Weakness in the composition and structure of rock or soil may also cause landslides.
2. Erosion: Erosion of slope toe due to cutting down of vegetation, construction of roads might increase the vulnerability of the terrain to slide down.
3. Intense rainfall: Storms that produce intense rainfall for periods as short as several hours or have a more moderate intensity lasting several days have triggered abundant landslides. Heavy melting of snow in the hilly terrains also results in landslide.
4. Human Excavation of slope and its toe, loading of slope/toe, draw down in reservoir, mining, deforestation, irrigation, vibration/blast, Water leakage from services.

5.5 Causes of Urban and Industrial waste

1. **Lack of policies to control pollution:** The lack of effective policies has allowed many industries to bypass laws made by the pollution control board, resulting in mass-scale pollution that has immensely affected many people's lives.
2. **Unplanned industrial growth:** Unplanned industrial growth is the hasty expansion of industrial activities that neglects environmental sustainability. This results in heightened pollution caused by improper waste management, emissions control, and resource consumption.
3. **Use of outdated technologies**: In most industries, old technologies are still used in the production of goods as a way to avoid the high initial capital costs associated with new developments. Unfortunately, the old production technologies and techniques produce a great deal of pollution.
4. **Presence of a large number of Small scale industries:** Many small-scale industries and factories that don't have enough capital and rely on

government grants to run their day-to-day businesses often escape environmental regulations and release many toxic gases into the atmosphere.

5. **Inefficient Waste Disposal :** The mismanagement of waste within industrial settings is a major contributor to environmental pollution. Failure to properly handle waste leads to the release of toxic substances into the air, water, and soil. Insufficient waste treatment facilities, improper handling of hazardous materials, and the absence of recycling programs compound the issue.
6. **Leaching of resources from our natural world :**For industries to generate completed goods, a lot of raw materials are needed. This necessitates the removal of minerals from deep inside the earth, a task frequently carried out by machinery powered by fossil fuels. It is hazardous for marine life when the oils leak into the ground and eventually into the sea.

5.6 Effects of Industrial Pollution on Environment

1. Water Pollution :

The effects of industrial pollution are far-reaching and liable to affect the ecosystem for many years to come. Most industries require large amounts of water for their work. When involved in a series of processes, the water comes into contact with heavy metals, harmful chemicals, radioactive waste, and even organic sludge. These are either dumped into open oceans or rivers. As a result, many of our water sources have a high amount of industrial waste, which seriously impacts the health of our ecosystem. The same water is then used by farmers for irrigation purposes, affecting the quality of food produced. Actually, many groundwater supplies are currently unusable for both people and wildlife due to water pollution. At best, it can be recycled and used again in other sectors.

2. Soil Pollution :

Soil pollution is creating problems in agriculture and destroying local vegetation. It also causes chronic health issues for the people that come into contact with such soil on a daily basis. Soil Pollution has gradually become a major challenge that we need to overcome for establishing a healthy environment. Weathering of the earth's crusts by different processes leads to the formation of soil that accumulates over the centuries. The soil is the home for a large part of bacterial biodiversity and other microscopic and macroscopic living organisms.

3. Air Pollution :

Air pollution has led to a steep increase in various illnesses, and it continues to affect us every day. With so many small, mid-sized, and large-scale industries coming up, air pollution has taken a toll on our health and that of the environment. Air pollution occurs when certain gases, droplets, or particles mix with ambient air, rendering the air harmful to living things. There are many different kinds of air pollution, produced from many sources and resulting in many different problems for people, other animals, plants, and the environment.

4. Wildlife Extinction :

In general, the problem of industrial pollution results in the failure of natural cycles and patterns, which has a serious impact on wildlife. It is becoming more difficult for the environment to recover from each natural disaster as habitats are destroyed, species are going extinct, and these trends are continuing.

5. Industrial disasters :

Industrial disasters such as oil spills, fires, and radioactive material leaks have a devastating impact that can be difficult to mitigate due to the short timeframe in which their effects occur. Chemical disasters can severely affect people, have a high death toll, and cause extensive property and environmental damage. The industrial plant, its staff, hazardous chemical vehicles, the citizens of adjoining settlements, adjacent buildings, occupants, and the surrounding community are the elements most at risk from chemical disasters.

6. Global Warming :

Definition: "Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants. "With the rise in industrial pollution, global warming has been increasing at a steady pace. Emissions of smoke and greenhouse gases from industrial practices have greatly contributed to this issue.

Global warming is the phenomenon of a gradual increase in the temperature near the earth's surface. This phenomenon has been observed over the past one or two centuries. This change has disturbed the climatic pattern of the earth.

However, the concept of global warming is quite controversial but the scientists have provided relevant data in support of the fact that the temperature of the earth is rising constantly. There are several causes of global warming, which have a negative effect on humans, plants and animals. These causes may be natural or might be the outcome of human activities

The devastating impacts of global warming are seen in the form of melting glaciers, the endangerment of polar bears, and natural disasters such as floods, tsunamis, and hurricanes.

7. Biodiversity Loss :

Industrial pollution continues to cause significant damage to the earth and its inhabitants due to chemical wastes, pesticides, radioactive materials, etc. It affects wildlife and ecosystems and disrupts natural habitats. Animals are becoming extinct, and habitats are being destroyed. The growing amount of liquid, solid, and hazardous wastes endangers ecosystem's health and jeopardizes food, water, and health security. Industrial pollution disasters, including oil spills and radioactive leakage, take years to decades to clean up.

8. Atmospheric Deposition :

The other effect of industrial pollution is increasing the Cadmium (Cd) content in the soil. Several studies have found that mines can contribute to this contamination, resulting in topsoils that show varying levels of Cd concentrations.Industrial effluents are commonly discharged to surface water drainage systems after clarification in tailing ponds. Recent investigations have disclosed very high concentrations of Cd in the overbank and bottom sediments of the rivers.

5.7 Ways to Control or Reduce Industrial Pollution

Industrial pollution is a worldwide issue. Its negative impacts are increasing, and numerous organizations and individuals are working to reduce carbon footprints. Despite these attempts, the problem of industrial pollution persists, and long-term, focused work is required to address it successfully but despite the efforts, industrial pollution remains rampant and may take years of collective commitment to control and regulate properly. Here are some of the steps that can be taken to seek permanent solutions to the problem.

1. Source Control :

Adopting new technology, effectively training staff for safe use, developing better waste disposal technologies, and being more mindful about the use of raw materials can all assist to limit industrial pollution at its source.

2. Recycling :

Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. Recycling can benefit your community, the economy, and the environment. Products should only be recycled if they cannot be reduced or reused .Recycling as much polluted water in the industries as possible by increased recycling efforts to reduce industrial pollution.

3. Cleaning of Resources :

Organic methods should be adopted to clean the water and soil, such as using microbes that use heavy metals and waste as feed naturally. Cooling rooms or bins need to also be developed to allow industries recycle the water they use instead of pushing it back into the natural water source it came from.

4. Industry site selection and Proper treatment of Industrial waste :

It is also imperative to consider the location of sites before establishment and the potential impact on the surrounding environment as a way to help reduce harmful consequences.This can be attained by developing and implementing adequate treatment facilities for handling industrial waste and adopting proper habits that can help reduce pollution

5. Rebuilding habitats and afforestation :

Rebuilding habitats by planting more trees and plants can help give wildlife back their homes, and the trees can help purify the air with enough oxygen and act as a buffer against the environment.

6. Stricter Laws and Enforcement :

The Environmental Protection Agency (EPA) should come up with even more stringent regulations on environmental conservation and impose harsher penalties on individuals and companies that violate these measures while at the same time recognizing those that operate ethically.

7. Environmental consciousness :

To foster environmental consciousness in industries, it is imperative to conduct periodic environmental impact assessments and report the findings for evaluation. If any adverse effects on the environment are detected, appropriate mitigation measures must be implemented and enforced.

5.8 Effects of Industrial Pollution on Environment

The pollution is one of the worst because the smoke and other chemicals emitted by industries into the air contribute a lot to ozone depletion, global warming, and health problems for animals and humans. Moreover, these industrial pollutants release many harmful and unnatural chemicals into both soil and water, eventually leading to the extinction of some plant and animal species Industries contribute to environmental pollution by dispensing toxic waste into the air, water, and land.

1) **Air pollution**, factories are undoubtedly a common source of toxic smoke, which releases hazardous chemicals and gases into the atmosphere. This smoke poses a significant health risk for humans, animals, and plants. Even more, some of these gaseous emissions contribute to the depletion of the ozone layer and the exacerbation of global warming. Air pollution occurs when certain gases, droplets, or particles mix with ambient air, rendering the air harmful to living things. There are many different kinds of air pollution, produced from many sources and resulting in many different problems for people, other animals,

plants, and the environment. Both natural and human-induced air pollution can be dangerous, although the latter tends to be more widespread and continuous, like the on-going combustion of fossil fuels for energy

2) **Water pollution,** on the other hand, comes from the wastewater that factories dump into oceans or rivers. This water is often untreated and therefore contains toxic chemicals that harm aquatic life. Even worse, this water is sometimes recycled for commercial use or irrigation, posing high health risk to plants as well as humans and animals that consume them. Two-thirds of the earth's is covered by water and seventy-six perfect of our body is made up of water. As we know water is everywhere and all around. However, we have a fixed amount of water on earth. It just changes its states and goes through a cyclic order, known as the Water Cycle. The water cycle is a natural process that is continuous in nature. It is the pattern in which the water from oceans, seas, lakes etc. gets evaporated and turns to vapour. After which it goes through the process of condensation, and finally precipitation when it falls back to earth as rain or snow. Some of the most commonly occurring water pollutants are Domestic Waste, Industrial effluents, Insecticides and pesticides and Detergents and Fertilizers.

3) **Land pollution** occurs when industries contaminate the environment by throwing their untreated waste, whether liquid or solid, on land. This waste causes soil pollution, attracting agricultural problems and chronic health issues for humans and animals. Land pollution occurs when trash, compost, and other toxins are dumped on the land, contaminating or polluting it. Land pollution is caused by human activities such as littering and waste washed ashore from boats, oil rigs, and sewage treatment plants.

The degradation of the earth's land surfaces, both above and below ground level, is referred to as land pollution. The accumulation of solid and liquid waste products, which contaminate groundwater and soil, is the cause. The greater the permeability of the soil, the greater the risk of land contamination. Land pollution can harm the human body in a variety of ways. Toxic waste and contaminants can be ingested by people. Disposal of hazardous radioactive wastes also contributes to land contamination. Chronic respiratory disease, lung cancer, heart disease, and even brain damage are all long-term health consequences.

❖ **Exercise**

Q-1 MCQ:

1) Plastic bags, industrial wastes as chemical residues, metallic and nuclear waste, agricultural wastes are the main source of _____
   a) Soil Erosion
   b) Air Pollution
   c) Thermal Pollution
   d) None of these

2) Heavy metals enter into the water body through:
   a) **Rain**
   b) Plastic
   c) Burning of Organic Material
   d) Soil Erosion

3) Unregulated growth of habitations, inadequate infrastructure facilities, lack of proper facilities for collective transportation, poor waste disposal are contributing to increase causing_____
   a) Water-Borne Disease
   b) Sanitary Problems
   c) Pollution Hazards
   d) **Health Hazards**

4) Which of the following is NOT considered a primary air pollutant?
   a) Nitrogen dioxide
   b) Carbon monoxide
   c) Sulfur dioxide
   d) Ozone

5) Which of the following pollutants is primarily responsible for industrial smog?
   a) Carbon monoxide
   b) Nitrogen oxides
   c) Sulfur dioxide
   d) Particulate matter

Q-2 Give answers in detail.

1) Give Meaning and Definition of Environmental Pollution.
2) Write a note on Solid Waste Management.
3) Write in details about the following:
   - Floods
   - Earthquake
   - Cyclone
   - landslides
   - Tsunami
   - Drought
4) Describe the Causes of Urban and Industrial waste.
5) What are the Effects of Industrial Pollution on Environment? Explain.
6) Explain the Ways to control or reduce Industrial pollution.
7) Explain the Effects of Industrial Pollution on Environment.

UNIT-6 SOCIAL ISSUES AND THE ENVIRONMENT

6.1 Introduction

Human beings interact both with the social world and nature. Both, economic development and stable environment are required for the continual improvement of lifestyle and living standards. But until now, the development was human oriented and limited to rich nations. The development was achieved by damaging the environment and over exploitation of natural resources which were non-renewable that caused instability of environment and crossed the threshold limit of environmental damage. Forests are essential for maintaining renewable resources, reducing carbon dioxide levels and maintaining oxygen levels in the earth's atmosphere. Their loss impairs future human development.

Loss of forests depletes biodiversity which has to be preserved to maintain life on earth. Major heavy industries if not planned carefully lead to environmental degradation due to air and water pollution and generate enormous quantities of waste that lead to long term environmental hazards. Toxic and Nuclear wastes can become serious economic problems as getting rid of them is extremely costly. In order to safeguard the existence of life and future of humanity, we have to change our approach from unsustainable to sustainable development. A judicious balance between developmental activities and environmental protection should be assured. It is possible only trough sustainable development.

When ecosystems are compromised, the natural goods that they provide clean air and water, crop pollination, and storm protection inevitably will decline. Studies show that declining access to clean water and intensifying storms and droughts related to climate change could displace 100 million people just in the next 30 years. Humans will not be the only ones to suffer in a warming world. After all, we share the planet with around nine million species of plants and animals. As ecosystems falter, species large and small will come increasingly under strain, and will need to adapt or perish. Many will go extinct, whereupon it will take millions of years for Earth to recover its breadth and depth of biodiversity. With the planet fundamentally and irreversibly changed, the implications for humanity itself would be immediate and far-reaching.

Moreover, the demand for food to sustain our growing population can be met with our current agricultural lands, simply by reducing food waste. But we also need to restore near-shore artisanal fisheries, and develop regenerative agriculture that provides local and healthier food while rebuilding the soil and absorbing much of the carbon pollution we emit into the atmosphere. Our natural resources are just dwindling due to over exploitation. If this growth continues in the same way we will be facing a doom's day as suggested by the world's famous report "The limits to growth". Development has to be visualized in a holistic manner, where it brings benefits to all, not only for the present generation but also for future generation. There is an urgent need to interlink the social aspects with development and environment.

6.2 Urban problems related to energy

Urban areas are currently facing the increasingly pressing issue of urban heat worldwide, which is being worsened by climate change and rising urbanization. Energy requirements of urban population are much higher than that of rural ones. This is because urban people have a higher standard of life and then life style demands more energy inputs in every sphere of life.

Energy demanding activities include i) Energy use for transportation ii) Energy use for buildings Energy used for residential, commercial and industrial buildings is responsible for green house gas emissions.

In residential and commercial sectors, most building energy is used for water heating, space heating and space cooling. More than 80% of all energy used for residential buildings. iii) Energy use for industries Large proportion of energy is utilized by industries. iv) Energy based techniques.

A large amount of waste generation which has to be disposed off properly using energy based techniques. Control and prevention of pollution which need energy dependent technologies Energy Management Encourage use of low energy content building materials and agricultural and industrial residues in construction. Speed up commercialization of renewable energy technologies through tax incentives, subsidies and innovative venture (chance) capital schemes. Promote non motorized transport and relate it with public transport system. Energy consumption must be minimized in all aspects. Provide incentives for increasing use of energy efficient household appliances. Imposing strict laws, penalties and energy audit As a result, there is a growing need for new approaches to enhance urban resilience and adapt to these challenge.

6.3 Water Conservation

Water conservation aims to sustainably manage the natural resource of fresh water, protect the hydrosphere, and meet current and future human demand. Water conservation makes it possible to avoid water scarcity. It covers all the policies, strategies and activities to reach these aims. Population, household size and growth and affluence all affect how much water is used.

Climate change and other factors have increased pressure on natural water resources. This is especially the case in manufacturing and agricultural irrigation. Many countries have successfully implemented policies to conserve water conservation. There are several key activities to conserve water. One is beneficial reduction in water loss, use and waste of resources.

The key activities to conserve water are as follows:

- Any beneficial reduction in water loss, use and waste of resources.
- Avoiding any damage to water quality.
- Improving water management practices that reduce the use or enhance the beneficial use of water.

One of the strategies in water conservation is rainwater harvesting. Digging ponds, lakes, canals, expanding the water reservoir, and installing rain water catching ducts and filtration systems on homes are different methods of harvesting rain water. Many people in many countries keep clean containers so they can boil it and drink it, which is useful to supply water to the needy. Harvested and filtered rain water can be used for toilets, home gardening, lawn irrigation, and small scale agriculture.

Another strategy in water conservation is protecting groundwater resources. When precipitation occurs, some infiltrates the soil and goes underground. Water in this saturation zone is called groundwater. Contamination of groundwater causes the groundwater water supply to not be able to be used as a resource of fresh drinking water and the natural regeneration of contaminated groundwater can take years to replenish.

Some examples of potential sources of groundwater contamination include storage tanks, septic systems, uncontrolled hazardous waste, landfills, atmospheric contaminants, chemicals, and road salts.

Contamination of groundwater decreases the replenishment of available freshwater so taking preventative measures by protecting groundwater resources from contamination is an important aspect of water conservation.

Another is avoiding any damage to water quality. A third is improving water management practices that reduce the use or enhance the beneficial use of water. The question here is why we should conserve water; the reasons of water conservation efforts include the following.

- With less than 1% of the world's water being freshwater, one aim is ensuring the availability of water for future generations where the withdrawal of freshwater from an ecosystem does not exceed its natural replacement rate.
- Energy conservation as water pumping, delivery, and wastewater treatment facilities consume a significant amount of energy.
- In some regions of the world, over 15% of the total electricity consumption is devoted to water management. Habitat conservation where minimizing human water usage helps to preserve freshwater habitats for local wildlife and migrating waterfowl, but also water quality.

Water conservation methods may include the following:

1. Decreasing run off losses
2. Reducing irrigation losses
3. Proper treatment of industrial and domestic waste water
4. Avoid discharge of sewage
5. Increasing block pricing
6. Rainwater harvesting
7. Construction of proper storage, reservoirs and dams.

6.4 Rain water Harvesting

It is a technique of increasing the recharge of ground water by capturing and storing rain water. This is done by constructing dug wells, percolation pits, lagoons, check dams etc., Objectives of Rain water harvesting.

- To reduce run off loss
- To avoid flooding of roads
- To meet increasing demands of water
- To raise water liable by recharging ground water.
- To reduce ground water contamination

Before adopting rain water harvesting system, soil characteristics, topography, rainfall pattern and climatic conditions should be understood. Modern technique for rain water harvesting is Roof top rain water harvesting. This system is mostly adopted in several parts of the world. This system consists of three basic elements namely,

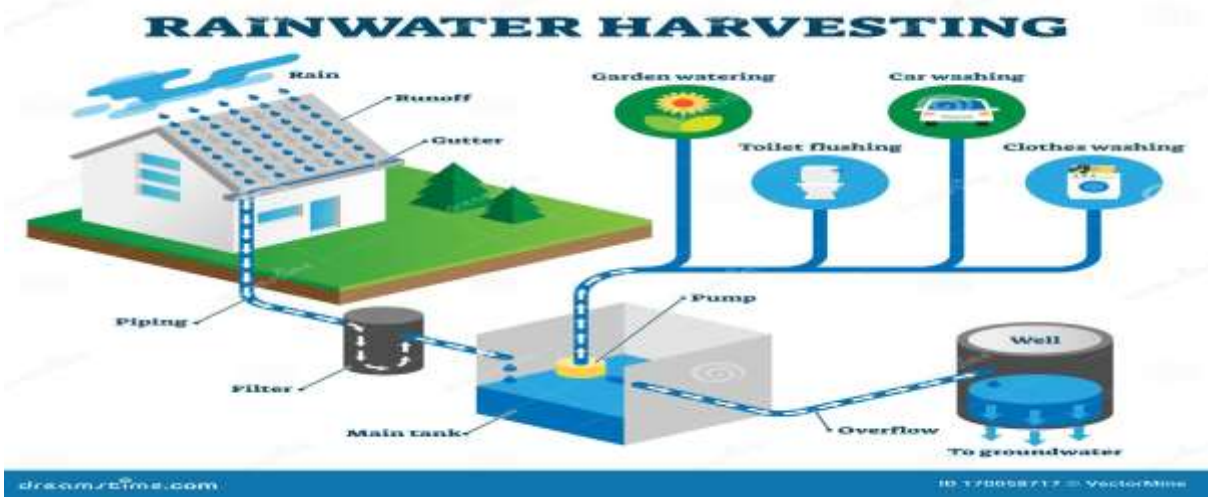
i) Collection area
ii) Conveyance system
iii) Storage vessels or storage facilities

A smooth, cleaner and impervious roofing material contributes to better water quality and greater quantity. Both drainpipes and roof surfaces should be chemically inert such as wood, PVC, aluminum and in order to avoid adverse effects on water quality.

(i) Through hand pump
(ii) Through abondoned dug well

Storage tanks may be constructed some distance away from the building. This method is suitable where the rainfall exceeds 400 mm per year. Painted surfaces should be avoided as much as possible and overhanging vegetation should be avoided.

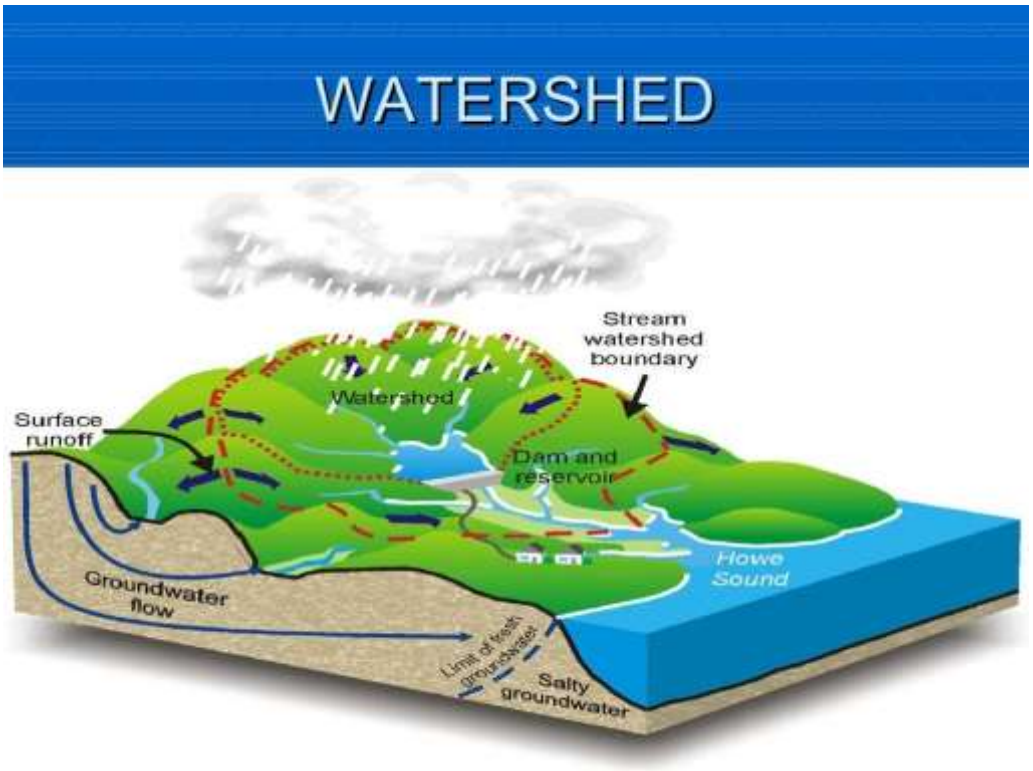
It is low cost and effective technique for urban houses and buildings. The rain water from the top of roofs, road surfaces, play grounds, open lands is diverted into surface tank or recharge pits through a delivery system which can be later used for several purposes. The pit base is filled with stones and sand which serves as a sand filter.



6.5 Watershed Management

Definition: "The management of rainfall and resultant run off is called watershed management".

` The word "watershed" introduced in 1920 was used for the "water parting boundaries". Watershed is that land area which drains or contributes runoff to a common outlet. Watershed is defined as a geo-hydrological unit draining to a common point by a system of drains. All lands on earth are part of one watershed or other. Water shed is the land and water area, which contributes runoff to a common point. Rain falls, snow melting fields, forests, rooftops, lawns, parking lots and streets flows toward a lake or river and forms water shed. Water shed ranges from a few square kilometers to few thousand square kilometers in size.



The three main components in watershed management are land management, water management and bio mass management.

i) Land Management
ii) Water Management
iii) Biomass Management

- **Objectives:**

Objectives of watershed management are as follows:

i) Soil conservation
ii) Water conservation
iii) Conservation farming practices to improve agriculture.
iv) Controlled grazing to keep pasture productive.
v) Development of waste land.
vi) To minimize the risks of flood, droughts and landslides.

Watersheds are degraded due to uncontrolled, unplanned and unscientific land use activities. Mining, overgrazing, deforestation, construction activities, industrialization, soil erosion degrade various watersheds.

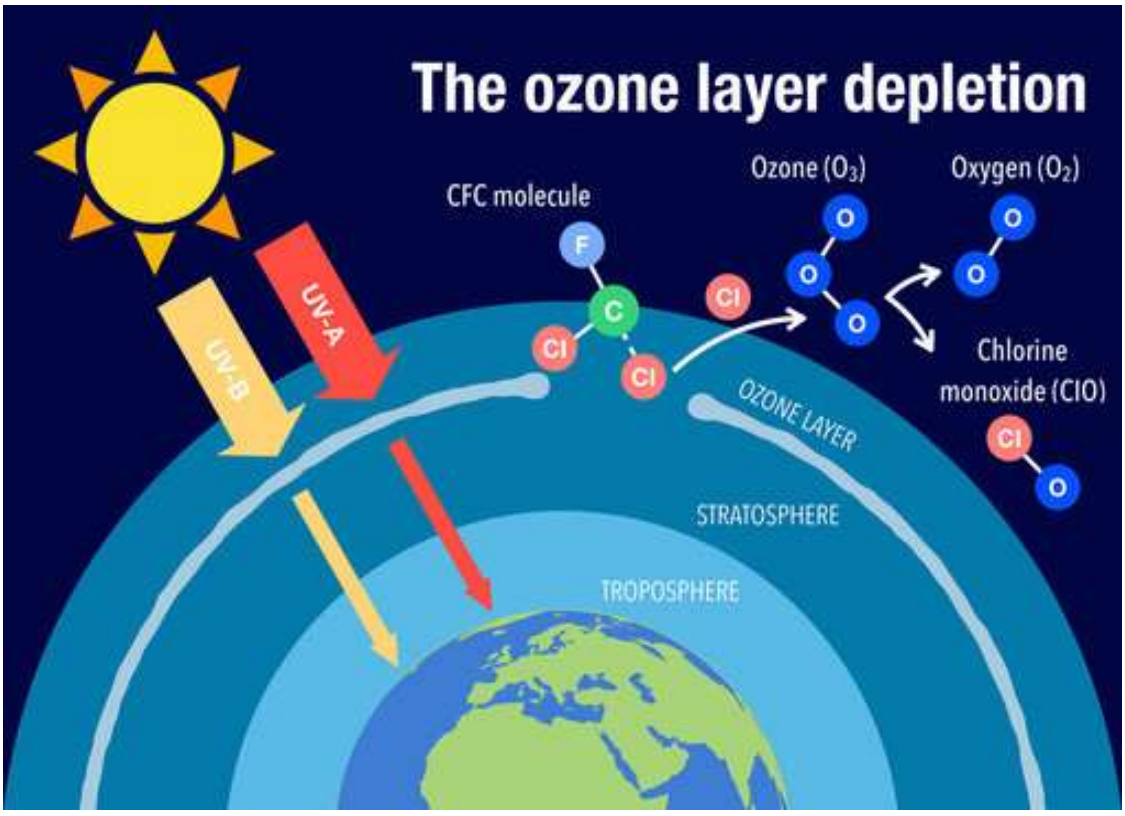
6.6 Ozone layer Depletion

For the last 450 million years, earth has had a natural sunscreen in the stratosphere called ozone layer. This layer filters out harmful ultra violet radiations from sunlight and protects various life forms on earth.

Ozone Formation Ozone is a triatomic form of oxygen (O3). In stratosphere, ozone is formed by absorption of short wavelength UV radiations. UV radiations less than 242 nm decompose molecular oxygen to atomic oxygen (O) by photolytic decomposition.

$O2 + h\gamma = O\bullet + O\bullet$

$O\bullet + O2 + M = O3 + M$



M = third body to carry away energy released in the reaction. Ozone thus formed distributes itself in stratosphere and absorbs harmful UV radiations (200 - 320 nm).The amount of atmospheric ozone is measured by Dobson spectrometer and is measured in Dobson Unit (DU).

Ozone layer is destroyed by man made chlorofluoro carbons (CFC). They are used in coolants in refrigerators & air conditioners. They slowly pass to stratosphere in presence of UV radiation from sun, CFC breaks up into Cl• (Chlorine free radical) which consumes ozone. Thus each atom of chlorine liberated attacks 10000 ozone molecules. Due to this continuous attack of Cl• , thinning of ozone layer takes place & leads to formation of 'ozone hole.'

Effects of Ozone layer depletion are as follows:

i) Impact on climate Depletion of ozone layer will lead to absorption of UV radiation & it reaches the earth's surface. Thus increases the average temperature of earth's surface.

ii) Impact on human health.

- Exposure of humans to UV rays will reduce the immunity, retard physiological growth & cause further suppression of mental development.
- UV-B radiations affect DNA result in cancer.
- Melanin producing cells of epidermis will be destroyed by UV rays resulting in immune suppression.
- Fair people will be at risk of UV exposure.
- Eye ailments such as cataract formation take place.

iii) Impact on marine life UV rays directly affect marine forms such as phytoplankton, fish and crabs. Phytoplankton consumes CO2. Decrease in population of phytoplankton would leave more amount of CO2 in atmosphere, results in global warming.

iv) Impact on biotic communities Yield of vital crops like corn, rice, soyabean, cotton, bean, pea & wheat will decrease and affect the whole food chain.

v) Impact on materials Degradation of plastics, paints & other polymer will result in economic loss.

vi) Control of Ozone Depletion : To stop using of ozone depleting chemicals, Use of gases such as methyl bromide which is a crop fumigant also to be controlled Implementing the use of alternatives to CFCS.

6.7 Climate change

Weather changes all the time. The average pattern of weather called climate, usually remains unchanged for centuries if it is left to itself. People participate in activities that can change the earth and its climate. The various elements of climate are temperature, pressure, wind, rainfall, humidity and clouds.

Causes of climate change is due to Human emission which is significantly modifying the concentrations of some gases in atmosphere. Greenhouse gases which have a global effect tend to warm the earth by absorbing some of the infrared radiation it emits. Ozone layer depletion also increases global temperature.

The below mentioned are some Effects of climate change.

1) Climatic change affects land forms, soil types and vegetation.
2) Water resources, marine systems, human settlements, energy, industry and human health are affected by climatic change.
3) Climatic change upset the hydrological cycle results in floods and droughts in different regions of the world cause sea level rise, death of humans as well as lives stock.
4) The likelihood of many of these changes is probably very low but is expected to increase with rate, magnitude & duration of climate change.

Few Examples are as follows:

i) Slowing of warm North Atlantic currents.

ii) Large reduction in Greenland and West Antarctic ice sheets.

iii) Accelerated global warming due to releases of terrestrial carbon from permafrost (permanently frozen subsoil) regions of methane from hydrates in coastal sediments. Control of climate change Adaptation could reduce adverse impacts of climate change and enhance beneficial impacts.

- **GREEN HOUSE EFFECT**

"Short wave radiation of sun is absorbed by earth. The earth radiates heat energy back into space in form of longer wave radiation. This radiation is trapped by number of gases and thus heat is again reradiated back to earth. This is called "Greenhouse effect". The average global temperature is 15°C. In absence of greenhouse gases, this temperature would have been - 18° C.

Green house gases :

1. Carbon dioxide: It contributes 55% to global warming from green house gases produced by human activity. Most abundant gas in atmosphere. This is due to burning of fossil fuel, deforestation and change in land use.

2. Methane: It accounts for 18% of increased green house gases. It stays in atmosphere for 7-10 years. Concentration is 1.675 ppm and increasing at the rate of 1%. Due to land fills, natural gas leaks, oil and gas production.

3. Nitrous oxide: Responsible for 6% of human input of green house gases. It stays in atmosphere for 140-190 years. Concentration is 0.3 ppm and increasing at a rate of 0.2% annually. It is released from nylon products, from burning of biomass and nitrogen rich fuels.

4. Chlorofluoro carbons (CFCS): CFCS are synthetic gaseous compounds of carbon and halogen. Responsible for 24% of human contribution to green house gases. Deplete ozone in stratosphere.

i) Atmospheric concentration is 0.00225 ppm increasing at a rate of 0.5% annually due to leaking of air conditioners, refrigerators, aerosols etc.,

These green house gases in lower levels of atmosphere act like the glass of a green house.

6.8 Global warming

The increasing concentration of greenhouse gases in the atmosphere leads to global warming; also affect various climatic and natural processes.
Impacts of enhanced Green house effect (Global Warming) are as follows:

i) Increase of Global temperature It is estimated that earth's mean temperature will rise between 1.5 to 5.5°C by 2050, if green house gases continues to rise at present rate.

ii) Rise in sea level Heating will melt the polar ice sheets and glaciers resulting in further rise in sea level. By 2030, 20cm rise is expected in sea level.

iii) Effects on human health Global warming changes rainfall pattern and thereby distribution of vector borne diseases like malaria, cholera, elephantiasis etc.

iv) Food production Global warming will reduce crop production due to increased plant diseases, pests and explosive growth of weeds.

v) Effect on range of species distribution Each plant and animal species occur within a specific range of temperature. Many will be at risk from extinction, whereas more tolerant varieties will thrive.

To slow down enhanced global warming, following steps will be important.

- Use energy more efficiently
- Plant more trees
- Shift to renewable energy sources
- Minimize water logging
- Cut town the rate of use of CFCS and fossil fuel
- Remove CO2 from smoke stacks
- Reduction of N2O emission by minimizing the use of nitrogen fertilizer in agriculture
- Remove atmospheric CO2 by utilizing photosynthetic algae
- Adopt sustainable agriculture

6.9 Acid rain

Acid rain represents one of the major consequences of air pollution. The term 'acid rain' was used for the first time by Robert Angus Smith in 1852 while examining rainwater reaction from the U.K. and Scotland's industrial sites. Acid rain, also called acid deposition, is a broad term for any form of precipitation with high concentrations of sulfuric and nitric acids. According to the Environmental Protection Agency (EPA), deposition can be wet such as in rain, fog, snow, mist, or dry, as in dust, gas, and smoke.

Enormous emissions of SOx and NOx from major industrial areas pollute the atmosphere greatly. In these areas, falling rain reacts with these oxide pollutants to produce a mixture of sulphuric acid, nitric acid and water. This is known as acid rain.

Formula:

SOx + H2O = H2SO4

NOx + H2O = HNO3

Acid rain is measured using a scale called pH, pH of pure rain water = 5.6 and pH of acid rain < 5.6.

Acid rain forms when two significant pollutants, sulfur dioxide (SO_2) and nitrogen oxides (NO_X), are released into the atmosphere due to various natural and human activities. While natural sources such as volcanoes, lightning, or decomposing vegetation emit SO_2 and NO_X, acid rain's primary cause is human-made. The emission of coal, petroleum, and natural gas from the factories, smelting of ore, and automobile emission are all manmade sources.

The process starts when SO_2 and NO_X are emitted into the atmosphere, undergo photo oxidation in the presence of sunlight and oxygen, and react with water and other components present in the atmosphere. Wind and air currents spread these acidic substances over long distances. They eventually precipitate down in the form of wet deposits such as rain (sulfuric and nitric acids), fog, snow, and mist, or dry deposits as dust, gas, and smoke, adversely affecting soil heath and aquatic life.

Normal rain is slightly acidic, having a pH of 5.6. It forms when carbon dioxide reacts with water to form weak carbonic acid, which has no harmful effects.

However, acid rain generally has a pH between 4.2 and 4.4. Here, sulfur dioxide and nitrogen dioxide undergo oxidation before reacting with water.

Effects of Acid rain on water:

1) **Effects on Soil**: It robs the soil of its essential nutrients such as calcium, releasing aluminum that prevents water uptake in plants. It causes a change in soil composition, thus affecting crop production. Acid rain also affects forests, especially those at higher elevations.

2) **Effects on Plants**: It weakens the trees by washing away the waxy, protective coating on leaves, thus damaging them. Acid rain washes away the essential nutrients and minerals from the soil, causing stunted growth in plants by affecting photosynthesis.

3) **Effects on Water Bodies**: Acid rain makes lakes, streams, ponds, rivers, and other water bodies more acidic. It adversely affects aquatic life, such as freshwater shrimps, snails, and mussels. Most fish species cannot survive a pH of less than 5. When the pH becomes 4, the lake is dead, which means it becomes devoid of life. Again, the fall of acid rain causes aluminum absorption from the soil, which is carried into the water bodies. The combination of both makes water bodies more toxic for their survival.

   Some aquatic species can tolerate acidic pH better than others. Nevertheless, since all ecosystems are interconnected, organisms in one ecosystem depend on the other for their survival. For example, if a fish species disappear, the animals, including the birds that feed on them, will also become extinct.

4) **Effects on Building, Monument, and Statue:** All structures, especially those made of limestone and sandstone, are mostly affected by the effect of acid rain. The calcium carbonate (limestone) present in the rocks or monuments reacts with sulfuric acid to form calcium sulfate, making them corrode. The soluble substances in the acidic deposition get dissolved in water and then washed away, known as chemical weathering

Remedies for acid rain:

The only way to reduce the consequence of acid rain is by checking the emission of nitrogen and sulfur oxides, which can be done by the following ways.

- Regulating their emission from coal-based and metal extracting industries by filtering the exhaust before releasing into the environment
- Reducing the dependence on non-renewable energy resources such as coal, petroleum, and natural gas. According to the EPA, this can be done by increasing renewable energy consumption from sunlight, wind, and water.
- Using eco-friendly vehicles instead of petrol or diesel-based ones. The use of catalytic converters filters the exhaust gases from the vehicles before releasing them into the environment.

- Planting more trees or afforestation helps to purify the atmosphere by reducing toxic gases.
- Restoring water-body damage by using powdered limestone that neutralizes the water, a process known as liming.

6.10 Environmental ethics: Issues and possible solutions

It is the branch of philosophy that tries to understand the nature of good life and our rights and responsibilities towards others, so that we can act on that knowledge.

Environmental Ethics means the normal relationship of human beings with environment. It is concerned with do's and don'ts of the human beings to the environment.

Some of the Environmental issues are as follows:

- Population growth is the root cause of current global environmental crisis
- Urbanisation
- Pollution
- Land degradation and soil erosion
- Water scarcity
- Deforestation activities

Possible solutions :

A healthy economy depends upon a healthy environment. The environment can be protected by the following activities.

- One should respect the power of environment
- Resources should not be wasted or over exploited
- Soil degradation must be reduced
- Reduce population growth
- Creating awareness to the public
- Recycle and reuse the waste products
- Protection of biodiversity
- One should oppose the use of nuclear weapons
- Sustainable development
- Prevention of pollution (The main purpose of the Central Pollution Control Board was to regulate air pollution)

❖ **Exercise:**

Q-1 Multiple Choice Questions:

1. Which of the following statements is correct about achieving sustainable development?

    a. Sustainable development can be achieved by restricting the usage of renewable resources
    b. Sustainable development can be achieved by controlling the growth rate of world's population
    c. Sustainable development can be achieved by controlling the menace of pollution
    d. All of the above
    Answer: d

2. Which of the following statements is true about global warming?

    a. Global warming has led to large scale deforestation
    b. Global warming has led to a rise in the sea levels
    c. Global warming has led to a rapid increase in the population across several countries
    d. Global warming has led to a huge amount of waste generation
    Answer: b

3. Which of the following was the main purpose behind setting up the Central Pollution Control Board (CPCB)?

    a. The main purpose of the Central Pollution Control Board was to regulate air pollution
    b. The main purpose of the Central Pollution Control Board was to regulate water pollution
    c. The main purpose of the Central Pollution Control Board was to regulate noise pollution
    d. The main purpose of the Central Pollution Control Board was to regulate deforestation
    Answer: a

4. Which of the following statements is correct?

    a. Tides are a conventional source of energy
    b. Sun is a conventional source of energy
    c. Wind is a conventional source of energy
    d. Dried dung is a conventional source of energy
    Answer: d

5. Which of the following statements about the ozone shield is accurate?

    a. Ozone shield is found in the troposphere
    b. Ozone shield is found in the stratosphere
    c. Ozone shield is found in the exosphere
    d. Ozone shield is found in the mesosphere
    Answer: b

6. Which of the following statements is true about the ozone layer depletion?

    a. Ozone layer depletion leads to the problem of skin cancer within humans
    b. Ozone layer depletion results in a lower amount of production of phytoplankton
    c. Ozone layer depletion hampers the growth of the terrestrial plants
    d. All of the above
    Answer: d

7. Which of the following statements is true?

    a. Ozone depletion is one of the main reasons for soil erosion
    b. Deforestation is one of the main reasons for soil erosion
    c. Air pollution is one of the main reasons for soil erosion
    d. Global warming is one of the main reasons for soil erosion
    Answer: b

8. Which of the following statements is true?

    a. Economic growth is the modern concept for development
    b. Political growth is the modern concept for development
    c. Sustainable growth is the modern concept for development
    d. Social growth is the modern concept for development
    Answer: c

9. Which of the following statements is correct?

    a. Global warming is a result of ozone layer depletion
    b. Global warming is a natural phenomenon
    c. Global warming is defined as the rise in the average temperature of the surface of the Earth
    d. Global warming is simply another term that scientists use to describe the greenhouse effect
    Answer: c

10. Which of the following statements is correct?

    a. The Chipko movement was about banning the use of chlorofluorocarbon, bromine and chlorine compounds
    b. The Kyoto protocol was about banning the use of chlorofluorocarbon, bromine and chlorine compounds
    c. The Appiko movement was about banning the use of chlorofluorocarbon, bromine and chlorine compounds
    d. The Montreal protocol was about banning the use of chlorofluorocarbon, bromine and chlorine compounds
    Answer: d

11. Which of the following statements about climate change is true?

    a. Plantation can be a preventive measure to tackle climate change
    b. The usage of cycles instead of bikes or cars for transportation can be a preventive measure to tackle climate change

c. The usage of organic products can be a preventive measure to tackle climate change
d. All of the above
Answer: d

12. Which of the following statements gives the correct meaning of absorptive capacity?

a. Absorptive capacity is defined as the ability of our environment to absorb degradation
b. Absorptive capacity is defined as the method of resource generation that is within the assimilating capacity of our environment
c. Absorptive capacity is defined as the average number of organisms that are living within a given environment
d. Absorptive capacity is defined as the minimum population that is currently surviving in the world
Answer: a

13. Which of the following is true about the environment?

a. The environment includes only biotic factors
b. The environment includes only abiotic factors
c. The environment includes both biotic and abiotic factors
d. The environment includes neither biotic nor abiotic factors
Answer: c

14. Which of the following statements is true?

a. The United Nations Conference on Climate Change was held in India in the year 1997
b. The United Nations Conference on Climate Change was held in Japan in the year 1997
c. The United Nations Conference on Climate Change was held in China in the year 1997
d. The United Nations Conference on Climate Change was held in Canada in the year 1997
Answer: b

Q-2 Fill in the blanks:

1) _____wastes can become serious economic problems as getting rid of them is extremely costly. (Toxic and Nuclear)
2) _____means the normal relationship of human beings with environment. It is concerned with do's and don'ts of the human beings to the environment. (Environmental Ethics)
3) The only way to reduce the consequence of _____is by checking the emission of nitrogen and sulfur oxides.(acid rain)
4) One of the strategies in water conservation is_____ (rainwater harvesting)

5) Climate change and other factors have increased pressure on _____(natural water resources)
6) When the pH becomes ____, the lake is dead, which means it becomes devoid of life.(4)
7) Planting more trees or afforestation helps to purify the atmosphere by reducing _____(toxic gases)
8) The management of rainfall and resultant run off is called _____(watershed management)
9) Normal rain is slightly_____, having a pH of 5.6.(acidic)
10) Enormous emissions of _____from major industrial areas pollute the atmosphere greatly. (SOx and NOx)

Q-3 Give answers in detail:

1) What are the main urban problems related to energy? Explain any two in your own words.
2) Write a note on Water Conservation.
3) Write a note on Rain water Harvesting.
4) Describe Watershed Management.
5) Write a note on Ozone layer Depletion.
6) Write a note on Climate change.
7) Describe Global warming.
8) Write a note on Acid rain.
9) What is Environmental ethics? Write the issues and its possible solutions.
10) How climate change affects environment? Give your views.

UNIT-7 SUSTAINABLE DEVELOPMENT

7.1 Overview and introduction:

Environment includes living and non-living things or all resources that influence each other for the requirement. all living elements includes the birds, animals, fisheries, plants and forests etc. and non-living elements include water, Rocks, sunlight air and land etc. of the environment.

Ecosystems is defined as a study of the inter- relationship between these biotic and abiotic components of the environment. The environment performs four major functions such as it supplies resources, assimilates waste, sustains life by providing genetic, bio diversity and provides aesthetic services. it includes both renewable and non-renewable resources. Renewable resources mean are those types of resources which can be used without the possibility of the resource becoming depleted. In simple words, resources continuous remains available for use such as the trees in the forests and the fishes in the ocean. Non-renewable resources are those types of resources which is adverse of renewable resources and which get exhausted with extraction and use such as fossil fuel.

If the resource extraction is lower the rate of renewal of the resource and the wastes produced are beyond the conforming capacity of the environment then the environment fails to perform its main function of life sustenance and resultant in an environmental crisis. This is the happened today all around the world.

The increasing population of the developing countries that impact the consumption and production and place burden on environment and nature. Many resources generated the wastes beyond the absorptive capacity of the environment and the resultant today at the edge of environmental crisis. Development polluted and dried up rivers and the intensive and extensive extraction of renewable and non-renewable resources has also exhausted.

7.2 Meaning of sustainability:

It is defined as the development which meets the present needs of society without compromising the capacity of future generations to meet their own needs using natural resources. Sustainable development is intensive efforts towards building an inclusive, sustainable and resilient future for people and planet by the people or society as a whole.

Environment and economy are dependent on each other for satisfying need and requirement. Therefore, development that ignores the consequences of using natural resources or exploit the natural resources will destroy the environment that sustains life forms.

In simple words, Sustainable development is the balance between the development and use of resources which is limited or best possible use of limited resources. Sustainable development is a future of people because it takes care of nature and aware about or guide us how to use resources economically.

7.3 Problem Faced by Environment:

The environment faces numerous issues including such as Climate Change, Pollution, Biodiversity Loss, Resource Depletion, Waste Management, Human Impact and Other Environmental Issues. Which is discussed below:

Climate Change is a major issue in today's environment due to over pollution because of heavy industrialization and demands and consumption in the market. Climate Change includes Rising global temperatures, Extreme weather events such as hurricanes, droughts, flood and heavy rain, Melting glaciers and sea-level rise and Ocean acidification.

Pollution is a very serious issues in the front of world in today's environment. there are many types of problems which faced by society in today's environment such as Air pollution includes the particulate matter and ozone related issues. Water pollution includes such as plastics and chemicals which pollute the water. Soil pollution includes the heavy metals and pesticides which degrade the soil quality. Noise pollution is a very dangerous because it is directly affecting the human body.

Biodiversity Loss: due to cutting of trees and forest there are many specials of animals and birds are rare to found in the forest. It includes the Species extinction such as plants, animals and insects, Habitat destruction and fragmentation, Overexploitation of resources such as overfishing, and deforestation, Invasive species.

Resource Depletion: resources are limited and it is our moral responsibility to conserve the resources for future generations. It includes the Water scarcity, Soil degradation and erosion, Deforestation and land degradation and Overconsumption of fossil fuels.

Waste Management: it is a very powerful tools because if every human is mastermind or have a skill to manage the waste then there is not scarcity in the earth. It

includes Plastic waste and pollution, Hazardous waste such as chemicals and batteries, Solid waste management such as landfills and incineration, Recycling and waste reduction challenges.

Human Impact: human are best creatures of nature but for luxurious life of human destroy the nature and environment and exploit the resources of nature. It includes Overpopulation, consumption, Urbanization and sprawl, Agricultural pollution and soil degradation, Industrial activities such as mining and drilling.

Other Environmental Issues: it includes Desertification, drought, Ocean dead zones, marine pollution, Forest fires, wildfires, Environmental degradation from conflict and war.

Global warming is a serious issues faced by environment in modern days, it means a gradual increase in the average temperature of the earth's lower atmosphere. The major cause of global warning is greenhouse gases after the Industrial Revolution. it is a human-induced and produced by human through increases in carbon dioxide and the burning of fossil fuels and deforestation. The carbon dioxide, methane and other gases have potential to absorb heat to the atmosphere with no other changes make planet's surface heater. During the past decades, the atmospheric temperature and sea level has risen several inches and resultant melting of polar ice with a rise in sea level and coastal flooding. There are several consequences of global warming which includes the disruption of drinking water supplies reliant on snow melts, extinction of some species as ecological niches vanishes, tropical storms and an increased occurrence of tropical diseases. There are some factors that contributing to global warming such as burning of coal and petroleum products, deforestation, burning of animal waste and use of fossil fuels.

Ozone Depletion define as the phenomenon of reductions in the ozone in the stratosphere. The problem of ozone depletion is increased due to high levels of chlorine and bromine compounds in the stratosphere layer. The roots cause of chlorine and bromine compounds are chlorofluorocarbons (CFC) used in cooling air- conditioners and refrigerators and Bromo fluorocarbons (halons) and aerosol propellants used in fire extinguishers. Through the depletion of the ozone or stratosphere layer ultraviolet radiation or UV rays comes to Earth and which is harmful to living organisms. UV radiation responsible for skin cancer in human's body and also reduce the production of phytoplankton which affects the aquatic organisms. It can also stimulus the growth of terrestrial plants on the earth. The ozone or stratosphere layer stops most harmful wavelengths of ultraviolet radiation from the Earth's atmosphere. It is observed and projected that decreases in ozone layer have the major issues as a worldwide. As the Consequences Montreal Protocol was accepted worldwide which means the banning the use of chlorofluorocarbon (CFC) gas and other ozone depleting gases or chemicals such as bromine compounds, carbon tetrachloride, trichloroethane and methyl chloroform.

7.4 Need of sustainable development:

The needs of sustainable development can be categorized into many areas such as Economic Needs, Social Needs, Environmental Needs and Interconnected Needs.

- Poverty Reduction: Due to increase in the population and huge pressure of consumption that Ensure access to elementary needs like food, water, shelter, and healthcare to each and every person of society.
- Foster economic growth and employment opportunities pressurized new development and exploitation of resources. Promote sustainable use of renewable and non-renewable resources in the society.
- Innovation and Technology Inspire sustainable innovation and adoption of clean technologies which produce a clean energy.
- Educate and Aware all the individuals about sustainable development and its importance to the society.
- Health and Well-being access to every living being and promote healthy lifestyles.
- Promote social justice, equality, and human rights in the society and foster community participation and involvement in such types of projects.
- Reduce greenhouse gas emissions and promote and encourage Change Mitigation type of project.
- Promote and aware about the Conservation and Restoration Protect that restore natural ecosystems and biodiversity in the society.
- Ensure that sustainable use of natural resources like water, land, and minerals is helpful for future generations.
- Promote Waste Management and Reduction types of programs such as Promote waste reduction, recycling, and proper waste management.
- Encourage collaboration across the sectors and disciplines such as material and waste.
- Encourage Participatory Governance such as Foster inclusive decision-making processes in the government schemes.
- Develop skills and capacities for sustainable development known as Capacity Building program.
- Monitoring and Evaluation and Establish systems for tracking progress and adapting to new challenges regarding environment.

7.5 Measures taken for sustainable development:

These measures are being taken by individuals, businesses, governments and around the world to promote sustainable development and to prevent or reduce the environmental, social and economic challenges facing by globe.

1. Economic Measures:

Investing in renewable energy: individuals, businesses and governments should compulsory to invest in solar, wind and other renewable energy in each and every project. Promote and encourage other to use renewable energy.

Implementing sustainable agriculture practices: it is most important because India is a farming-based country. Encourage and promote the farmers to use eco-friendly farming methods and reducing chemical use.

Encouraging sustainable consumption: it is our moral duty as a human being to responsible for consumption patterns and reducing waste. Encourage and promote human beings to consume as per their need and reduce waste.

Developing green infrastructure: individuals, businesses and governments should compulsory Invest and use green buildings, urban planning and transportation systems. Encourage and promote every individual to use green energy and green infrastructure.

Fostering sustainable tourism: Businesses and governments start Promoting eco-tourism and responsible travel practices. Encourage people or aware people for accepting eco-tourism.

2. Social Measures:

Promoting education and awareness: Educating and encouraging individuals and students about sustainable development and its importance for next generation. Aware about the negative and positive impact on health's of human beings and society.

Fostering community engagement: Encouraging community participation in sustainable development initiatives. Aware the people of society to use the eco friendly products and limited use of economic resources.

Supporting human rights: Ensuring equal access to resources, opportunities and services to all the community of the society. each and all individuals have an equal rights for resources.

Addressing poverty and inequality: government should take steps towards the Implementing policies to reduce poverty and promote social equity.

Improving healthcare: government and business should Invest in healthcare systems, healthcare infrastructure and promoting healthy lifestyles.

3. Environmental Measures:

Conserving natural resources: encourage and promote the society for Protecting and restoring natural ecosystems, natural resources such as forests, oceans, river, soil and wildlife.

Reducing pollution: individuals take steps towards reducing the use of pollutant components and substances. Governments should encourage and promote the society to reduce pollution and Implementing policies to reduce air, soil and water pollution.

Mitigating climate change: government should take necessary or strict steps towards Reducing greenhouse gas emissions and adapting to climate change impacts. Individuals supports in mitigating climate changes.

Promoting sustainable land use: encourage and promote sustainable agriculture practices and reducing deforestation and Implementing policies in favour of sustainable use of land.

Protecting biodiversity: it is very important to preserve rare species on the earth because next generation will not even see some species due to deforestation and urbanization. People should take steps towards Preserving and restoring natural habitats and ecosystems.

4. Governance Measures:

Developing sustainable policies: government should frame new laws and policies which encourage and promote sustainable development and aware about the Enacting laws and policies that support sustainable development.

Encouraging international cooperation: government should Collaborate with global partners and agencies to address sustainable development challenges. They can start new initiatives which encourage people for sustainable development.

Fostering public-private partnerships: government take new steps towards public private partnership and collaborating with private sector entities to achieve sustainable development goals.

Strengthening institutions: government should develop new institution which can take care of sustainable development and Build capacity and strengthening institutions to support sustainable development.

Monitoring and evaluating progress: all the steps of process of sustainable development and Tracking progress towards sustainable development goals and adjusting strategies.

5. Technological Measures:

Investing in clean technologies: government and business can invest more funds in Developing and deploying clean energy technologies such as solar, air, water and wind power because clean energy is the future of globe.

Implementing sustainable transportation: society and government can combine take a step towards Promoting and using electric and hybrid vehicles and improving public transportation.

Developing sustainable materials: material that can utilized by society Creating from sustainable materials and products such as bioplastics and recycled materials.

Enhancing energy efficiency: government should encourage and promoting the new Improved energy efficiency in buildings, industry and transportation sector.

Fostering digital innovation: government take new steps of Leveraging digital technologies to support sustainable development such as e-commerce platform and telemedicine.

7.6 Strategies for sustainable development:

Use of Non-conventional Sources of Energy: India is largely dependent on thermal and hydro power plants to satisfy its power needs. Both the sources of energy have adverse environmental impacts. Thermal power plants discharge large quantities of carbon dioxide (CO2) which is a greenhouse gas. It also releases fly ash, which cause pollution of water bodies and land of the environment. Hydroelectric projects destroy forests and interfere with the natural flow of water in the river basins. Wind power and solar energy are known as cleaner and greener energy sources but are not much accepted on a large scale due to lack of promotion and encouragement of technological devices.

LPG and Gobar Gas in Rural Areas: in rural areas, Households use wood, dung cake or other biomass as fuel for cooking food. It has adverse consequences such as deforestation, wastage of cattle dung, air pollution and reduction in green cover. To prevents these types of practices, government give the subsidy for using LPG in India and Gobar gas plants are being available through easy loans and subsidy. LPG is a clean fuel and reduces household pollution to a large extent in the rural areas and energy wastage is reduced. In Gobar gas plant cattle dung is fed in the plant and gas is produced which is used as fuel and the slurry which is left over is used as an organic fertiliser and which improve the soil conditioner.

CNG in Urban Areas use as a fuel in public transport has lowered air pollution and the air has become cleaner.

Wind Power: Wind mills can be setup in desert areas where speed and flow of wind is high and provide electricity without any adverse impact on the environment. through the Wind turbines electricity is generated and use to satisfy the needs of the society. the initial cost is very high and the benefits are higher than the cost.

Solar Power through Photovoltaic Cells: India is naturally gifted with solar energy in the form of sunlight. We use such as dry our clothes, grains, other agricultural products as well as use sunlight to warm ourselves in winter, Plants use solar energy for photosynthesis and food. With the use of photovoltaic cells, solar energy can be transformed into electricity. photovoltaic cells capture solar energy and then convert the energy into electricity. This technology is useful for rural and remote areas and for places where supply of power is not possible or very costly. This is a free from pollution.

Mini-hydel Plants: In mountainous regions, a large of such streams are perennial. Mini-hydel plants use the energy of such streams to move small turbines. The turbines produce electricity which can be used for daily work. Such power plants are more or less environment-friendly. they generate enough power to meet local demands of society.

Bio composting: From the last three decades of India, increase agricultural production and neglected the use of **Bio** compost and completely dependent on chemical fertilisers and pesticides. Hence, the large tracts of productive land have been adversely affected such as water bodies and soil suffered due to the chemical contamination.

Bio-pest Control: With the advent of green revolution, more and more use of chemical pesticides for higher yield is increased and nutrient fertility of soil are damaged badly. the adverse impacts on food products were contaminated, soil, water bodies and even ground water were polluted with pesticides. To reduce the use of pesticides and chemicals efforts are to bring better methods of pest control. One of the solutions is to use suitable pesticides based on plant products. Neem trees are evidencing to be quite useful in farming as an eco-friendly pesticide. Several types of pest controlling chemicals neem are being used. Mixed cropping and growing different crops in years by year on the same land have helped farmers.

7.7 Urban development:

Urban development known as the process of planning, designing, and managing the growth and development of cities and urban areas. In simple words, urban development is a process of planning and designing the urban areas and cities. Growth and development of urban areas and cities depends upon various factor such as population, area, industry, infrastructure, hospital, road and educational institutions etc. urban developments and growth needs a huge funds for developments projects.

Types of Urban Development: there are various types of urban development such as Physical Development, Economic Development, Social Development and Environmental Development. All the types of urban developments are discussed below.

1. Physical Development: it is a type of urban development in which planning and designing focused on growth and developments of Building infrastructure, such as roads, bridges, cinema hall, restaurant, hospitals, complexes, malls and public transportation. It is very important because it is the foundation of urban developments.
2. Economic Development: it is a type of urban developments which is related with Encouraging businesses and promoting new business, promoting industries, and innovation to create jobs and stimulate economic growth. Urban developments can only be possible when the ample numbers of opportunities are there in the market.
3. Social Development: it is very important types of urban developments because it is made of people and society. Social developments include the Improving quality of life providing quality education to society, better healthcare opportunities and infrastructure, and community services which will useful for individuals and society a lot.
4. Environmental Development: it is necessary for longer period of time because if environment is good then health of society will also good. It includes the Preserving natural resources such as water, air, soil and other natural resources which is freely available in the environment, reducing pollution and promoting sustainable practices in the society.

- **Characteristics of urban development's includes:**

Urban Planning: the main characteristics of urban development's includes the Designing and managing the physical layout of cities. In urban areas, there are lot of people reside so that there is a need of good physical infrastructure with all the amenities such as services of public transportation.

Advanced Infrastructure: it is the main factor which attract people for residing in urban areas in compare to rural areas because of Building infrastructure, making maintaining roads, public transportation, and all the basics utilities which will necessary for people.

High Population Density: Urban areas have a high concentration of people living in a small area because area is to small and too much public in urban areas. People are coming from rural areas in search of education and job.

Diverse Economy: in urban areas or Cities have a diverse range of industries, houses, services and businesses. Because there is a specific area allotted to market, business and households for resident.

Complex Social Systems: in urban areas or Cities, we seen always a rush of people and complex social systems of government, education, and healthcare institutions. It includes a smaller number of infrastructures in compare to numbers of public reside in area.

High Standard of Living and Urban Sprawl: Urban areas have a higher standard of living compared to rural areas because people are rich and some adoptions of western culture are also making them fashionable so standard of living is high. Cities often experience urban mass with development spreading away from the city center.

Housing and Real Estate Markets and Innovation and Entrepreneurship: Urban areas have dynamic housing and real estate markets and often hubs for innovation and entrepreneurship.

Public Services and Amenities and Transportation Systems: urban areas provide a range of public services and amenities such as parks, libraries, and cultural institutions. Urban areas have well-developed transportation and road connectivity such as public transportation and traffic management.

Environmental Concerns and Global Connectivity: they face environmental concerns such as air pollution, water pollution and waste management. Urban areas have more connected with the global economy and culture through trade, tourism, and communication.

Cultural Diversity and Social Inequality: urban areas are culturally diverse with people from different backgrounds, different culture and lifestyles living together. This can experience social inequality with disparities in income, education and standard of living.

Governance and Economic Growth: Urban areas have composite systems of governance and often drivers of economic growth and development.

Challenges of urban developments:

Rapid Urbanization: it is very difficult for urban areas to manage more and more public are coming in search of job and how to accommodate in congested areas and hence it is very difficult to Managing rapid population growth and increasing demands of resources.

Inequity and Poverty: all the people are coming from different back ground, education and society are not the same so it is sure to have inequality of social and economic disparities.

Environmental Degradation: in urban areas people are more compare to rural areas due to various reasons that creates a chaos and mitigating the impact of urbanization on the environment.

Infrastructure Deficits: in urban areas, there is always the need for modern and efficient infrastructure for people who enjoy a good standard of living.

Climate Change: it is a very big challenges in urban areas because cities have to Prepare for climate-related challenges and opportunities because it is

- **Opportunities or benefits of urban developments**:

1. Innovation and Technology: Leveraging technology to improve urban living.
2. Sustainable Development: Creating green spaces, reducing waste, and promoting eco-friendly practices.
3. Community Engagement: Fostering inclusive and participatory decision-making processes.
4. Economic Growth: Attracting businesses, creating jobs, and stimulating local economies.
5. Improved Quality of Life: Enhancing public services, healthcare, and education.

7.8 Rural development:

Rural development is a type of development which is entirely different from urban areas and it includes the process of improving the quality of life for people living in rural areas through economic, social, and environmental initiatives. Rural development is very difficult because there is a scarcity of resources in these types of areas.

- **Objectives of Rural development:**

1. Economic Development: in rural areas, we can Enhance rural livelihoods through job creation, income generation, and entrepreneurship. Economic developments in rural areas are only possible if industrialization or industry start in the areas.
2. Social Development: it is very important in rural areas to Improve access to education, healthcare, and social services by every individual of society. Social development is the key challenges of rural developments.
3. Environmental Conservation: in rural areas there is always seen a good and responsible citizen which do not harm the environment and always Protect and preserve natural resources such as land, water, and biodiversity.

4. Inclusive Growth: it is the main objectives because to Ensure that development benefits transfer to all segments of the rural population and society. it is very important for rural development to develop every stance of the society simultaneously.
5. Sustainable Practices: in rural areas, local government should Promote environmentally sustainable practices and resource management because it can save form diseases to rural people.
6. Capacity Building: in rural areas, local government should support to Strengthen the local business and build capacity for sustainable development.

- **Strategies of Rural development**:

1. Agricultural Development: Support small-scale farmers, improve agricultural productivity, and promote sustainable practices.
2. Infrastructure Development: Invest in roads, bridges, and public transportation to connect rural areas to markets and services.
3. Human Resource Development: Provide training, skills development, and education to enhance employability and entrepreneurship.
4. Community Engagement: Empower local communities to take ownership of development initiatives.
5. Innovation and Technology: Leverage technology to improve rural services, such as e-commerce, telemedicine, and digital payments.

- **Challenges of Rural development**:

1. Limited Access to Resources: Rural areas often lack access to basic services, such as healthcare, education, and infrastructure.
2. Poverty and Inequality: Rural populations often experience higher poverty rates and limited economic opportunities.
3. Environmental Degradation: Rural areas are vulnerable to environmental degradation, including deforestation, soil erosion, and water pollution.
4. Brain Drain: Young and educated individuals often migrate to urban areas, leaving rural areas with a shortage of skilled workers.
5. Limited Market Access: Rural producers often face challenges in accessing markets and selling their products.

- **Opportunities of Rural development**:

1. Sustainable Agriculture: Promote eco-friendly farming practices, organic farming, and agroforestry.
2. Rural Tourism: Develop tourism initiatives that showcase rural culture, heritage, and natural beauty.
3. Renewable Energy: Invest in renewable energy sources, such as solar, wind, and biogas, to power rural development.
4. Digital Rural Development: Leverage digital technologies to improve rural services, such as e-commerce, telemedicine, and digital payments.

5. Community-Led Development: Empower local communities to drive development initiatives and decision-making processes.
6. Participatory Approach: Involve local communities in decision-making processes.
7. Integrated Development: Address multiple aspects of rural development, including economic, social, and environmental.

7.9 Business Responsibility related to Sustainable Development

Business responsibility towards sustainability involves adopting practices that minimize harm to the environment, social systems, and economies, while promoting long-term value creation for stakeholders. Business entity have the various responsibility such as Environmental Responsibility, Social Responsibility and Economic Responsibility.

- **Environmental Responsibility: it includes the following responsibility.**

1. Reduce Greenhouse Gas Emissions, Implement energy-efficient practices and transition to renewable energy sources.
2. Conserve Natural Resources, implement sustainable supply chain practices and reduce waste.
3. Protect Biodiversity, implement environmentally responsible practices to preserve ecosystems and species.
4. Minimize Waste, Implement recycling and waste reduction programs.

- **Social Responsibility: it includes the following responsibility**

1. Promote Human Rights, Respect and protect human rights in operations and supply chains.
2. Foster Diversity and Inclusion, Encourage diverse workplaces and inclusive cultures.
3. Support Community Development, Engage in philanthropy and community development initiatives.
4. Ensure Safe Working Conditions, Provide safe and healthy working environments.

- **Economic Responsibility: it includes the following responsibility**

1. Promote Sustainable Consumption, Encourage sustainable consumption patterns and product design.
2. Support Sustainable Supply Chains, Implement sustainable procurement practices and supplier engagement.
3. Foster Innovation, invest in research and development to drive sustainable innovation.
4. Ensure Transparency and Accountability, Disclose sustainability performance and progress.
5. Integrate Sustainability into Business Strategy and Embed sustainability into core business operations.

6. Engage Stakeholders and Collaborate with stakeholders to understand their needs and expectations.

- **Benefits of sustainable development:**

1. Enhanced Reputation through Demonstrate commitment to sustainability and social responsibility.
2. Cost Savings through Reduce waste, energy consumption, and operational costs.
3. Increased Innovation includes Drive innovation and new business opportunities.
4. Improved Risk Management involves Mitigate sustainability-related risks and liabilities.
5. Long-term Value Creation Contribute to a sustainable future and create long-term value for stakeholders.

❖ **Exercises:**

1. Answers the following MCQs:

1. What is the meaning of sustainability?
   A) Increasing carbon emissions for economic growth.
   B) Reducing waste and energy consumption.
   C) Meeting the needs of the present without compromising the ability of future generations to satisfy their needs.
   D) Maximizing profits without considering environmental.

Answer: C) Meeting the needs of the present without compromising the ability of future generations to satisfy their needs.

2. Which is a key principle of sustainability?
   A) Environmental protection
   B) Economic growth
   C) Social equity and justice
   D) none of the above

Answer: C) Social equity and justice

3. What is the primary objective of sustainable development?
   A) To promote economic growth and job creation
   B) To reduce poverty and inequality
   C) To balance economic, social and environmental needs
   D) all of the above

Answer: C) To balance economic, social and environmental needs

4. Which of the following is known as a sustainable agriculture?
   A) Use of synthetic fertilizers and pesticides
   B) Organic farming and agro ecology
   C) Monoculture farming
   D) none of the above

Answer: B) Organic farming and agroecology

5. What is the impact of climate change on global food systems?
   A) Decreased food production and increased food insecurity
   B) Increased food production and availability

C) No impact
D) none of the above

Answer: A) Decreased food production and increased food insecurity

6. From the given below, which is a sustainable transportation option?

A) Public transportation and non-motorized transport
B) Private car use
C) Air travel
D) All of the above

Answer: A) Public transportation and non-motorized transport

7. What is the role of education in sustainability?

A) To focus only on environmental education
B) To educate people about sustainable practices
C) To promote consumerism
D) all of the above

Answer: B) To educate people about sustainable practices

8. Which of the following is a benefit of sustainable practices?

A) Reduced innovation and competitiveness
B) benefits to the environment
C) Increased costs and reduced profits
D) Improved brand reputation and customer loyalty

Answer: D) Improved brand reputation and customer loyalty

9. What is the primary challenge to achieving sustainability?

A) Inadequate policy and regulation
B) Lack of technology and innovation
C) Changing societal values and behaviors
D) Limited financial resources

Answer: C) Changing societal values and behaviors

10. Which is a key indicator of sustainability?

A) Carbon footprint and greenhouse gas emissions
B) Biodiversity and ecosystem health
C) Gross Domestic Product
D) All of the above

Answer: D) All of the above

2. Answers the following short and long-term questions.

1. What is Sustainable Development?
2. Define sustainability.
3. Explain the Problem Faced by Environment.
4. Explain the Need of sustainable development.
5. Explain the Measures taken for sustainable development.
6. Explain the Strategies for sustainable development in details.
7. Explain the Urban development in details.
8. Explain the Rural development in details.
9. Explain the Business Responsibility related to Sustainable Development.
10. Write a short note on Ozone Depletion.
11. Write a short note on Global warming.
12. Write a short note on Solar Power through Photovoltaic Cells.
13. Write a short note on Bio composting.

UNIT-8 NATURAL DISASTERS & MANAGEMENT

8.1 Introduction

Disaster is an event or hazard that threatens the safety and lives of the people and is often unforeseen. It causes a severe ecological and psychosocial disruption that exceeds the coping ability of the affected people/community.

United Nations Office for Disaster Risk Reduction (UNDRR), defined disaster as "A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts".

The Disaster Management Act (DMA) (2005) states, disaster as "a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area".

8.2 Definition

Disaster, as defined by the United Nations, is a serious disruption of the functioning of a community or society, which involve widespread human, material, economic or environmental impacts that exceed the ability of the affected community or society to cope using its own resources

1. Disaster management is how we deal with the human, material, economic or environmental impacts of said disaster, it is the process of how we "prepare for, respond to and learn from the effects of major failures"

2. Though often caused by nature, disasters can have human origins. According to the International Federation of Red Cross & Red Crescent Societies a disaster occurs when a hazard impacts on vulnerable people.

The combination of hazards, vulnerability and inability to reduce the potential negative consequences of risk results in disaster

8.3 Types of Disasters

Natural and human-caused disasters affect thousands of people each year. Major adverse events such as these have the potential to cause catastrophic loss of life and physical destruction. They are often unexpected and can leave whole communities in shock.

People who live through a disaster can experience emotional distress. Feelings of anxiety, constant worrying, trouble sleeping, and other depression-like symptoms are common responses to disasters before, during, and after the event. Many people are able to "bounce back" from disasters with help from family and the community, but others may need additional support to cope and move forward on the path of recovery. Anyone can be at risk, including survivors living in the impacted areas and first responders and recovery workers.

8.3.1 Natural Disasters

Natural disasters are large-scale geological or meteorological events that have the potential to cause loss of life or property. These types of disasters include:

❖ **Tornadoes and Severe Storms**

Tornadoes are outgrowths of powerful thunderstorms that appear as rotating, funnel-shaped clouds. They extend from a thunderstorm to the ground with violent winds that average 30 miles per hour. Also, they can vary in speed dramatically from being stationary to 70 miles per hour. With a loud roar that sounds similar to a freight train, tornadoes in the United States typically are 500 feet across and travel on the ground for five miles. Every state is at some risk from tornadoes and the severe storms that produce them. These same destructive storms also cause strong gusts of wind, lightning strikes, and flash floods.

Tornadoes can strike quickly with little or no warning, giving those in impacted areas barely enough time to take shelter. Because of the unpredictable nature of tornadoes and severe storms, it's normal for people to experience emotional distress. Feelings such as overwhelming anxiety, trouble sleeping, and other depression-like symptoms are common responses to these types of disasters. Other signs of emotional distress related to tornadoes and severe storms include:

- Worrying a lot or feeling guilty but not sure why
- Feeling helpless or hopeless
- Thinking that something is going to happen when forecasts for any storm are issued
- Constant yelling or fighting with family and friends
- Having nightmares or thoughts and memories related to the storm

Symptoms of distress may appear before, during, and after a tornado or severe storm and may manifest in the hours, days, weeks, months, or even years after the storms occur. Learn more about warning signs and risk factors for emotional distress related to tornadoes and other disasters.

❖ **Hurricanes and Tropical Storms**

Hurricanes are types of tropical storms that form in the southern Atlantic Ocean, Caribbean Sea, Gulf of Mexico, and eastern Pacific Ocean. Hurricanes affect millions of people who live along the Atlantic and Gulf of Mexico coasts each year. Parts of

the Southwest United States and the Pacific Coast can also experience severe weather associated with hurricanes, which include tornadoes, floods, and heavy winds.

It's normal for hurricanes to cause people to experience emotional distress. Feelings such as overwhelming anxiety, constant worrying, trouble sleeping, and other depression-like symptoms are common responses before, during, and after these types of storms. Other signs of emotional distress related to hurricanes include:

- Fearing that forecasted storms may develop into a hurricane even when the chances they will are low
- Constant yelling or fighting with family and friends
- Having thoughts, memories, or nightmares related to the storm that you can't seem to get out of your head

❖ **Floods**

Floods are one of the most common hazards in the United States. They occur when land that is normally dry experiences an overflow of water. Several events cause floods, including hurricanes and tropical storms, failed dams or levees, and flash floods that occur within a few minutes or hours of excessive rainfall.

Although coastal areas are more vulnerable to floods, particularly during hurricane season, they can occur anywhere and can vary in size and duration. Even very small streams, gullies, and creeks that may appear harmless in dry weather can flood.

The physical destruction of a flood can vary, with some carrying away everything in its path, including houses, bridges, cars, and even people who may be trapped or wading in water. Further, the economic loss from hazardous flood conditions can be significant.

It's normal for people to experience emotional distress during a flood. Simply anticipating the possibility of what could be lost or destroyed during a flood can cause people to experience overwhelming anxiety or lose sleep. Other signs of emotional distress related to floods include:

- Feeling helpless or hopeless
- Fearing that forecasted storms may develop into a hurricane, even when the chances they will are low
- Constant yelling or fighting with family and friends
- Excessive absences from work or school
- Having thoughts and memories related to the flood that you can't get out of your head

❖ **Wildfires**

Wildfires are usually triggered by lightning or accidents and often go unnoticed at first. They can spread quickly and are especially destructive if they occur near forests, rural areas, remote mountain sites, and other woodland settings where people live. While not reported as often as floods or tornadoes and severe storms, they, too, can cause emotional distress in people living in affected areas.

Feelings such as overwhelming anxiety, constant worrying, trouble sleeping, and other depression-like symptoms are common responses before, during, and after wildfires. Other signs of emotional distress related to wildfires include:

- Having thoughts, memories, or nightmares related to the wildfire that you can't seem to get out of your head
- Worrying a lot of the time; feeling guilty but not sure why
- Excessive absences from work or school

These are just a few warning signs of disaster-related distress. Learn more about warning signs and risk factors for emotional distress related to wildfires and other disasters.

❖ **Earthquakes**

An earthquake is the shifting of the Earth's plates, which results in a sudden shaking of the ground that can last for a few seconds to a few minutes. Within seconds, mild initial shaking can strengthen and become violent. Earthquakes happen without warning and can happen at any time of year. Certain states are more prone to higher frequency of earthquakes, particularly California, Hawaii, Nevada, and Washington.

Earthquakes are quite common and occur somewhere around the world every day. However, the vast majority are considered minor. The U.S. Geological Survey in 2015 reported more than 3,000 earthquakes in the United States.

Even minor earthquakes that cause little damage and destruction can cause people to experience emotional distress (especially in areas not accustomed to these events). Aftershocks can continue to occur for months afterwards and can be just as stressful.

It's normal for people to experience emotional distress during an earthquake. Simply anticipating the possibility of what could be lost or destroyed during the event can cause people to experience overwhelming anxiety or lose sleep. Other signs of emotional distress related to earthquakes include:

- Being easily startled
- Having difficulty sleeping or sleeping too much
- Having thoughts and memories related to the earthquake that you can't get out of your head

❖ **Drought**

A drought is a normal, reoccurring weather event that can vary in intensity and duration by region of the country and even by location within a state. Drought occurs when there is lower than average precipitation over a significant period of time, usually a season or more. Other causes of drought can be a delay in the rainy season or the timing of rain in relation to crop growth.

Drought is a slow-moving hazardous event, so the psychological effects of living through this type of disaster are more subtle and last longer than with other natural disasters. Low water availability creates shortages in water supplies that impact various activities and the environment. The impact is even greater as humans place demands on water supplies. Additionally, drought conditions increase the risk of other natural disasters, such as wildfires, and landslides.

Warning signs for emotional distress related to drought may include:

- Feelings of overwhelming anxiety
- Constant worrying
- Trouble sleeping and other depression-like symptoms
- Disputes between people over limited water supplies

- Health concerns related to dust, low water flow, or poor water and air quality
- Financial concerns related to crop failures, low supply and demand of agricultural-related products, or rising food prices

8.3.2 MAN MADE DISASTERS

Nuclear and Radiological Emergency:-The growth in the application of nuclear science and technology in the fields of power generation, medicine, industry, agriculture, research and defence has led to an increase in the risk of occurrence of Nuclear and Radiological emergencies. India has traditionally been vulnerable to natural disasters on account of its unique geo climatic conditions and it has, of late, like all other countries in the world, become equally vulnerable to various man-made disasters.

Nuclear and Radiological Emergency can arise in a nuclear facility at plant level leading to plant/ site or offsite emergency depending upon the extent of its impact on the surroundings. It can also take place while using radiation sources, either at Hospitals, Industries, Agriculture or Research Institutions due to loss or misplacement or due to faulty handling. The other events that can lead to Nuclear or Radiological Emergency in the public domain, include, accident of a vehicle carrying radioactive/nuclear material, due of an orphan source i.e. the source which is not under regulatory control or due to usage of radiation source/radioactive material in Malevolant activities.

Any radiation incident resulting in or having a potential to result in exposure and/or contamination of the workers or the public in excess of the respective permissible limits can lead to a nuclear/radiological emergency.

Biological disasters are causative of process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic microorganisms, toxins and bioactive substances that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Examples of biological disasters include outbreaks of epidemic diseases, plant or animal contagion, insect or other animal plagues and infestation. Biological disasters may be in the form of:-

Epidemic affecting a disproportionately large number of individuals within a population, community, or region at the same time, examples being Cholera, Plague, Japanese Encephalitis (JE)/Acute Encephalitis Syndrome (AES); or,

Pandemic is an epidemic that spreads across a large region, that is, a continent, or even worldwide of existing, emerging or remerging diseases and pestilences, example being Influenza H1N1 (Swine Flu).

Chemical Disaster:- Chemical, being at the core of modern industrial systems, has attained a very serious concern for disaster management within government, private sector and community at large. Chemical disasters may be traumatic in their impacts on human beings and have resulted in the casualties and also damages nature and property. The elements which are at highest risks due to chemical disaster primarily include the industrial plant, its employees & workers, hazardous chemicals vehicles, the residents of nearby settlements, adjacent buildings, occupants and surrounding community. Chemical disasters may arise in number of ways, such as:-

1. Process and safety systems failures
    - -Human errors

- -Technical errors
- -Management errors

2. Induced effect of natural calamities
3. Accidents during the transportation
4. Hazardous waste processing/ disposal
5. Terrorist attack/ unrest leading to sabotage

8.4 The causes of natural disasters are:

(i) Global warming

Global warming is a serious contributor to natural disasters because it affects our globe in so many areas. As hurricanes draw their energy from seawater, global warming causes ocean temperatures to rise, resulting in more and larger hurricanes and tropical storms.

(ii) Natural activities in the earth's crust

Natural disasters are often triggered by natural events in the earth's crust. Tension can build up inside the earth's crust due to natural processes, which can be released through earthquakes.

(iii) Tectonic movement

Because the globe is made up of several plates sliding on our planet's underlying mantle rather than a single surface, a relocation or colliding of these plates might have disastrous consequences. Earthquakes, volcanic eruptions, and tsunamis are all possible outcomes.

(iv) Deforestation

Forests normally mitigate floods and droughts by balancing and holding back natural groundwater resources, so deforestation might lead to an increase in natural catastrophes.

(v) Soil erosion

Soil erosion can result in significant soil degradation, which can result in a loss of fertility and, as a result, hunger for local inhabitants. Soil erosion also can result in landslides, which can be devastating to both nature and humanity.

(vi)Seismic activity

Earthquakes can be caused by seismic activity inside our planet.

8.5 Disaster Management

Disasters take many shapes. Human-made disasters result from human errors and include industrial explosions or structure failures. Natural disasters result from physical phenomena and include earthquakes and droughts. Disasters classified as complex can include epidemics or armed conflicts.

In whatever form, disasters disrupt communities and can take a serious toll on people, property, economies, and the environment. They often stretch a community's capacity to cope.

Disaster management is a process of effectively preparing for and responding to disasters. It involves strategically organizing resources to lessen the harm that disasters cause. It also involves a systematic approach to managing the responsibilities of disaster prevention, preparedness, response, and recovery.

❖ **Understanding Risks in Disaster Management**

Often, issues such as a poorly maintained levee system or other negligence can worsen the outcome of a disaster. Such was the case when Hurricane Katrina overwhelmed New Orleans' levees in 2005.

By addressing deferred infrastructure maintenance and other causal factors, governments and organizations can often prevent, or at least reduce, the fallout of disasters.

Disaster management involves examining and managing causal factors. It requires assessing the extent to which a community can withstand a disaster. Some communities are more vulnerable than others. For example, poorer communities have fewer resources to prepare themselves for a storm or bounce back from flood damage.

Disaster management also involves analyzing exposure to loss. For example, homes built below sea level may face greater exposure to flooding if a hurricane hits them.

8.5.1 The Scope of Disaster Management

Disaster management has a broad scope. To understand what disaster management is, it is useful to study prevention, preparedness, and response and recovery.

❖ **Prevention**

Mitigation and prevention efforts aim to reduce the potential damage and suffering that disasters can cause. While disaster management cannot prevent disasters, it can prevent them from becoming compounded as a result of neglecting causal factors and manageable risks. Mitigation specifically refers to actions taken that can lessen the severity of a disaster's impact. Investing in measures that limit hazards can greatly reduce the burden of disasters.

Srategies that disaster management professionals implement to protect vulnerable communities and limit hazards include the following:

- Raising awareness about potential hazards and how to address them
- Educating the public about how to properly prepare for different types of disaster
- Installing and strengthening prediction and warning systems

Managing hazards and risks means planning to minimize a community's vulnerability to disasters. This can involve:

- Encouraging community members to buy appropriate insurance to protect their properties and belongings
- Educating families and businesses on how to create effective disaster plans
- Promoting the use of fire-retardant materials in construction
- Advocating for capital works initiatives, such as the construction and maintenance of levees

- Building partnerships between sectors and agencies at the federal, state, and local levels to collaborate on mitigation projects.

Disaster management professionals working on mitigation efforts also focus on the following:

❖ Land Use and Building Codes

Building schools, hospitals, and neighborhoods in flood-prone areas increases their exposure to disasters. Disaster management spotlights these risks and presents ideas to use land in safer ways.

For example, rather than constructing homes in floodplains, community planners can designate those areas as places for outdoor recreation, wildlife attractions, or hiking trails. They can also urge people to avoid these areas during flood season. These measures make residents and their homes less vulnerable to harm.

Additionally, mitigation efforts can do the following:

- Address ways to engineer bridges to sustain earthquakes
- Enforce building codes that safeguard buildings during hurricanes

❖ Critical Infrastructure

Protecting critical infrastructure during a disaster can mean the difference between life and death. Critical infrastructure, which comprises the systems and assets vital to a community's economy, security, and public health, deserves special attention as regards disaster management mitigation.

Setting up protective measures that limit damage to water and wastewater systems or nuclear plants, for example, can prevent serious repercussions.

As an example, Japan experienced devastating physical and psychological consequences after a 2011 earthquake triggered a tsunami. The inundation of water cut off the power supply to the cooling system for Fukushima Daiichi reactors, leading to a massive nuclear accident.

❖ Preparedness

Well-coordinated responses to disasters require prior planning. This helps ensure fast, effective response efforts and limits duplicated efforts.

Disaster preparedness plans:

- Identify organizational resources
- Designate roles and responsibilities
- Create procedures and policies
- Organize activities that improve disaster readiness

Anticipating the needs of communities that disasters affect improves the quality of the response efforts. Building the capacities of volunteers, personnel, and disaster management teams to respond to disasters also makes the response efforts more effective.

Plans may include the following:

- Emergency shelter sites
- Evacuation routes
- Emergency energy and water sources

They may also address:

- Chains of command
- Training programs
- Communication procedures
- Emergency supply distribution
- Stockpile needs

❖ **Contingency Planning**

Disaster readiness calls for contingency planning, advance decisions about managing human and monetary resources, coordinating procedures between different agencies, and organizing logistics.

Contingency plans answer three basic questions:

- What will happen?
- What will the response be?
- What will be done ahead of time to prepare?

❖ **Response and Recovery**

During and immediately after an emergency, disaster management focuses on delivering help and interventions that can save lives, safeguard health, and protect buildings, animals, and community property. Following an initial response, efforts shift toward supporting communities as they rebuild emotionally, economically, and physically.

❖ **Disaster Relief**

Disaster relief addresses the immediate and short-term needs of disaster-affected communities. It can include evacuations, search and rescue missions, and emergency medical assistance.

Examples of disaster relief are:

- Setting up temporary shelters that provide a safe place to sleep, food, and emotional support from trained personnel
- Delivering meals and water
- Distributing emergency supplies and necessities, such as toiletries for hygiene and tarps, shovels, trash bags for clean-up efforts
- Providing emergency health services, such as first aid for injuries and prescription medication replacements

❖ **Rebuilding**

Emergency management helps communities rebuild their lives after trauma. This involves longer-term efforts to restore:

- Housing
- Economies
- Infrastructure systems

- Individual and community health

Federal agencies and supporting organizations help communities with problem-solving and finding resources as they redevelop and revitalize.

Recovery assistance may include the following:

- Unemployment assistance
- Housing assistance
- Legal services
- Mental health counseling
- Disaster case management

8.6 Safety Measures Immediately before a Disaster

8.6.1 Earthquake

❖ **Pre-Disaster:**

1. Shelves for books and household items should be fixed to the walls. Remove heavy objects from shelves above head level as these can topple over and fall
2. Locate beds away from the windows and heavy objects that could fall
3. Secure applications that could move, causing rupture of gas or electrical lines
4. Know location of master switches and shut off valves
5. Make sure that overhead electrical fixtures are well secured to the ceiling & move heavy unstable objects away from exit routes
6. Replace glass bottles with plastic containers or move them to the lowest shelves
7. Be aware that in a severe earthquake utility services like electricity and water-supply will probably be down. Emergency services may be extremely limited for a few days
8. Store emergency supplies like water, food, first-aid kit, medicines, tools, portable radio, flash light, batteries, blankets, fire extinguisher etc.

- **During Disaster:**

1. Keep calm & help others to be calm
2. Try to run safely to the nearest open space which is not surrounded by buildings, trees and overhead power lines but do so with great caution
3. Do not use an elevator during the earthquake & do not rush to the roof of the house
4. Choose your exit as carefully as possible
5. If you feel it is not possible to get out of the house/building fast & safely, especially when you are inside a high rise building, stay calmly inside
6. While inside the house/building, choose a safe place to protect yourself. Take refuge under a desk, table, bed or stand below the doorway (in case of an Assam type house)
7. If you are moving in a vehicle, drive immediately to a place which is away from buildings, high/heavy structures, bridges, electric lines etc & park the vehicle there. Remain inside the car till the earthquake stops

8. Do not light candles, gas stove, and cigarette (to prevent any fire due to possible leakage of gas)
9. Shut off your gas connection
10. Release your pets, domestic animals if they are inside an enclosure
11. Do not panic no matter how hard the tremor

- **Post - Disaster:**

1. Check yourself for injuries
2. Examine all sections of your building
3. Do not stay inside a room/house where cracks have developed along the walls, ceiling. Get everyone out of the house if it is found unsafe
4. Use a helmet or cover your head with a pillow or rubber sheet while moving around inside the house
5. Be prepared for additional earthquakes (after-shocks)
6. Stay away from overhanging portions of buildings/structures and power lines and poles
7. Close the valve of the gas cylinder and do not use open flame
8. Do not switch on electric appliances
9. Wear rubber soled shoes while moving around
10. Attend to injured persons and inform the medical authorities as soon as possible
11. If you are trapped inside a collapsed building, wait patiently for help. Remain calm.
12. Use a stick/pole to detect any life inside a collapsed building
13. Do not spread rumors or be alarmed by rumors
14. Turn on your radio and listen to announcements

8.6.2 Fire

- **Before:**

1. Install smoke alarms. Place smoke alarms on every level of a multi-storey building at spots close to fire-causing sources
2. Test and clean smoke alarms once a month and replace batteries at least once a year
3. Replace smoke alarm systems regularly as advised on the manufacturer's label
4. Do not take illegal connections or tinker with power connections
5. Review escape routes with your family
6. Make sure windows are not nailed or permanently bolted
7. Make sure security gratings on windows can be easily opened from the inside
8. Consider escape ladders if your residence has more than one level and ensure that burglar bars and other anti-theft systems can be easily opened from the inside
9. Teach family members to stay low on the floor (where the air is safer) when escaping from a fire
10. Clean out storage areas. Do not let trash such as old newspapers/magazines and polythene bags accumulate

- **Flammable Items-**

1. Store flammable liquids in safe containers in well-ventilated storage areas
2. Never smoke near flammable liquids
3. Discard all rags or materials that have been soaked in flammable liquids after you have used them. Safely discard them outdoors in a metal container.
4. Insulate chimneys and place spark arresters on top. The chimney should be at least three feet higher than the roof. Remove tree branches hanging above and around the chimney.

- **Heating Sources-**

1. Be careful when using alternative heating sources
2. Place heaters at least three feet away from flammable materials. Make sure the floor and nearby walls are properly insulated
3. Use only the type of fuel designated for your unit and follow manufacturer's instructions
4. Store ashes in a metal container outside, away from your residence
5. Keep open flames away from walls, furniture, drapery, and flammable items

Matches and Smoking-

1. Keep matches and lighters away from children, and, if possible, in a locked cabinet
2. Never smoke in bed or when drowsy or medicated

- **Electrical Wiring-**

1. Have the electrical wiring in your residence checked by a certified electrician
2. Inspect extension cords for frayed or exposed wires or loose plugs
3. Make sure outlets have cover plates and no exposed wiring
4. Make sure wiring does not run under rugs, over nails, or across high-footfall areas
5. Do not overload extension cords or outlets. If you need to plug in two or three appliances, get a unit with built-in circuit breakers to prevent sparks and short circuits
6. Make sure insulation does not touch bare electrical wiring

- **Other-**

1. Install fire extinguishers at your residence and read the instructions on the labels carefully. Teach family members how to use them
2. Consider installing an automatic fire sprinkler system in your residence
3. Ask your local fire department to inspect your residence for fire safety and prevention.

- **During Fire:**

1. If your clothes catch fire, you should stop, drop, and roll until the fire is extinguished. Running only makes the clothes burn faster

2. Cover your nose / mouth, possibly with a moist cloth or in its absence with your hands, to prevent inhalation of smoke and asphyxiation
3. While escaping from a burning house, it will help if you could cover yourself with a thick blanket
4. Check closed doors for heat before you open them. If you are escaping through a closed door, use the back of your hand to feel the top of the door, the doorknob, and the crack between the door and door frame before you open it.
5. Never use the palm of your hand or fingers to test for heat - burning those areas could impair your ability to escape a fire (for ladders and crawling)
6. The window is your best escape option. If you cannot escape, hang a white or light-coloured sheet outside the window, alerting fire fighters to your presence
7. Crawl low under any smoke to your exit - heavy smoke and poisonous gases collect first along the ceiling
8. Close doors behind you as you escape if you can to delay the spread of the fire
9. Do not re-enter once you have escaped. Call the local fire department

- **After Fire:**

1. If you are with burn victims, or are a burn victim yourself, cool and cover burns to reduce chances of further injury or infection
2. Go to the nearest medical doctor for help
3. If you detect heat or smoke when entering a damaged building, evacuate immediately
4. If you have a safe or strong box, do not try to open it. It can hold intense heat for several hours. If the door is opened before the box has cooled, the contents could burst into flames

8.6.3 Landslide

- **What are the causes of landslide?**

The primary cause of landslide is denudation of vegetation on hill slopes resulting in loose / unstable soil that cannot withstand the pressure of rainfall, snow or traffic. Clearance of vegetation for construction purposes or agriculture (jhum) has an adverse impact on the stability of soil. Tremor from earthquakes or explosion could also trigger landslide, apart from erosion as a result of floods and quarrying.

- **Safety measures before landslide:**

1. Investigate susceptible areas to identify factors of instability and carry out corrective measures to prevent/minimize instability
2. Carry out re-forestation in barren areas as the roots of plants / trees will arrest slippage of soil. Plant trees on vulnerable areas
3. Always be watchful on hill roads and try to note features like cracks on road surface and slopes
4. Do not build house near steep slopes, close to mountain edges, near drains or natural water outlets
5. Construct embankment on high gradient slopes

- **Safety measures during landslide:**

1. Be alert during heavy rainfall and continuous damp weather
2. Stay out of the path of a landslide or debris flow
3. Listen for any unusual sound that might indicate moving debris, trees cracking or rolling boulders (large stones)
4. Be alert when there is a sudden increase in volume of water in streams and a marked transformation from clear to muddy water
5. Contact local rescue units

- **What to do if you suspect imminent landslide:**

1. Alert local authorities
2. Informing people around you about the potential threat may help save many lives
3. Evacuation or getting out of the path of landslide or debris flow is the best protection
4. Make yourself less vulnerable and protect your head if escaping is not possible

- **Safety measures after landslide:**

1. Avoid the landslide area. There may be danger of subsequent slides
2. Look out for flooding which may follow a landslide on debris flow
3. Help persons who may require special assistance - infants, elderly persons and the disabled

8.7 Steps in Disaster Management

It is about organizing and managing resources to deal with emergencies. It includes being prepared, responding to the situation, and recovering from it in order to minimize the impact of disasters.

The goal is to prevent hazards from turning into disasters and to reduce the loss of life and property. It involves planning and taking steps before, during, and after a disaster. This includes preparing for disasters, implementing effective response systems, and building resilient communities.

- **The three main steps:**

1) Pre-disaster management:

This phase focuses on taking action before a disaster occurs. The main purpose is to mitigate human loss. It involves developing information systems, mobilizing resources, assessing risks, issuing warnings through various communication channels, and ensuring the safe transportation of people to secure locations.

2) Management during Disasters:

This phase is crucial and depends on the preparedness done in the pre-disaster phase. It involves taking quick action to help victims in disaster-prone areas, ensuring their safety by relocating them to secure areas, and providing essential needs like food, clothing, and healthcare.

3) Post-disaster management:

In this phase, the focus is on rebuilding and reconstructing the affected areas. The administration is responsible for providing assistance to affected people, including employment or compensation.

8.8 Regional Disaster Management and Planning

Regional disaster management and planning involve coordinating efforts to prepare for, respond to, recover from, and mitigate the impacts of disasters within a specific geographic area. Effective management ensures that resources are used efficiently and that communities are better equipped to handle emergencies. Here's a breakdown of key elements:

1. Risk Assessment

- **Identify Hazards**: Determine which hazards (natural, technological, or human-made) are most likely to affect the region, such as floods, earthquakes, or industrial accidents.
- **Vulnerability Analysis**: Assess the susceptibility of people, property, and infrastructure to these hazards.
- **Impact Analysis**: Evaluate potential consequences and the overall risk they pose to the community.

2. Mitigation

- **Preventive Measures**: Implement strategies to reduce the impact of disasters, like building codes, land-use planning, and environmental regulations.
- **Community Education**: Raise awareness about risks and promote safety practices among residents.

3. Preparedness

- **Emergency Plans**: Develop and regularly update disaster response plans that outline roles, responsibilities, and procedures.
- **Training and Drills**: Conduct training sessions and simulations to ensure that first responders and the public are familiar with emergency protocols.
- **Resource Inventory**: Maintain an up-to-date inventory of available resources, including personnel, equipment, and supplies.

4. Response

- **Coordination**: Establish a command structure to manage disaster response, often involving local government, emergency services, and community organizations.
- **Communication**: Implement systems for timely and accurate information dissemination to the public and between agencies.
- **Emergency Services**: Provide immediate assistance, including medical care, search and rescue operations, and shelter.

5. Recovery

- **Damage Assessment**: Evaluate the extent of damage and prioritize recovery efforts.
- **Restoration**: Rebuild infrastructure, restore services, and support community healing and rebuilding.
- **Support Services**: Offer psychological and financial support to affected individuals and businesses.

6. Resilience Building

- **Infrastructure Improvement**: Strengthen buildings, roads, and utilities to withstand future disasters.
- **Community Engagement**: Involve local communities in planning and recovery efforts to foster a sense of ownership and preparedness.
- **Sustainability**: Integrate disaster resilience into broader regional planning, including climate adaptation and sustainable development practices.

7. Collaboration

- **Regional Partnerships**: Work with neighbouring regions, state and federal agencies, and international organizations for comprehensive disaster management.
- **Public-Private Partnerships**: Engage businesses and non-profit organizations in disaster preparedness and response efforts.

Effective regional disaster management and planning rely on proactive strategies, collaboration, and continuous improvement. Each region's approach will be tailored to its specific risks and resources, with a focus on creating resilient communities capable of withstanding and recovering from emergencies.

❖ **Exercise**

- **Long Question: -**

1. Introduction to Natural Disasters with it causes

- **Short Question: -**

1. What are types of disaster and what safety should be taken in it.

- **Short Note: -**

1. Types of Disasters
2. Write a note on Regional Disaster Management and Planning

- **Fill Ups: -**

1. There are_____types of Natural Disaster
2. The disaster occur due to water is called _____

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Education for All

યુનિવર્સિટી ગીત

સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ
સ્વાધ્યાયઃ પરમં તપઃ

શિક્ષણ, સંસ્કૃતિ, સદ્‌ભાવ, દિવ્યબોધનું ધામ
ડૉ. બાબાસાહેબ આંબેડકર ઓપન યુનિવર્સિટી નામ;
સૌને સૌની પાંખ મળે, ને સૌને સૌનું આભ,
દશે દિશામાં સ્મિત વહે હો દશે દિશે શુભ-લાભ.

અભણ રહી અજ્ઞાનના શાને, અંધકારને પીવો ?
કહે બુદ્ધ આંબેડકર કહે, તું થા તારો દીવો;
શારદીય અજવાળા પહોંચ્યાં ગુર્જર ગામે ગામ
ધ્રુવ તારકની જેમ ઝળહળે એકલવ્યની શાન.

સરસ્વતીના મયૂર તમારે ફળિયે આવી ગહેકે
અંધકારને હડસેલીને ઉજાસના ફૂલ મહેંકે;
બંધન નહીં કો સ્થાન સમયના જવું ન ઘરથી દૂર
ઘર આવી મા હરે શારદા દૈન્ય તિમિરના પૂર.

સંસ્કારોની સુગંધ મહેંકે, મન મંદિરને ધામે
સુખની ટપાલ પહોંચે સૌને પોતાને સરનામે;
સમાજ કેરે દરિયે હાંકી શિક્ષણ કેરું વહાણ,
આવો કરીયે આપણ સૌ
ભવ્ય રાષ્ટ્ર નિર્માણ...
દિવ્ય રાષ્ટ્ર નિર્માણ...
ભવ્ય રાષ્ટ્ર નિર્માણ

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