Master of Arts in English

(M.A. - English)

Environmental Sciences

(DMAEAE209T24)

Self-Learning Material

(SEM 1)

Jaipur National University

Centre for Distance and Online Education

Established by Government of Rajasthan

Approved by UGC under Sec 2(f) of UGC ACT 1956

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COURSE INTRODUCTION

The course entitled Environmental Science is a 2 credit course that is divided into 07 units. It is an interdisciplinary academic field that aims to understand and address environmental challenges. This course provides a holistic understanding of the natural world and the complex interplay between human activities and the environment. By exploring various dimensions of the environment, students will be equipped with the knowledge and skills needed to contribute to sustainable solutions.

The course is structured into seven units, each focusing on a specific aspect of environmental studies. By the end of this course, students will have a comprehensive understanding of environmental studies and the critical issues affecting our planet. They will be equipped with the knowledge to analyze environmental problems, understand the interconnections between human activities and natural systems, and contribute to sustainable solutions. This course will inspire students to become proactive stewards of the environment and advocates for sustainable development.

Course Outcomes: After successful completion of the course, the students will be able to:

- Acquire foundational knowledge of key concepts, principles, and issues in environmental science.
- Understand the interrelationships between human activities, ecosystems, and the broader environment.
- Apply scientific methodologies to analyze and interpret environmental data and phenomena.
- Analyze the impact of human activities on the environment, considering ecological, social, and ethical dimensions.
- Evaluate environmental policies, practices, and solutions, taking into account their effectiveness and sustainability.
- Create a comprehensive research project or proposal addressing a specific environmental issue or challenge.

Acknowledgements:

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Unit - 1

Environmental Studies

Objectives

- To realize that the problems that happen in our ecosystem are global and that they affect everyone and everything.
- Resource management
- To Understand Environmental sciences are an interdisciplinary field of study.

Introduction

Environmental science is, without a doubt, one of the most important fields people need to get acquainted with today. The world is, to put it simply, a mess when it comes to the problems we are witnessing in our environment.

Global warming, air and water pollution, disturbance in nature in forms of tsunamis, and droughts, and threat to the species - all of these problems affecting our lives every year and every day. That is why science-based evidence that documents the changes human actions have on this planet need to be present in the academic world.

Importance of Environment Science

One issue facing today's globe is its intimate ties to politics, or more accurately, its economy, which appears to prioritize production over preservation, at least when it comes to the successful application of environmental research. Diverse resources are necessary for human survival. The way we manage our resources and how many of the ways we employ are damaging the planet are issues that gained prominence in the 20th century and have only become worse in the modern day.

There are various reasons why environmental studies is a crucial area of research. It first aids in our comprehension of the intricate and dynamic interactions that exist between people and their surroundings, as well as the effects that they have on one another. The loss of biodiversity, the deterioration of ecosystems, the contamination of air, water, and soil, the depletion of natural resources, the adaptation and mitigation of climate change, and the shift to a low-carbon and circular economy are just a few of the opportunities and challenges it helps us recognize and

address. Thirdly, it assists us in acquiring and putting into practice the values, knowledge, and abilities necessary to build a more just and sustainable future for all living things, including ourselves.

Sustainability

One of the main ideas and objectives of environmental studies is sustainability. It speaks to the capacity to satisfy current demands without jeopardizing the capacity of future generations to satisfy their own. It means respecting the rights and interests of all parties involved, including non-human animals and ecosystems, and striking a balance between the social, economic, and environmental aspects of human growth.

Sustainability benefits from environmental studies because they offer the theoretical underpinnings and useful instruments for attaining it. Environmental studies, for instance, can assist us in measuring and tracking environmental trends and indicators, such the planetary limits, the ecological footprint, the carbon footprint, and the environmental performance index. It can also assist us in developing and putting into practice sustainable plans and solutions.

Interdisciplinary Approach

First and foremost, environmental science must take an interdisciplinary approach to defining and explaining issues that arise in our surroundings. The scientific disciplines of biology, physics, chemistry, geography, and even the social sciences all take a similar approach but concentrate on different aspects of it.

As previously stated, resource management and pollution are problems that pose a fundamental threat to life, but they are also political issues. This implies that many viewpoints must be considered while addressing an issue that is best defined as "hurting the only home we have." Not about talking about the problem's existence—that tale is long in the past—but about how to handle problems that crop up every day. Maintaining the health of our ecology is a need of today’s time.

As a result, environmental scientists are currently under a great lot of pressure. Not only as elements in the political conversation where a growing number of individuals seek to undermine their scientific legitimacy, but also as fellow humans attempting to bring attention to the concerns of others. The ongoing coronavirus pandemic has highlighted the significance of medical organizations and systems. Not just on the level of doing the ultimate good deed and saving lives if afflicted, but also on the level of teaching and enlightening people about the truth and appropriate behavior in the event of a pandemic.

The same holds true for environmental studies today; despite the fact that the virus is different (mainly due to human activity), the significance of research and proof based on science provided by environmental science remains the same.

Summary:

Understanding and safeguarding the environment require environmental studies. We learn about the environment and its elements, organism behavior, and the relationships among them through environmental studies. Studying the environment also enables us to adopt a sustainable lifestyle, make better use of natural resources, and acquire problem-solving abilities for the environment. Environmental studies encourage sustainability and help us get ready for a variety of environmental challenges.

Unit - 2

Natural Resources

Objectives:

- Examine both non-renewable and renewable resources.
- Explain the resources found in forests.
- Investigate water sources.
- Give an explanation of minerals.
- Talk about food sources.
- Explain the energy sources

Introduction

Uneven consumption is the primary issue pertaining to natural resources. In the "developed" world, a significant portion of natural resources are used. Because of their larger population, the so-called "developing nations" also overuse a variety of resources. On the other hand, most developing countries consume up to 50 times less resources per capita (person) than do industrialized countries. Global industrial waste and greenhouse gas emissions are produced by more than 75% of advanced countries. In developed nations, the amount of energy derived from fossil fuels is significantly higher. In addition to having far higher waste rates, they also consume far more food per person. The USA, for instance, consumes almost 25% of global resources despite having just 4% of the world's population. More land is needed for the production of animal feed for human consumption than for crop growth. Therefore, compared to nations where the majority of the population is vegetarian, those that heavily rely on non-vegetarian diets require far bigger regions for pastureland. You could liken our natural resources to banknotes. We will run out of capital if we use it quickly. However, if we just use the interest, it will be plenty to support us in the long run. We refer to this as sustainable development or usage. Two measures of a sustainable use of resources are the standard of human life and the health of Earth's ecosystems. Indicators of sustainable living are evident throughout human existence. These are: longer life expectancy, greater knowledge, and higher income. The "human development index" refers to these three taken combined. It refers to a natural resource that is

typically kept in reserve, an ecosystem unaffected by human activity, or a source of sustenance. It refers to the supply reserve that organisms can obtain from the natural world in order to survive. the natural reserve stock or supply that humans depend on for survival and well-being. The definition of natural resources is "a variety of goods and services provided by nature which are necessary for our daily lives." Examples include the living (biotic), as well as the non-living (abiotic) parts.

Renewable Resources: Renewable resources are those that are available for use but that, in the event that the natural regeneration cycle is not interrupted, can be replenished by natural processes. For example, wood and water.

Non-Renewable Resources: Those that, if we keep taking them without considering the needs of future generations, will eventually run out. Minerals and fossil fuels are examples. The details of the various resource categories—forest, water, food, energy, and land—are provided here.

- **Forestry resources**

A biotic community dominated by trees, bushes, or any other woody plants, usually in a closed canopy, is referred to as a forest. It comes from the Latin word "foris," which meaning "outside." 2,055% of India's total land, or 6, 76,000 square kilometres, is covered by forests. According to scientific estimates, 33% of India's land should be covered by forests. As of right now, just roughly 12% as a result, we must both preserve our current forest cover and expand it.

- **Forestry Functions:**

i) Protective and restorative roles are played by forests.
ii) Productive roles
iii) Recreational and educational uses
iv) Developmental processes
v) Protective and restorative roles are played by forests.
vi) Safeguarding watersheds
vii) Raising the infighter from rate in order to decrease the rate of water surface runoff. Stopping soil erosion and flash floods resulting in a lengthy, slow runoff that protects against drought.

Control of erosion: retaining soil (by stopping rain from eroding it directly)

Bank of Land: preserving the structure and nutrients of the soil.

Control of the atmosphere: sun heat absorption during evapotranspiration preserving carbon dioxide concentrations for plant development preserving the climate in the area.

Productive roles

Local usage: The use of forest products by those living nearby who gather them for food

Food: (consumptive use) foraging for plants, fishing, and forest hunting.

Cattle feed

For heating and cooking, use charcoal and fuel wood. Poles for constructing dwellings in remote and untamed regions Timber for building and household itemsfiber used in the weaving of nets, strings, ropes, baskets, etc. Silk production by sericulture.

Bee rearing for honey is known as apiculture (using bees as pollinators).

Medicinal plants used in traditional medicine and their potential as a source of novel, contemporary medications Market usage (productive use): The majority of products are utilized for consumption and provide a good source of income for those who live in forests.

NTFPs, or minor forest products: For forest inhabitants, fuel wood, fruits, gum, fiber, etc. are collected and sold in nearby markets as a source of revenue.

Significant wood exploitation for industrial, paper pulp, and building purposes. The Indian Forest Department extracts timber, but in many of the countries and the world's woods, illicit logging persists.

Recreational and educational uses

Developmental processes

The importance of forests ecologically:

- Maintains the atmosphere's CO_2 and O_2 balance,
- Regulates the hydrological cycle and the earth's temperature,

- Promote seepage to lessen runoff losses and avoid drought,
- Lessens soil erosion (root binding), stops reservoir siltation, and stops landslides, which then reduces floods
- Litter contributes to the fertility of the soil.
- A safe haven from wind, sun, and rain for birds, wild animals, and other organisms

Deforestation

Deforestation is the term used to describe the large-scale removal of trees, whether they are in forests, on bare ground, or in the trees we pass on our daily route to school. Natural forests are being destroyed so that the land may be used for farming, constructing homes and industries, logging, creating areas for livestock to graze, mining, extracting oil, building dams, or gathering wood for fuel and furnishings.

From the dawn of civilization, forest wood has been a basic human necessity and is still the primary supply for a wide range of everyday needs. In addition to providing habitat for living things, trees support the water cycle. It occurs in a region where trees are abundant, and it is often seen in a forest like the Amazon jungle. Almost 30% of the globe is covered in forests.

The loss of forest cover has an impact on biodiversity, which puts human lives at risk. Wide-ranging issues include soil erosion, less crops, floods, disturbance of the water cycle, greenhouse gas emissions, changes in climate, and biodiversity loss result from the shrinking of forests.

Causes of Deforestation

The causes of deforestation are:

Logging: The livelihoods of those who depend on forests are destroyed by widespread illegal logging operations. Industries that rely on wood, such as paper, matchsticks, and furniture, require a significant supply of wood. The most frequent fuel utilized is wood, hence a lot of trees are chopped down to provide fuel. Fuels include charcoal and firewood.

Agricultural Activities:

One of the main causes of deforestation cutting of trees for agriculture and livestock grazing because of the increasing need for food goods. In order to acquire land and satisfy the demands of agriculture and timber, more than 40% of the woods are cleared.

Mining:Large tracts of forest land are needed for the extraction of coal and oil. Since roads allow access to isolated areas, their construction causes deforestation. Mining waste contaminates the surrounding ecosystem and has an adverse effect on neighboring animals.

Forest as Habitat

Urbanization: People's needs rise along with the population, which accelerates deforestation. For the purpose of building highways, housing developments, mining operations, and industrial growth, forests are severely reduced in size. Because more space is required for homes and settlements as cities grow, an increasing population has a direct impact on forests.

Timber Production:

The manufacture of lumber is one of the main causes of deforestation. The demand for wood is high, which leads to a rise in deforestation. It serves as a source of raw materials for both building and the manufacture of paper.

Forest Fires: Every year, fires in forests throughout the globe cause us to lose a significant amount of trees. Severe summers and harsh winters are to blame for this. Man-made or natural fires cause a significant loss of forest cover.

Consequences of deforestation

Greenhouse Gas Emissions:

Climate change is caused by gases like carbon dioxide and methane that trap heat in the Earth's atmosphere. Global warming is a result of trees absorbing carbon dioxide and releasing oxygen and water into the atmosphere. Reducing carbon dioxide pollution benefits the ecosystem, but as trees disappear, there is a shortfall in absorption. The removal of forests results in the release of greenhouse gases.

Soil Erosion:

When trees are cut down, forests are cleared, which causes soil erosion. The moisture in the soil evaporates when it is exposed to the heat of the sun. The microorganisms that aid in the breakdown of organic materials are impacted when nutrients evaporate. Rain causes erosion as a result of washing the soil's surfaces. Excessive volumes of dirt damage irrigation infrastructure and hydropower installations by washing into nearby streams and rivers.

Biodiversity Losses:

Due to terrain alteration caused by deforestation, many species and animals become extinct. The entire species may go extinct if there is further deforestation. The "biodiversity loss" is this. There are still many amazing plant and animal species that are in risk of extinction. Since every species in an ecosystem depends on every other species, the extinction of one species can have a profound effect on other species. Because their habitats are being destroyed, we lose between fifty and one hundred kinds of animals every day. Deforestation has put millions of plant and animal species in danger of going extinct.

Floods:

Land erosion is a result of deforestation because trees keep the mountain tops intact. Floods are caused by the abrupt rise in river levels. Trees use their roots to help them absorb and store a lot of water when it rains. When trees are chopped down, the water flow is disturbed, and in certain places, this causes flooding.

Forest conservation

Forest conservation is the preservation and protection of forests. It also comprises the halting of deforestation and the decrease of pollutants in the pollution.

Reforestation

Planting new trees in deforested places to replenish previously damaged forests is known as reforestation. An essential step in the endeavor to protect the environment is reforestation. Large woods are continuously being harmed or destroyed for a number of causes, which makes it significant. Forest fires, human necessities, logging, mining, and agricultural requirements are only a few of the reasons why the earth's surface is losing its green cover on a regular basis. Plans for reforestation often aim to:

- Preserving ecosystems and environment
- Put an end to the loss of broad-based forests, which are essential for producing oxygen, absorbing carbon dioxide, and slowing down climate change.
- Substantial fresh tree planting is required. The enhanced greenhouse effect is the result of less trees. In addition, this issue has gradually led to desertification, or the depletion of rich, productive soil.

- Trees contribute to the recycling of atmospheric air. Whereas plants need carbon dioxide for photosynthesis, humans breathe in oxygen and exhale carbon dioxide. During this process, trees release oxygen into the atmosphere, which is good for non-photosynthetic plants and all complex living forms. Therefore, all of the heterotrophic creatures that comprise the atmospheric ecosystem rely only on autotrophic plants as their supply of oxygen.
- Wood and other plant materials have been used by humans for countless applications for thousands of years. Afforestation and reforestation are results of the dearth of trees.

Reforestation Types

Two categories of reforestation plans exist: Reforestation in urban areas

(i) and rural areas

(ii) Urban Reforestation:

Depending on the demands of the city, urban forestry helps to enhance air quality and change the climate (green spaces are good for combating the heat). While increasing the amount of covered spaces or improving the attractiveness of the surrounding region, urban congestion raises CO_2 levels.

Reforestation in rural area:

Many trees are planted in places that were formerly forests, jungles, or covered in semi-arid vegetation but have since been cleared of trees.

Another possibility is forestation, which involves the planting of trees where none had previously existed.

Depending on the goal, reforestation can take many various forms. Restoring, preserving, and safeguarding fruitful agroforestry systems.

Water Resources

One of the most essential resources for all living things is water. Even though water is a renewable resource, there are still many places in the globe where there is a severe shortage of good water. Water is necessary for us to create food, maintain cleanliness, produce energy, put out fires, and—above all—to survive.

Types of Water Resources

Saltwater Resources:

• Seawater covers the planet's atmosphere. However, saltwater is essentially inefficient when it comes to sources of drinkable water. Even while they do exist, desalination facilities are hard to come by because of their high energy costs.

• In addition to breathtaking views of the ocean, mankind have profited from saltwater possibilities. Indeed, a lot of people's diets all throughout the world include seafood. Tidal waters have also been utilized to produce hydroelectric power.

Groundwater Resources:

Groundwater is arguably the most plentiful freshwater resources.

This water is unsaturated since it is in the vadose zone. Nearly 80% of the pores in the vadose zone are filled with air rather than water.

Groundwater uses the same inputs, outputs, and storage as surface water. The important difference is that, relative to inputs, groundwater storage is usually substantially larger (in volume) than surface water storage because of the slower turnover rate.

Surface Water Resources:

- Surface water is the term for the water found in lakes and rivers. Groundwater natural resources supply more than sixty-three percent of the municipal water supply. Uses for this water include potable water, recreation, industry, agriculture, transportation, cattle, and hydroelectric generation. Five8% of the water used for irrigation comes from surface water. For 58% of its water system, irrigation depends on groundwater.
- The majority of water utilized by industry comes from surface water systems, around 98%. Maintaining and enhancing the quality of surface water is therefore essential. Streamflow and groundwater management are regularly monitored by watershed agencies.
- Despite being named the "water planet" because water makes up 75% of the planet, this water cannot be used for household use. Because it is naturally salty, ocean water is unfit for human consumption. The amount of freshwater on Earth makes up just 2.7% of the total water. Freshwater is no longer suitable for human consumption due to a number of factors, including ongoing water contamination and global warming.

Reasons For Decline Of Ground Water

- Pricing of Agricultural Crops and Water-Intensive Crops: The increasing demand for water extraction connected to agriculture is the main factor contributing to groundwater depletion.
- Groundwater resources are being used more extensively due to a move towards income crops and water-intensive crops.

- Energy Subsidies and Groundwater Extraction: One of the main causes of India's declining water levels is the practice of providing electricity subsidies to farmers.
- The availability of inexpensive or subsidized electricity in 2009 led to the use of almost 89% of extracted groundwater for irrigation.
- Such incentives encourage more groundwater resource extraction, which spreads widely.

Insufficient Groundwater Law Regulation:

- Private groundwater ownership is a widespread problem in both urban and rural areas.
- The problem of groundwater depletion has been made worse by unrestrained and excessive exploitation brought on by a lack of controls.
- Impact of the Green Revolution: In areas where water shortage was already a concern, the Green Revolution enabled the growth of crops that require a lot of water.
- This change in agriculture accelerated the depletion process by increasing groundwater extraction.
- Groundwater Quality: Pollution management and groundwater restoration efforts are still insufficient in the face of growing groundwater source contamination.
- Intervention at the federal or state levels is necessary when pollutants such as arsenic, nitrate, fluoride, and salinity are found in groundwater.
- High Minimum Support Price (MSP): Farmers are encouraged to plant crops that need a lot of irrigation when the MSP for a particular crop is high. Because of the rising demand for water, this adds to the declining conditions of the groundwater.
- Groundwater Depletion and Contamination: These two problems are related to one another.

- Contamination of groundwater occurs when some contaminants surpass the restrictions for drinking water.
- Arsenic, fluoride, nitrate, and iron are examples of frequent contaminants that come from a variety of human activities, including sewage, agriculture, and industry.
- Groundwater Contamination Sources:
- Groundwater contamination is caused by a variety of factors, including pesticide and fertilizer overuse, underground gas tank leaks, septic tank leaks, and landfill pollution.
- About 60% of the nation's districts struggle with the availability and quality of groundwater.

Food Resources

Animals and plants are food sources. Animal-based food is a mainstay in the diets of many civilizations worldwide. It contains a range of fish, meats, and dairy products, all of which are good sources of essential nutrients. Plants are dietary sources that provide vital elements for human nutrition, such as fruits, vegetables, grains, legumes, nuts, seeds, and herbs.

Fruits, vegetables, lean meats, dairy products, nuts, seeds, and whole grains are good dietary sources of vitamins, iron, calcium, zinc, and other nutrients. Plant-based foods are abundant in vitamins, minerals, fiber, and antioxidants—nutrients that are critical to overall health. Consuming a diet high in plant-based foods can reduce the chance of developing chronic illnesses. Furthermore, compared to meals generated from animals, plant-based diets are frequently more ecologically friendly and sustainable. Foods generated from animals encompass a diverse range of dietary items sourced from various animal species. These foods constitute a significant component of a balanced diet and offer an abundance of nutrients, such as protein, fat, and minerals.

World Food Problems:

Population increase: Of the 105 developing nations, 64 have food production that is not keeping up with the rate of population expansion.

Unsustainable farming methods: Degrading woods are caused by unsustainable farming methods including slash and burn, shifting crops, or "rab" (wood ash) agriculture.

Agricultural land degradation: Every year, 5 to 7 million hectares of cropland worldwide are degraded. Two of the main causes of land degradation are misuse of agricultural pesticides and nitrogen loss. One major contributing factor to subpar agricultural results is water shortage. Worldwide, a significant portion of agricultural land has been impacted by salinization and water logging.

Genetic Diversity Loss: Crop genetic variety has been severely reduced as a result of modern agricultural methods. Just the unique traditional rice types found in India are estimated to number between 30,000 and 50,000. Due to the promotion of a few commercial varieties by international seed firms, the majority of these have been lost to farmers during the past few decades. Our food security is put at danger because farmers may lose all of their product as a result of a disease that spreads quickly. A crop that grows in different places and has numerous variations prevents the spread of illness quickly.

Food security: It is the capacity for everyone to always have access to adequate food for a wholesome and active existence. An estimated 18 million people worldwide perish each year from famine or malnutrition, and many more suffer from other nutritional inadequacies. The majority of these deaths are thought to occur in children. There is only so much food that the planet can produce. Conflict and anarchy will ensue if the world's ability to produce food is not sufficient to fulfill the demands of an expanding population.

To guarantee food security, the following three requirements must be met:

There needs to be food available.

Everyone needs to be able to access it.

The food used has to meet nutritional standards.

To Achieve Food Security

Through the family welfare program, population control and food security are tightly related. It has something to do with the water availability for agricultural as well. Food security can only exist when it is divided fairly among all people. Many of us unintentionally throw away a lot of food. Our environmental resources will eventually be under a lot of stress as a result.

Institutional assistance for small farmers: Helping small farmers stay in the agricultural sector instead of moving to cities to work as unskilled industrial workers is a big problem.

Concerns pertaining to trade: Another issue that worries planners who deal with international trade issues is international trade policies about an enhanced flow of food across national boundaries from those who have excess to those who have a deficit in the developing world. The "dumping" of cheap, developed-world agricultural goods onto underdeveloped markets depresses prices and drives farmers in such nations to use unsustainable business methods in order to remain competitive.

Preserving genetic variety: Growing our Protected Areas' network and coverage is the most cost-effective approach to stop the loss of genetic variation. Other potential strategies to stop extinction include the establishment of germplasm collections, seed banks, and tissue culture facilities, however they are very costly. Using qualities from agricultural plants' wild cousins is the most efficient way to introduce desired features into crops. These kinds are quickly going extinct as the wilderness gets less. When they are gone, their excellent qualities cannot be reintroduced when it becomes required later on.

Eco-friendly agricultural practices include using integrated pest management (IPM) and integrated nutrient management (INM) instead of chemical agriculture.

Urban environments may support a variety of crops, such as fruit and vegetables that can be produced using leftover home water and vermi-composting pit fertilizer.

Preventing the deterioration of water and land: Desertification, land degradation, and water source pollution need to be quickly stopped. The key to agricultural output to meet future demands is adopting soil conservation measures, utilizing proper farming practices, especially on hill slopes, improving the soil with organic matter, crop rotation, and micro-level management of watersheds.

Population control: Most significantly, there is a direct correlation between the global efficacy of population control initiatives and the availability of food.

Education: Supporting the food requirements and security of many developing nations requires educating women about nutrition, as they are more directly involved in feeding the family.

evolving eating habits: Dietary patterns are evolving globally these days. Individuals are consuming more non-vegetarian cuisine as living levels rise. The global need for agriculturally based animal feed rises as people switch from consuming grains to meat. The conclusion is that the world's poor do not have enough food because this requires more land and water per unit of food produced. Women are essential to the production of food, both in the kitchen and in feeding

the family. The majority of rural areas lack access to technical training and health professionals who are skilled in nutrition-related teaching and learning.

Land Resources

The earth's land supply is as limited as that of all other natural resources. In order to preserve nature and its resources over the long run, scientists now think that each ecosystem's land and water bodies need to retain at least 10% of them as wilderness. There are several sorts of soil, such as desert soil, laterite soil, black cotton soil, red soil, and so on.

India is the fastest-moving continent in nature, moving 5 cm/yrnortheastward, which causes the Eurasian plate to flex and compress India by 4 mm annually.

Degradation of land refers to a drop in the quality of the land or a decrease in its output or productivity.

Mechanisms that initiate land degradation include

Physical processes include decertification, compaction, erosion, crusting, contamination of the environment, and unsustainable use of natural resources.

Chemical processes include loss of nutrients, acidification, leaching, and a reduction in the ability of calcium to be retained.

Biological processes: Decline in land biodiversity and total and biomass carbon.

Crops cannot grow on salinized soil or water logging caused by heavy irrigation.

The soil is eventually poisoned by the continued application of chemical fertilizers, rendering the area unusable.

Causes for land degradation:

Deforestation: As a result of the rising demand for fuel, timber, and other forest products, deforestation is happening more quickly, which is causing land resources to deteriorate.

Overgrazing: occurs when cattle consume an excessive amount of grass and other green vegetation. Reduced vegetation growth, a decrease in plant species variety, an increase in the establishment of undesirable plant species, soil erosion, and land degradation are all brought on by cattle movement.

Agricultural Practices: The natural fertility and quality of the agricultural land have been degraded by the overuse of pesticides and fertilizers in contemporary agriculture.

Industrialization: The expansion of industries for the nation's economic growth causes excessive land consumption and deforestation, resulting in the loss of the land's natural upgrading quality.
Urbanization: The need for more residential and commercial space due to population increase is one of the factors contributing to land degradation.

Land use planning:

The requirement needed to accomplish a sort of land use that is economically viable, socially and ecologically acceptable, sustainable, and attractive is created by land use planning. Implementation methods and global models are used mechanically and without critical thought, which is why planning techniques frequently fail. The process of land use planning is not one that is universally applied and standardized. An original regional or local scenario study served as the foundation for its content. Planning for land use should take these guidelines into account.
It should consider local environmental knowledge and conventional practices.
Two fundamental ideas of land use planning are the gender approach and the differentiation of state holders.
Because of the land use's ecological, economical, technological, financial, social, and cultural dimensions, an interdisciplinary approach must be used.
It should seek to address current issues (such as poor yield, soil erosion, and low income in rural households) while preparing for long-term preservation and sustainable land resource use.
Desertification: In arid, semiarid, and dry subhumid regions of the world, it is land degradation. It's a process wherein climate change or poor land management causes productive areas to turn desert. The planet is home to several man-made deserts.
The needs of growing people that live on the land to cultivate food and graze animals typically result in desertification, which is happening much more quickly now than it did in the past. Over 1 billion people rely on these areas for existence, and 40 percent of the earth's surface is made up of these vulnerable dry regions.
According to UN EP estimates, some 800 million people are at risk of desertification and that almost 80% of the arable land in the world's dry and semi-arid regions is turning into deserts. In the last 50 years, around 2 billion acres of land have been turned into deserts worldwide. Approximately 15 million acres of desertification occur annually, with sub-Saharan Africa seeing the highest rate. The RajasthaniThar desert spans an area of around 12,000 hectares.

Causes of desertification:

1) Overgrazing: Livestock compaction increases the amount of fine debris in the soil, decreases the pace at which the soil percolates, and compacts the substrate with their hooves, all of which promote erosion by wind and water. Plants that aid in binding the soil are diminished or eliminated by grazing and timber harvesting.

2) Growing population: The strain of livestock on marginal soils quickens the process of desertification.

3) Deforestation practices: When there are no longer any plants to bind the soil, there is surface runoff, which causes nutrient depletion and soil erosion.

4) A rise in food production on marginal lands in semi-arid or dry regions.

5) Watering initiatives in regions lacking a drainage infrastructure.

Effects: Loss of productivity, such as the shift from grasslands dominated by perennial grasses to ones dominated by perennial shrubs, and loss of biodiversity are two of the main effects of desertification. The ability of a place to support life is eliminated when severe circumstances are fulfilled.

How to control of desertification

1. Soil erosion, flooding, and water logging can be prevented by planting soil-binding grasses and reforesting areas.

2. Mixed cropping and crop rotation increase the soil's fertility. Production would rise, supporting a sizable population.

3. Artificial bunds or mechanical measures that cover the region with the right kind of vegetation might be used to check for desertification.

4. Sand shifting can be managed by mulching (applying a man-made covering).

5. Better drainage allows one to examine the soil's salinity. More water can be added to the leaching process to restore saline soil, especially in areas with low groundwater tables.

Preservation of natural resources

Until recently, humans believed that they could continue to exploit the ecosystems and natural resources found on Earth's surface, such as soil, water, forests, and grasslands, as well as mine the subsurface for minerals and fossil fuels. However, over the past several decades, it has

become more and more clear that the world environment can support only a certain amount of use. When biological systems are abused or overworked, their capacity to replace resources is compromised. Pressure builds to a point where it upsets their equilibrium. Even biological resources that have historically been categorized as "renewable," like those found in our wetlands, meadows, seas, and forests, are being irreversibly lost due to abuse.

No natural resource is infinite, either. If we keep using "non-renewable" resources as heavily as we do now, they will quickly run out.

The two most detrimental elements contributing to the current, rapid depletion of all natural resources are "rapid population growth" and rising "consumerism" among the wealthier segments of society. Both elements are the outcome of the decisions each of us makes.

Energy conservation

- As soon as you exit a room, turn off the fans and lights.
- Instead of using bulbs, use energy-saving tube lights and bulbs. The light output of a 40-watt tube light is equivalent to a 100-watt bulb.
- Maintain the tubes and bulbs clean. Dust on tubes and lightbulbs reduces illumination by 20 to 30 percentage.
- As soon as the interesting show ends, turn off the radio or television.
- Cooking energy may be reduced by up to 75% with a pressure cooker. It is also quicker.
- During cooking, keeping the pot covered with a lid promotes speedier cooking and lowers energy use.

Water conservation:

- When brushing your teeth or taking a bath, keep the taps closed.
- In agricultural regions, use drip and sprinkler irrigation.
- Incorporate rainwater gathering techniques.
- Reuse bath and kitchen waste water for gardening

Soil conservation:

- Use contour farming, agroforestry, and strip cropping;
- Avoid cutting trees and causing soil erosion;

- Use no-till farming to cause the least amount of soil disturbance.
- Use organic fertilizers and vermicompost; •
- Steer clear of overusing insecticides and fertilizers; • Adopt integrated pest control techniques.

Summary

An organism's environment is everything that surrounds it and has an impact on its life in many ways. Both biological and physical elements are present. The environment's physical elements include the soil, water, air, light, and temperature. We refer to these as biotic constituents. Since gasoline is a non-renewable resource, it will eventually run out. There won't be any fuel left at some point. Natural resources, including coal, oil, and natural gas, are limited because they take millions of years to develop and cannot be replenished after they are used up. Resources found in forests are crucial to the growth of governments, regions, and countries. Variations in growth, harvest, and land use conversions of these resources make them susceptible to change.

Keywords

Environment: The term "environment" refers to everything that surrounding an organism and has an impact on its life in many ways. It consists of both biological and physical elements.

Mineral Resources: Iron, copper, cobalt, zinc, fluorine, and selenium are among the minor minerals found in mammals. Plants have two types of minerals: macronutrients and micronutrients.

Non-Renewable Resources: Because they originated from plant photosynthetic activity millions of years ago, non-renewable resources have a high carbon content.

Physical Components: The physical components of the environment are soil, water, air, light and temperature.

Renewable Resources: Renewable resources are those resources that can be replaced as they are used up.

MCQs

1..... of stratosphere provides protection to our life.

(a) Nitrogen. (b) Hydrogen. (c) Ozone. (d) Argon.

2. Which of the following soil is the best for plant growth?

(a) Sandy soil. (b) Clay. (c) Gravel. (d) Loamy soil.

3. Both power and manure are provided by.....

(a) Thermal plants. (b) Nuclear plants. (c) Biogas plants. (d) Hydroelectric plants.

4. Atomic energy is obtained by using ores of.....

(a) Copper. (b) Uranium. (c) Neither (a) nor (b). (d) Both (a) and (b).

5. Which one of the following is not a fossil fuel?

(a) Natural gas. (b) Petrol. (c) Coal .

Answers :

1. (c) 2.(d) 3.(c) 4.(b) 5.(d)

Important Questions

1. Role of an individual in conservation of natural resources. Discuss.
2. Explain the equitable use of resources for sustainable lifestyles.
3. What do you understand about the renewable resources?
4. Explain the non-renewable resources?
5. Discuss the importance of forest resources in India.
6. What are the uses of forest resources in India?
7. Give a detailed overview of the water resources?
8. Explain about the mineral resources in India.

Unit - 3

Ecosystem

Objectives:

- Explain the concept of an ecosystem.
- Define energy flow in the ecosystem.
- Understand the structure and function of an ecosystem.
- Describe the food chains, food webs and ecological pyramids.
- Know about the producers, consumers and decomposers.

Fundamental of Ecology and Ecosystem

The study of interactions between organisms and their biophysical environment—which consists of both biotic and abiotic elements—is known as ecology (from Greek: o□κος, "house", or "environment"; -λογία, "study of"). Interest-worthy subjects include species coexistence and competition both within and across species, as well as biodiversity, biomass, and population sizes of organisms.

Ecosystems are dynamically interacting networks of living things, the communities they inhabit, and the inanimate objects that make up their surroundings. Primary production, pedogenesis, nutrient cycling, and niche building are examples of ecosystem processes that control the movement of matter and energy through an ecosystem. Organisms possessing distinct life histories are responsible for maintaining these processes.

Ecology is not the same as natural history, environmentalism, or environmental science. It shares similarities with the closely related fields of genetics, ethology, and evolutionary biology. Increasing our understanding of how biodiversity influences ecological function is a key goal for ecologists. Ecologists try to explain:

• The interactions, processes, and adaptations of life

• The flow of resources and energy inside inhabited areas

• The distribution and quantity of species, as well as biodiversity, within the framework of the environment; the successional evolution of ecosystems.

Ecosystems consist of creatures and resources that support biophysical feedback mechanisms that regulate processes impacting the planet's biotic (living) and abiotic (non-living) components. Ecosystems that produce biomass—food, fuel, fiber, and medicine—maintain their life-sustaining processes in addition to producing natural capital, which includes water filtration, soil formation, erosion control, flood protection, and many other naturally occurring features with historical, scientific, or commercial value.

Ernst Haeckel, a German scientist, first used the word "ecology" ("Ökologie") in 1866. Political and ethical philosophy are the main sources of influence for ecological thinking. Through their research on natural history, ancient Greek thinkers like Hippocrates and Aristotle established the groundwork for ecology. In the latter part of the 1800s, modern ecology developed into a far more rigorous discipline. Natural selection and adaptation-related evolutionary ideas served as the foundation for contemporary ecological theory.

Components of Ecosystem

An Ecosystem includes all of the living things (plants, animals and organisms) in a given area, interacting with each other, and also with their non-living environments (Weather, Earth, Sun, Soil, Climate, Atmosphere).

The primary focus of ecosystem science is the examination of specific mechanisms that connect the biotic—or living—and abiotic—or non-living—components of an ecosystem. Biogeochemical cycles and energy transformations are the primary processes that make up ecosystem ecology.

Structure of the Ecosystem:

Structural Aspects

Components that make up the structural aspects of an ecosystem include:
1) Inorganic aspects – C, N, CO_2, H_2O.
2) Organic compounds – Protein, Carbohydrates, and Lipids – link Abiotic to biotic aspects.
3) Climatic regimes – Temperature, Moisture, Light & Topography.
4) Producers – Plants.
5) Macro consumers – Phagotrophs – Large animals.
6) Micro consumers – Saprotrophs, absorbers – Fungi.

Types of Ecosystems

Terrestrial Ecosystems	Aquatic Ecosystems
Forest	Pond
Grassland	Lake
Semi arid areas	Wetland
Deserts	River
Mountains	Delta
Islands	Marine

Abiotic Components

These comprise the inanimate or physico-chemical components of the environment, such as the air, soil, and water, as well as the fundamental substances. Abiotic influences can be roughly categorized into three groups: Climate variables, which comprise the physical aspects of the surroundings including light, humidity, wind, and air temperature; Edaphic variables include things like soil type, soil profile, organic matter, minerals, soil water, and soil organisms. They also have to do with the structure and composition of the soil, including its chemical and physical qualities. substances that are not organic, such as water, carbon, sulfur, nitrogen, phosphorus, and so on. organic materials such as lipids, proteins, carbohydrates, and humic compounds, among others.

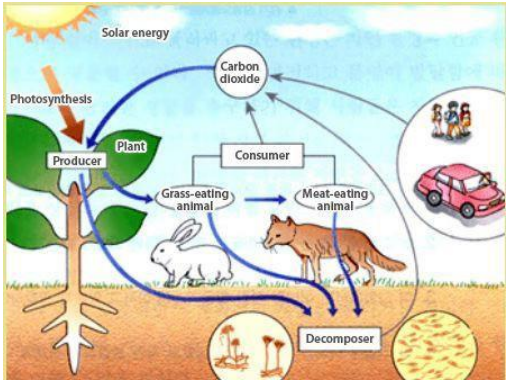
Biotic Components

It is made up of all the elements that make up the living world, such as the numerous interconnected populations of various species coexisting in the same area. The animal, plant, and microbial populations are the ones that comprise the populations. The three groups that make up the biotic community are autotrophs, saprotrophs, and heterotrophs. In Greek, autotrophs (auto = self, trophos = feeder) are sometimes referred to as producers, transducers, or convertors. These are photosynthetic plants, often chlorophyll-bearing ones, that use the sun's assistance to create a high-energy complex organic molecule, or food, from inorganic basic materials. This process is known as photosynthesis. The foundation of every biotic system is the autortoph.

Autotrophs in terrestrial environments are often rooted plants. The primary producers in aquatic environments are the shallow-rooted, floating plants known as macrophytes and the floating plants known as phytoplankton.

The consumers, or heterotrophs (Greek: heteros, other; trophs, feeder), are often creatures that devour other species. The term "phagotroph" also refers to consumers (phago = to swallow or eat), whereas herbivores and carnivores are often macro consumers. Since herbivores consume only green plants, they are sometimes referred to as first order or main consumers. Cattle, deer, grasshoppers, rabbits, and other animals are examples of consumers in the terrestrial environment. Protozoans, crabs, etc. are consumers in the aquatic environment.
Animals that hunt or consume other animals are known as carnivores. Animals that devour herbivorous species are classified as primary carnivores or second order consumers. For instance, foxes, frogs, tiny fish, raptors, snakes, etc.

Animals that consume primary carnivores are known as third order consumers or secondary carnivores. Like wolves, owls, peacocks, etc. Prey for certain bigger predators is secondary carnivores. Animals that consume secondary carnivores are referred to as quaternary consumers or tertiary carnivores. Take the tiger, lion, etc. as examples. There are no other animals that consume them. The term "top carnivores" also refers to bigger carnivores that are incapable of being further preyed upon.



Saprotrophs are also known as reducers or decomposers (from the Greek sapros, which means rotting, and trophos, which means feeder). They disintegrate the intricate organic components

found in dead stuff, such as animals and plants. They do not consume the food, decomposers. Rather, they break down the organic material by secreting a digestive enzyme into the rotting remnants of deceased plants or animals. The complex organic chemicals in the dead matter are broken down by the enzymes. To sustain themselves, decomposers take in some of the byproducts of decomposition. During the mineralization process, the residual material is added to the substratum as minerals. Plants, who are the producers, employ the released minerals as nutrients again or as needed.

Food-chain, food-web, trophic levels, energy flow, cycling of nutrients,

An ecosystem's functional characteristics enable the interdependence of its constituent elements. The natural events or energy exchanges that occur in living organism across the globe's many biomes are known as ecosystem functions. For instance, green leaves produce food that is subsequently ingested by herbivores and carnivores, while roots collect nutrients from the ground. Decomposers perform the operations that reduce complicated organic components into simply comprehended inorganic products that manufacturers can employ.

The flow of nutrients and energy within the food chain is the essence of ecosystem activities. These exchanges sustain the planet's plant and animal life as well as the decomposition of organic materials and the production of biomass. The ecosystem's many functions are all made possible by well-regulated and balanced processes.

Food chain

A food chain is the arrangement of living things in a community wherein one creature feeds on the others and is fed by them in return to exchange energy. Another definition of a food chain is "a chain of organisms that exists in any natural community and transfers energy through them."

All living things, regardless of their size or environment, require food in order to thrive, from microscopic algae to enormous blue whales. In many ecosystems, the structure of the food chain varies depending on the species. Every food chain serves as an essential conduit for nutrients and energy within the environment.

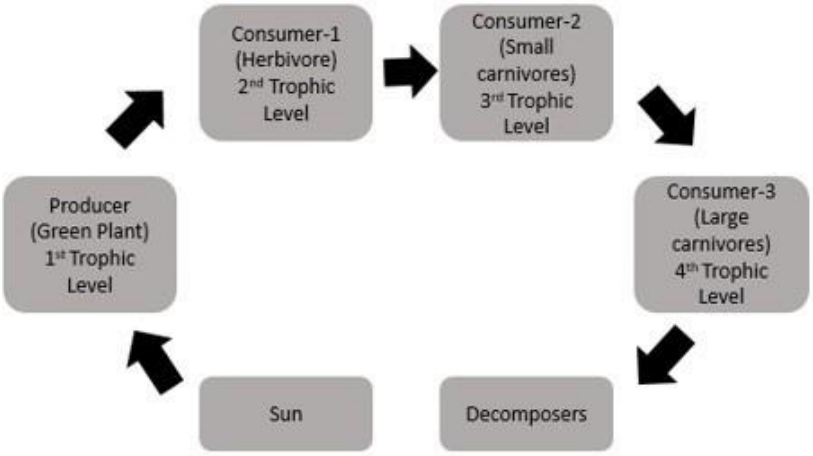


Figure 1: Food chain

The African-Arab scholar and philosopher Al-Jahiz originally described food chains in the ninth century. Charles Elton popularized the concept in a book he wrote in 1927.

A producer, like plants, is the first link in a food chain. The foundation of the food chains is the producer. Next, there are several order consumers. species that consume other species are called consumers. With the exception of the initial organism, every creature in a food chain is a consumer.

Because they employ photosynthesis to create their own food, plants are known as producers while consumers depends on plants or other animals for food. Every creature receives energy from the ones at the levels below it in a particular food chain. There is consistent energy transmission at every link in a food chain. The body does not absorb all of the energy at a given level of the cycle in the following stage.

Trophic Levels in a Food Chain

The various groupings of organisms in a food chain are referred to as trophic levels. They are listed below.

Producers (First Trophic Level) − Also referred to as autotrophs, synthesize their own food via photosynthesis. In every food chain, they make up the base. Autotrophs include plants, single-celled animals, certain kinds of bacteria, algae, etc.

Consumers (second trophic level) depends upon others for food.

Primary Consumers (Second Trophic Level) − eat the producers. They are called herbivores. Deer, turtle, and many types of birds are herbivores.

Secondary Consumers (Third Trophic Level) − eat herbivores. They can be carnivores (meat eaters) and omnivores (animals that eat both animals and plants).

Tertiary Consumers (Fourth Trophic Level)− eat other carnivores.

Decomposers − Decomposers, who are sometimes absent from the visual depiction of the food chain, are crucial to its completion. These creatures decompose garbage and dead organic matter. The primary decomposers in many ecosystems are bacteria and fungi, which derive their metabolic energy from the chemical energy found in waste products and dead matter.

Knowing the food chain facilitates our understanding of the interactions and feeding relationships that exist between an organism and its environment. It also makes it possible for us to understand how energy moves across an ecosystem.

Food Web

The term "web" refers to a network. "A network of interrelated food chains so as to form multiple feeding relationships among different organism of a biotic community" is the definition of a food web.

In an ecosystem, a food chain cannot exist in isolation. There might be many chains that include the same food source. At the lower tropic level, the resource is capable of doing this.

Every food chain within an ecosystem is referred to as a food web. Understanding that every organism in an ecosystem is a link in a network of food chains is crucial

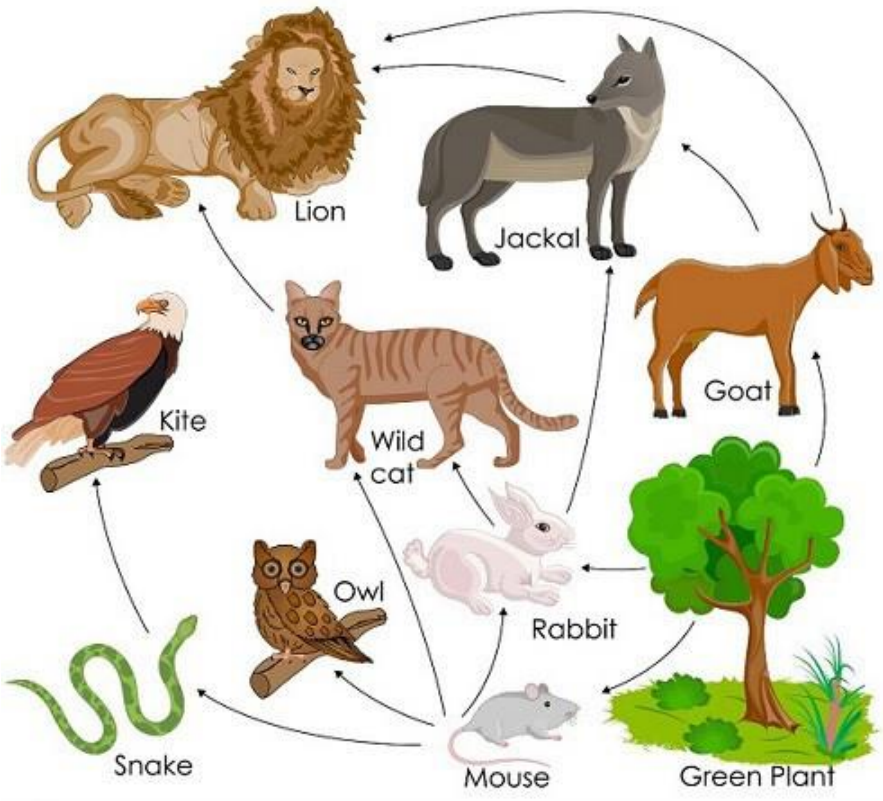


Figure 2: Food web

Food Web

The only viable route for energy and nutrients to travel through the ecosystem is via a single food chain. A food web is made up of all the linked and overlapping food systems within an ecosystem.

Food webs are important resources for comprehending how plants support all ecosystems and food chains by giving the necessary nutrients and oxygen for life to exist and reproduce. The ecology is stabilized by the food web.

Quaternary consumers devour the tertiary consumers. Consider a hawk that preys on owls. Every food chain has an apex predator and an animal without natural enemies at the bottom (such as an alligator, hawk, or polar bear).

Ecological Pyramid

It is a graphical (pyramidal) representation of the number of organisms, biomass, and productivity at each trophic level. It is also known as Energy Pyramid. They are as follows −

Pyramid of Biomass

This displays the quantity of live biomass at each trophic level that is present per unit area. The top predators are at the tip, while the producers are at the base of the drawing.

Typically, to determine the biomass pyramid, all organisms belonging to each trophic level are gathered independently and their dry weight is measured. Standing crop, defined as the mass of living creatures (biomass) or the number in a unit area, is the specific mass of living material at a given moment in each trophic level.

Upright Pyramid of Biomass

The majority of terrestrial ecosystems are composed of erect biomass pyramids with a sizable base of primary producers and a smaller trophic level positioned on top.

Producers or autotrophs have the highest biomass. The principal consumers at the next trophic level have a lower biomass than the producers. Comparatively speaking, secondary and tertiary customers make up a smaller portion of the market than its lowest level. There is remarkably little biomass at the apex of the pyramid.

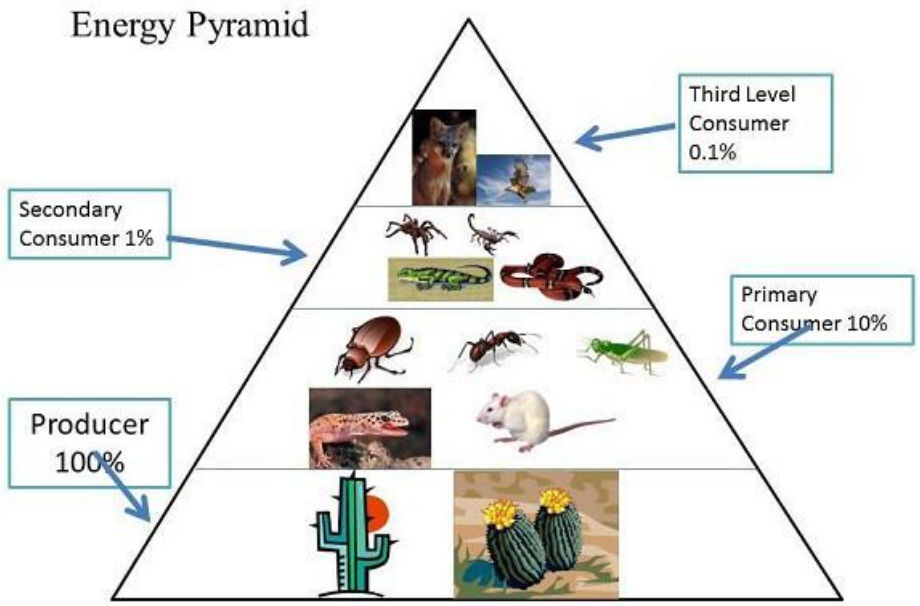


Figure 3:Upright pyramid of biomass

Inverted Pyramid of Biomass

However, the majority of aquatic ecosystems have a reverse pyramidal shape. In this case, the biomass pyramid can take on an inverse shape. On the other hand, the aquatic ecosystem's numerical pyramid is erect.

The producers in a body of water are microscopic phytoplankton, which multiply and expand quickly. Under these circumstances, the base of the biomass pyramid is modest, with the producer biomass supporting the heavier consumer biomass. It takes on an inverse form as a result.

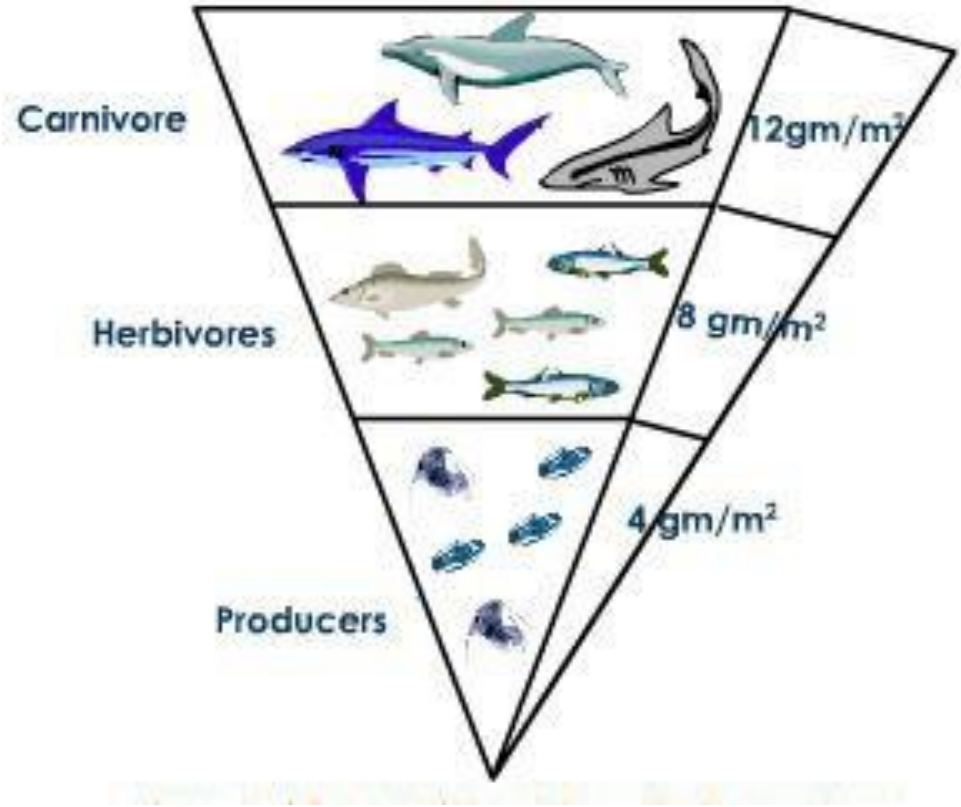


Figure 4: Inverted pyramid of biomass

Pyramid of Numbers

It is a graphical representation of the number of people in each trophic level per unit area. A greater number of producers often make up the base, whereas fewer top predators or carnivores tend to occupy the tip. The numerical pyramid's form differs depending on the ecology.

For instance, there are many autotrophs or producers per unit area in grassland or aquatic environments. Less herbivores are supported by the producers, and fewer carnivores are supported as a result.

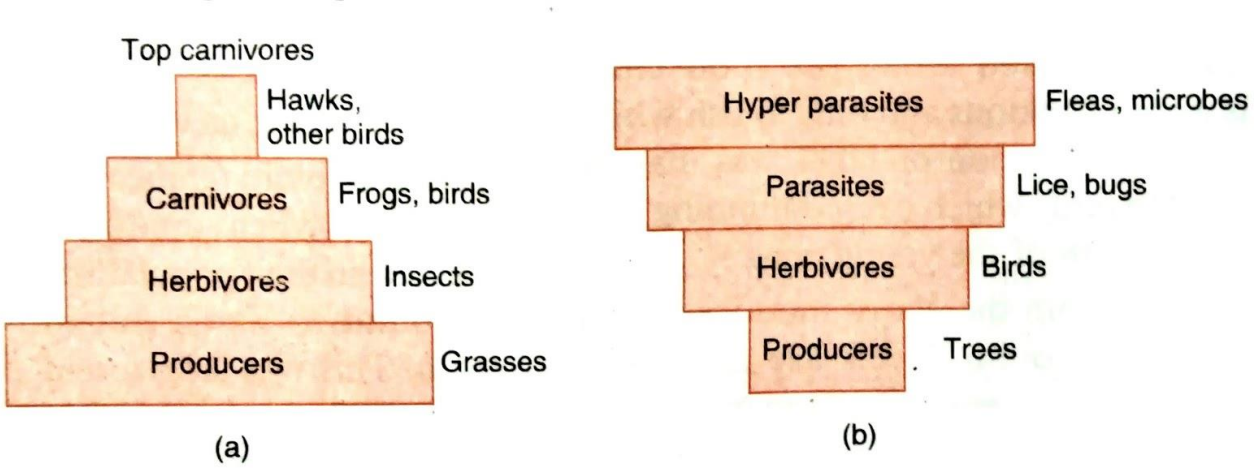


Figure 5: pyramid of number a) Upright b) Inverted

Upright Pyramid of Numbers

The number of people falls from the lower level to the upper level in an upright pyramid of numbers. The environments of ponds and grasslands are often home to this kind of pyramid. Because of its abundance, grass in a grassland environment is at the lowest trophic level, followed by herbivores (such as grasshoppers). The number of grasshoppers is quite less than that of grass. Then there are the main carnivores, such rats, which are far less common than grasshoppers. The secondary consumers, such snakes that eat rats, make up the next trophic level. Subsequently, there are apex predators like hawks, who consume snakes and have a smaller population than snakes.

Inverted Pyramid of Numbers

From the lower to the higher trophic levels, there are more individuals in this area. The environment of trees, for instance.

Pyramid of Energy

It is a diagram that shows how energy moves through the trophic levels of a food chain in a specific area of the natural world. Each trophic level's energy content is represented as an energy pyramid, with energy loss at each level moving to a higher trophic level.

The energy pyramid, also known as the trophic or ecological pyramid, is a helpful tool for calculating the amount of energy that moves up the food chain from one creature to another.

Moving up the trophic pyramid from the base to the top results in a reduction in energy. The energy pyramid is therefore continuously pointing upward.

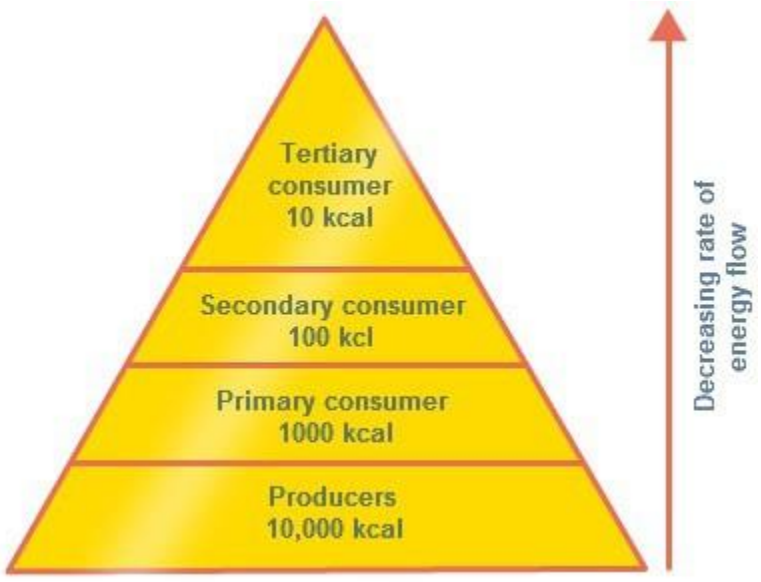


Figure 6: Upright pyramid of energy

Summary

A range of biotic and abiotic elements that work in concert with one another make up ecosystems. A few of the most crucial elements include soil, atmosphere, solar radiation, water, and living things. Both live things, or biotic factors, and non-living things, or abiotic factors, are present in an ecosystem. The environment's physical and chemical features are the non-living elements, also referred to as biotic factors. Energy may be shown moving sequentially from one tropic level to another within an ecosystem. Such a food chain places an immediate demand on ecosystems for solar radiation. The study of the food chain aids in our comprehension of the interactions and eating patterns amongst creatures within an ecosystem.

Keywords

Detritivores: These are scavengers which feed on dead plants and animals or their waste.

Ecosystem: It is a community of living and non-living elements with their surroundings.

Microorganisms: Found all throughout the planet, microorganisms are little single-celled creatures that include bacteria, fungus, and viruses.

Reproduction: A basic characteristic of all known life is reproduction, which is the reason behind the existence of each individual organism.

Saprotrophs: A saprophyte or saprotroph is an organism which gets its energy from non-living organic matter.

MCQs

1. Which one is the important biotic factors in ecosystems:

    I. Temperature.

    II. Water.

    Wind.(a) I only. (b) II only. (c) III only. (d) I, II, and III.

All of the following statements about ecology are correct except:(a) The study of ecology examines how biotic and abiotic elements of the ecosystem interact.(b) The study of ecology is distinct from the study of natural selection and the history of evolution.(c) Ecologists may research organismal populations and communities.(b) Ecology encompasses a progressively wider range of organizational levels, from people to ecosystems.

Choose the correct sequence of arrangement from most to least inclusive:(a) Ecosystem, community, population, individual.(b) Community, ecosystem, individual, population.(c) Individual, population, community, ecosystem.(d) Population, ecosystem, individual, community.

Choose the correct biotic factors that can affect the structure and organization of biological communities:(a) Nutrient availability, soil pH, light intensity.(b) Precipitation, wind, temperature.(c) Predation, competition, disease.(d) None of these.

Landscape ecology is best described as the study of:(a) The array of interacting species within a community.(b) A biotic factor and the community of species that exist in a particular area.(c) The factors affecting the abundance of single species.(d) Related arrays of ecosystems.

Answers:

1. (d) 2. (b) 3. (a) 4. (c) 5. (d)

Important Questions

1. Explain the concept of an ecosystem.
2. Discuss the energy flow in the ecosystem.
3. Explain about structure and function of an ecosystem.
4. What are the functions of management?
5. Explain about food chains, and food webs.
6. What are ecological pyramids?
6. Discuss about the producers, consumers and decomposers.
7. What are difference between consumers and decomposers?
8. Define the ecological succession.

Unit - 4

Classification of Ecosystem

Objectives:

- Identify the ecosystem.
- Define structure and function of forest ecosystem.
- Understand about structure and function of grassland ecosystem.
- Describe the desert ecosystem.
- Discuss about the aquatic ecosystems.

Major Ecosystem types:

Ecosystems can be divided into two categories: terrestrial and aquatic. Both of these categories include all other sub-ecosystems.

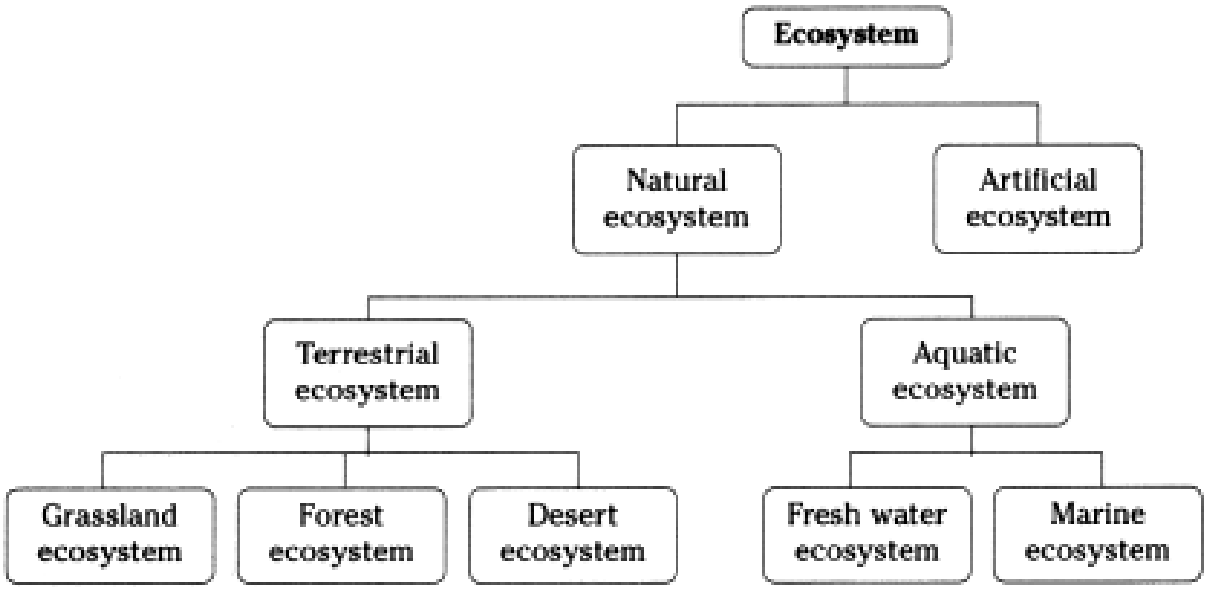
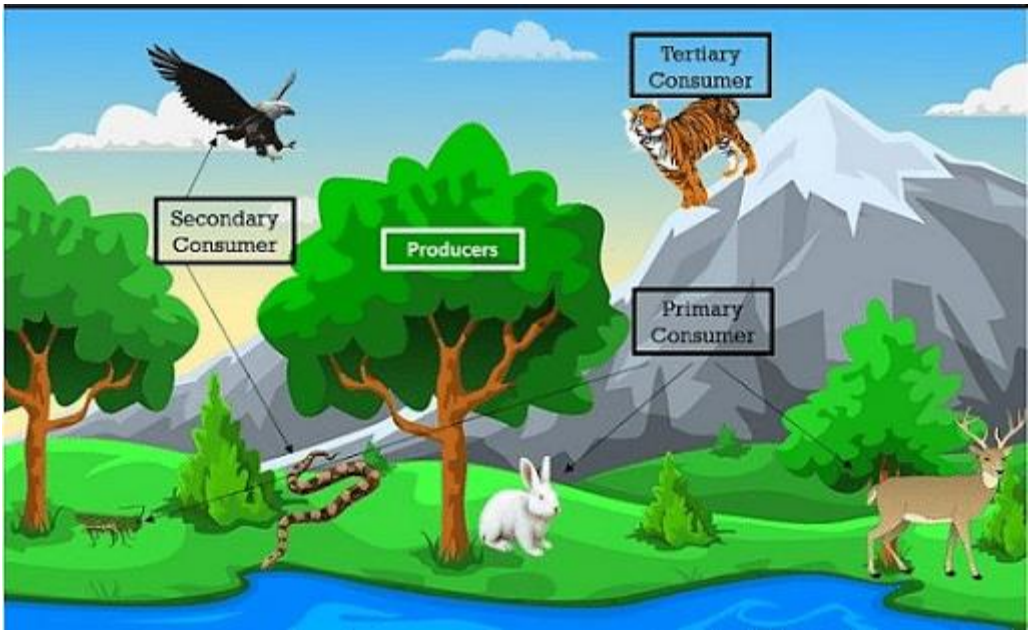


Figure: 1 Classification of Ecosystem

Terrestrial ecosystem



Except for highly populated areas, terrestrial ecosystems can be found anywhere. Consequently, there are a lot of living things in forest ecosystems at a high density. Terrestrial ecology refers to an ecosystem that is found on land. One category of ecosystems is aquatic, which are further divided into four categories after they form outside of bodies of water.

a. Forest ecosystem

It consists of every wild animal, bird, and bug that inhabits woods, as well as trees and various types of grass that grow there. To survive in this ecosystem, all of the biotic and abiotic elements work in concert with one another.

Rainfall in tropical evergreen woods averages 80 inches per 400 inches of yearly precipitation. Dense vegetation made up of tall trees at various heights is what gives the woodlands their distinctive appearance. Animals of many kinds find refuge on each floor.

Tropical deciduous forest: A wide variety of trees coexist with dense bushes and shrubs as the predominant vegetation. This kind of forest is widespread around the world and is home to a wide range of animals and plants.

Temperate evergreen forests: They have a large number of trees because ferns and mosses make up for their lack of trees. Spikes on leaves are a result of trees trying to reduce transpiration.

Temperate deciduous forest: The forest is found in damp, temperate regions with enough rainfall. There is a distinct difference between summer and winter, and in the winter, trees lose their leaves.

Taiga: The taiga, which lies just before the arctic areas, is characterized by evergreen conifers. The remaining months are humming with migratory birds and insects because the temperature stays below zero for nearly six months.

b. Grassland ecosystem

Grasslands can be found worldwide in both tropical and temperate locations, though their ecosystems differ somewhat. The grasses and herbs are essential to the grassland ecology. Savanna habitats, as well as tropical and temperate regions, are examples of grassland ecosystems. The primary vegetation consists of plants, legumes, and grasses in the composite family. The grasslands are home to several herbivores, insectivores, and grazing animals. The two main kinds of grasslands ecosystems are:

Savanna: The tropical grasslands feature few individual trees and are arid during certain seasons. They provide food for numerous grazers and predators.

Prairies: It's a temperate grassland with no big trees or plants in sight. There are three types of prairies: mixed grass, tall grass, and short grass.

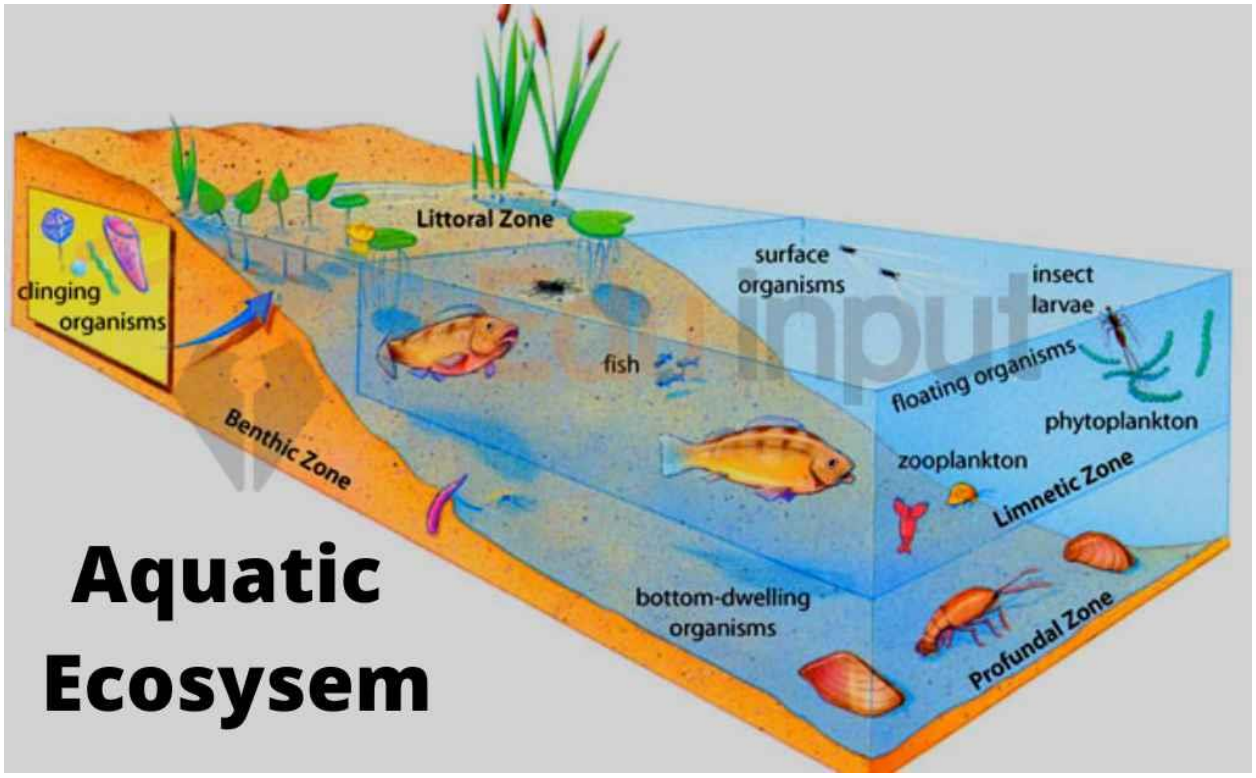
c. Desert ecosystem

Deserts cover an area that receives less than 25 inches of rainfall. Approximately 17% of the planet's land area is occupied by them. Fauna and vegetation are rare and poorly developed because to the great heat, scarcity of water, and strong sunshine. Most of the vegetation is made up of bushes, bushes, a few unusual trees, and grasses. To save as much water as possible, the plants have altered their stems and leaves. Succulents like spiky-leaved cacti are the most well-known types of desert plants. In such an environment, there is not much vegetation. Desert animals include foxes, camels, and kangaroos, among others.

d. Tundra ecosystem

Trees can be found in colder regions, in an ecosystem called the tundra. Snow covers this area of the ecosystem for the majority of the year. Mountain tops and polar regions are home to this ecology.

Aquatic Ecosystems



An aquatic body of water contains an ecology known as the aquatic ecosystem. It also includes water qualities, aquatic plants, and wildlife. Aquatic ecosystems are primarily classified as freshwater or marine.

1. Biotic or Living Components

Microorganisms, plants, and animals are examples of biotic components in ecosystems. The Producers or Autotrophs, Consumers or Heterotrophs and Decomposers or Detritus are ecosystem's biotic components.

2. Abiotic or Non-living Components

The term "abiotic components" refers to the climate or the elements that influence it, including temperature, light, humidity, precipitation, gases, wind, water, soil, salinity, topography, minerals, and habitat. For every ecosystem on Earth to function, energy flow and the cycling of nutrients and water are essential. The foundation for ecosystem function is provided by non-living elements.

3. Aquatic Ecosystem

The term "aquatic ecosystem" refers to an ecosystem found in water. The aquatic environment in which they live and depend determines the nature and characteristics of the communities of living, or biotic, organisms and non-living, or a biotic, components that interact and involve one another. Marine ecosystems and freshwater ecosystems are the two basic categories into which aquatic ecosystems fall.

i. Marine Ecosystem

These ecosystems, which make up about 71% of the planet's surface and hold 97% of its water, are the largest ecosystems on Earth. The deep water, the sea bottom, mangroves, coral reefs, estuaries, lagoons, and salt marshes are all found there.

The marine environment supports a huge kingdom of species and has a distinctive flora and fauna. Both the terrestrial and marine habitats depend on these ecosystems for their general health. Mangrove forests, seagrass wetlands, and salt marshes are some of the most productive ecosystems. The world's coral reefs support the greatest diversity of marine life by offering food and shelter. The biodiversity of the marine environment is high.

ii. Freshwater Ecosystem

The freshwater ecosystem is made up of ponds, rivers, streams, and lakes. Large freshwater bodies encircled by land are called lakes.
The freshwater ecosystem depends on plants and algae for food and oxygen production through photosynthesis, which they accomplish. Estuaries are home to a special kind of plant life that has

evolved to withstand both freshwater and saltwater conditions. Two types of estuarine plants are pickle weed and mangroves. Freshwater ecosystems support a wide variety of animals. For human use as a source of drinking water, energy, transportation, recreation, and other necessities, freshwater ecosystems are vital. 0.009% of Earth's total water content and 0.8% of its surface are made up of freshwater ecosystems, in contrast to marine habitats.

Freshwater habitats can be divided into three fundamental types:
Lentic: Tilled or slowly moving water in lakes, ponds, or pools.
Lotic: Water that moves quickly, as rivers and streams.
Wetlands are areas where the soil is flooded or wet for an extended length of time.

Around 41% of the world's fish species live in these settings, along with amphibians and reptiles. In comparison to slow-moving pools, faster-moving turbulent waters usually have higher quantities of dissolved oxygen, which supports a higher level of biodiversity.

Summary

An ecosystem is a group of living things that work together and with inanimate objects to develop sustainably and adapt to changing environmental conditions. Therefore, because they provide the foundational meals for other organisms in food chains and food webs, plants are referred to as the primary producers.

When there is more rain than is necessary for deserts but insufficient for forests, grasslands grow. Although the desert sand was once rock, it has become dunes over time as a result of wind and water erosion. An aquatic ecosystem is a community of living things that live in close proximity to one another and rely on the water environment for shelter and nutrients like phosphorus and nitrogen.

Keywords

Biodiversity: The variety and distinctions among living things from all sources, such as terrestrial, marine, and other aquatic environments as well as the ecological complexes in which they are embedded, is known as biodiversity.

Estuaries: A partially contained body of water along the coast where freshwater from streams and rivers combines with ocean saltwater is known as an estuary.

Landscape: Landscapes are a live representation of the synthesis of people and place that is essential to local and national identity. They combine the physical origins of a region with the cultural overlay of human presence, frequently formed over millennia.

Physiology: Anatomy and physiology are closely related fields of study; anatomy is the study of form, and physiology is the study of function.

Pond Ecosystem: The relationship between biotic factors—plants, animals, and microorganisms—and their physical environment that is abiotic factors forms the foundation of the ecology, known as the ecosystem.

MCQs

A. What kind of environment would be categorized as a biome?

i. Lake
ii. Bay
iii. Meadow
iv. Desert

B. Which of the following describes a correct organizational hierarchy?

i. Ecosystem- landscape –community- biome
ii. Biome- community- landscape- ecosystem
iii. Community -ecosystem -landscape -biome
iv. Landscape –community- ecosystem –biome

C. In a boreal forest, what kind of trees is present?

i. Coniferous
ii. Deciduous
iii. Temperate
iv. Hardwoods

D. Which of the following is not present in tropical rain forests but is present in temperate rainforests?

i. Amphibians
ii. Epiphytes
iii. Evergreen trees
iv. Relatively constant temperature

E. Which biome among these has the highest biodiversity?

i. Boreal forest
ii. Temperate grassland
iii. Temperate rain forest.
iv. Tropical rain forest.

Answers

1. (iv) 2. (iii) 3. (i) 4. (iv) 5. (iv)

Important Questions

1. Explain how ecosystems are categorized.
2. Explain the composition and operation of the forest ecosystem..
3. Describe the composition and purposes of the ecology of grasslands.
4. What kinds of desert ecosystems are there?
5. Describe the aquatic ecosystem..
6. Describe rivers and streams.
7. Discuss about the pond ecosystem.

Unit - 5

Environmental pollution

Objectives

- Understand the idea of pollution and pollutants.
- Explore different types of environmental pollutions.
- Identify the marine pollution
- Explain the thermal and the radioactive pollution and its effect on health.

Introduction

Environmental pollution is a serious worldwide problem that endangers biodiversity, human health, and ecosystems. It is the release of dangerous pollutants into the environment that have a negative impact on both the natural world and living things. Numerous factors, such as human activity, industrial operations, transportation, and natural events, can produce pollution. To effectively reduce the consequences of pollution and maintain environmental quality, it is important to have a thorough understanding of the nature, sources, and implications of pollution.

Definition of Pollution and Pollutants

Pollution refers to the presence of substances or agents in the environment that cause adverse effects on living organisms, ecosystems, and natural processes. These substances, known as pollutants, can originate from both natural and anthropogenic sources. Common pollutants include chemical compounds, particulate matter, biological agents, and energy emissions.

Pollutants can be classified into several categories based on their origin, chemical composition, and environmental impact. Here are some common classifications:

1. Primary Pollutants: These contaminants come from identified sources and are released into the environment directly. Examples include emissions from cars, factories, and power plants of carbon monoxide (CO), sulfur dioxide (SO2), nitrogen oxides (NOx), particulate matter (PM), and volatile organic compounds (VOCs).

Secondary Pollutants: Chemical interactions between primary pollutants and atmospheric

elements result in the formation of secondary pollutants in the atmosphere. Ozone (O3), which is created when NOx and VOCs react photochemically in the presence of sunlight, and secondary aerosols, which are created when gaseous precursors oxidize and condense, are two examples.

2. Criteria Pollutants: These pollutants are regulated by environmental agencies due to their widespread presence, adverse health effects, and environmental significance. The criteria pollutants identified by regulatory authorities typically include carbon monoxide (CO), sulfur dioxide (SO2), nitrogen dioxide (NO2), ozone (O3), particulate matter (PM), and lead (Pb).
3. Toxic Pollutants: Toxic pollutants are substances that pose significant risks to human health and the environment due to their toxicological properties. Examples include heavy metals (e.g., lead, mercury, cadmium), persistent organic pollutants (e.g., polychlorinated biphenyls, dioxins), pesticides, and industrial chemicals (e.g., benzene, formaldehyde).
4. Biological Pollutants: Biological pollutants include microorganisms, pathogens, and biological agents that contaminate air, water, and soil, posing risks to human health and ecosystem integrity. Examples include bacteria, viruses, fungi, protozoa, and parasites responsible for waterborne diseases, foodborne illnesses, and infectious diseases.
5. Particulate Matter (PM): Particulate matter refers to tiny particles suspended in the air, ranging in size from coarse particles (PM10) to fine particles (PM2.5) and ultrafine particles (PM0.1). PM originates from combustion processes, industrial emissions, vehicle exhaust, dust storms, and natural sources, posing respiratory and cardiovascular health risks.
6. Greenhouse Gases (GHGs): Greenhouse gases are compounds that absorb and emit infrared radiation, contributing to the greenhouse effect and climate change. Major greenhouse gases include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), fluorinated gases, and water vapor.

Understanding the classification of pollutants is essential for assessing their sources, transport mechanisms, environmental fate, and health impacts, thereby informing pollution control strategies and regulatory measures.

Different Types of Environmental Pollution

Environmental pollution manifests in various forms, each posing unique challenges and impacts on ecosystems and human well-being. The primary types of environmental pollution include:

1. Air Pollution:The discharge of toxic gasses, particulate matter, and other pollutants into the atmosphere results in air pollution. Vehicle emissions, industrial processes, the burning of fossil fuels, and agricultural practices are some of the causes of air pollution. Carbon monoxide (CO), sulfur dioxide (SO2), nitrogen oxides (NOx), ozone (O3), volatile organic compounds (VOCs), and particle matter (PM) are among the main air pollutants. Climate change, respiratory ailments, cardiovascular disorders, and environmental damage can all be caused by air pollution.
2. Water Pollution:The term "water pollution" describes the release of toxic compounds into bodies of water, including lakes, rivers, seas, and groundwater. Water contamination can arise from several sources, such as inappropriate waste disposal, sewage effluents, agricultural runoff, and industrial discharges. Common water pollutants include heavy metals, pesticides, pathogens, nutrients, and synthetic chemicals. Water pollution threatens aquatic ecosystems, compromises drinking water quality, and poses risks to human health through waterborne diseases and toxic exposures.
3. Soil Pollution: Soil pollution occurs when contaminants accumulate in the soil, adversely affecting soil health, fertility, and productivity. Sources of soil pollution include industrial activities, mining operations, improper waste disposal, and agricultural practices. Soil pollutants include heavy metals, pesticides, petroleum hydrocarbons, and hazardous chemicals. Soil pollution can impair plant growth, contaminate food crops, degrade ecosystems, and pose risks to human health through exposure pathways such as ingestion, inhalation, and dermal contact.
4. Noise Pollution: Excessive or unwelcome sound that interferes with human activity, the natural environment, or bodily functions is referred to as noise pollution. Transportation, industrial machinery, construction, urbanization, and leisure activities are some of the sources of noise pollution. Noise pollutants can cause annoyance, stress, hearing impairment, sleep disturbances, and adverse effects on wildlife behavior and communication.

Additional Forms of Pollution

In addition to the primary types mentioned above, several other forms of pollution warrant attention due to their specific impacts and environmental implications:

1. Marine Pollution: Marine pollution involves the introduction of pollutants into marine environments, including oceans, seas, and coastal areas. Sources of marine pollution include oil spills, plastic debris, chemical contaminants, sewage discharge, and marine litter. Marine pollution poses significant threats to marine ecosystems, biodiversity, fisheries, and coastal communities, affecting both aquatic organisms and human livelihoods.
2. Thermal Pollution: Thermal pollution occurs when human activities, such as industrial processes and power generation, increase water temperatures in natural water bodies. Elevated water temperatures can result from the discharge of heated effluents or the removal of riparian vegetation, leading to thermal stratification, reduced oxygen levels, and disruptions to aquatic habitats. Thermal pollution adversely impacts aquatic ecosystems, particularly cold-water species, and can contribute to fish kills and algal blooms.
3. Radioactive Pollution: Radioactive pollution involves the release of radioactive materials into the environment, posing risks to human health and environmental stability. Sources of radioactive pollution include nuclear accidents, radioactive waste disposal, industrial processes, and medical applications. Radioactive pollutants emit ionizing radiation, which can cause genetic mutations, cancer, birth defects, and ecosystem disturbances. Controlling radioactive pollution requires stringent regulations, safe handling practices, and proper disposal methods to prevent long-term environmental and health impacts.

Causes, Effects, and Control of Air Pollution

Causes of Air Pollution:

1. Fossil fuel combustion: One of the main causes of air pollution is the burning of coal, oil, and natural gas for transportation, industrial activities, and energy generation. As a result, the atmosphere is exposed to contaminants such particulate matter (PM), sulfur dioxide (SO2), nitrogen oxides (NOx), and carbon monoxide (CO).

2. Vehicle Emissions: Particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOCs), and other motor vehicles release pollutants from their tailpipes that contribute to urban air pollution.
3. Industrial Activities: Pollutants including sulfur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (VOCs), heavy metals, and particulate matter (PM) are released into the atmosphere during industrial activities like manufacturing, refining, and power generation.
4. Agricultural Practices: Agricultural activities such as livestock farming, crop burning, and fertilizer application release ammonia, methane, and nitrous oxide, contributing to air pollution and greenhouse gas emissions.
5. Construction and Demolition: Construction activities generate dust and particulate matter (PM), while demolition activities release hazardous materials such as asbestos and lead into the air, contributing to localized air pollution.

Effects of Air Pollution:

1. Cardiovascular and Respiratory Conditions: Breathing in air pollutants like particulate matter (PM), sulfur dioxide (SO2), nitrogen dioxide (NO2), and ozone (O3) can cause heart attacks and strokes in addition to respiratory conditions like asthma, bronchitis, and chronic obstructive pulmonary disease (COPD).
2. Degradation of the Environment Because air pollution damages plant tissues, lowers agricultural yields, and interferes with ecological processes, it can affect ecosystems, vegetation, and animals. When sulfur dioxide (SO2) and nitrogen oxides (NOx) mix with atmospheric moisture, acid rain is produced. This can acidify soils, lakes, and rivers, which can have an impact on aquatic life and biodiversity.
3. Climate Shift A few types of air pollution, namely greenhouse gases like carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), trap heat in the atmosphere and cause climate change. This causes the temperature to rise, the weather to change, glaciers to melt, the sea level to rise, and other environmental effects.

4. Visibility Reduction: In metropolitan areas, picturesque landscapes, and national parks, particulate matter (PM), sulfur dioxide (SO2), and other air pollutants can scatter and absorb sunlight, resulting in haze, smog, and impaired visibility.
5. Costs of Economy: Society bears heavy financial burdens from air pollution in the form of medical bills, missed wages, property damage, and environmental remediation expenses. The detrimental effects of air pollution on business, tourism, agriculture, and public health can jeopardize quality of life and economic growth.

Control of Air Pollution:

1. Regulatory Measures: Governments can implement regulations, standards, and emission limits to control air pollution from industrial facilities, power plants, vehicles, and other sources. These measures may include emission standards for vehicles, pollution permits for industries, and regulations on fuel quality and combustion processes.
2. Technological Solutions: New developments in pollution control technologies, such scrubbers, electrostatic precipitators, catalytic converters, and selective catalytic reduction (SCR) systems, can lower the amount of pollutants released by power plants, automobiles, and industrial sources.
3. Alternative Energy Sources and Fuels: By switching to greener and sustainable energy sources like nuclear, solar, wind, hydroelectric, and hydropower, air pollution and greenhouse gas emissions may be reduced and dependency on fossil fuels can be minimized.
4. Transportation Policies: Promoting public transportation, encouraging fuel-efficient vehicles, implementing vehicle emission standards, and investing in clean transportation infrastructure can reduce emissions from the transportation sector and alleviate urban air pollution.
5. Public Awareness and Education: Raising awareness about the health impacts of air pollution, promoting sustainable lifestyle choices, encouraging energy conservation, and fostering community engagement can empower individuals and communities to take action to reduce air pollution and protect public health.

Causes, Effects, and Control of Water Pollution

Water Pollution Causes:

1. Industrial Discharges: Effluent discharges from industrial processes including mining, manufacturing, and chemical processing introduce contaminants into water bodies. Surface water and groundwater sources may be contaminated by these contaminants, which can also include organic compounds, heavy metals, hazardous chemicals, and suspended particles.
2. Municipal Wastewater: Disposal of untreated or inadequately treated sewage and wastewater from urban areas contributes to water pollution. Municipal wastewater contains pathogens, nutrients (e.g., nitrogen and phosphorus), organic matter, and pollutants such as heavy metals and synthetic chemicals, which can degrade water quality and pose risks to human health and aquatic ecosystems.
3. Agricultural Runoff: Agricultural practices such as fertilizer and pesticide application, livestock farming, and soil erosion contribute to water pollution through runoff and leaching of nutrients, pesticides, herbicides, and sediment into rivers, lakes, and streams. Agricultural runoff can cause eutrophication, algal blooms, and contamination of drinking water supplies.
4. 4Stormwater Runoff: As impermeable surfaces like parking lots, roofs, and roadways grow due to urbanization and land development, stormwater runoff and nonpoint source pollutants rise. Pollutants include oil, grease, heavy metals, bacteria, and trash can enter water bodies through stormwater runoff, affecting aquatic ecosystems and water quality.
5. Illegal Dumping and Littering: Improper disposal of waste materials, including trash, plastics, chemicals, and hazardous substances, through illegal dumping, littering, and improper waste management practices, can contaminate water bodies and degrade aquatic ecosystems.

Effects of Water Pollution:

1. Health Risks: Water pollution can pose significant risks to human health through the consumption of contaminated drinking water, recreational activities in polluted water bodies, and exposure to waterborne pathogens, toxins, and pollutants. Waterborne

diseases such as cholera, typhoid, dysentery, and hepatitis can result from microbial contamination of water sources.

2. Ecosystem Degradation: Water pollution harms aquatic ecosystems, including rivers, lakes, wetlands, and coastal areas, by disrupting ecological processes, impairing water quality, and depleting biodiversity. Pollution can degrade habitats, harm fish and wildlife populations, and lead to declines in aquatic species diversity and abundance.
3. Eutrophication: Excessive nutrient runoff, particularly nitrogen and phosphorus from agricultural and urban sources, can cause eutrophication in water bodies. Eutrophication leads to algal blooms, oxygen depletion, and ecological imbalances, resulting in fish kills, habitat loss, and degraded water quality.
4. Habitat Destruction: Pollution from industrial discharges, urban runoff, and sedimentation can degrade aquatic habitats and destroy critical ecosystems such as coral reefs, mangrove forests, and freshwater wetlands. Habitat destruction reduces biodiversity, impairs ecosystem services, and diminishes the resilience of aquatic ecosystems to environmental stressors.
5. Economic Costs: Water pollution imposes economic costs on society through impacts on public health, fisheries, tourism, recreation, and water-dependent industries. The costs of treating contaminated drinking water, restoring polluted ecosystems, and mitigating pollution-related damages can be substantial and place burdens on local communities and governments.

Control of Water Pollution:

1. Regulatory Measures: Governments can enact laws, regulations, and standards to control water pollution from industrial, municipal, agricultural, and other sources. These measures may include discharge permits, effluent standards, water quality criteria, pollution prevention plans, and enforcement mechanisms to ensure compliance with environmental regulations.
2. Wastewater Treatment: Implementing wastewater treatment technologies such as primary, secondary, and tertiary treatment processes can remove pollutants from sewage and industrial effluents before discharge into water bodies. Wastewater treatment plants

remove contaminants such as suspended solids, organic matter, nutrients, pathogens, and toxic substances to protect water quality and public health.

3. Best Management Practices (BMPs): Promoting BMPs for agricultural and urban land management can reduce nonpoint source pollution and mitigate runoff of sediment, nutrients, pesticides, and other pollutants into water bodies. BMPs may include conservation tillage, cover cropping, buffer strips, stormwater management practices, and erosion control measures to protect water resources.
4. Pollution Prevention: Adopting pollution prevention strategies and technologies can minimize the generation and release of pollutants into the environment. Source reduction, product substitution, recycling, reuse, and pollution control measures can help industries, businesses, and individuals reduce their environmental footprint and prevent pollution at its source.
5. Public Awareness and Education: Educating the public, stakeholders, and decision-makers about the importance of water quality protection, pollution prevention, and sustainable water management practices can foster environmental stewardship and promote community engagement in water pollution control efforts.

Causes, Effects, and Control of Soil Pollution

Causes of Soil Pollution:

1. Industrial Activities: Industrial processes such as manufacturing, mining, and waste disposal release pollutants into the soil through spills, leaks, and improper disposal practices. Contaminants from industrial sources may include heavy metals, organic chemicals, solvents, petroleum hydrocarbons, and toxic substances.
2. Agricultural Practices: Agricultural activities such as pesticide and fertilizer application, livestock farming, irrigation, and soil erosion contribute to soil pollution through the introduction of agrochemicals, nutrients, pathogens, and sediment. Pesticides, herbicides, and fertilizers contain toxic chemicals and nutrients that can accumulate in soil and contaminate groundwater.
3. Waste Disposal: Improper disposal of municipal solid waste, hazardous waste, and electronic waste in landfills, dumpsites, and open burning sites can contaminate soil with

toxic substances, heavy metals, organic pollutants, and leachate. Landfills and dumpsites may release pollutants into the soil and groundwater, posing risks to human health and the environment.

4. Mining Activities: Mining operations, including extraction, processing, and disposal of minerals and ores, can release pollutants such as heavy metals, metalloids, and acid mine drainage into the soil and surrounding environment. Mining activities can disturb soil, disrupt ecosystems, and create barren landscapes with elevated concentrations of toxic substances.
5. Urbanization and Construction: Urban development, construction activities, and infrastructure projects can lead to soil compaction, erosion, and contamination through soil disturbance, land clearing, and disposal of construction debris. Urban runoff and stormwater discharge can transport pollutants such as sediment, heavy metals, and petroleum products into soil and water bodies.

Effects of Soil Pollution:

1. Degraded Soil Quality: Soil pollution degrades soil quality by altering its physical, chemical, and biological properties, including texture, structure, fertility, pH, organic matter content, and microbial diversity. Contaminants such as heavy metals, pesticides, and industrial chemicals can persist in soil for long periods, impairing its ability to support plant growth and ecosystem functions.
2. Crop Contamination: Soil pollution can contaminate food crops, vegetables, fruits, and livestock feed with toxic substances, heavy metals, and pesticides, posing risks to human health through dietary exposure. Contaminated soils may accumulate pollutants in plant tissues, leading to bioaccumulation and biomagnification of contaminants in the food chain.
3. Groundwater Contamination: Soil pollution can leach pollutants into groundwater sources, contaminating aquifers and drinking water supplies. Contaminants such as nitrates, pesticides, volatile organic compounds (VOCs), and petroleum hydrocarbons can migrate through soil pores and fractures, leading to groundwater contamination and risks to human health.

4. Ecological Impacts: Soil pollution harms terrestrial and aquatic ecosystems by disrupting soil biodiversity, impairing habitat quality, and affecting plant and animal communities. Pollutants can accumulate in soil organisms, disrupt soil food webs, and cause declines in soil-dwelling organisms such as earthworms, microorganisms, and beneficial insects.
5. Human Health Risks: Soil pollution poses risks to human health through direct contact, inhalation, and ingestion of contaminated soil, dust, and food crops. Exposure to toxic substances, heavy metals, and carcinogens in soil can cause adverse health effects such as cancer, respiratory illnesses, neurological disorders, and reproductive problems.

Control of Soil Pollution:

1. Contaminated Site Remediation: Remediation of contaminated sites involves the cleanup and restoration of soil and groundwater contaminated with hazardous substances. Remediation technologies such as excavation, soil washing, thermal treatment, bioremediation, and phytoremediation can remove or immobilize pollutants and restore soil quality.
2. Pollution Prevention: Preventing soil pollution requires implementing pollution prevention measures and best management practices (BMPs) to minimize the generation, release, and migration of pollutants into soil. Source reduction, recycling, waste minimization, and proper waste management practices can prevent pollution at its source and reduce environmental impacts.
3. Regulatory Measures: Governments can enact laws, regulations, and policies to regulate soil pollution and protect soil quality. Soil protection measures may include soil quality standards, land use planning, zoning regulations, environmental permits, and enforcement mechanisms to prevent soil contamination and ensure compliance with environmental laws.
4. Sustainable Land Management: Adopting sustainable land management practices such as conservation tillage, cover cropping, crop rotation, organic farming, and agroecological approaches can improve soil health, fertility, and resilience to pollution. Sustainable agriculture practices can reduce reliance on agrochemicals, minimize soil erosion, and promote soil conservation and regeneration.

5. Public Awareness and Education: Educating the public, stakeholders, and communities about the importance of soil health, pollution prevention, and sustainable land management practices can raise awareness and promote behavior change. Outreach programs, training workshops, and educational campaigns can empower individuals and organizations to take action to protect soil resources and promote environmental stewardship.

Causes, Effects, and Control of Noise Pollution

Causes of Noise Pollution:

1. Transportation: Traffic from cars, trucks, buses, airplanes, and trains contribute significantly to noise pollution.
2. Industrial Activities: Factories, construction sites, and mining operations produce loud machinery and equipment noises.
3. Urbanization: Rapid urban development leads to increased noise from residential and commercial areas, including honking, loud music, and construction.
4. Social Events: Concerts, festivals, and gatherings can generate high levels of noise pollution.
5. Technological Advancements: Use of loud equipment, appliances, and electronic devices contribute to noise pollution.
6. Natural Sources: Some natural sources like thunderstorms, earthquakes, and volcanic eruptions also produce loud sounds.

Effects of Noise Pollution:

1. Health Effects: Prolonged exposure to loud noises can lead to hearing loss, stress, hypertension, sleep disturbances, and cardiovascular diseases.
2. Psychological Effects: Noise pollution can cause irritability, anxiety, depression, and decreased concentration and productivity.
3. Interference with Communication: Excessive noise makes it difficult to communicate effectively, leading to misunderstandings and decreased social interaction.
4. Impact on Wildlife: Loud noises disrupt wildlife habitats, communication, mating rituals, and navigation, affecting their survival.

5. Economic Impact: Noise pollution can reduce property values, increase healthcare costs, and affect tourism and productivity in affected areas.

Control Measures for Noise Pollution:

1. Legislation and Regulations: Governments can implement noise control laws, zoning regulations, and building codes to limit noise levels in different areas.
2. Urban Planning: Proper urban planning can help in minimizing noise pollution by designing soundproof buildings, creating buffer zones between residential and industrial areas, and controlling traffic flow.
3. Noise Barriers: Constructing physical barriers like walls, berms, and fences along highways and railways can reduce noise levels.
4. Use of Quieter Technologies: Encouraging the use of quieter machinery, vehicles, and equipment through regulations and incentives can help in controlling noise pollution.
5. Public Awareness and Education: Educating the public about the harmful effects of noise pollution and promoting responsible behavior can encourage people to adopt quieter practices.
6. Noise Monitoring and Management: Regular monitoring of noise levels and implementing effective noise management strategies can help in identifying and addressing sources of noise pollution.

Causes, Effects, and Control of Marine Pollution

Causes of Marine Pollution:

1. Plastic Pollution: Improper disposal of plastic waste, such as plastic bags, bottles, and microplastics, leads to their accumulation in marine environments.
2. Oil Spills: Accidental or deliberate discharge of oil from ships, offshore drilling rigs, and oil refineries contaminates marine ecosystems.

3. Chemical Pollution: Industrial discharges, agricultural runoff, and improper waste disposal introduce pollutants such as heavy metals, pesticides, and fertilizers into marine ecosystems.
4. Sewage and Wastewater: Inadequate sewage treatment and runoff from urban areas carry untreated sewage, pathogens, and pollutants into coastal waters.
5. Shipping Activities: Ballast water discharge, antifouling paints, and litter from ships contribute to marine pollution.
6. Noise Pollution: Underwater noise from shipping, seismic surveys, and construction activities can disrupt marine life and affect their behavior and communication.

Effects of Marine Pollution:

1. Ecosystem Degradation: Marine pollution disrupts marine ecosystems, leading to loss of biodiversity, habitat destruction, and imbalances in marine food chains.
2. Harm to Marine Life: Pollutants can harm marine animals through ingestion, entanglement, habitat degradation, and exposure to toxic substances, leading to population declines and species extinction.
3. Human Health Risks: Contaminated seafood, harmful algal blooms, and pathogens from polluted waters pose risks to human health through consumption and recreational activities.
4. Economic Impact: Marine pollution impacts fisheries, aquaculture, tourism, and coastal economies, resulting in loss of revenue and livelihoods for communities dependent on marine resources.
5. Ocean Acidification: Pollution, particularly CO2 emissions, contributes to ocean acidification, harming marine life with calcium carbonate shells and skeletons, such as corals and shellfish.

Control Measures for Marine Pollution:

1. Regulations and Enforcement: Implementing and enforcing laws and regulations to control pollution from shipping, industries, and coastal development.
2. Waste Management: Promoting proper waste management practices, recycling, and reducing single-use plastics to minimize marine debris.

3. Sewage Treatment: Upgrading sewage treatment facilities and implementing wastewater treatment technologies to prevent untreated sewage from entering marine environments.
4. Oil Spill Response: Developing and implementing oil spill response plans, training personnel, and deploying cleanup equipment to minimize the impact of oil spills.
5. Marine Protected Areas: Establishing marine protected areas and marine reserves to conserve biodiversity and protect sensitive habitats from pollution.
6. International Cooperation: Collaborating at regional and international levels to address transboundary marine pollution through agreements, conventions, and partnerships.

Certainly! Thermal pollution is the elevation or decrease in temperature of natural water bodies caused by human activities. Here's an outline covering its causes, effects, and control measures:

Causes, Effects, and Control of Thermal Pollution

Causes of Thermal Pollution:

1. Industrial Activities: Discharge of heated water from power plants, industrial facilities, and manufacturing processes into water bodies raises their temperature.
2. Power Generation: Power plants that use water for cooling purposes, such as nuclear, coal-fired, and thermal power plants, release heated water back into rivers, lakes, or oceans.
3. Urbanization: Urban development leads to the replacement of natural land cover with impervious surfaces, such as roads and buildings, which absorb and retain heat, raising the temperature of nearby water bodies.
4. Agricultural Practices: Agricultural runoff containing fertilizers and pesticides can increase water temperature due to the heat generated by microbial decomposition of organic matter.
5. Deforestation: Removal of vegetation along riverbanks and streams reduces shading, exposing water bodies to direct sunlight and increasing water temperature.
6. Climate Change: Global warming can lead to increased air temperatures, which in turn raise water temperatures in rivers, lakes, and oceans.

Effects of Thermal Pollution:

1. Habitat Alteration: Elevated water temperatures can alter aquatic habitats and disrupt ecosystems, affecting the distribution and abundance of aquatic plants and animals.
2. Changes in Oxygen Levels: Higher water temperatures reduce the solubility of oxygen in water, leading to decreased oxygen levels and potential hypoxia (low oxygen) or anoxia (absence of oxygen) conditions, which can harm aquatic organisms.
3. Altered Reproductive Cycles: Thermal pollution can disrupt the reproductive cycles of aquatic organisms, leading to changes in breeding behavior, reduced reproductive success, and population declines.
4. Migration Patterns: Changes in water temperature can affect the migration patterns of fish and other aquatic species, impacting their ability to find suitable habitats and food sources.
5. Increase in Disease Susceptibility: Elevated water temperatures can weaken the immune systems of aquatic organisms, making them more susceptible to diseases and parasites.
6. Loss of Biodiversity: Thermal pollution can lead to the loss of sensitive species and reduce overall biodiversity in affected water bodies.

Control Measures for Thermal Pollution:

1. Cooling Technologies: Implementing cooling technologies such as cooling towers, spray ponds, and natural draft cooling systems in industrial and power plant facilities to reduce the temperature of discharged water.
2. Effluent Limitations: Establishing and enforcing regulations and effluent limitations on water temperature for industrial and power plant discharges to prevent excessive heating of receiving water bodies.
3. Vegetative Buffer Zones: Maintaining vegetative buffer zones along riverbanks and streams to provide shading and reduce the impact of urbanization and deforestation on water temperature.
4. Water Conservation: Promoting water conservation practices to reduce the volume of water withdrawn for cooling purposes by industrial and power plant facilities.

5. Restoration and Rehabilitation: Restoring degraded habitats, reforesting riverbanks, and implementing watershed management practices to improve water quality and reduce thermal pollution.
6. Public Awareness and Education: Educating the public about the impacts of thermal pollution and promoting sustainable water management practices to mitigate its effects on aquatic ecosystems.

In conclusion, environmental pollution represents a complex and multifaceted challenge that demands urgent attention and concerted action at local, national, and global levels. By understanding the causes, impacts, and consequences of pollution, society can develop innovative solutions and adopt sustainable practices to safeguard environmental quality, protect human health, and promote ecological resilience for future generations.

Summary

A polluted environment is one in which pollutants have been introduced and are causing physical systems or living things in it instability, chaos, injury, or discomfort. Chemical compounds or energy, such as heat, light, or sound waves, can be considered forms of pollution. In addition to naturally occurring chemicals or energies, pollutants are aspects of pollution that are deemed to be too high amounts of naturally occurring substances or energies. The issue of environmental pollution is considerably more widespread than we realize; in many of our cities, issues with air pollution, noise pollution from traffic, and other disruptive noises are common. The introduction of chemical, physical, or biological materials into freshwater or oceanic environments that deteriorate the water's quality and have an impact on the species that inhabit it is known as water pollution. Nonconventional pollutants include degradable and persistent organic carbon compounds that are released into water as a byproduct of industry or as an essential component of products that are sold, as well as dissolved and particulate forms of metals, both hazardous and benign.

Keywords:

Environmental Pollution: any release of materials or energy into the air, water, or land that degrades the quality of life or threatens the Earth's ecological balance either permanently or temporarily.

Pollution:describe the introduction of pollutants into an ecosystem that results in physical systems or living species experiencing instability, disorder, damage, or discomfort.

Secondary Pollutants:which, in the environment, are unable to keep their shape. It contains peroxyacyl nitrate, which is produced when main contaminants such hydrocarbons and nitrogen oxides react.

Water Pollution: introduction of physical, chemical, or biological materials into freshwater or ocean environments that deteriorate the water's quality and have an impact on the species that inhabit there.

MCQs

1. A natural phenomenon that becomes harmful due to pollution is.....

(a) Global warming. (b) Ecological balance. (c) Greenhouse effect. (d) Desertification.

2. One of the best solutions to get rid of non-biodegradable wastes is.....

(a) Burning. (b) Dumping. (c) Burying. (d) Recycling.

3. Animal dung is .....waste.

(a) Biodegradable. (b) Non-biodegradable. (c) Hazardous. (d) Toxic.

4. The largest amount of usable water found on earth is used for.....

(a) Recreation. (b) Crop irrigation (c) Industrial uses. (d) Household use.

5. Which two of the following might apply to acid rain pollution?

(a) Secondary pollutant (b) Primary pollutant

(c) May be derived from a chemical reaction between sulphur dioxide, sulphur trioxide or nitrogen dioxide with rainwater

(d) Derived from aerosol cans and refrigerators.

Answers

1. (c) 2.(d) 3.(a) 4.(b) 5.(c)

Important Questions

1. Explain the natural pollution.
2. Explain the man-made pollution.
3. What do you mean by radioactive pollution?
4. What are differences between water pollution and land pollution?
5. Discuss about the air pollution.
6. Explain the soil misuse and solid waste.
7. What do you mean by marine pollution?
8. Explain the control of various types of pollution
9. What is the role of an individual in prevention of pollution?

Unit - 6

Social issue and the environment

Objectives:

- Understand the concept of green house effect
- Elucidate the source and consequence of acid rain
- Designate in element the idea of global warming
- Discover nuclear accidents and holocaust

Greenhouse effect

This concept explains the election of gases from earth to atmosphere through the greenhouse gas that absorbs UV light from sun. this help the earth to maintain optimum temp and in-trun protect earth surface from sun

This insulates the surface of the earth and prevents it from freezing."

- Plant growth can be enhanced using glass house where radiation from the sun haet up the plants and air inside green house. This heat is trapped and is not allowed to move out. This condition is essential for increasing the growth for plants
- Same concept is followed with earth's atmosphere, where the temp rises at day and after the heat is radiated back at night the temp fall. The green house gas absorb the heat. This enhances the temp at earth surface and make it optimum for the growth of animals
- But due to continuous increase in greenhouse gas temp of the globe is increasing leading to various ill effects

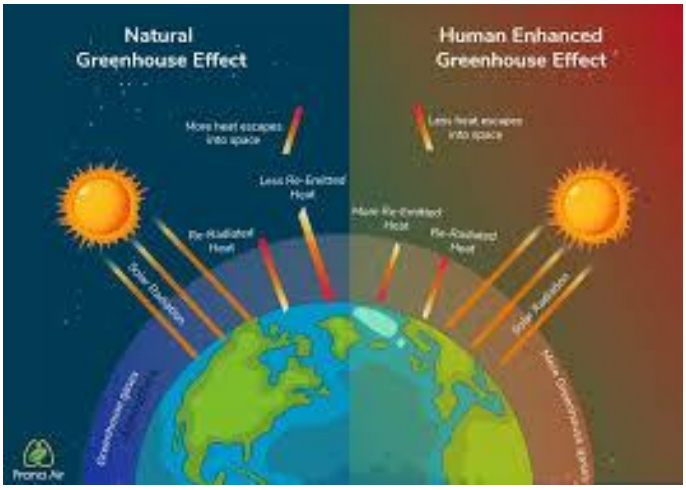


Fig 1 Green house gases

Greenhouse Gases

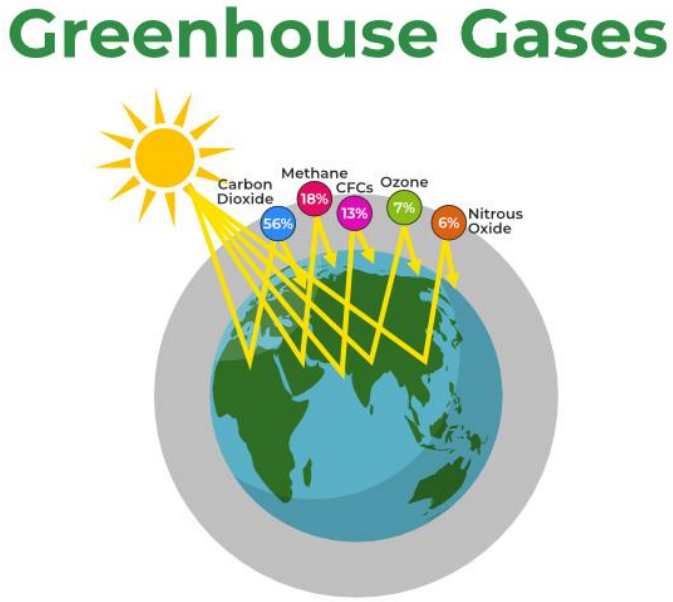


Fig 2 examples of green house gases

- gases that absorb the infrared radiations producing greenhouse effect. For eg., CO2 andCFC."

- Sources that release those gases ate mainly factories, automobiles. Increase in which enhance the temp because green house gases never allow the radiation to move out of earth

Causes

Greenhouse gas	Main cause
Carbon dioxide (CO_2)	Burning fossil fuels Cement manufacture Deforestation (release of CO_2 and reduction in absorption by plants)
Methane (CH_4)	Burning fossil fuels Burning biomass Fossil fuel mining and distribution Waste disposal in landfills Animal husbandry (e.g. cattle and sheep) Rice agriculture
Nitrous oxide (N_2O)	Agricultural fertilisers Burning biomass Animal husbandry Industrial activities (e.g. nylon manufacture)
Tropospheric ozone (O_3)	Burning fossil fuels Burning biomass Land use change
Halocarbons	Refrigerants Manufacturing processes
Aerosols	Burning fossil fuels Burning biomass Mining Industrial processes

Source: IPCC (2007a).

Table 1 Causes of global warming

Sequence of Greenhouse effect

Step 1: Earth's atmosphere gets theSolar radiation few isreplicated back into interstellar region.

Step 2: Earth is heated when radiation is absorbed by earth

Step 3:Earth radiates heat back to space.

Step 4: Few Radiations Is Trapped Back, Increasing the Temp

Step 5: Anthropogenic Activity Increase the Green House Gas.

Step 6: This increase the temperature due to trapping of extra gases

GLOBAL WARMING

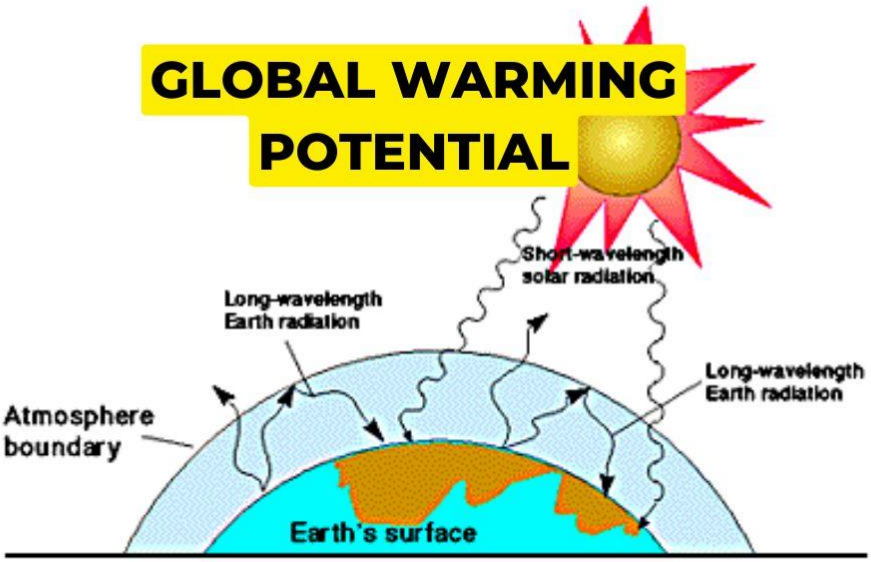


Fig 4 process of global warming

CAUSES OF GLOBAL WARMING :

CO2 and Nitrous oxide released by oil and gas from burning of coal. Since tree absorb CO2, deforestation add to increase of green house gases. Methane produced by livestock farming increase green house gas nitrous oxide emissions caused by fertilizers containing nitrogen

Fig 5 reason of Global warming

CONSEQUENCES

- Rain-fed agriculture, in the main source of freshwater. 80% of total rain in plain region in India occurs during June to September. In four months
- Disasters, including storms, heat waves, floods, and droughts raises the temp of earth
- Majorly hydrology is effected changing water resources and agriculture of the country. thermal expansion of sea water increases sea level. Climate change is again a side effect
- Ice-fed rivers like Himalayan rivers are very vulnerable to climate change.

Precipitation Patterns:

near the Equator rainfall increases and reduced in subtropics. Precipitation and evaporation will increase which can ultimately lead to flooding

Drought:

- increase in droughts is lacking of insufficient amount of rain for an extended period of time.

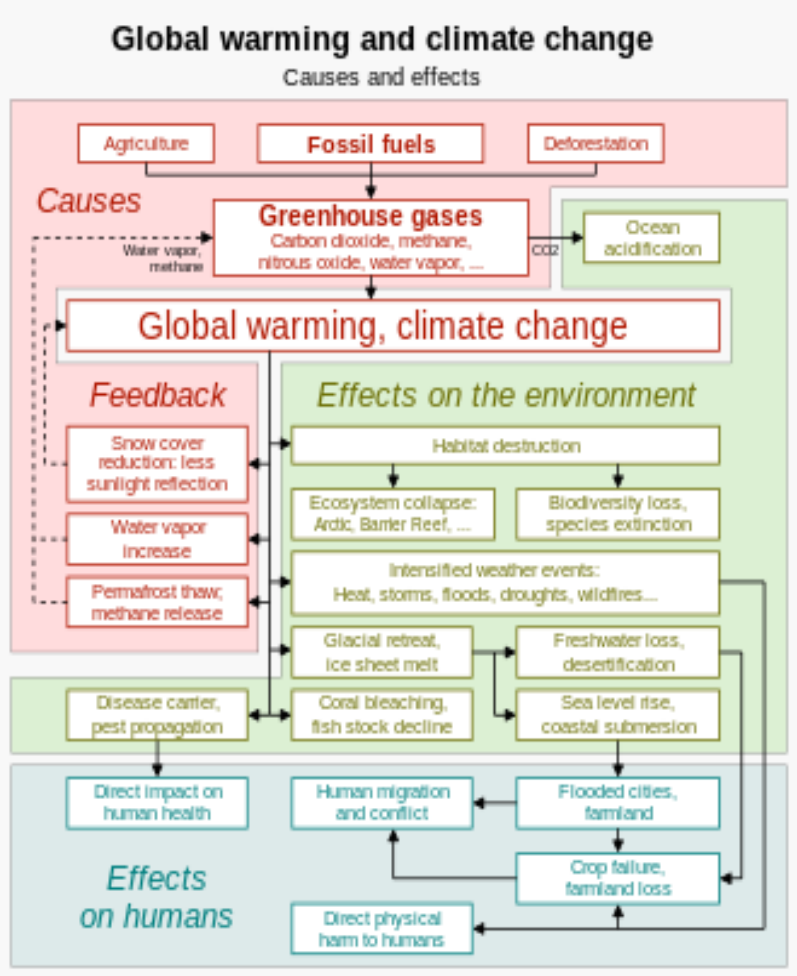


Fig 6 effect on environment

9.2.6 Agriculture:

- from mid to high temperature upsurges (1-3ºC), shared with higher (CO2) levels and changes in rainfall, can slightly benefit crop yields.
- Global agricultural manufacture might see an increase due to the doubling of the CO2 fertilization effect. However, rising sea levels can increase salinity, pushing back the freshwater interface and affecting the supply of fresh groundwater along coastal areas. Some regions will experience drying conditions, while others will see increased precipitation, altering the extent and types of species in forests. Meteorological analysis predicts anrisingdrift in mean temperature, a descending trend in comparative humidity, annual rainfall, and No of wet days per year in India.

- Warming is also projected to reduce agricultural output in India, making small and marginal farmers more vulnerable. Agrawal (2008) indicated that agricultural productivity could decline by up to 25%, and by as much as 50% in rainfed agriculture.

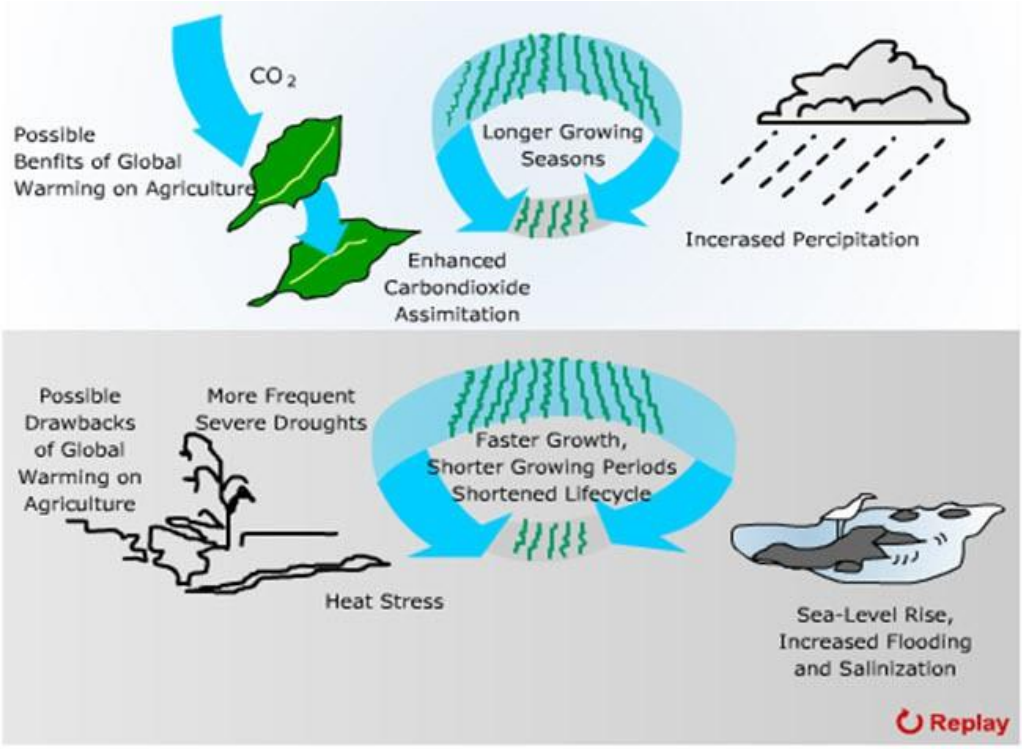


Fig 7 Water level and global warming

Acidification Of Ocean:

Process of calcification is effected which pose a risk to animal like reef.

Ozone Depletion:

greenhouse effect, damages plants, and damages lung tissue can increase with Ozone in the lower atmosphere. Ozone in atmosphere reflect excess rays from the sun. carbon dioxide from the atmosphere is naturally absorbed by ocean.

Carbonic acid reacts with carbonate ions present in seawater, which are crucial for the formation of corals and the shells like phytoplankton, forming the foundation. Thus, increased levels of carbon dioxide in the atmosphere lead to a decrease in the necessary components for the creation of calcium carbonate skeletons in corals and other calcium carbonate-dependent organisms.

Ocean acidification, along with ocean waters, is expected to have numerousinfluences on coastal and ocean resources:

- Potential breakdowns in marine food webs
- Inhibited or slowed growth of corals, calcifying phytoplankton, and zooplankton
- Habitat loss due to the decline of coral reefs
- Loss of aquatic plants and animals intolerant to increased salinity levels.

Ozone Depletion

Ozone, a form of oxygen comprising three atoms, is normally absent in reduced atmosphere and primarily in stratosphere, spanning 20 to 50 km above the Earth's surface.

Ozone plays a critical role as it filters UV radiation, serving as a shield contrary to UV radiation that can elevate the risk of skin cancer, cataracts, and other eye diseases. Moreover, it affects the humandefense mechanisms, heightening susceptibility to infectious diseases. AugmentedUV radiation can severely impact plant and fish productivity.

It is also referred to the reduction or breakdown of ozone in the stratosphere, initially identified in the 1970s with the rise of supersonic aircraft emitting nitrogen oxides in the lower stratosphere.

Ozone-Depleting Substances

Ozone-depleting substances encompass various compounds responsible for ozone layer degradation. Chlorofluorocarbons (CFCs) are identified as the primary cause. CFCs find wide application in refrigerants, foaming agents, plastic manufacturing, and other industrial processes. Other substances controlled by the Montreal Protocol include halons, carbon tetrachloride,

methyl chloroform, hydrobromofluorocarbons, hydrochlorofluorocarbons, methyl bromide, and bromochloromethane.

Ozone depletion carries severe consequences, such as varying impacts on plants and animals' tolerance to ultraviolet rays. These rays damage DNA, particularly affecting crops like soybeans.

The UVB radiation is absorbed by all forms of life, melanoma can be a result of ozone layer depletion which is cancer that has turned to epidemic in UN

Acid Rain-

Wet or dry from of sulfuric or nitric acid when forms on ground from the atmosphere, such acidic precipitation is acid deposition

Forms of Acid Rain

2 forms wet and dry

- Wet Deposition: wind blows the acidic chemicals in the air and air has moisture, the acids fall to the ground in the form of rain
- Dry Deposition: on the other hand, when the weather is dry, the acidic pollutants slip into dust or smoke and fall to the ground as dry particles.

Causes of Acid Rain

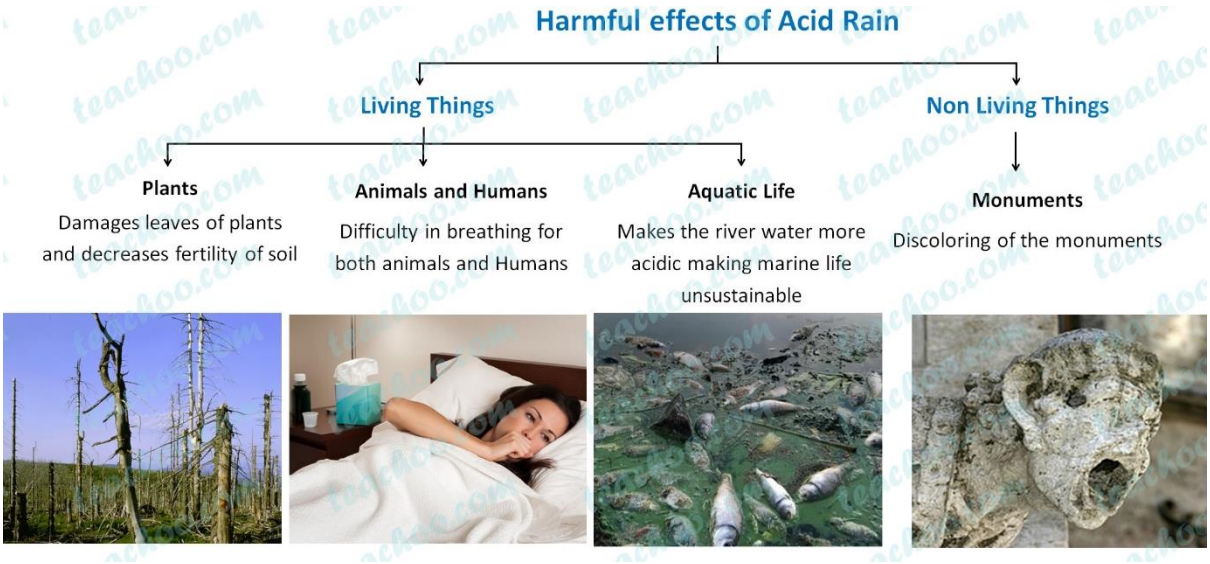
Both natural and anthropogenic sources are recognized to play a role in the formation of acid rain. But, it is mostly caused by combustion of fossil fuels which results in emissions of SO2and NOx.

1. **Natural Sources-** naturally nitric oxides produced by volcanic emissions or Lighting react with water molecules to produce nitric acid, thereby forming acid rain.
2. **Man-made sources**

Human activities leading to chemical gas emissions such as sulfur and nitrogen are the primary contributors to acid rain.

Effects of Acid Rain

Public health plants animal all are greatly affected by acid rain



Solutions

1. routine and timely Cleaning up Exhaust Pipes and Smokestacks
2. ReinstatingSpoiled Environments
3. Substitute Energy Sources
4. Individual, National/State, and International Actions

Nuclear accidents and Holocaust

- Process when unstable nucleus result in emission of particle and ray is called Radioactivity they are serious threat to human health. Their sources are
- Normal sources:
- Anthropogenic Sources:
- nuclear explosions: local, tropospheric and stratospheric.
- Local fallout is quite intense but short-lived.

Radioactive waste causes

- Soil pollution
- Water pollution

The consequence of radioactive pollution depends upon

- Half –life
- Energy liberating capacity
- Amount of diffusion
- Amount of deposition of the contaminant.
- Numerous atmospheric and climatic conditions such as wind, temperature, rainfall also determine their properties.

The imaginable possessions of radioactive wastes are categorised into

- • Somatic Consequence
- • Genetic Outcome
- • Biomagnification

MCQ

1. Which of the succeeding is not a major greenhouse gas?

(a) CO2. (b) Water vapour. (c) Calcium Carbonate. (d) Methane.

2. Max.CO2emissions from fossil fuel burning is at

(a) Japan and China. (b) Europe. (c) Developing nations. (d) North America.

3. anthropogenic origingreen house gas is ?

(a) Nitrous oxide. (b) Water vapour. (c) Carbon dioxide. (d) CFCs.

4. The shortest wavelength of light visible to the human eye is what?

(a) Red. (b) Blue. (c) Violet. (d) Green.

Answers

1. (c) 2.(d) 3.(d) 4.(c)

Important Questions

1. What do you understand by about the green house effect?
2. What is the solar radiation?
3. Discuss about the greenhouse gases.
4. Explain the greenhouse effect.
5. What is acid rain?
6. How do we measure acid rain?
7. Explain the effects of acid rain.
8. What do you know about the ozone depletion?

Unit - 7

Social Issue and Environment

Objective:

- From unsustainable to sustainable development, analyze.
- Describe the extent of the energy-related issues facing cities.
- Recognize the significance of watershed management, rainwater harvesting, and conservation.
- Examine the issues and concerns surrounding the resettlement and rehabilitation of individuals.

Sustainable Development:

i. Humans inhabit both the natural and social worlds.

ii. The natural and social aspects of our lives are significantly impacted by our technological advancements.
Growth in the Gross National Product (GNP) of a few different countries is not indicative of development.
Thus far, human development has primarily benefited a select few wealthy nations.

iii. They have achieved remarkable advancements in science and technology, but at what cost? There is severe pollution in the food we eat, the water we drink, and the air we breathe. Because of excessive exploitation, our natural resources are simply running out.

iv. The world-famous report "The limits to growth" warned that if this growth keeps up its current pace, we will soon face the end of time.
According to G.H. Brundtland, the Director of the WHO and the Prime Minister of Norway, sustainable development is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." Development must be envisioned in a holistic way that benefits everyone, not just the current generation but also future generations.

v. There is an urgent need to link the social aspects with development and environment.

Aspects for Sustainable development

a. **Intergenerational equity:** In order to leave our future generations with a safe, healthy, and resourceful environment, we must minimize any negative effects on the environment and resources. This can only be accomplished by stopping over-exploitation of resources, lowering emissions and waste discharge, and maintaining ecological balance.
b. **Intra-generational equity:** This will support the economic growth of poor countries, narrow the wealth gap, and lead to sustainability. The development process should aim to minimize the wealth gaps within and between nations. Technology should address the problems of developing countries, producing vaccines for infectious diseases, clean fuel for domestic and industrial use, and drought-tolerant varieties for uncertain climates.

Sustainably developed measures:

a. Making use of the right technologies:

- Employing indigenous technologies is more beneficial, economical, and sustainable.
- Appropriate technology is that which is environmentally friendly, cost-effective, resource-efficient, and culturally appropriate (involves local resources and labor).
- Less waste and less resources should be used by the technology.

b. **Using the 3Rs (Reduce, Reuse, Recycle):** This method lessens the strain on resources and lowers pollution and trash production.

- Reducing the usage of resources: If there is less of a market for any metallic product, less metal will be mined, which will result in less waste being produced.
- Reusing them repeatedly: Reusable containers can be made from refillable materials that are disposed of after use. For example, rubber bands can be made from leftover rubber tubes.

- Recycling the material: Recycling is the process of turning waste resources into new, practical goods. Paper recycling is one example of this.

c. **Encouraging environmental education and awareness :**

- This helps in change people's perspectives and attitudes toward the environment and our planet.
- Give children an early exposure to the topic, which will help them develop a sense of earthly belonging.
- Help us change our way of life to one that is more sustainable.

d. **Utilization of resources in accordance with carrying capacity:**

- A system's carrying capacity determines how many species it can support sustainably.
- When a system's carrying capacity is exceeded, environmental degradation occurs.
- The two fundamental elements of carrying capacity are
  Supporting capacity: The ability to replenish
- Assimilative capacity: The ability to with stand various types of stress.
- Sustainability can be attained if the resources are used in accordance with the first two characteristics.

WATER CONSERVATION:

It is necessary to conserve water because it is one of the most valuable and essential resources. The water conservation techniques listed below can be implemented:

1. **Reducing runoff losses** : It can be accomplished in the following ways:
   - Creating a series of benches to catch runoff water through contour cultivation on small ridges and furrows across slopes.
   - Channeling water through a series of vertically spaced diversions.
   - Channeling water through small depressions dug in the area to provide temporary water storage.

- Applying chemical wetting agents or conditioners, such as gypsum, to sodic soils to improve soil permeability and reduce runoff.
- Surface crop residues Animal waste, tillage, and mulch • Water storage facilities like farm ponds and wells.

2. **Reducing Evaporation losses:**
    - Super slurper, a co-polymer of starch and acrylonitrile, absorbs water 4000 times its weight.
    - An asphalt horizontal barrier positioned beneath the soil's surface increases water availability.
3. **Water storing in Soil:**
    - It is necessary to wet the soil to the field capacity.
    - By keeping the land fallow for a season, water can be saved for crop growth the following year.
4. **Reducing irrigation losses:**
    - Watering in the early morning or late at night
    - Using drip or sprinkler irrigation
    - Using lined canals to minimize seepage
5. **Water reuse:**
    - Fertilizer can be made from treated waste water.
    - Washing cars and gardens with grey water from bathtubs and washing machines
6. **Preventing wastage of water**
    - Closing faucets when not in use
    - Fixing any pipeline leaks
7. **Increase block pricing**
    - A higher water usage results in a proportionately higher bill for the customer.

RAIN WATER HARVESTING

Now a days, with the construction of concrete homes, well-constructed walkways, roads, and courtyards, there aren't many open spaces remaining. Additionally, the amount of exposed earth, concrete jungles, and natural forest cover has decreased, leaving less space for water to seep into, raising the ground water table.

In order to increase the recharge of ground water, a technique known as rainwater harvesting involves capturing and storing water. This is accomplished by building specific water harvesting structures such as check dams, dug wells, percolation pits, and lagoons.

Aims of Rain water Harvesting:

1. Reducing runoff loss
2. Preventing road flooding
3. Meeting the growing demand for water
4. Raising the water table by replenishing groundwater

Techniques of Rain water Harvesting:

1. **Conventional/Traditional approach:** Rainwater is traditionally gathered from rooftops and kept in open storage areas like tanks, ponds, and lakes. In villages, people still carry it out. Embankments or underground tanks (known as tankas in Rajastan) are used in rural areas to store harvested rainwater. In foothills, springs' water flow is collected through embankment-style water storage.
   People in the foothills of the Himalayas use hollow bamboo as a conduit to carry water from natural springs.
2. **Modern approach:** There are two primary methods for collecting rainwater:
   • Depositing water onto the surface to be used later
   • Groundwater recharge
   It's a very old tradition to store water above ground for later use. Groundwater replenishment is a relatively new idea, and the buildings utilized to do so are:
   - **Pits:** recharge pits are built in order to replenish the shallow aquifer. These have a width of 1-2 meters and a depth of 3 meters. In order to facilitate filtration prior to percolation, this is backfilled with boulders, gravel, and sand.
   - **Trenches:** Where a permeable stream is available at a shallow depth, trenches measuring approximately 0.5-1 m wide, 1-1.5 m deep, and up to 20 m long are

built. Similar to what happens with pits, the trench is likewise backfilled with filter material.

- **Dug Wells:** These could serve as structures for recharge. Percolation should occur after the extra water has passed through the filter media.
- **Technique for spreading:** water is let to spread in streams and nullahs, or in a percolation pond, check dams, nullah bunds, and cement plugs.
  Furthermore, rainwater collected on city roofs and in roadside areas is utilized for recharging aquifers. The artificial recharge of ground water through rainwater harvesting is being promoted these days by the Central Ground Water Board and the local government.

WATERSHED MANAGEMENT

- A water shed is a geographical feature, or a plot of land, that gathers, holds, and releases water.
- Rain, snowmelt, and fog produce the collected water.
- Lakes, ponds, subsurface soil, etc. are places where water is kept.
- Rivers, streams, and groundwater flow release the stored water.
- The water shed refers to the area of land where water flows naturally to a shared drainage channel, such as a lake, river, stream, estuary, or even the ocean.
- The size of a water shed can vary from a few square kilometers to a few thousand square kilometers.
- The intricate relationships between water, vegetation, soil, and land use activities make up the water shed.

Reason of Watershed degradation:

The following are the main causes of watershed degradation:

- Shifting cultivation
- Complex interactions between soil, land, vegetation, land use activities, and water;
- Overgrazing
- Deforestation
- Mining
- Industrialization

- Construction activities
- Soil erosion

Watershed management: Watershed management involves using land and water resources rationally to maximize production while causing the least amount of harm to the environment.

Objectives of Watershed Management:

- In order to restore ecological balance needs to sustainable resource development of natural resourses.
- Encourage sustainable economic development by making the best use of land, water, and vegetation.
- Reducing the risk of landslides, floods, and droughts
- Managing watersheds for the purpose of beneficial developmental activities such as irrigation, hydropower production and domestic water supply to controlling soil erosion and moisture retention.

Practices of Watershed Management:

1. **Water Harvesting:**
   - It also assists in mitigating floods.
   - Percolation tanks, wells, check dams, and other structures are built at the foot of hills and mountains to collect rainwater and prevent it from running off.
   - Allowing sufficient time for water to seep into the subsurface and raise the groundwater table
2. **Agro forestry and Afforestation:**
   - In areas with high rainfall, woody trees are planted between crops to reduce runoff and loss of fertile soil
   - in Dehradun, trees like eucalyptus and grasses like chrysopogan are grown alongside maize or wheat
   - in high rainfall areas, afforestation and crop plantations play a significant role in the development of watersheds

- In addition, they help to prevent soil erosion and retain moisture.

3. **Mechanical process to reduce run off loses and soil erosion**

   Various mechanical techniques are employed to minimize runoff losses and soil erosion including:

   - ✓ Terracing
   - ✓ Bunding
   - ✓ Bench terracing
   - ✓ No-till farming
   - ✓ Contour cropping
   - ✓ Strip cropping.

     Bunding has shown to be a very effective technique in Dehradun for lowering peak discharge, runoff, and soil loss.

4. **Quarrying and Scientific mining:**
   - Improper mining causes instability and disturbance of the hills, which leads to landslides, rapid erosion, etc.
   - It is recommended to minimize the destructive effects of mining by Draining water courses in the mined area
   - Planting some soil-binding plants, such as Vitex and Ipomeoea
   - Contour trenching at 1 m intervals on overburden dumps
5. **Public participation:**
   - For the success of watershed management programme related to soil and water conservation it is particularly important for the involvement of farmers and tribal people.
   - Communities must be motivated by
   - To protect newly planted areas
   - Water harvesting structures implemented by the government or non-governmental organizations must be maintained
   - Proper education of the populace is essential

- Haryana state has successfully managed its watersheds thanks to the active participation of the local people.

RESETTLEMENT AND REHABILIATION ISSUES:

Numerous development initiatives frequently result in the impoverished and frequently uneducated native or tribal people being displaced. Their recovery represents a significant socioeconomic concern.

Concerns and issues:

1. **Displacement problems due to dams:**
    - The large-scale local population displacement from their ancestral homes and the loss of their traditional profession or occupation make the big river valley projects among the most detrimental socioeconomic effects.
    - It is estimated that over 20 million people in India have been impacted, either directly or indirectly, by the construction of large dams.
    - Affected by the Hirakund dam are over 20,000 people who were living in roughly 250 villages.
    - Since the Bhakra Nangal dam was built in the 1950s, not even half of the displaced people have been able to find new homes.
    - The Sardar Sarovar and Tetri dams share the same problems.
    - Displacement due to mining:
    - Mining operations cover thousands of hectares of land, uprooting native populations in the process.
    - Accidents that take place in mined areas, such as land subsidence, can occasionally cause locals to be uprooted and cause such movements.
    - Residents in Jharkhand's Jharia coal fields are being asked to leave because underground fires have been causing serious problems for them.
    - The cost of population relocation is expected to be approximately Rs. 18,000 crore, while the cost of putting out the fire is estimated to be approximately Rs. 8,000 crore.
2. **Displacement due to creation of national parks:**

- There is a social component to the designation of a forest area as a national park, even though it is a positive step toward the preservation of natural resources.
- The declaration of a large section of the forest as a core area restricts locals' access. Thus, they initiate acts of destruction.

The main problems with relocation and rehabilitation are:

- Women and broken families are the most negatively impacted; tribes are typically the most affected among the displaced who are already impoverished.
- The tribal people lack knowledge of market trends and policies.
- The dissolution of marriages, social and cultural institutions, folk songs, dances, and other activities; loss of identity and close ties among the populace

ENVIRONMENTAL ETHICS

Environmental ethical values must be fostered in order to instill in people a sensitivity to environmental degradation. Regardless of cultural differences, environmental ethics aims to define what is right and wrong. Respecting and caring for the Earth, preserving biodiversity, life-support systems, and ensuring sustainable development are all fundamental obligations that humans have to the natural world.

The following ethical principles regarding the environment should be instilled:

- Environmental consciousness
- Self-reliance
- Adoption of an eco-friendly culture
- Preservation of the planet's diversity
- Sharing of an environment; humility, reverence, responsibility, commitment,
- Respect for all living things and the environment;
- Global environmental citizenship;

The range of environmental activities for fostering environmental ethics includes:

1. Using recycled paper for notes and circulars

2. Moving waste from the kitchen to the garden
3. Turning off lights when not in use
4. Walking or bicycling; using public transportation
5. Collecting rainwater; avoiding using freshwater for gardening
6. Using cloth towels instead of paper towels
7. Avoiding needless outdoor lighting; organizing tree-plantation campaigns
8. Listening to radio programs on the environment and its problems
9. Setting up eco-clubs
10. Setting up trash cans and dustbins around the college grounds
11. Celebrating Environment Day on June 5 and Earth Day on April 22
12. Planting trees in and around the campus.
13. Preserving energy resources by avoiding needless energy waste
14. Cutting and putting on display images and newspaper cuttings portraying environmental crises
15. Putting on short plays about environmental crises to raise awareness of the issue

WILD LIFE PROTECTION ACT, 1972

1. It was established in 1972.
2. In 1976, Wild Life was moved from the state list to the concurrent list, granting the central government more authority.
3. The establishment of national parks and wildlife sanctuaries was a proactive endeavor undertaken by the Indian Board of Wildlife (IBWL).
4. It clarifies terminology pertaining to wildlife.
5. The appointment of the wild life warden and advisory board, as well as their responsibilities and powers
6. Creation of national parks and wildlife sanctuaries
7. An exhaustive list of threatened species of wildlife
8. Outlawing the taking of endangered animals by hunting
9. Preserving endangered species such as the blue vanda and ladies slipper orchid, among others

10. Trade and commerce in certain wild species that require a license to be sold, possessed, transferred, etc.
11. Outlawing the sale or trade of scheduled animals
12. Officers' legal authority and offenders' penalties
13. Several conservation initiatives were started to protect threatened species like crocodiles, lions, and tigers, among others.

Drawbacks

- There are only three years of imprisonment, a fine of Rs. twenty-five thousand, or both as the maximum punishments for offenders.
- Documents proving individual ownership of items pertaining to animals

THE WATER PREVENTION & CONTROL OF POLLUTION ACT 1974

1. It was started by Smt. Indira Gandhi following the Stockholm conference in 1974.
2. It is an act to provide for the prevention and control of water pollution, maintaining and restoring the wholesomeness of water.
3. The term "water pollution" refers to any modification of the physical, chemical, or biological properties of water that renders it unfit for its intended purpose in its unaltered state.
4. Offers water restoration and maintenance services.
5. Allows for the formation of State and federal pollution control boards.
6. Delegating to such boards duties and responsibilities
7. The steps involved and the different sanctions for noncompliance
8. The central boards
    - Will advise the government on issues related to controlling water pollution
    - Provide advice and counsel state boards
    - Organizing training and awareness programs
    - Gathering, compiling, and publishing pertinent technical data
    - Possibly establishing own laboratories for pollution analysis
9. State boards

- Develop pollution control programs
- Counsel state government
- Support research; oversee effluent treatment plants
- Establish or amend pollution release standards
- Maintain or alter sewage treatment and recycling facilities.

Drawbacks

1. The state boards suffer from a lack of resources and knowledge to carry out their missions.
2. The fines are far smaller than the price of equipment for pollution control and treatment

THE AIR PREVENTION & CONTROL OF POLLUTION ACT 1981

1. The act addresses air pollution prevention, control, and abatement.
2. According to the act, air pollution is any solid, liquid, or gaseous material (including noise) that is present in the atmosphere and has the potential to endanger people, other living things, plants, or property.
3. In 1987, noise pollution was added to the list of pollutants in the act.
4. The regulatory power is vested in pollution control boards at the federal or state levels.
5. Provisions outlining the constitution, authorities, roles, resources, audits, sanctions, and processes
6. Boards are required by section 17 to verify that industries are adhering to standards.
7. Section 20's provision for guaranteeing car emissions standards
8. The state government may designate a region as a "air pollution control area" and forbid the use of any fuel other than authorized fuel in the area that contributes to air pollution, after consulting with the state pollution control board (Under section 19)
9. An appellate authority has been established as a means of handling appeals (Under section 31)

Downsides

1) Insufficient funding and expertise prevent the state boards from pursuing their goals.

2) The fines are substantially lower than the price of treating and controlling pollution from cars (under section 20).

FOREST CONSERVATION ACT 1980

1. The act addresses the preservation of forests and associated issues.
2. The state government may only use forests for forestry operations.
3. The central government must give its prior consent before using it in any other capacity.
4. The clearing of forests for farming, mining, planting economically significant trees in place of some naturally occurring trees, and other non-forest activities
5. Some construction projects in the forest, such as building pipelines, fencing, and water holes, are exempt from non-forest activity regulations in order to protect wildlife or manage the forest.
6. Provisions for protecting all kinds of forests
7. Illegal non-forest activities can be put an immediate stop to within a forest area.
8. In 1992, the Act underwent some changes that permitted certain non-forest activities in forests, such as restricted tree cutting and seismic surveys, among other things.
9. It is strictly forbidden to engage in any non-forest activity in national parks and wild life sanctuaries.
10. The non-forest activities include the cultivation of oil-producing plants, tea, coffee, spices, and other plants.
11. The practice of tribal people cultivating tussier, a kind of insect that yields silk, in forested areas for their own subsistence is regarded as forestry.
    Twelve)
12. An EIA and cost-benefit analysis are required for any proposal for non-forest activity submitted to the central government.

Downsides

1. All decision-making regarding the use of the forest area is done at the top level, with no input from the local communities.

2. The tribe is prevented from stealing any resources and is forced to engage in criminal activity.

Summary:

A person's social surroundings comprise their place of employment and residence, their financial status, their educational background, and the communities they are a part of. In the end, it must minimize resource depletion, environmental harm, and social instability in order to reduce poverty among people in developing nations. Because of how quickly cities are growing, it is getting harder to fit all of the commercial, industrial, and residential facilities inside of a small municipality. Another development activity that drives native people away is mining. The native population is displaced as a result of mining operations covering thousands of hectares of land. Complex interactions between soil, landform, vegetation, land use, and water make up the watershed. Humans and animals coexist in a water shed and influence one another in different ways.

Key wards:

Chemical Wetting Agents: Chemical wetting agents help a liquid spread more widely by lowering the surface tension of water, which permits droplets to fall onto a surface.

Economic development: this term typically describes the persistent, coordinated efforts of communities and legislators to raise the standard of living and strengthen the local economy.

Rainwater harvesting: The process of collecting and storing rainwater for later use before it enters the aquifer is known as "rainwater harvesting."

Sustainable development: Although the phrase "sustainable development" is frequently overused, it is essential to addressing a number of interconnected global issues, including hunger, poverty, inequality, and environmental degradation.

Watershed Degradation: In part, this disconnect arises from the failure to recognize watersheds as essential social-ecological units in the context of sustainable management policies.

MCQ

1. What was the main subject of 1962's Silent Spring by Rachel Carson?
    i. The risk that growing population will cause resource depletion, which will result in worldwide poverty and starvation.
    ii. The possible destruction of the ecosystem by pesticides like DDT.
    iii. Rapid global warming brought on by the burning of fossil fuels and deforestation.
    iv. A computer virus that causes economic and social instability in a society that is overly reliant on technology and computers

2. Which of the following does not represent a significant environmental issue brought on by human meddling with the nitrogen cycle?
    i. The emission of nitrous oxide causes global warming.
    ii. More acid rain.
    iii. Eutrophication.
    iv. Depletion of stratosphere ozone.

3. Which of these doesn't qualify as a significant greenhouse gas?
    i. Water vapor.
    ii. Carbon Dioxide
    iii. Methane
    iv. Calcium carbonate

4. For what purpose did the parties to the 1987 Montreal Protocol sign it?
    i. To lessen the anthropogeni greenhouse effect, to start shifting from the use of fossil fuels to more renewable energy sources.
    ii. CFC use should be gradually phased out as it has been discovered to be causing ozone layer thinning.
    iii. Prohibiting the use of nuclear weapons in tropical seas.
    iv. To halt the international trade in goods derived from threatened or endangered tigers.

5. Approximately what percentage of the world's land area is utilized by the billion people who live there for grazing and agriculture?

   i. Three-quarters.
   ii. One-third.
   iii. 10 percent.
   iv. Half

Answers

1. (ii) 2.(iv) 3.(iv) 4.(ii) 5.(ii)

Important Questions

Give an explanation of sustainable development.

2. Describe population and the implications of it.
3. By "issues of human settlement," what do you mean?
4. Describe the energy-related issues facing cities.
5. Describe water management.
6. A little note on rainwater collection.