Uttar Pradesh Rajarshi Tandon Open University

Bachelor of Science

UGEVS-101 (N)

Fundaments of Environmental Sciences

COURSE INTRODUCTION

In this course learner will understand the basic concepts of environmental sciences. The student will learn how to the nature and living beings are depended each other's and how it use useful. We know environment effects on health, our food and our water bodies. To know about our nature and its principle are primary needs today. Our ancestors have deep knowledge to nature and its regulation and also have well understanding the weather and mansoon. The Vedic and modern concept of understanding the nature are discuss along the environmental education, environmental segment and environmental challenges in this course. The course is organized into following blocks:

Block 1 covers the concept of environmental history and evaluation.

Block 2 deals the understanding of environmental education.

Block 3 describes about the man and environmental sustainability.

Rajarshi Tandon Open University, Prayagraj

Fundaments of Environmental Sciences

Block- 1

Environmental History and Evaluation

UNIT -1

Vedic Concept of Environment

UNIT-2

Modern Concept of Environment

UNIT-3

Evolution

UGEVS-101N

Fundaments of Environmental Sciences

Rajarshi Tandon Open University, Prayagraj

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Unit-1: Vedic Concept of Environment

Contents

1.1.Introduction

The Vedic concept of the environment is rooted in the ancient Indian scriptures called Vedas. The Vedas are a collection of sacred texts that contain knowledge and wisdom passed down through generations of ancient Indian seers and sages. They provide a comprehensive understanding of the universe and the relationship between humans and nature. The Vedic concept of environment revolves around the idea of harmony and balance between human beings and nature. According to the Vedas, the environment is not merely a physical space but a living entity with which we interact. The environment is seen as a divine manifestation that provides us with sustenance, shelter, and resources necessary for our survival. The Vedas teach that all living beings are interconnected, and our actions have an impact on the environment and other living beings. One of the central principles of the Vedic concept of the environment is the concept of Ahimsa or non-violence. This principle urges humans to live in harmony with nature and not cause harm to any living being. The Vedas teach that humans should respect and protect nature, as it is essential for their survival. The Vedic concept of the environment recognizes the importance of the five elements - earth, water, fire, air, and ether - and their role in sustaining life on earth. These elements are considered to be the building blocks of nature and the universe. The Vedas teach that all living beings are composed of these five elements and are interconnected. he Vedas also emphasize the importance of living in balance with nature. This means that humans should not exploit nature for their selfish needs but should work towards sustainable living. The Vedas advocate for living a simple and minimalistic lifestyle and avoiding unnecessary

consumption and waste. he Vedic concept of environment also includes the concept of Yajna or sacrifice. This principle emphasizes the importance of giving back to nature and acknowledging the divine forces that sustain life on earth. Yojna involves performing rituals and offering sacrifices to the gods and nature as a sign of gratitude and respect.

Objectives

- To discuss the concept of veda in environmental conservation
- To discuss the Bhartiyagyanparampara
- To discuss the role of bhartiyavaigyanik in environmental conservation
- To discuss the moral and aesthetic nature of environmental science

1.2. Bhartiyagyanparamparaaurbhartiyavaigyanik

Bhartiya Gyan Parampara is the Indian knowledge system that has been passed down from generations and is an amalgamation of various fields of knowledge. It includes knowledge of philosophy, science, art, literature, music, and various other disciplines. The Bhartiya Gyan Parampara has always emphasized the importance of living in harmony with nature and respecting the environment. In recent times, Indian scientists have made significant contributions to the field of environmental science, drawing inspiration from the Bhartiya Gyan Parampara. ndian scientists have made significant contributions to the field of environmental science in the past few decades. They have been involved in various research projects that focus on understanding the impact of human activities on the environment and finding solutions to environmental problems. Some of the prominent Indian scientists who have made contributions to the field of environmental science are discussed below.

Dr. Vandana Shiva is an environmental activist and scholar who has worked extensively on issues related to agriculture, biodiversity, and sustainable development. She is the founder of Navdanya, a non-governmental organization that promotes conservation of biodiversity and sustainable agriculture. Dr. Shiva's work highlights the importance of traditional knowledge systems and the need to integrate them with modern scientific knowledge to achieve sustainable development.

Dr. Anil K. Gupta is a professor at the Indian Institute of Management, Ahmedabad, and is known for his work on grassroots innovations. Dr. Gupta has extensively studied the role of

traditional knowledge systems in innovation and has documented numerous examples of grassroots innovations that have contributed to sustainable development. His work emphasizes the importance of local knowledge systems and the need to recognize and support grassroots innovators.

Dr. MadhavGadgil is a prominent ecologist who has contributed significantly to the understanding of India's biodiversity. Dr. Gadgil's research focuses on understanding the ecological processes that govern the distribution and abundance of species in India. He has also worked on developing conservation strategies that are based on the principles of sustainable development.

Dr. SunitaNarain is an environmentalist and the director-general of the Centre for Science and Environment, a non-governmental organization that works on environmental issues. Dr. Narain's work focuses on environmental policy, advocacy, and communication. She has played a key role in shaping India's environmental policies and has advocated for the need to integrate environmental concerns into economic decision-making.

Dr. RaghunathMashelkar is a chemical engineer and former director-general of the Council of Scientific and Industrial Research. Dr. Mashelkar's work focuses on developing sustainable solutions to environmental problems, particularly in the areas of energy and water. He has also worked on developing sustainable technologies for agriculture and industry.

Dr. C.R. Babu is a prominent ecologist and professor at the University of Delhi. Dr. Babu's research focuses on ecological restoration, conservation biology, and ecosystem services. He has played a key role in restoring degraded ecosystems in India and has advocated for the need to integrate ecological restoration into land-use planning.

Dr. Joyashree Roy is an environmental economist and professor at Jadavpur University. Dr. Roy's work focuses on the economics of climate change, energy, and sustainable development. She has played a key role in developing sustainable energy policies for India and has advocated for the need to integrate environmental concerns into economic decision-making.

JadavPayeng is another environmentalist who has gained international recognition for his work. Payeng, also known as the "Forest Man of India," has spent over 40 years planting trees and

transforming a barren sandbar into a thriving forest ecosystem. His work has not only helped to restore the environment but also provided a home for numerous species of animals and birds.

Medha Patkar is an Indian social activist and politician, best known for her work on issues related to environmental and social justice. Patkar is the founder of the Narmada BachaoAndolan, a social movement aimed at protecting the rights of those affected by the construction of dams on the Narmada River in central India. Patkar's activism has been the subject of several documentaries, including "Narmada: A Valley Rises" and "Jai Bhim Comrade." She continues to be an important voice on issues of social and environmental justice in India.

SundarLalBahuguna was an Indian environmentalist and social activist, who is best known for his efforts to protect the Himalayan forests and the communities that depend on them. Bahuguna's activism was centered around the Chipko movement, a nonviolent movement that started in the 1970s in which local communities, mainly women, hugged trees to protect them from being cut down by contractors. This movement was instrumental in the conservation of forests and raising awareness about the importance of sustainable development. Bahuguna was also a vocal critic of large-scale hydroelectric projects in the Himalayas, such as the Tehri Dam. He believed that such projects were ecologically damaging and threatened the livelihoods of local communities. He undertook several hunger strikes to draw attention to the issue. In recognition of his work, Bahuguna was awarded the Padma Shri in 1981 and the Padma Vibhushan in 2009, two of India's highest civilian honors. He was also nominated for the Nobel Peace Prize in 2005. Bahuguna's legacy continues to inspire environmental and social activists in India and beyond.

Mahatma Gandhi and Dr. B.R. Ambedkar both had their own thoughts on the environment, which were shaped by their respective beliefs and life experiences.

Mahatma Gandhi believed in the principle of Ahimsa, which means non-violence or non-injury to all living beings. He emphasized the importance of living in harmony with nature and advocated for sustainable living. He believed that human beings should not exploit nature for their own selfish interests but should respect and protect it. Gandhi was a strong advocate of traditional methods of agriculture and believed that a society should be self-sufficient and not dependent on industrialization.

Dr. B.R. Ambedkar, on the other hand, was a strong advocate for the rights of marginalized communities and believed that access to resources, including environmental resources, should be equal for all. He believed that the environment should be protected not just for its intrinsic value but also for its utility to human society. Ambedkar emphasized the importance of education and awareness-raising in promoting environmental protection and conservation.Dr. Ambedkar's work on water management is particularly noteworthy. He was instrumental in the planning and construction of the Bhakra-Nangal Dam, one of India's largest multipurpose dams. Dr. Ambedkar also played a key role in drafting the Damodar Valley Corporation Act, which established an organization to manage the Damodar River basin for flood control, irrigation, and power generation. He emphasized the need for decentralized water management systems that involved local communities. He believed that traditional knowledge and practices should be integrated with modern science and technology to ensure sustainable use of water resources. He was concerned about the impact of industrialization and urbanization on the environment. He recognized the need for economic growth and development but argued that it should not come at the cost of the environment or the well-being of marginalized communities

Apart from these prominent environmentalists, India has many grassroots organizations and activists working to promote environmental sustainability and conservation. For example, the Chipko movement, which originated in the 1970s, was a grassroots movement that mobilized villagers to protect forests from commercial logging. The movement was successful in pressuring the Indian government to enact a moratorium on commercial logging in the region.

Another grassroots organization is the BeejBachaoAndolan, which works to conserve traditional seed varieties and promote sustainable agriculture. The organization was founded by farmers in the state of Uttarakhand in response to the introduction of genetically modified crops and the loss of traditional seed varieties. The organization has been successful in promoting sustainable agriculture and biodiversity conservation in the region. Despite the efforts of Indian environmentalists and activists, India continues to face numerous environmental challenges. Air pollution remains a major problem in many cities, with high levels of particulate matter and other pollutants contributing to respiratory illnesses and premature deaths. Water scarcity is also a growing concern in many parts of the country, with increasing demand for water.

In conclusion, the Bhartiya Gyan Parampara has always emphasized the importance of living in harmony with nature and respecting the environment. Indian scientists have drawn inspiration from this knowledge system and have made significant contributions to the field of environmental science. They have worked on understanding the impact of human activities on the environment, developing sustainable solutions to environmental problems, and advocating for the need to integrate environmental concerns into economic decision-making. The contributions of these scientists have played a key role in shaping India's environmental policies and have helped in promoting sustainable development.

1.3. Concept of Environmental conservation in Veda

The Vedas, the ancient scriptures of India, contain a wealth of knowledge and wisdom on various aspects of life, including the environment. Environmental conservation and sustainability were key values in Vedic society, and many passages in the Vedas emphasize the importance of protecting and preserving nature.

The Rigveda, the oldest of the Vedas, contains numerous references to nature and the environment. For example, one verse from the Rigveda says: "O Mother Earth, you who are rich in water, abundant in plants, and full of medicinal herbs, grant us your protection, so that we may live long and prosper." This verse highlights the importance of the earth's natural resources, such as water and plants, and the need to protect them for our well-being. The Vedas also acknowledge the interconnectedness of all living beings and emphasize the need to live in harmony with nature. For example, the Atharvaveda says:

May the forest be with us for a hundred autumns,
May the trees be with us for a hundred autumns,
May we live for a hundred autumns,
May we hear with our ears what is good and auspicious for a hundred autumns."

His passage shows the importance of the forest and trees in our lives and the need to protect them for future generations. The Vedas also prescribe certain rituals and practices that promote environmental conservation, such as the yajna or fire sacrifice. The yajna involves the offering of various materials such as grains, ghee, and herbs into a sacred fire. The smoke from the fire is believed to purify the environment and protect it from pollution.

The Vedas also highlight the importance of water conservation. For example, the Yajurveda says:

"May the waters, who are the mothers of plants, and who support the earth, protect us and make us prosperous."

This passage emphasizes the role of water in sustaining life and the need to conserve it. The Vedas prescribe certain rituals and practices that promote water conservation, such as the construction of stepwells and the digging of wells to harvest rainwater.

The Vedas also emphasize the importance of biodiversity conservation. The Atharvaveda says:

> The earth is my mother, I am her son.
> The great earth be pleased with me and
> may I be pleasing to the earth
> May the plants and herbs be pleased with me
> May the animals be pleased with me
> May the cows be pleased with me

This passage highlights the interconnectedness of all living beings and the need to respect and protect all forms of life. The Vedas also prescribe certain practices that promote biodiversity conservation, such as the protection of wildlife habitats and the preservation of sacred groves.

In conclusion, the Vedas contain a wealth of knowledge and wisdom on environmental conservation and sustainability. The Vedas emphasize the importance of protecting and preserving nature, living in harmony with it, and acknowledging the interconnectedness of all living beings. The Vedas prescribe certain rituals and practices that promote environmental conservation, such as the yajna and the construction of stepwells, and highlight the need to conserve water and biodiversity. The values and principles of environmental conservation in the Vedas continue to inspire people today to protect and preserve the environment for future generations.

1.4. Moral and aesthetic nature of environmental science

Environmental science is a field of study that explores the relationships between humans and the natural environment. It encompasses a wide range of disciplines, including ecology, geology, atmospheric science, and environmental policy. Environmental science is concerned not

only with the physical properties of the environment but also with its moral and aesthetic dimensions. The moral dimension of environmental science refers to the ethical considerations that arise from human interactions with the environment. Humans have a responsibility to protect and preserve the natural world, not only for our own benefit but also for the benefit of future generations. This responsibility is rooted in the principle of intergenerational equity, which states that present generations have a moral obligation to leave the environment in a condition that is at least as good as the condition in which it was received. This principle recognizes that humans are not the only stakeholders in the environment and that we must consider the needs and interests of other species and future generations when making decisions that affect the environment.

The Lord Buddha recognised the importance of education in, about, and for the environment. It was implicit in his teachings that he deeply cared about the environment and that he had an insight regarding ecosystems. His emphasis on harmonious co-existence between humans and nature, for example, demonstrates his understanding of the interdependence among all living things and their environment.

Buddhist teaching on preservation of nature Buddhism has had a long and close relationship with nature and, in particular, forests. The Lord Buddha was born under the Sala tree, enlightened under the Bodhi tree, gave his first sermon in the forest named Isippatanamarukatayawan, and died under the Sala tree (Religious Development Committee, 1992). The Lord Buddha lived closely with nature and taught his followers to take care of nature. The first precept is to abstain from taking life of living forms. This precept is based on loving-kindness and can be seen as an environmental ethic to conserve animals and plants. More specifically, the Lord Buddha was supportive of water conservation as seen in the discipline he introduced prohibiting monks and nuns from disposing waste into canals or rivers. It is considered sinful to pollute water because all life forms depend on water to survive. In addition, according to Phra Buddadasa Bhikkhu, deforestation is unacceptable in Buddhism, and it is important to show respect for trees that provide food, canopy and protection for all forest-dwellers. More generally, Buddhism emphasises the importance of human harmonious co-existing with nature while denouncing human conquering of nature. It also emphasises compassion, respect for all living creatures, and harmony between living things sharing the planet

Environmental ethics is a branch of philosophy that seeks to explore the moral dimensions of environmental issues. Environmental ethicists examine questions such as: What are our moral obligations to the environment? How do we balance the needs and interests of humans and other species? What is the value of biodiversity, and how do we weigh it against other values, such as economic growth or human convenience? These are complex questions with no easy answers, but they are essential for guiding our actions and policies in the face of environmental challenges. The aesthetic dimension of environmental science refers to the emotional and cultural connections that humans have with the natural world. Humans have a deep appreciation for the beauty and complexity of nature, and this appreciation can inspire us to protect and preserve the environment. Environmental aesthetics is a field of study that explores the ways in which humans perceive and value the environment. It examines questions such as: What is beauty in nature, and how do we appreciate it? How does our emotional connection to nature influence our behavior and decision-making? How can we use art and literature to inspire environmental action.

Environmental aesthetics is not just an academic pursuit but also has practical implications for environmental management and conservation. For example, the design of parks and protected areas can be informed by aesthetic considerations, such as the preservation of scenic vistas or the promotion of biodiversity. Environmental education programs can also incorporate aesthetic elements, such as nature walks or art classes, to help students develop a deeper appreciation and connection with the natural world. The moral and aesthetic dimensions of environmental science are not separate from its scientific and technical dimensions but are integral to them. Environmental problems are not just technical challenges to be solved by experts but also have ethical and cultural dimensions that require input from a wide range of stakeholders. Scientists and policymakers must consider not only the physical properties of the environment but also the values and beliefs that shape human behavior and decision-making. he moral and aesthetic dimensions of environmental science are essential for understanding and addressing environmental challenges. The moral dimension emphasizes the ethical considerations that arise from human interactions with the environment and the need to protect and preserve the natural world for future generations. The aesthetic dimension highlights the emotional and cultural connections that humans have with the natural world and the ways in which these connections can inspire environmental action. By recognizing the moral and

aesthetic dimensions of environmental science, we can develop more holistic and effective approaches to environmental management and conservation.

1.5. Objectives and historic roots of the environmental science

Environmental science is an interdisciplinary field that focuses on the study of the natural environment and its interaction with human society. It has its roots in the natural sciences, such as ecology and geology, as well as social sciences, such as economics and political science. The objective of environmental science is to understand the complexities of the environment and to develop strategies to protect and manage it in a sustainable manner.

The roots of environmental science can be traced back to the early civilizations of Mesopotamia, Egypt, and the Indus Valley, where humans began to manipulate the environment for agriculture and other purposes. These early civilizations developed systems of irrigation, drainage, and crop rotation, which are still used today. However, the environmental impacts of these activities were not fully understood, and many civilizations eventually collapsed due to environmental degradation. In the Western world, the scientific study of the environment began in the 18th and 19th centuries, with the emergence of natural history and geology. Naturalists such as Alexander von Humboldt and Charles Darwin began to study the diversity of life on Earth and the interactions between living organisms and their environment. Geologists such as James Hutton and Charles Lyell developed theories of the Earth's history and the processes that shape its surface. The early 20th century saw the emergence of conservation movements, as people began to recognize the environmental impacts of industrialization and urbanization. The conservation movement focused on the protection of natural areas and the preservation of wildlife, and it was led by figures such as John Muir and Theodore Roosevelt.

The 1960s and 1970s marked a turning point in the history of environmental science, as concerns about pollution and the degradation of natural resources reached a critical mass. The publication of Rachel Carson's book "Silent Spring" in 1962, which documented the negative effects of pesticides on wildlife and human health, was a key catalyst for the modern environmental movement. The first Earth Day was held in 1970, and it brought together millions of people around the world to demand action on environmental issues. Since then, environmental science has become an increasingly important field of study, as the environmental challenges facing humanity have become more complex and urgent. The scientific study of the environment

has been enriched by advances in technology, such as remote sensing, geographic information systems, and computer modeling, which allow scientists to collect and analyze vast amounts of data about the environment.

Today, environmental science is a highly interdisciplinary field, drawing on knowledge and techniques from a wide range of disciplines, including ecology, geology, atmospheric science, environmental chemistry, and social science. The objective of environmental science is to understand the interactions between humans and the environment, and to develop strategies to protect and manage the environment in a sustainable manner. One of the key objectives of environmental science is to understand the impacts of human activities on the environment. Human activities such as agriculture, urbanization, and industrialization have led to deforestation, pollution, and the depletion of natural resources. Environmental scientists use a variety of methods to measure and quantify these impacts, including air and water quality monitoring, soil analysis, and ecological surveys.

Another objective of environmental science is to develop strategies to mitigate the negative impacts of human activities on the environment. This can involve developing technologies that reduce pollution, such as catalytic converters for cars, or designing buildings that are energy-efficient and use renewable energy sources. Environmental scientists also work to develop policies and regulations that promote sustainable development and protect the environment. The historic roots of environmental science have had a significant impact on the development of the field. The recognition of the interdependence between humans and the environment, which dates back to the early civilizations, has become a fundamental principle of environmental science. The emergence of natural history and geology in the 18th and 19th centuries provided the foundation for the scientific study

1.6. Summary

The Vedic concept of environment is based on the principles of interdependence, balance, and harmony between humans and nature. The Vedas, which are ancient scriptures of India, recognize the interconnectedness of all living and non-living things and emphasize the importance of respecting and preserving the environment. According to the Vedas, the environment is not just a physical entity, but also a spiritual and moral one. The environment is seen as a manifestation of the divine and a source of inspiration and wisdom. The Vedas promote

the idea of living in harmony with nature, rather than dominating or exploiting it. The Vedas recognize the importance of preserving natural resources, such as water and forests, and advocate for sustainable practices, such as agriculture and animal husbandry. The Vedas also recognize the negative impacts of human activities on the environment, such as pollution and deforestation, and emphasize the need to minimize these impacts. Overall, the Vedic concept of environment promotes a holistic and sustainable approach to environmental conservation, based on respect for nature and a deep understanding of its interconnectedness with human society.

1.7. Terminal questions

Q.1 What can modern societies learn from the Vedic concept of environment and how can this knowledge be applied to address the environmental challenges of today?

Answer:----------

Q.2 What is the bhartiyagyanparampara of environmental conservation?

Answer:----------

Q.3 Discuss the role of Veda in environmental conservation.

Answer:----------

Q.4 Discuss the Objectives and historic roots of the environmental science.

Answer:----------

Q.5 Discuss the moral and aesthetic nature of environmental science.

Answer:----------

1.8. Further suggested readings

1. S.C. Sandra, "Environmental Science", A new Central Book Agency,2008
2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017

3. NeerjNachiketa, Environment and Ecology: A Dynamic Approach, G.K. Publication Ltd, 2021
4. V. K. Ahluwalia, "Environmental Science, Ane Books India, 2013S.
5. M.C. Dash, "Concepts of Environmental Management for Sustainable Develop Concepts of Environmental Management for Sustainable Development, I K International Publishing House Pvt. Ltd

Unit-2: Modern Concept of Environment

1. Introduction

Objectives

2. Principles environmental science
3. Concept of environmental studies
4. Concept of environmental technology
5. Concept of environmental chemistry

2.5.1. Atmospheric chemistry

2.5.2. Soil chemistry:

2.5.3. Aquatic chemistry:

2.5.4. Toxicological chemistry

2.5.5. Green chemistry

6. Concept of environmental biotechnology
7. Concept of environmental microbiology
8. Environmental awareness
9. Summary
10. Terminal questions
11. Further suggested readings

2.1. Introduction

Environmental science is the study of interactions between the physical, chemical and biological components of the environment. The objectives of environmental education is to in lighted the public particularity students, about important of protection and conservation of our environment and need to restrain human activities for sustainable development. Science helps us understanding both how this work and how we can make our environment safer, more comfortable, and more enduring. Environment literally means surroundings include biotic and abiotic factors.Environmental studies deals with interaction of various living organisms and itsrelationship with nonliving environment (matter and energy). The knowledge being gained by scientist is fundamental to our ability to manage the earth's resources in as sustainable manner

and to improve the quality of life. The environmental scientists work on the different aspect of nature and solve the problem for good and clear environment. Because of significant of scientist findings and understanding the environmental science is becoming increasingly necessary for any educational person. At present many environmental issues, which have grown in size and complexity day by day, threaten the survival of mankind on earth. So it need to learn the principle of environmental science and protect our environment.

Objectives

- Creating the awareness about environmental problems among people.
- Imparting basic knowledge about the environment and its allied problems.
- Developing an attitude of concern for the environment.
- Motivating public to participate in environment protection and environment improvement.

2.2. Concept of environmental science

The environmental science is the systematic study of our environment and our place. Environmental studies deals with interaction of various living organisms and its relationship with nonliving environment (matter and energy). This is important branch of science which integrates wide range of disciplines including physics, chemistry, biology, engineering, sociology, geology and resource technology etc. As per Douglas and Holland the describe environments“ in the aggregate, all the external forces, influences and conditions, which affect the life, nature, behavior and the growth, development and maturity of living organisms’’. Relatively it is new field for of interdisciplinary study of science and social science. It encompasses the study of the Earth's air, water, soil, and biotic systems, as well as the impacts of human activities on these systems. It integrates information form biology, chemistry, agriculture, geography and other related field. Environmental Science attempts to explain how life on Earth is sustained, what contributes to our many environmental problems, and how these problems can be solved. Environmental Science & Management stands at the interface between humans and the Earth and explores the interactions and relations between them.

One of the key principles of environmental science is the understanding that the environment is a complex and dynamic system that is affected by many different factors.

Environmental scientists use a range of tools and techniques, such as GIS, remote sensing, and statistical analysis, to study the environment and to understand how it is changing over time.

The scope of environmental science is broad and encompasses many different disciplines and subfields, including ecology, geology, atmospheric science, hydrology, and oceanography. Environmental scientists work on a wide range of issues, from air and water pollution to climate change to conservation biology. The environment mainly consists of atmosphere, lithosphere and hydrosphere.Atmosphere is protective layer of gases, surrounding the earth and mainly composedof N2, O2, CO2 and other trace gases. Biosphere indicates the realm of living organisms and their interactions with atmosphere, hydrosphere and lithosphere.Lithosphere is solid earth consist of minerals, earth crusts of minerals and organicmatter, air and water whereas hydrosphere consist of oceans, seas, lakes, rivers,streams, reservoir, polar icecaps, glaciers, and ground water. They also work in a variety of settings, including government agencies, non-profit organizations, and private industry, and research institutions.

2.3. Concept of environmental studies

Environmental Studies is an interdisciplinary field that draws on knowledge and analytical tools from many areas of study to understand the function of natural ecosystems, the effects of human societies on the environment, and the role that the environment has played in shaping human cultures and artistic endeavors. Environmental studies are the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment. Environmental studies deals with every issue that affects an organism. According to UNESCO (1971), the objectives of environmental studies are:

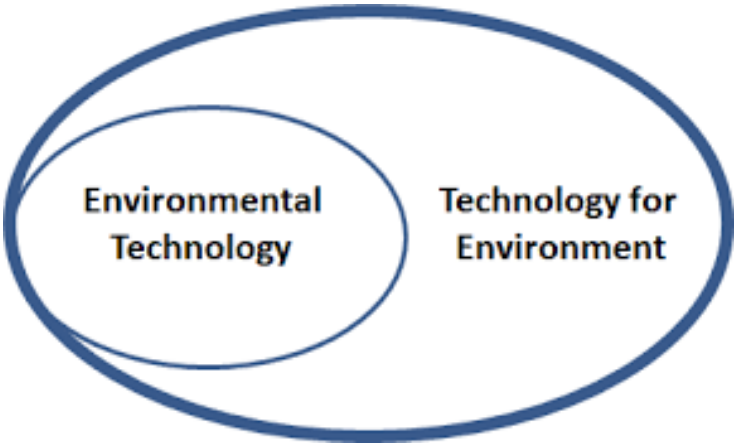
(a) Creating the awareness about environmental problems among people.

(b) Imparting basic knowledge about the environment and its allied problems.

The major in Environmental Studies and Sustainability prepares students for careers in policy-making, education, conservation, government service, research, and the arts. Students will also be well prepared to work for non-governmental organizations or enter into post-graduate studies in environmental law, urban planning, and scientific disciplines such as ecology.

2.4. Concept of environmental technology

Environmental Technology is the advanced branch of environmental science, where the technological aspect is used to resolve the environmental problems. Thus we can say that environmental technology is green or clean technology where technological principle works on the environmental principles. It is the technologies which aim to conserve, monitor or reduce the negative impact of technology on the environment and the consumption of resources. This technology is useful in the sustainable energy generation, waste minimization, air, water, and soil pollution control and monitoring. It is also useful to analyzing and assessment of forest resource, landscape and habitat degradation. Sustainable development is the core of environmental technologies.



The term environmental technologies are also used to describe a class of electronic devices that can promote sustainable management of resources. However, environmental technologies aim to protect the environment. They offer ways of consuming which are less polluting or do so in a sustainable manner, and often provide new ways to avoid depletion of natural resources altogether. The role of environmental technology is in environmental monitoring that is useful in analysis and monitoring of quality of the environment. Environmental monitoring has emerged as an essential component of governmental and private organization policies across the globe.

2.5. Concept of environmental chemistry

The environmental chemistry is the branch of environmental sciences which deals the chemical and biochemical phenomenon of nature and also the origin, transport, reactions, effects

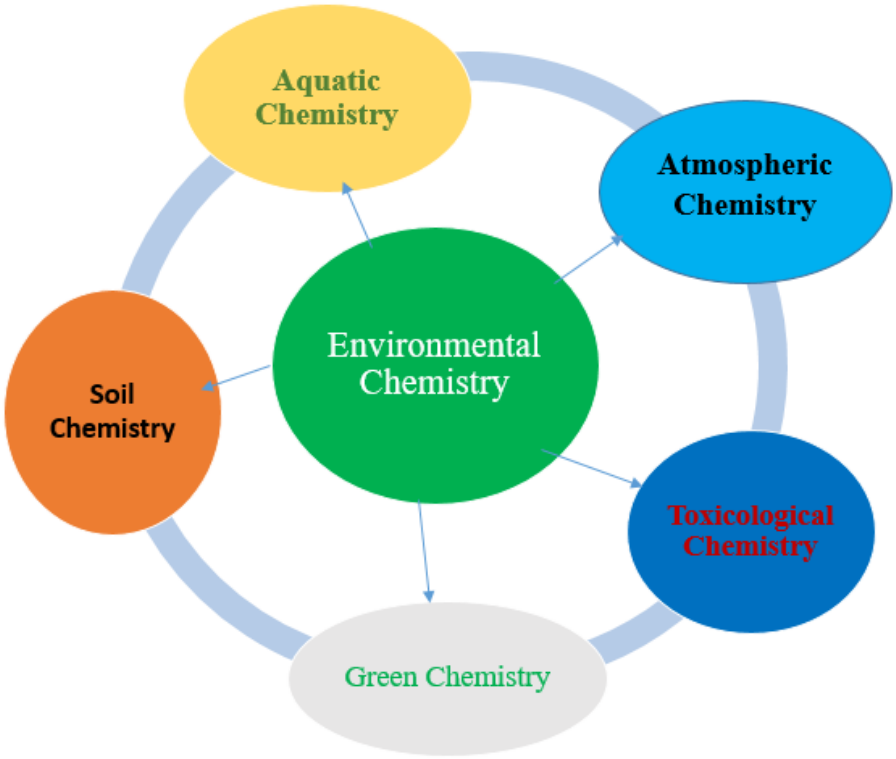
and fates of chemical species in the environment. Environmental chemistry is the systematic study of chemical transformation, chemical accumulation and chemical fate of chemical element in environmental segments. Thus we can say that the environmental chemistry involved the study of the effects that chemical have on the air, water and soil. There are several aspect of environmental chemistry, such as pollution, waste minimization and treatment etc.

Environmental chemistry involves first understanding how the uncontaminated environment works, which chemicals in what concentrations are present naturally, and with what effects. Without this it would be impossible to accurately study the effects humans have on the environment through the release of chemicals. Environmental Chemists are therefore often the more public-facing chemists, as the research they conduct helps inform decisions that affect all of us. Environmental chemistry is an interdisciplinary science that includes atmospheric, aquatic and soil chemistry. Environmental chemistry work on the fundaments of principle of many subjects area, including organic chemistry, physical chemistry, inorganic chemistry, soil chemistry, biochemistry, toxicology and ecology. The environmental chemistry also deals with the chemistry of organic and inorganic compounds, whether they are produced on purpose or generated as by-products of industrial processes, and about their reactivity and their interactions with living systems. In addition, mostly through chemistry of pollution and chemistry of toxic material in natural habitat. Environmental chemistry is used in monitoring and analysis of water quality include dissolved oxygen (DO), chemical oxygen demand (COD), biochemical oxygen demand (BOD), total dissolve solids (TDS), pH, Nutrients, heavy metals, soil chemical (including copper, zinc, lead and mercury and pesticides and herbicides.

The objectives of environmental educiton are to enlighten the public and students about important of protection and conservation of our environment. Environmental chemistry is part of environmental chemistry is part of environmental education. At present there are many environment issues which have grown in size and complexity day by day, threatening the survival of mankind on earth.

Environmental science involves first understanding how we the uncontaminated environment work, which chemical in what concentrations are present naturally, and with what effects. Without it will be would be impossible to accurately study the effects on human beings.

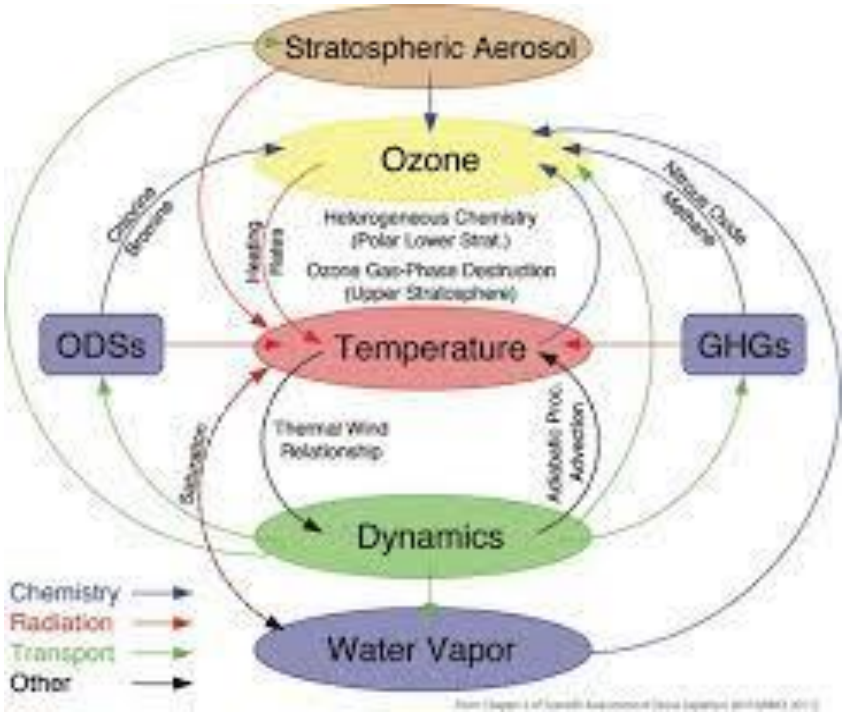
Today, with increasing population of earth, human activities have increases and influence the chemical nature in environment that affects natural balance.



2.5.1. Atmospheric chemistry

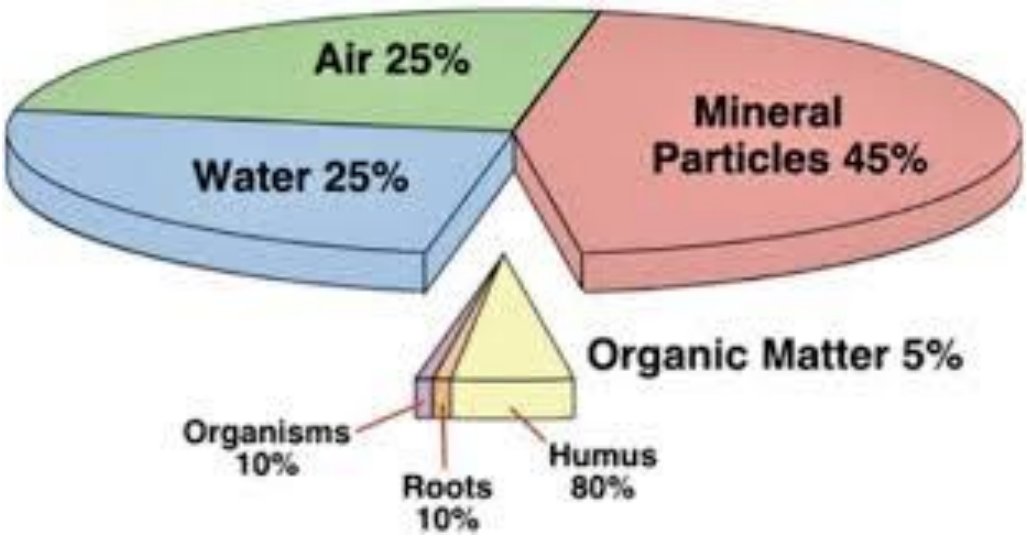
Atmospheric chemistry deals the chemical process and elements present in atmosphere, in include chemistry of air pollution and global climate change from the gases and particles. Chemistry of ozone and aerosol are the main components of atmospheric chemistry. The atmospheric chemistry helps researchers to determine the effects and magnitude of emissions on, for example, the production of ozone (O_3), particulate matter, acids, photochemical smog and other air pollutants. This chemistry is described by a complex array of elementary reactions. An elementary reaction is defined as a chemical transformation that occurs in a single molecular step.

A chemical mechanism is a series of elementary reactions that describe the overall *chemical* change that occurs in chemical entities in the atmosphere. Gas-phase chemical mechanisms are vital components of the atmospheric models used to describe this chemistry.



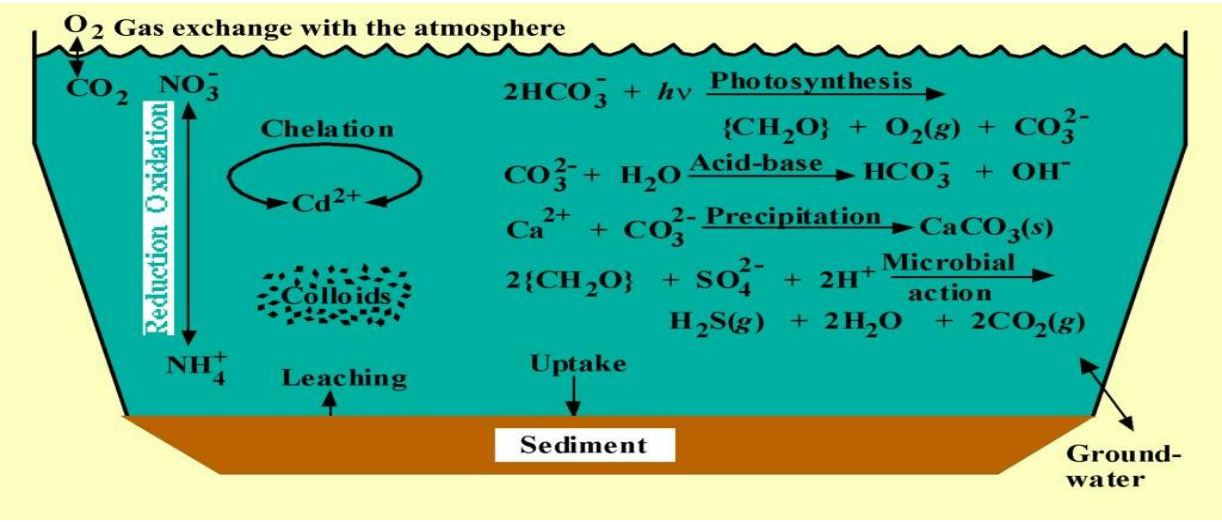
2.5.2. Soil chemistry:

Soil chemistry is the branch of soil science that deals with the chemical composition, chemical properties, and chemical reactions of soils. Soils are heterogeneous mixtures of air, water, inorganic and organic solids, and microorganisms. Soil chemistry traditionally focused on the chemical reactions in soils that affect plant growth and plant nutrition. Knowledge of environmental soil chemistry is fundamental in predicting the fate of contaminants in the surface and subsurface environments. An understanding of the chemistry and mineralogy of inorganic and organic soil components is necessary to comprehend the array of chemical reactions that contaminants may undergo in the soil environment. Soils are complex assemblies of solids, liquids, and gases. The inorganic components of soils represent more than 90% of the solid components. Their properties such as size, surface area, and charge behavior, greatly affect many important equilibrium and kinetic reactions and processes in soils.



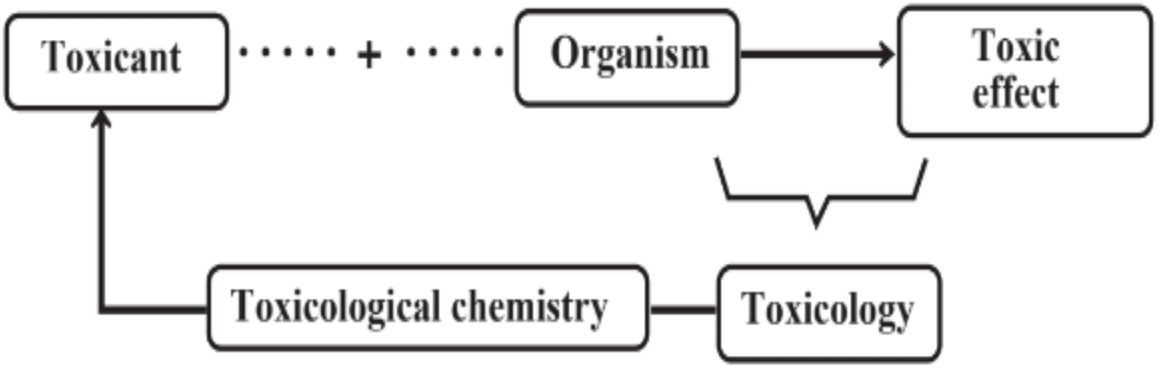
2.5.3.Aquatic chemistry:

Aquatic Environmental Chemistry covers the composition and underlying properties of both freshwater and marine systems and, within this framework, explains the effects of acidity, complexation, oxidation and reduction processes, and sedimentation. Aquatic chemistry deals the chemistry of water of all reservoirs and ocean. The water quality parameters such as pH, acidity, alkalinity, Biological oxygen demand, chemical oxygen demand, Dissolve oxygen, nitrate, phosphates, sulfates, chlorine, sodium and other organic and inorganic compounds were estimated.



2.5.4.Toxicological chemistry

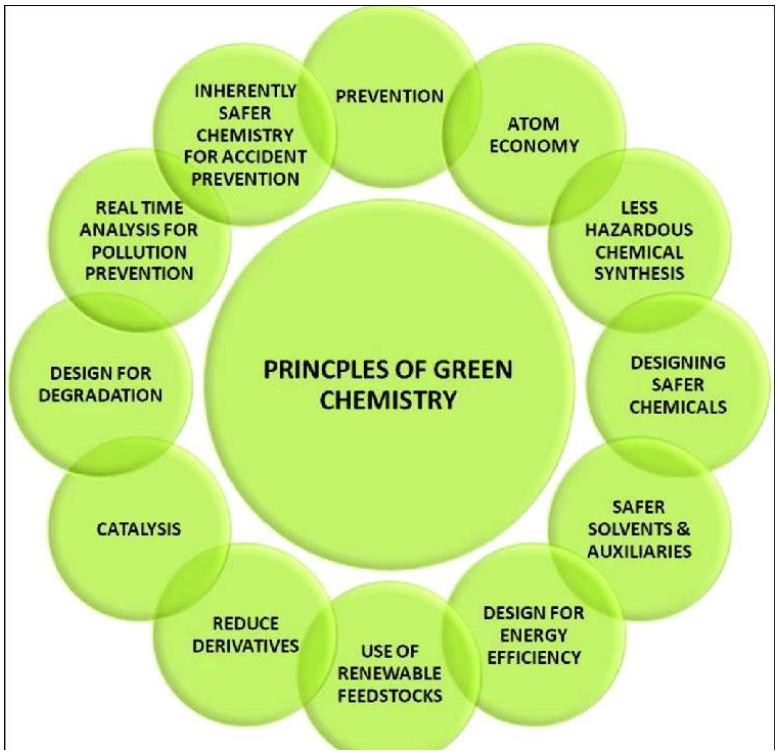
Toxicological chemistry is the science that deals with the chemical nature and reactions of toxic substances, their origins and uses, and the chemical aspects of their exposure, transformation, and elimination by biological systems. It emphasized the chemical formulas, structures, and reactions of toxic substances.



The nature of toxic substances depends upon their chemical characteristics, how they are bonded together, and how they react. Mechanisms of toxicity are basically chemical in nature. Chemical processes carried out by organisms play a strong role in determining the fates of toxic substances. In some cases, chemical modification of toxicants by organisms reduces the toxicity of chemical substances or makes them entirely nontoxic. In other cases, chemical activation of foreign compounds makes them more toxic. For example, benzo(a)pyrene, a substance produced by the partial combustion of organic matter, such as that which occurs when smoking cigarettes, is not itself toxic, but it reacts with oxygen through the action of enzymes in the body to produce a species that can bind with DNA and cause cancer**.**

2.5.5. Green chemistry

Recently for clean and need environment, environmental scientist adopted the principle of green chemistry. The green chemistry is seeks to reduce potential pollution of sources by using alternative process of productions. Thus we can say that the green chemistry deals with the design of chemical products and processes that reduce or eliminate and generation of hazardous substances.



However, green chemistry seeks to

- Reduced waste and consumption of resources
- Initially used renewal resources and reduce energy consumption
- Chemicals that are less hazardous to human health and the environment are: Less toxic to organisms.
- Designs chemical products and processes to reduce their intrinsic hazards
- Applies innovative scientific solutions to real-world environmental problem
- Reduces the negative impacts of chemical products and processes on human health and the environment.

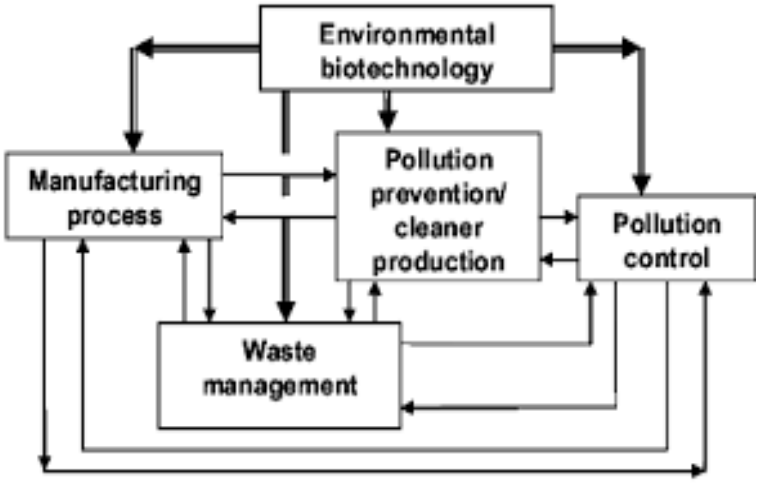
2.6. Concept of environmental biotechnology

Biotechnology is the advanced field of biological science, which work on principle and basic and engineering science. It is one of the important major technologies of the twenty-first

century with broad multidisciplinary application including protection of environment to production of biomaterials.

Biotechnology is the emerging field of biological research and development has lots of application in medical, agriculture, forestry, industry as well as in field of nanotechnology. It also has equally importance area of global concern that has emerged recently the environmental application. Thus it is clear that the environmental "biotechnology is the branch of biotechnology that deals the environmental problems such as waste minimization, removal of heavy metals, energy generation, and biomass and fertilizer production by exploiting biological resources". Understanding the environment and its components is very important to use biotechnology for the sustainable development. Environmental biotechnology can be used to detect, prevent and remediate the emission of pollutant in the environmental, it also the use of bacteria to break down pollutants in water and soil, the use of algae to absorb excess nutrients from wastewater, and the use of fungi to decompose organic matter in landfills. Biotechnological mechanism has to apply for modification of solid, liquid and gaseous waste to make a new product or also modify the end product for less harmful to the environment. Replacing chemical materials and processes with biological technologies can reduce environmental damage.

Today, environmental biotechnology is fastest growing and most practically field for the contribution of sustainable development because of their eco-friendly principles. Research into the genetics, biochemistry and physiology of exploitable microorganisms is rapidly being translated into commercially available technologies for reversing and preventing further deterioration of the earth's environment.



The aim of environmental biotechnology is to prevent arrest and reverse environmental degradation through the appropriate use of biotechnology in combination with other technologies, while supporting safety procedures as a primary component of the programme. Such principle of environmental biotechnology, merged into new area of research and development as bioremediation, argumentation and bioaccumulations, the bioremediation is the recent field of biotechnology which used living organism to degrade environmental pollutants or to prevent pollution through waste treatment. Bioremediation is emerging as most ideal alternative technology for removing pollutants from the environment, restoring contaminated sites and preventing further pollution. Environmental biotechnology is useful for the Waste Water and Industrial Effluents treatment, Aerobic Biological Treatment, Activated Sludge Process, Soil and Land Treatment, Air and Waste Gases treatment, Genetic Engineering and Enzyme Application. Five environmental buzzwords are the 5rs for efficient use of energy and better control of waste, which might help in sustainable development and quality living by environmental biotechnology such as

- Reduce (Reduction of waste)
- Reuse (Efficient use of water, energy)
- Recycle (Recycling of wastes)
- Replace (Replacement of toxic/hazardous raw materials for more environment- friendly inputs) 5
- Recover (useful non-toxic fractions from wastes)

2.7. Environmental microbiology

Environmental microbiology is the scientific study of microorganisms in the environment. This discipline includes air microbiology, soil microbiology and water microbiology. In addition, the environmental microbiology is the study of how microbes interact with the environment and each other, including their effects on the landscape, the spread of viruses and bacteria, the distribution of algae, fungi and parasitical organisms and the associated implications for human health and the environment.

Environmental microbiology also researches how microbes can be used to solve global problems. For example, an environmental microbiologist may study the use of microbes to clean

up oil spills or other contaminated areas or use organisms that thrive in certain elements to create medicines, topical sunscreens and water purification solutions. The microbiology is most closely related to field of microbial ecology which comprises the study of the interaction of microorganism with an environment. Thus it's associated with soil, water and air microbiology for their microbial diversity and its significance for environmental contamination. Because the environmental microbes can affect so many aspects of life, and are easily transported between environments, the field of environmental microbiology interfaces with a number of different subspecialties, including soil, aquatic, and aero microbiology, as well as bioremediation, water quality, occupational health and infection control, food safety, and industrial microbiology.

Several events occurred simultaneously that highlighted the need for a better understanding of environmental microorganisms. The first of these events was the emergence of a series of new waterborne and food borne pathogens that posed a threat to both human and animal health. In the same time frame it became increasingly apparent that, as a result of past waste disposal practices, both surface water and groundwater supplies are frequently contaminated with organic and inorganic chemicals.

Microorganisms including pathogens present in surface water and soil are regularly or at least less frequently enter aquifers through possible routes. The possibility of groundwater contamination is determined by the survival and transport rate of pathogens within the system. Organisms usually survive longer in such systems if organic matter is readily accessible, as it can

be a source of nutrients for the microorganisms. Though, antibiotics and other toxic organic materials will reduce the growth and survival rate of pathogens. Microorganisms flourish in moist soil due to water as a substrate and facilitate nutrient transport, and decomposition of organic contaminates in water. The microbial communities are expected to include heterotrophs and chemolitho autotrophs, which are attuned to living in nutrient-deficient and anaerobic conditions, particularly for deep and confined aquifers. Thus, the microbial communities appear in aquifers are oligotrophs and k-strategists that reproduce slowly and have low tolerance to rapid changes.

2.8. Environmental awareness

Environmentalism is an ideology that places the need and responsibility of humans to respect, protect and defend the natural world from the damages caused by the previous and current generation of humans. Environmental awareness is an essential component for the movement to become a success. By teaching our friends and family that the physical environment is indispensable. By taking the utmost care, we can solve the problems that threaten it. The only important thing to do with an environmental awareness campaign is to make people aware of the dangers of excessive consumption that we are doing than needed. People need to better understand the threats to our planet to realize our environment's depth of concern. Therefore, there is awareness of issues such as environmental health, global warming, and sustainable development. There is no doubt that human activities have a great record in damaging the environment. The concentration of greenhouse gases has increased by a third since the Industrial Revolution shows our lack of concern towards the environment. Hence, we have to improve our environment and ensure that our behavior contributes to its sustainability. he increase in greenhouse gas emissions has led to the **greenhouse effect**, which has led to global warming. These gases also cause water, air, and land pollution. We can conduct an environmental awareness campaign which can help in-

1. Imparting basic knowledge about environmental issues and at the primary school level.
2. Creating real-life conditions of the environment at the secondary school level to understand the environmental problems.
3. Developing problem-solving skills about managing natural resources at the secondary school level.

4. Sustainable development and conservation of natural resources at the college and university level for experiments and solutions to environmental problems and issues.

2.9. Summary

In summary, Environmental Science is an interdisciplinary field that studies the interactions between the natural environment and human society. It encompasses the study of the Earth's air, water, soil, and biotic systems, as well as the impacts of human activities on these systems. Environmental science provides a framework for understanding the complex relationships between natural resources, pollution, climate change, and other environmental issues, and helps to develop solutions to mitigate and adapt to these challenges. Principles of environmental science include understanding the complexity of the environment and the importance of sustainability. The scope of environmental science is broad, encompasses various disciplines and subfields and addresses a wide range of environmental issues. Environmental Science attempts to explain how life on Earth is sustained, what contributes to our many environmental problems, and how these problems can be solved. Biotechnology is the emerging field of biological research and development has lots of application in medical, agriculture, forestry, industry as well as in field of nanotechnology. Environmental microbiology also researches how microbes can be used to solve global problems.

2.10. Terminal questions

Q.1: What is the environment? Discuss the factors affecting the environment.

Answer:----------

Q.2: What is the environmental science and environmental study? Discuss the principle and scope of environmental science.

Answer:----------

Q.3: What is the environmental chemistry? How chemistry is relevant with environmental chemistry.

Answer:----------

Q.4: What the aquatic environmental chemistry? Discuss briefly.

Answer:----------

Q.5: Discuss about environmental microbiology.

Answer:----------

Q.6: Why environmental awareness is needful for human beings.

Answer:----------

2.11.Further suggested readings

1. S.C. Sandra, "Environmental Science", A new Central Book Agency,2008
2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017
3. NeerjNachiketa, Environment and Ecology: A Dynamic Approach, G.K. Publication Ltd, 2021
4. V. K. Ahluwalia, "Environmental Science, Ane Books India, 2013S.
5. M.C. Dash, "Concepts of Environmental Management for Sustainable Develop Concepts of Environmental Management for Sustainable Development, I K International Publishing House Pvt. Ltd

Unit-3: Evolution

3.1. Introduction

Biological evaluation is the gradual change in living beings, it is complexes of change in to a different things. This changes is occurs with the time and steady way. The evaluation is two types such as micro evolution and macroevolution. He micro evaluation is refers to change in

appearance of populations and species over generation with the time duration. The change is occurs in mean and modal phenotype, morphrations etc. There are several factors are directly and indirectly involved for the process of evaluation. This change appear with in population from one generation to next generation. The small-scale evolution can be observed in nature or generated experimentally in the laboratory. The macro generation is refers to change in large scales phyletic change over geological time as well as extinctions of taxa with such group. Darwin's theory of evolution was propelled by the works of naturalists, geologists and population theorists. A large body of evidences from biogeography, embryology and anatomy however, helped him formulate the theory of evolution by natural selection. In his work On the Origin of Species (Darwin 2009), he laid down three observations and proposed two implications. The first observation was that all organisms have the ability of explosive population growth that can use up all the food. Evolutionary forces subject human populations to changes in biological traits that are inherited through generations. Studying these biological differences among human populations in an evolutionary framework comes under the purview of biological anthropology in general and population genetics in particular. It deals with assessment of genetic differences underlying biological traits to comprehend the allele and genotype frequencies in populations and predicting the way they would change over a period of time.

Objectives

- To discuss the process of evaluation
- To discuss the various theory of origin
- To discuss the Darwinism and natural selection
- To discuss the Hardy -Weinberg equilibrium

3.2. Darwinism

Darwinism designates a distinctive form of evolutionary explanation for the history and diversity of life on earth. Its original formulation is provided in the first edition of *On the Origin of Species* in 1859. This entry first formulates 'Darwin's Darwinism' in terms of five philosophically distinctive themes:

(i) probability and chance,

(ii) the nature, power and scope of selection,

(iii)adaptation and teleology,

(iv)nominalism vs. essentialism about species and

(v) the tempo and mode of evolutionary change.

Both Darwin and his critics recognized that his approach to evolution was distinctive on each of these topics, and it remains true that, though Darwinism has developed in many ways unforeseen by Darwin, its proponents and critics continue to differentiate it from other approaches in evolutionary biology by focusing on these themes. This point is illustrated in the second half of the entry by looking at current debates in the philosophy of evolutionary biology on these five themes.

3.3. Speciation

Speciation is how a new kind of plant or animal species is created. It is lineage splitting event that produces two or more separate species. Speciation occurs when a group within a species separates from other members of its species and develops its own unique characteristics.

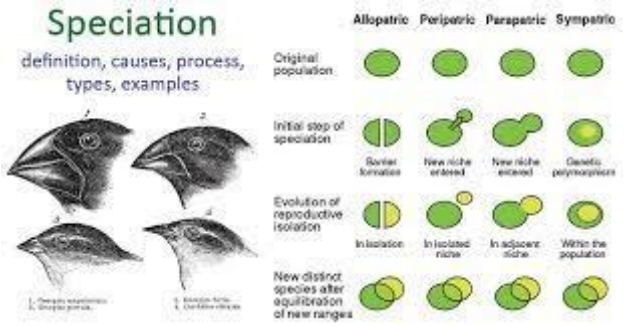


Fig.3.1: Different types of Speciation

The demands of a different environment or the characteristics of the members of the new group will differentiate the new species from their ancestors (**Fig.3.1)** . Thus we can say that the Speciation is the process of formation of new species from existing populations. The Speciation is following types such as

Allopatric Speciation

Allopatric speciation is the type of speciation caused by geographical isolation. In this, the population is separated by a physical barrier.

Parapatric Speciation

This is a type of allopatric speciation in which the species are not formed by any physical barrier. Instead, they are beside each other. This occurs by an extreme change in the habitat. Though the individuals in these areas can interbreed, they develop different characteristics and lifestyles.

Peripatric Speciation

This is a type of allopatric speciation in which new species are formed from an isolated peripheral population. In this, the populations are prevented from exchanging genes and therefore it is difficult to distinguish between them.

Sympatric Speciation

Sympathy speciation conversely does not require geographic isolation; instead it relies on the development of reproductive isolation mechanism to allow divergence of the two sub populations. Sympathy speciation selection act against individuals of an intermediate type either through decreased viability or decreased fecundity.

3.4.Origin of life

The origin of life on the earth has been a most important and interesting puzzle. To explaining origin of life, most of scientist gave many theories but the theory of spontaneous generation is considered more relevant to understand for origin of life. However, the Modern Synthetic Theory of Evolution showed a number of changes as to how the evolution and the process of evolution are conceived. The theory gave a new definition of evolution as "the changes occurring in the allele frequencies within the populations, " which emphasizes the genetic basis of evolution.

According to the theory of evaluation, all species descended from earlier, ancestral species. In the other world, life comes from life. This scientific theory explains how life has changed over the past 3.7 billion years and why life is diverse today. Most of evidences supports the scientific theory of evaluation comes from fossils, mineralized or petrified replicas of skeletons, bones, teeth, shells, leaves and seeds or impression of such items found in rocks. These fossils provide physical evidences of ancient organisms and reveal what their internal structures looked like. Also the evidences of earth's early history also come from chemical analysis and measurements of elements in primitive rocks and fossil. The analysis of material in

cores drilled out buried ice and comparisons of the DNA of past and current organism's offers still more information.

3.4.1. Theory of spontaneous generation:

According to this theory, all forms of life a used spontaneously from non-living matter. It has no scientific significance. Abiogenesis is the generation of life form non-living matter. Abiogenesis, now more precisely known as spontaneous generation. This theory states that complex living organisms are generated form decaying organic substances. For example organism like mice spontaneously appears in stored grain or maggots appear meat.

3.4.2. Theory of special creation:

According to this theory, all animal and plant existing today were created by some supernatural power. These forms of life beings were designed according to their surrounding and form the period fill now days they existed unchanged.

3.4.3. Theory of catastrophism:

Catastrophism is the theory that, in the past, the Earth has been affected by sudden, short-lived, violent events, possibly worldwide in scope. According to this theory, a fresh origin of life after each catastrophe that resulted in complete annihilation of all living beings. The concept was first popularized by French scientist Georges Cuvier at the beginning of the 19th century, who suggested that new life forms had moved from other areas after local floods, avoiding religious or metaphysical speculation in his scientific writings.

3.4.4.Cosmologic theory:

According to this theory, life can do your planet accidently form the other part of universe in the form of spores. This means that although it is a physical science, it is of particular importance in terms of its implications for human life.

3.4.5.Hetrograph hypothesis:

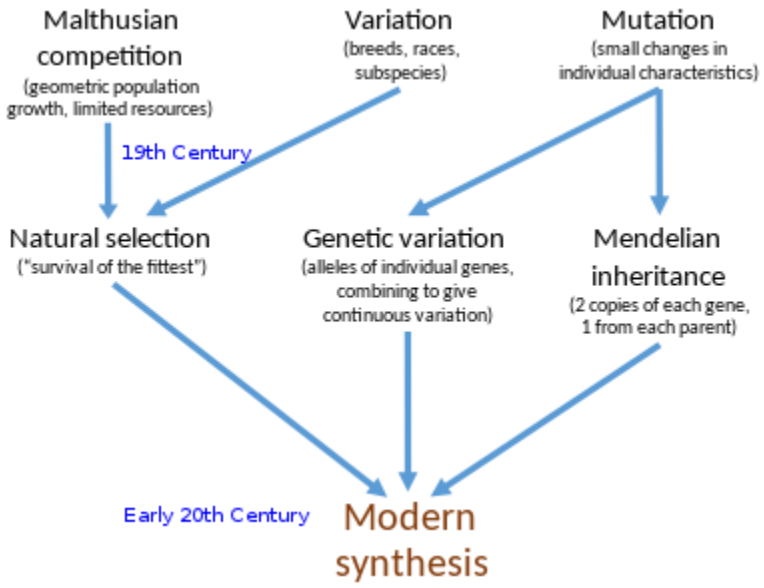
It assumes simple organism originated complex surrounding a heterotroph.

3.4.6. Autograph hypothesis:

Autotroph is green plants that are capable of making food. Autograph theory suggests that the first form of life were Autotroph. This theory assumes origin of simple organism by the complex organism.

3.4.7. Modern syntheses theory:

It is the most acceptable theory of origin of life. This theory is generally refers to the early to mid-century formulation of evolutionary. This theory proposed by Al Oparin and JBS Haldance. According to this theory life originated spontaneously form some non-living organic compound s or biochemical compounds in the ocean of the primitive earth about 3-5 billion year ago. Al Oparin concept of biochemical origin of life is considered to be the modern hypotheses of origin of life. In the year 1953, Oparin and Haldane suggested that life originated from non-living organic molecules like proteins and RNA. Thesis theory is merges the concept of Darwinian evolution with Mendelian genetics, resulting in a unified theory of evolution. This theory is also referred to as the Neo-Darwinian theory and was introduced by a number of evolutionary biologists such as such as T. Dobzhansky, J.B.S. Haldane, R.A. Fisher, Sewall Wright, G.L. Stebbins, and Ernst Mayr.



The modern theory that reconciled classical Darwinian selection theory with a newer population-oriented view of Mendelian genetics that attempted to explain the origin of biological diversity. The modern theory introduced several changes for of evolutionary process. The concept of evaluation is the changes in allele of genes within populations, (Alleles are alternate

forms of the same gene, characterized by differences in DNA sequence that result in the construction of proteins that differ in amino acid composition.) thus it emphasizing the genetic basis of evaluation. There are four factor of evolutionary were indentify that contributes in the changes in alleles frequencies. These are random genetic drift, gene flow, mutation pressure, and natural selection . In this factor the natural selection is considered most relevant factor for to understand the higher survival rate. Due to this evolutionary forces the organism can adopted to their environments. However the genetic drift. However, the genetic drift describes random changes in allele frequencies in a population. This changes is occurs due to the immigration and emigration of individuals form a population. In addition, the process of mutation is week but it so crucial because all genetic variation arises originally form mutation that create alteration in DNA sequencing resulting from errors during replication or other factors. The Modern Synthesis recognized that the majority of mutations are deleterious (have a harmful effect), and that mutations that are advantageous usually have a small phenotypic effect. Advantageous mutations may be incorporated into the population through the process of natural selection. Changes in species, the changes in species therefore occur gradually through the accumulation of small changes. However, the modern synthetic theory gives importance to both mutations and natural selection. The factors involved in Modern synthetic theory can be broadly divided into three main concepts i.e. genetic variation, natural selection, and isolation.

Genetic variations: the genetic variation occurs due to change in gene and gene frequency. Genetic variations are caused by factors such as gene mutation, genetic recombination, gene flow, genetic drift, chromosomal aberrations.

Natural selection: Natural selection is the process by which better-adapted organisms grow and produce more number of offspring in the population.

Isolation:

It is the separation of the population of a particular species into smaller units that prevents interbreeding between them. A barrier that prevents gene flow or exchange of genes between isolated populations, is called isolating mechanism.

3.5.Evolutionary forces shaping genetic variation

Evolution in a broader aspect can be defined as encompassing changes over time. In the context of evolution, existence of genetic variation becomes immensely important as they form the substrate for evolution. The key forces that shape the pattern of genetic variation are Mutation, Recombination, Genetic Drift, natural Selection, Assortative mating and Migration. This section presents a brief overview of each of the aforementioned evolutionary forces. 3.1.1 Mutation Mutation is the random change in the actual genetic code, including changes in single DNA bases, insertion or deletion of DNA sequences, and other rearrangements of DNA sequences(John, 2012).Differing by the number of bases affected, mechanism of mutation, and regions of localization these variants exist as single nucleotide polymorphisms (SNPs), insertion and deletion (InDel), short tandem repeats (STRs), variable number tandem repeats (VNTRs), copy number variations (CNVs), inversion and translocations. Mutation is the primary source of variation and has a significant impact in the process of evolution. The mutants that are found in less than 1% of a population are called variations. A polymorphic locus is defined by the presence of the most common allele in equal to or less than 99% of the chromosomes (Nei, 1987).

3.5.1.Mutation

Any change in the DNA sequence of a cell. Mutations may be caused by mistakes during cell division, or they may be caused by exposure to DNA-damaging agents in the environment. Mutation is the primary source of variation and has a significant impact in the process of evolution. The mutants that are found in less than 1% of a population are called variations. However, the Mutation is refers the random change in the actual genetic code, including changes in single DNA bases, insertion or deletion of DNA sequences, and other rearrangements of DNA sequences Mutations can be harmful, beneficial, or have no effect. If they occur in cells that make eggs or sperm, they can be inherited; if mutations occur in other types of cells, they are not inherited. Certain mutations may lead to cancer or other diseases. A mutation is sometimes called a variant.

3.5.2.Genetic Drift

Genetic drift is a stochastic process in which a subset of a population undergoes mating that result in allele frequency variation in the next generation. At the level of an entire population, this means that each generation may not have the exact same set of allele frequencies

as the previous generation (Relethford, 2012). Drift increases with the reduction in the size of the population and causes changes in allele and genotype frequencies over time. Either of the alleles is eliminated or is fixed as equilibrium is reached, but it is difficult to predict the identity of this allele due to the stochastic nature of the process. Wright (1931) proposed a model to explain the sampling in populations that leads to drift. The model assumes a finite population with a constant size and non-overlapping generations where all individuals are equally fit. Effective population size (Ne) is the number of individuals of an idealized population breeding among themselves and will have the same amount of variation in allele frequencies as the latter under drift. Ne can be used forthe comparison of genetic drift among different populations. It is also different for different parts of the genome. Two population events that occur due to genetic drift in populations that had a small size in the past are population bottlenecks (reduction in size and diversity of a single previously larger population) and founder effect (genetic separation and subsequent colonization of a subset of the total diversity of a source population).

3.5.3.Natural selection

Natural selection is the process through which species adapt to their environments. It is the engine that drives evolution. Charles Darwin developed the idea of natural selection after a five-year voyage to study plants, animals, and fossils in South America and on islands in the Pacific. In 1859, he brought the idea of natural selection to the attention of the world in his best-selling book, *On the Origin of* Species. Natural selection works with a bunch of different phenomenon and it was among the five vital theories given by Charles Darwin. The other theories were Evolution, Common Descent, Reproduction and Gradualism. All these theories supported one Idea or notion which was accounting the fact Origin of Species. Ernest Mayr (1991) in his book One Long Argument provided a convenient & simple way of understanding the process of natural selection. He gave five facts namely Super fecundity, steady populations, limited resources, unique individuals and heritability. In natural selection process, the living organism adopts and changes according to present environment. Individuals in a population are naturally variable, meaning that they are all different in some ways. This variation means that some individuals have traits better suited to the environment than others. Individuals with adaptive traits, traits that give them some advantage are more likely to survive and reproduce. These individuals then pass the adaptive traits on to their offspring. Over time, these advantageous traits become more common in the population. Through this process of natural

selection, favorable traits are transmitted through generations. Natural selection can alter the frequency of heretiable traits in three ways:

- Directional selection
- Stabilizing Selection
- Disruptive selection

The three modes of natural selection shown in Fig. (3.1.). The shaded areas show the groups being selected against. The top graph shows the original distribution of the individual whereas the final distributions of the individual appear in the graph after selection.

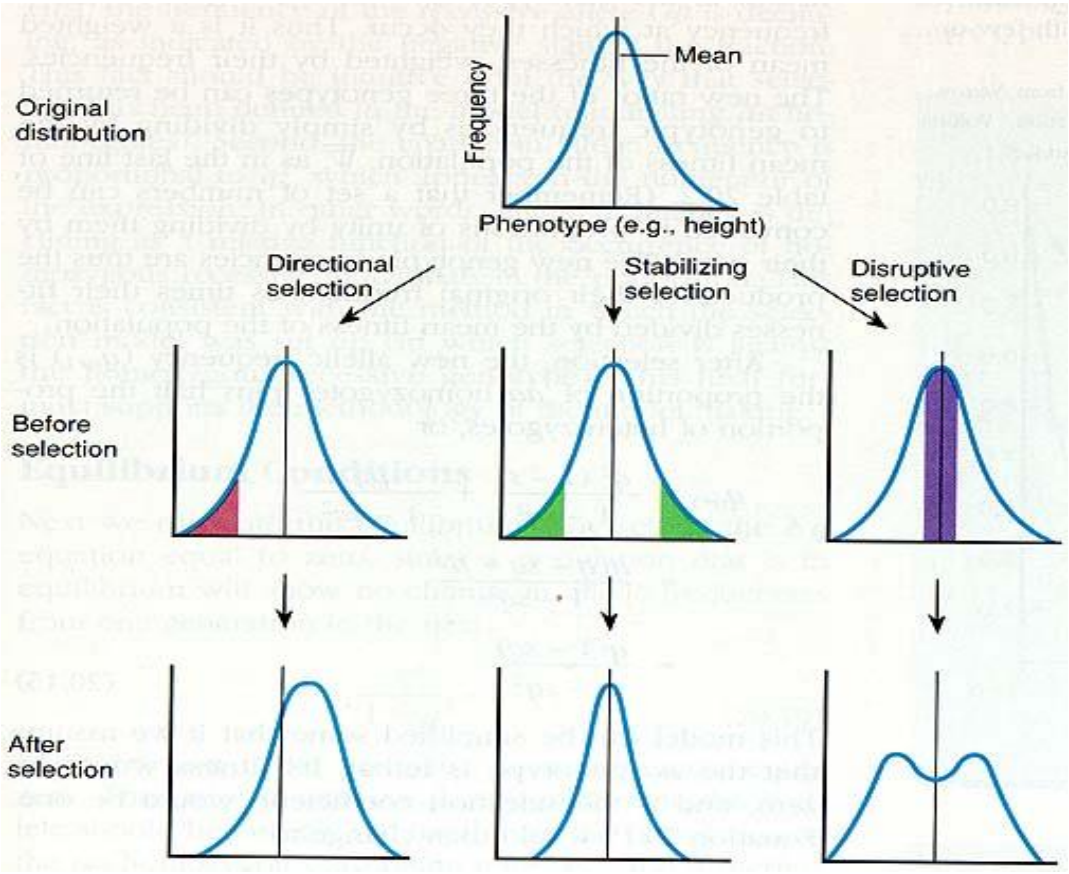


Fig.3.2:https://www.bio.miami.edu/dana/pix/selection.jpg

Directional selection: the directional selection has following characteristics such as

- It occurs due to change in the environment in a particular direction
- It favours the phenotype which has an extreme or non- average character.

- It alters the mean value of the trait in the population in one direction.
- It favours the phenotype which has an extreme or non- average character.
- It alters the mean value of the trait in the population in one direction.
- It eliminates the normal or average individual.

Example of directional selection is Industrial Melanism, before industrial melanism these species had light colour pattern, dark coloured or melanic moths were rare. But after industrial revolution light coloured became highly vulnerable to predators due to darkened tree trunks and killed off lichens. Thus due to sudden change in the environmental conditions dark coloured moth became abundant, the cause of this change was selective predation by birds, as they favored camouflage coloration in the moth.

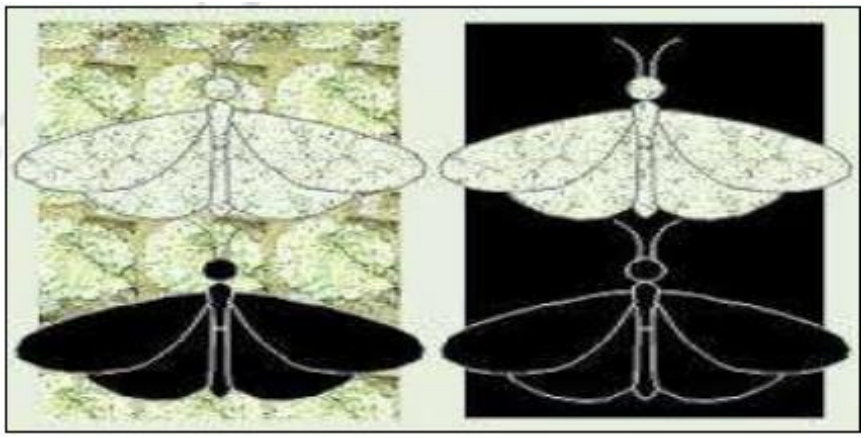


Fig.3.3: Industrial Melanism

Stabilizing selection: the stabilizing selection process has following characteristics

- It operates in a constant and changing environment.
- It keeps a population genetically constant.
- It favours the normal or average phenotypes.
- It introduces homozygosity in the population

For example the human baby with 73 lbs weight has less mortality rate whereas the human baby beyond 53 lbs and above 101 lbs has high mortality rate.

Disruptive Selection:

- It is a process that enhances the adaptedness of population that lives in heterogeneous environments. It has following features such as

- Previously homologous population breaks into several different adaptive groups.
- Extreme values have highest fitness and intermediate or mean values are relatively Disadvantageous.
- It occurs when a population previously adapted to a non- homologous environment is subjected to divergent selection pressure in different parts of its distributional area.

3.5.4.Gene flow or migration

Migration is the transfer of genetic material from one population to another in the process of the inter-region movement. Gene flow can take place between two populations of the same species through migration, and is mediated by reproduction and vertical gene transfer from parent to offspring. Gene flow balances out genetic differentiation and lessens allele frequency differences between populations. Island Model" proposed by Wright (1931) is the simplest model that shows a meta-population divides into smaller population islands of equal size which exchange genes at the same rate per generation. Another is "Stepping Stone Model that shows the genetic exchange is higher in geographically proximate populations.

3.5.5.Recombination

Recombination is a process by which pieces of DNA are broken and recombined to produce new combinations of alleles. This recombination process creates genetic diversity at the level of genes that reflects differences in the DNA sequences of different organisms. Genetic recombination is the exchange of segments of homologous chromosomes during meiosis. It leads to an increase in genetic diversity due to formation of new allelic combinations. Alleles in closely spaced loci do not undergo random segregation during meiosis as a result of infrequent recombination.

3.6.Biochemical basis of origin of life

Our nature consists lots of inanimate matter founds in air soil, air water and rocks. Some of elements are part of living organism. The chemical and physical laws describe the behaviour of these inanimate matters. When these elements become the part of living organism, they possess extra ordinary attributes as compare to inanimate. If we examine some of these special properties we can approach the study of biochemistry.

If we can see the body of any living organism, we found that the body of living organism has well organized cell structure. The cells which are the unit structure of body, consisting different kinds of complex molecules. Each components of living organism have specific purpose or functions made up of different kinds of cells. The cells make internal structure as well as external structure of organism. The macromolecules that are present in cell for example lipids; protein and nucleic acid have specific function. The specific function is found both in macroscopic structure (e.g. leaves, steams or heard, year legs) and microscopic intracellular structure (e.g. nucleus and protoplasm) components of living organism. Specific functions refers to change among chemical organization, is dynamic in components causes coordinating or compensating change in other in all set of organic components.

Living organism has capacity to synthesize, complex compound by using inanimate matter and convert into different kinds of macromolecules such as proteins, nucleic acid and lipids etc. Furthermore, the living organism can extract or transfer energy from their environments that not only use in maintenance and repairing of own structure but also utilize in other works. Self replication or self assemble means is the most extra ordinary attributions of living organism such as billions of daughter cells can carry a faithful copy of the genetic material of their parental cells. When we see the nature of living organism we found that there are lots of question arises in our mind such as i) how the living matter different from the non living matter, which also consists of inanimate molecules, ii) Why the living organism does appears to be more than sum of its inanimate part. iii) How different Biomolecules maintain the all process in living organism. To answer these quantities, the modern science has central goal to determine how the collection of inanimate interact with each other to contribute maintain and perpetuate living state.

The basic concept of organization of biology can be understood with their regularity structure. The biological system is biologically active structure and characterized by a definite arrangement of their components, these components interact themselves, resultant give biological function to the structure. Their for it for is resemble to consider the organization of living matter as unity of structure and function. On the other hand biological organization is a set of elements or sub systems of lower rank. The mechanism of elements in biological system made the hierarchy in biological system.

Although, the hierarchy nature of biological system is generally recognized which based on structured approach such as low molecules- weigh compounds- biomolecules- cells- tissues- organ system-organism-populations- biogeocenosis and biosphere. Therefore biological organization is also defined as the unity of structure, function and regulation of biological system. The biological system contains the different types of chemicals with their hierarchical level. The organization includes the level of the matter organization starting with the cell, lower subcellular and supramolecules structure are considered as distinct levels in the organization of biosynthesis.

3.7.Hardy -Weinberg equilibrium

G. H. Hardy and W. Weinberg collectively give the work on gene and genotype frequency and give the formula of gene regarding frequencies. Hardy-Weinberg law state that, relative frequencies of various kind of gene alleles remain constant from generation to generation, if population is large, mating at random and any kind of evolutionary forces such as mutation, natural selection or migration is absent.

This law is expressed by the algebraical equation:-

$$P^2 + 2pq + q^2 = 1$$

Where, p is the frequencies of dominant alleles, q is frequency of recessive alleles and the pq is the frequency of heterozygote It is also called as Hardy-Weinberg equilibrium, because the gene frequencies in a population are maintained in a certain equilibrium. Due to this genetic changes are stopped. If the population follows the Hardy-Weinberg equilibrium, then the role of evolution is zero. This law can be explained by citing example of a hypothetical large population which contain equal number of individuals with black (HH) and grey (hh) hairs which interbreed at random.

- The types of mating among them is of following three types:
    i. HH X HH
    ii. hh X hh
    iii. HH X hh
- If they are 50% males and 50% females, then F_1 individual produced in the ratio of 1:2:1

Parents- $HH^{\male}$ X $hh^{\female}$ $HH^{\female}$ X $hh^{\male}$

Gametes- H HhhHHhh

- Frequency of each H or h gene = 50% = 0.5 on representing their mating in checker board we find following results:-

Male gamete Female gamete	0.5H	0.5h
0.5H	0.25HH	0.25Hh
0.5h	0.25hH	0.25hh

- If 'H' is represented by 'p' and 'h' is represented by 'q'

Then, HH = p X p = p^2 = 0.25

hh = q X q = q^2 = 0.25

Hh = p X q = pq = 0.25

Hh + Hh = 2Hh = 2pq = 0.25

Hence, $p^2 + 2pq + q^2 = 0.25 + 0.50 + 0.25 = 1$

This is the Hardy-Weinberg equation.

Importance of Hardy-Weinberg equation:

- It emphasizes that in the absence of an evolutionary forces of all the genotype in a population reproduce equally successfully.
- It provides basis to examine the trends of gene frequencies in large populations
- In the absence of all evolutionary forces, the mating is a completely at random phenomenon in a population. It relates simply to statics of a large mendelian population.
- It provides basis for calculation, if the recessive homozygous is harmful.

The Hardy-Weinberg low is directly and indirectly affected by mutation, natural selection, non-random mating, small population and genetic drift, migration and gene flow.

3.8.Summary

Evolution is the change in the characteristics of a species over several generations and relies on the process of natural selection. The process of evaluation occurs through changes in the inherited characteristics of an organism. In humans, for example, eye colour is an inherited characteristic and an individual might inherit the "brown-eye trait" from one of their parents. The

19th-century English naturalist Charles Darwin argued that organisms come about by evolution, and he provided a scientific explanation, essentially correct but incomplete, of how evolution occurs and why it is that organisms have features such as wings, eyes, and kidneys clearly structured to serve specific functions. Evolutionists no longer are concerned with obtaining evidence to support the fact of evolution but rather are concerned with what sorts of knowledge can be obtained from different sources of evidence.

Spontaneous generation is a superseded scientific theory that held that living creatures could arise from nonliving matter and that such processes were commonplace and regular. It also explained the origin of life from the nonliving subjects. According to that theory, a piece of bread and cheese wrapped and left in a corner could give rise to mice in a few weeks, or maggots could rise from dead flesh. The modern synthetic theory of evolution describes the evolution in terms of genetic variations in a population that leads to the formation of a new species. It explains the contribution of factors such as genetic variations, reproductive and geographical isolation, and natural selection. Hardy-Weinberg law states that, relative frequencies of various kinds of gene alleles remain constant from generation to generation.

3.9.Terminal Question

Q.1. What is evolution? Discuss the origin of life.

Answer:----------

Q.2. Discuss the various theory of origin of life.

Answer:----------

Q.3. What are the three main concept of modern synthetic theory?

Answer:----------

Q.4. Discuss the evolutionary forces that shaping the genetic variation.

Answer:----------

Q.5. What is neturalselection; discuss the Darwinism and natural selection process.

Answer:----------

Q.6. Write the Hardy -Weinberg equilibrium in brief.

Answer:----------

3.10.Further suggested Readings

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Rajarshi Tandon Open University, Prayagraj

Fundaments of Environmental Sciences

Block- 2

Environmental Education

UNIT -4

Segment of Environment

UNIT-5

Environmental Education

UNIT-6

Environmental Issues

UGEVS-101N

Fundaments of Environmental Sciences

Rajarshi Tandon Open University, Prayagraj

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Unit-4: Segment of Environment

Contents

4.1. Introduction

We inhabit in two worlds one is the natural world of plants, animals, soil, air and water that proceeded by billions of years and of which are a part. And other is the world of social institutions and artifacts that we create for ourselves using science, technology and political organization. Both worlds are essential for our lives, but interacting them successfully causes enduring tensions. Environment can be defined by the circumstances and conditions that surround an organism or group of organism. In other world it is social and cultural conditions that affect an individual or community. Since human inhabit the natural world as well as build or technological, social and cultural world, all constitute important part of environment. Environment literally means surroundings include biotic and abiotic factors.Environmental studies deals with interaction of various living organisms and itsrelationship with nonliving

environment (matter and energy). This is important branchof science which integrates wide range of disciplines including physics, chemistry,biology, engineering, sociology, geology and resource technology etc. In other world environmental science also inclusive and holistic and mission oriented.

Objectives

- To discuss environmental segments
- To discuss the environmental factor
- To discuss different biogeochemical cycles

4.2. Environmental segments

Our earth has various life forms that survive under various conditions. The earth is unique planets on the solar system. Due to present of optimum distance between sun and earth the temperature is neither to hoot as in venous or mercury nor not to cold as Jupiter and other planets. This is main reason to existing the life on earth planet. This earth is surrounded by gaseous air which is regulated temperature on earth surface and also supports life on earth. As we know our surrounding is our environments so that we should know that this environment is comprises with four segments i.e. atmosphere, lithosphere, hydrosphere, and biosphere. All the environment is interact each other and make healthy environment for living beings.

4.2.1. Atmosphere

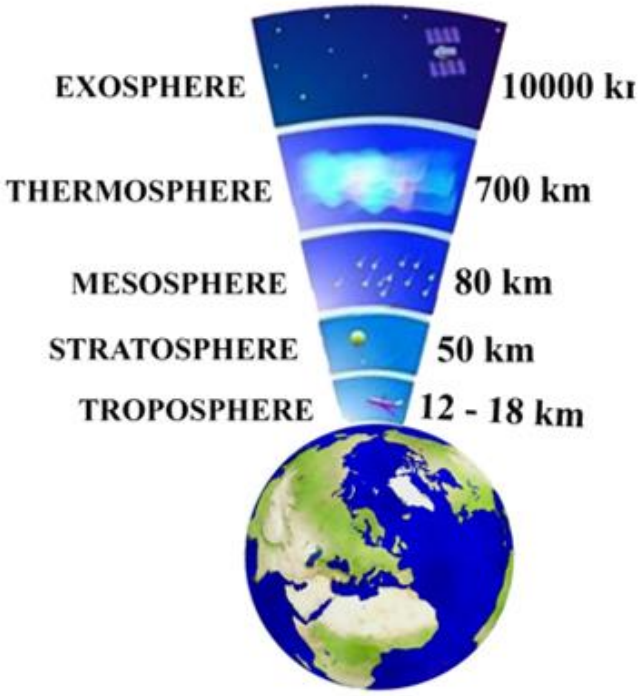
The atmosphere of the earth is the blanket of surrounding gases maintained in its place by earth's gravity. Which sustain the life on the earth and save it from hostile environmental conditions? It absorbs most of cosmic rays from the sun. it transmit only near ultraviolet, visible , near infrared radiation (300 to 2500 nm) and radio waves (0.14 to 40 m) while filtering out tissue-damaging ultra violate radiation below about 300 nm. Atmosphere pay important role in heath balance for the earth, through absorption of infrared radiation emitted by the sun and remitted form earth. The earth's atmosphere is composed of air. It comprises the nitrogen which amounts to 78%, oxygen to 21%, carbon dioxide to 0.33% and argon to 0.93%. The other gases present in the atmosphere are helium, methane, ozone, neon, xenon and many trace gases. Above a height of 50 km from the earth's surface, atmosphere contains only oxygen, ozone, helium and

hydrogen. Atmosphere contains water vapor and the amount of vapor in atmosphere varies with seasons.

The chemical composition of the earth's atmosphere varies with altitude, temperature and pressure profile of the different regions of atmosphere and also due to the penetration of incoming solar radiation. However, the vertical structure of atmosphere is very much related to radiant energy absorption and this can be described in terms of variable of temperature.

The atmosphere is the source of oxygen that is essential for living animals and carbon dioxide that is essential for plant for photosynthesis. Due to the evolution of life, the levels of oxy-gen increased significantly, lowering the levels of carbon dioxide. With the appearance of an ozone layer (ozone is an allotrope of oxy-gen) life forms were protected from the ultra-violet radiation of the sun. Atmosphere is responsible for:

- the unequal heating of the earth's surface by insolation,
- different heat zones,
- variation in temperature,
- changes in atmospheric pressure,
- origin of winds,
- formation of clouds, rainfall and snowfall.



On the basis of temperature the earth atmosphere is divided into troposphere, stratosphere, mesosphere, thermosphere and ionosphere. The characteristics of these layers vary in relation to their composition, temperature and impacts of radiation.

Troposphere is the layer lying just above the surface of the earth. It contains 70% of the mass of the atmosphere. It extends up to 8-18 km. The air in this sphere contains 1% water vapour and more CO2. It is a dusty layer. The fall of temperature in this zone is 1 deg. C per km. The temperature ranges from 150C to –56 0C.

Stratosphere is the second layer of the atmosphere. It extends up to 80 km. In this zone, meteors will be visible. In the stratosphere, there is 1000 times less water vapor and 1000 times more ozone than the troposphere. This layer is free from clouds. In this layer the temperature increases with increase in altitude from –520C to –20C.

Above the mesosphere, to a height of 700 km is the thermosphere, where the atmosphere density is extremely low with the temperature increasing rapidly. The temperature at 350 km is 12000C. This region is characterized by the dissociation of oxygen molecule, ionisation of oxygen atom, oxygen molecule, and nitrogen molecule.

The region above the thermosphere upto 10,000 km is termed exosphere. It has only atoms of hydrogen and helium. It has very high temperature due to solar radiation.

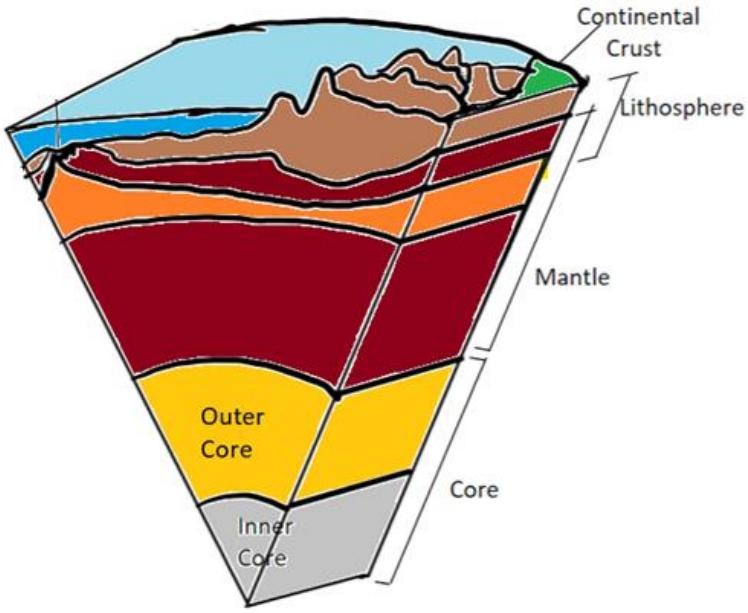
4.2.2. Hydrosphere

The hydrosphere is composed of liquid water component on the planet's surface. The hydrosphere is a collective term given to all different forms of water. It includes all types of water resources such as oceans, seas, rivers, lakes, streams, reservoirs, glaciers and ground water. Hydrosphere is the total amount of water on a planet. It includes water that is on the surface of the planet, underground and in the air. Oceans cover over 97% of Earth's water, and most of the remaining fresh water is in the form of ice. It is estimated that total amount of 1,300 million cubic feet. Exclusive of seawater, the water that circulates through environmental processes and cycles occurs in the atmosphere, underground as groundwater, and as surface water in streams, rivers, lakes, ponds, and reservoirs. Water exchanged between sea, atmosphere, land and living animals through massive evaporation is called hydrological cycles. The land surface and water surfaces on earth lose water by evaporation and by solar energy. Evaporation of water from the ocean exceeds precipitation by rain into the seas by 10%. This 10% excess which precipitates on land balances the hydrological cycle.

4.2.3. Lithosphere

This the outer mantle surface of solid earth, consisting of mineral occurring in the earths crust and the soil. The term lithosphere is derived from the Greek words "lithos," meaning stone, and "sphaira," meaning globe or ball. The lithosphere includes the brittle upper portion of the mantle and the crust, the outermost layers of the Earth's structure. It is the most rigid of the Earth's layers. Although the rocks of the lithosphere are still considered elastic, they are not viscous. The litho-sphere is also the coolest of the Earth's layers. There are two types of lithosphere: oceanic lithosphere and continental lithosphere. Oceanic lithosphere is associated with oceanic crust, and is slightly denser than continental lithosphere. The lithosphere also interacts with the atmosphere, hydrosphere, and cryosphere to influence temperature differences on Earth. Lithosphere is composed of a number of different layers. These layers are:

- The Core which is around 7000 kilometers in diameter (3500 kilometers in radius) and is situated at the Earth's center.
- The Mantle which environs the core and has a thickness of 2900 kilometers.
- The Crust floats on top of the mantle and is composed of basalt rich oceanic crust and granitic rich continental crust.



4.2.4. Biosphere

Biosphere is denoted the realm if life if living organism and their interaction with the environment viz. atmosphere, hydrosphere and lithosphere. Both the biosphere and environment are influenced considerable by each other. Thus the oxygen and carbon dioxide level of the atmosphere depends entirely on the plant kingdom. Because the green plant are responsible for the accumulation of oxygen in the atmosphere through the process of photosynthesis. Biosphere is very large and complex and is divided into smaller units called ecosystems. The complex of living organisms, their physical environment, and all their inter relationships in a particular unit of space is called the ecosystem. Within each ecosystem there are dynamic inter relationships between living forms and their physical environment. Within the ecosystem, organisms interact with one another and with their physical environment in various ways. On the basis of this interaction the biotic community can be grouped into the following: –

a) **Producers:** it includes green pants those prepared food form the process of photosynthesis

b) **Consumers:** Producers are consumed by herbivorous animals that in turn are consumed by carnivorous animals or the secondary consumers.

c) **Decomposers**: they degrade organic and inorganic material of plant and animals to obtained energy and food. They produced constituent elements of plants and animal bodies back to the surrounding medium or soil.

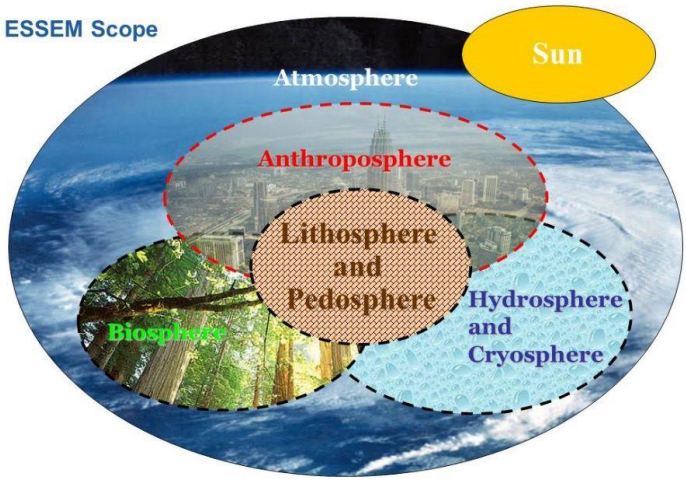
4.3. Anthroposphere

The anthroposphere (sometimes also referred as technosphere) is that part of the environment that is made or modified by humans for use in human activities and human habitats. It is one of the Earth's spheres where an interaction of Homo sapiens with all aspects of the environment is occurred. Where human technology becomes more evolved, for their developments and directly and indirectly destruction of environment. The anthroposphere encompasses the total human presence throughout the Earth system including our culture, technology, built environment, and associated activities. It is distinct environmental sphere, it is essential to consider it in the achievement of sustainability.Thus anthroposphere can be viewed as a human-generated equivalent to the biosphere, which is why some authorities consider it synonymous with the noosphere. While the biosphere is the total biomass of the Earth and its interaction with its systems, the anthroposphere is the total mass of human-generated systems and materials, including the human population, and its interaction with the Earth's systems.

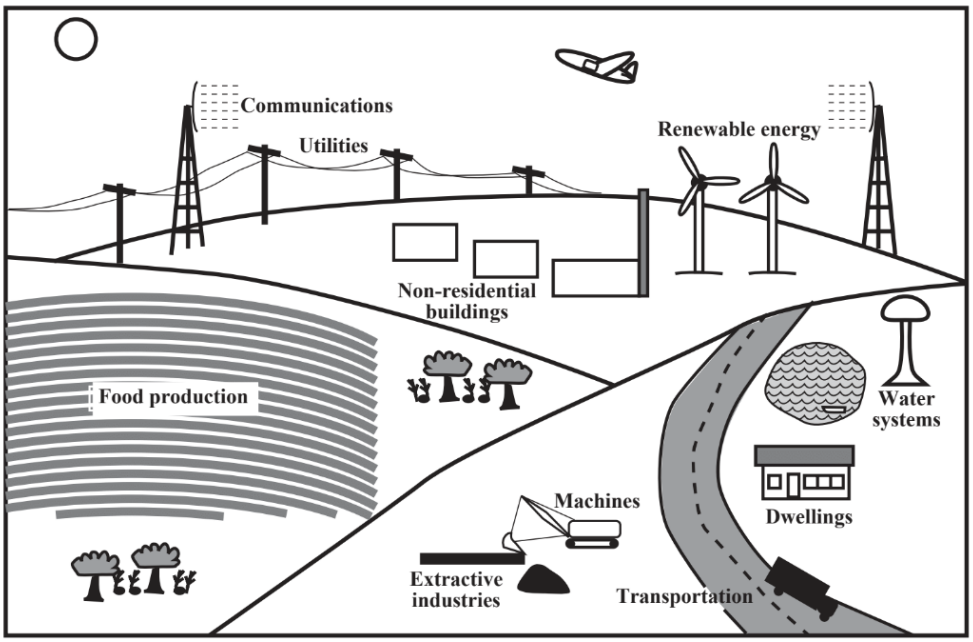
Prize-winning atmospheric chemist Paul Crutzen has argued convincingly that Earth is undergoing a transition from the holocene geological epoch to a new one, the **anthropocene**. This is occurring because human activities are now quite significant compared to nature in their impact on Earth’senvironment and are changing Earth’s fundamental physics, chemistry, and biology. There is concern that, especially through changes in global climate, activity in the anthrosphere will detrimentally alter Earth’s relatively stable, nurturing environment and produce one that is much more challenging to human existence.

The anthroposphere complements the term anthropocene – the age within which the anthroposphere developed. Some mark this age as beginning with the advent of agriculture, others with the industrial revolution. A growing movement within the geological community is

considering establishing the anthropocene as a new geologic era, possibly starting around 1950. In physical terms, the anthroposphere is comprised of the cities, villages, energy and transportation networks, farms, mines, and ports. It also encompasses books, software, blueprints, and communication systems – the mark of civilization.



Aspects of the anthroposphere include: mines from which minerals are obtained; automated agriculture which produces the food consumed by seven billion Sapiens; oil and gas fields; computer-based systems including the Internet; educational systems; landfills; factories; atmospheric pollution; artificial satellites in space, both active satellites and space junk; forestry and deforestation; urban development; transportation systems including roads, highways, and subways; nuclear installations; warfare.



4.4. Biogeochemical Cycle

Biogeochemical cycles mainly refer to the movement of nutrients and other elements between biotic and abiotic factors." The term biogeochemical is derived from "bio" meaning biosphere, "geo" meaning the geological components and "chemical" meaning the elements that move through a cycle. The six most common elements associated with organic molecules (carbon, nitrogen, hydrogen, oxygen, phosphorus, and sulfur) take a variety of chemical forms and may exist for long periods in the atmosphere, on land, in water, or beneath the earth's surface. But biogeochemical cycles important to living organisms include the water, carbon, nitrogen, phosphorus, and sulfur cycles. Different geologic processes, such as weathering, erosion, water drainage, and the movement of the continental plates involved and all play a role in recycling of these elements so that these elements is called the biogeochemical .

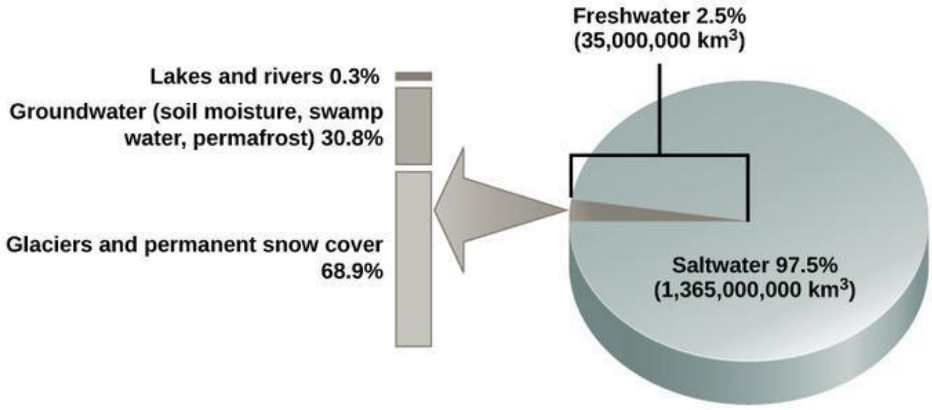
The biogeochemical cycle play important role in recycle and stored of organic molecules. Water, which contains hydrogen and oxygen, is essential to all living processes. Carbon, found in all organic macromolecules, is an important constituent of fossil fuels. Nitrogen, a major component of our nucleic acids and proteins, is critical to human agriculture. Phosphorus, a major component of nucleic acid (along with nitrogen), is one of the main ingredients in artificial fertilizers used in agriculture and their associated environmental impacts on our surface water. Sulfur, critical to the 3–D folding of proteins (as in disulfide binding), is released into the

atmosphere by the burning of fossil fuels, such as coal. The cycling of all of these elements is interconnected.

Biogeochemical cycles are categorized into two types: Gaseous and sedimentary. Atmosphere remains the reservoir for gaseous and earth crust is the reservoir for sedimentary cycle. Carbon, nitrogen and oxygen are included in gaseous biogeochemical cycle and phosphorus and Sulphur are grouped under sedimentary cycle. The sedimentary cycle consists of two phase, one water phase and the other soil/ sediment phase

4.4.1.The Water (Hydrologic) Cycle

The hydrological cycle is the continuous natural process which helps in exchange of water between the atmosphere, the land, the sea, living plant and animals. About one third of solar flux absorbed by the earth used to derive the hydrological cycle. The global ocean covers more than 70% of the Earth's surface and is remarkably heterogeneous. Marine productive areas, and coastal ecosystems comprise a minor fraction of the ocean in terms of surface area, yet have an enormous impact on global biogeochemical cycles carried out by microbial communities, which represent 90% of the ocean's biomass. Water has a large effect on climate, ecosystems, and living organisms and is continuously cycled through the environment. Water is the basis of all living processes. More than half of the human body is made up of water, while human cells are more than 70 percent water. Thus, most land animals need a supply of fresh water to survive. However, when examining the stores of water on earth, **97.5percent** of it is **non-potablesalt water**. Of the remaining water, 99 percent is locked underground as water or as ice. Thus, **less than 1 percent of fresh water is easily accessible from lakes and rivers**. Many living things, such as plants, animals, and fungi, are dependent on the small amount of fresh surface water supply, a lack of which can have massive effects on ecosystem dynamics. Humans, of course, have developed technologies to increase water availability, such as digging wells to harvest groundwater, storing rainwater, and using desalination to obtain drinkable water from the ocean. Although this pursuit of drinkable water has been ongoing throughout human history, the supply of fresh water is still a major issue in modern times.



Water availability: Only 6.5 percent of water on earth is fresh water. Less than 1 percent of fresh water is easily accessible to living things.

Water cycling is extremely important to ecosystem dynamics as it has a major influence on climate and, thus, on the environments of ecosystems. For example, when water evaporates, it takes up energy from its surroundings, cooling the environment. When it condenses, it releases energy, warming the environment. The evaporation phase of the cycle purifies water, which then replenishes the land with fresh water. The flow of liquid water and ice transports minerals across the globe. It is also involved in reshaping the geological features of the earth through processes including erosion and sedimentation. The water cycle is also essential for the maintenance of most life and ecosystems on the planet. Most of the water on earth is stored for long periods in the oceans, underground, and as ice. Residence time is a measure of the average time an individual water molecule stays in a particular reservoir. A large amount of the earth's water is locked in place in these reservoirs as ice, beneath the ground, and in the ocean, and, thus, is unavailable for short-term cycling (only surface water can evaporate).There are various processes that occur during the cycling of water, which include the following:

- evaporation / sublimation
- condensation /precipitation
- subsurface water flow
- surface runoff /snowmelt
- stream flow

The water cycle is driven by the sun's energy as it warms the oceans and other surface waters. This leads to the **evaporation** (water to water vapor) of liquid surface water and

the **sublimation** (ice to water vapor) of frozen water, which deposits large amounts of water vapor into the atmosphere. Over time, this water vapor condenses into clouds as liquid or frozen droplets, which is eventually followed by **precipitation** (rain or snow), returning water to the earth's surface. Rain eventually percolates into the ground, where it may evaporate again (if it is near the surface), flow beneath the surface, or be stored for long periods. More easily observed is surface runoff: the flow of fresh water either from rain or melting ice. Runoff can then make its way through streams and lakes to the oceans or flow directly to the oceans themselves. Rain and surface runoff are major ways in which minerals, including carbon, nitrogen, phosphorus, and sulfur, are cycled from land to water.

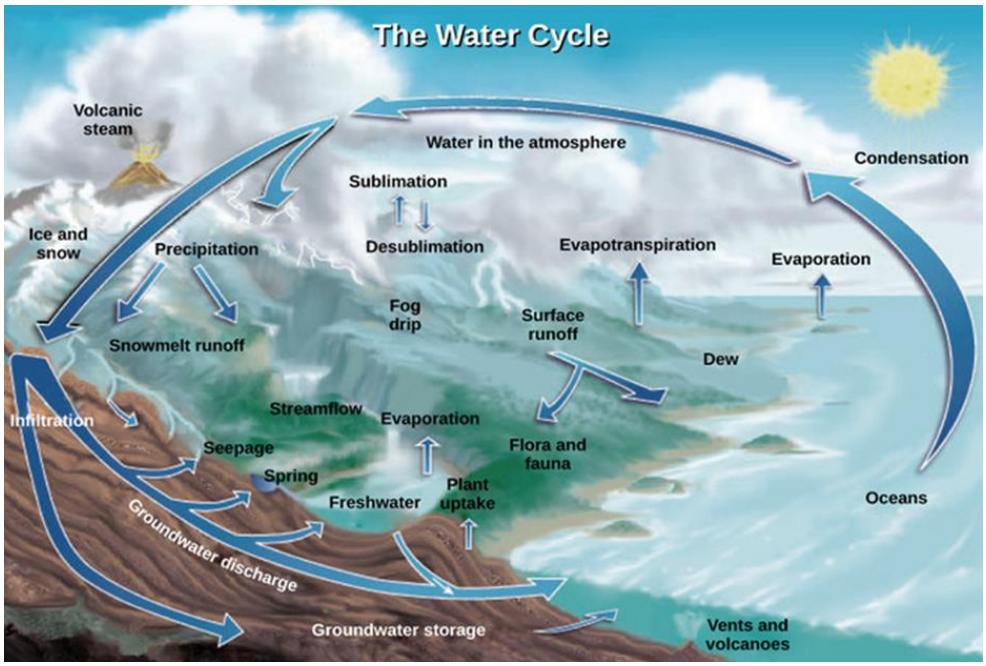


Fig.6.9: **Cyclingofwater**

Water from the land and oceans enters the atmosphere by evaporation or sublimation, where it condenses into clouds and falls as rain or snow. Precipitated water may enter freshwater bodies or infiltrate the soil. The cycle is complete when surface or groundwater reenters the ocean.

4.4.2.The Carbon Cycle

Carbon enters the atmosphere in the form of **carbondioxide** via the carbon cycle and returns to organic carbon via **photosynthesis**. Carbon, the **secondmostabundantelement** in living organisms, is present in all organic molecules. Its role in the structure of macromolecules is of primary importance to living organisms. Carbon compounds contain especially- high forms of energy, which humans use as, fuel. Since the 1800s (the beginning of the Industrial Revolution), the number of countries using massive amounts of fossil fuels increased, which raised the levels of carbon dioxide in the atmosphere. This increase in carbon dioxide has been associated with climate change and other disturbances of the earth's ecosystems. It is a major environmental concern worldwide.

The carbon cycle is most easily studied as two interconnected sub-cycles: one, dealing with rapid carbon exchange among living organisms and the other dealing with the long-term cycling of carbon through geologic processes.

The Biological Carbon Cycle

Living organisms are connected in many ways, even between ecosystems. A good example of this connection is the **exchange of carbon between autotrophs and heterotrophs**. Carbon dioxide is the basic building block that **most autotrophs use to build multi-carbon, high-energy compounds, such as glucose**.

The energy harnessed from the sun is used by these organisms to form the covalent bonds that link carbon atoms together. These chemical bonds store this energy for later use in the process of respiration. Most terrestrial autotrophs obtain their carbon dioxide directly from the atmosphere, while marine autotrophs acquire it in the dissolved form (carbonic acid, $H_2CO_3^-$). However carbon dioxide is acquired, a by-product of the process is oxygen. The photosynthetic organisms are responsible for depositing approximately 21 percent of the oxygen content in the atmosphere that we observe today.

Heterotrophs acquire the high-energy carbon compounds from the autotrophs by consuming them and breaking them down by respiration to obtain cellular energy, such as ATP. The most efficient type of respiration, aerobic respiration, requires oxygen obtained from the atmosphere or dissolved in water. Thus, there is a constant exchange of oxygen and carbon dioxide between the autotrophs (which need the carbon) and the heterotrophs (which need the

oxygen). Gas exchange through the atmosphere and water is one way that the carbon cycle connects all living organisms on Earth.

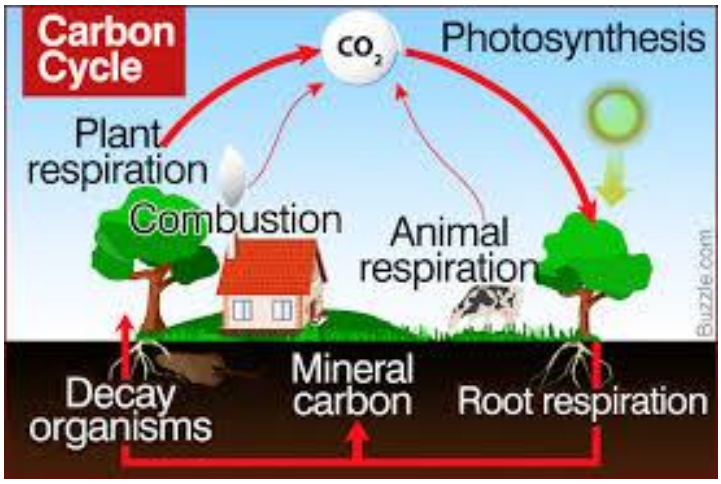


Fig6.10: **Carbon cycle**:

Carbon dioxide gas exists in the atmosphere and is dissolved in water. Photosynthesis converts carbon dioxide gas to organic carbon, while respiration cycles the organic carbon back into carbon dioxide gas. Long-term storage of organic carbon occurs when matter from living organisms is buried deep underground and becomes fossilized. Volcanic activity and human emissions bring this stored carbon back into the carbon cycle.

The Biogeochemical Carbon Cycle

The movement of carbon through the land, water, and air is complex and, in many cases, it occurs much more slowly than the biological carbon cycle. Carbon is stored for long periods in what are known as carbon reservoirs, which include the atmosphere, bodies of liquid water (mostly oceans), ocean sediment, soil, land sediments (including fossil fuels), and the earth's interior.

As stated, the atmosphere, a major reservoir of carbon in the form of carbon dioxide, is essential to the process of photosynthesis. The level of carbon dioxide in the atmosphere is greatly influenced by the reservoir of carbon in the oceans. The exchange of carbon between the atmosphere and water reservoirs influences how much carbon is found in each location; each affects the other reciprocally. Carbon dioxide (CO_2) from the atmosphere dissolves in water,

combining with water molecules to form carbonic acid. It then ionizes to carbonate and bicarbonate ions.

More than 90 percent of the carbon in the ocean is found as bicarbonate ions. Some of these ions combine with seawater calcium to form calcium carbonate ($CaCO_3$), a major component of marine organism shells. These organisms eventually form sediments on the ocean floor. Over geologic time, the calcium carbonate forms limestone, which comprises the largest carbon reservoir on earth.

On land, carbon is stored in soil as a result of the decomposition of living organisms or the weathering of terrestrial rock and minerals. This carbon can be leached into the water reservoirs by surface runoff. Deeper underground, on land and at sea, are fossil fuels: the anaerobically-decomposed remains of plants that take millions of years to form. Fossil fuels are considered a non-renewable resource because their use far exceeds their rate of formation. A non-renewable resource is either regenerated very slowly or not at all. Another way for carbon to enter the atmosphere is from land by the eruption of volcanoes and other geothermal systems. Carbon sediments from the ocean floor are taken deep within the earth by the process of subduction: the movement of one tectonic plate beneath another. Carbon is released as carbon dioxide when a volcano erupts or from volcanic hydrothermal vents.

4.4.3.The Nitrogen Cycle

Nitrogen, the most abundant gas in the atmosphore, is cycled through the biosphere via the multi-step process of nitrogen fixation, which is carried out by bacteria.

Getting nitrogen into the living world is difficult. Plants and phytoplankton are not equipped to incorporate nitrogen from the atmosphere (which exists as tightly-bonded, triple-covalent N_2), even though this molecule comprises approximately 78 percent of the atmosphere. Nitrogen enters the living world via free-living and symbiotic bacteria, which incorporate nitrogen into their macromolecules through nitrogen fixation (conversion of N_2). Cyanobacteria live in most aquatic ecosystems where sunlight is present; they play a key role in nitrogen fixation. Cyanobacteria are able to use inorganic sources of nitrogen to “fix” nitrogen. Rhizobium bacteria live symbiotically in the root nodules of legumes (such as peas, beans, and peanuts), providing them with the organic nitrogen they need. Free-living bacteria, such as Azotobacter, are also important nitrogen fixers.

Organic nitrogen is especially important to the study of ecosystem dynamics as many ecosystem processes, such as primary production and decomposition, are limited by the available supply of nitrogen. The nitrogen that enters living systems by nitrogen fixation is successively converted from organic nitrogen back into nitrogen gas by bacteria. This process occurs in three steps in terrestrial systems: ammonification, nitrification, and denitrification. First, the ammonification process converts nitrogenous waste from living animals or from the remains of dead animals into ammonium (NH_4^+) by certain bacteria and fungi. Second, the ammonium is converted to nitrites (NO_2^-) by nitrifying bacteria, such as Nitrosomonas, through nitrification. Subsequently, nitrites are converted to nitrates ($NO3^-$) by similar organisms. Third, the process of denitrification occurs, whereby bacteria, such as Pseudomonas and Clostridium, convert the nitrates into nitrogen gas, allowing it to re-enter the atmosphere.

Human activity can release nitrogen into the environment by two primary means: the combustion of fossil fuels, which releases different nitrogen oxides, and the use of artificial fertilizers in agriculture, which are then washed into lakes, streams, and rivers by surface runoff. Atmospheric nitrogen is associated with several effects on earth's ecosystems, including the production of acid rain (as nitric acid, HNO_3) and greenhouse gas (as nitrous oxide, N_2O), potentially causing climate change. A major effect from fertilizer runoff is saltwater and freshwater eutrophication: a process whereby nutrient runoff causes the excess growth of microorganisms, depleting dissolved oxygen levels and killing ecosystem fauna.

A similar process occurs in the marine nitrogen cycle, where the ammonification, nitrification, and denitrification processes are performed by marine bacteria. Some of this nitrogen falls to the ocean floor as sediment, which can then be moved to land in geologic time by uplift of the earth's surface, becoming incorporated into terrestrial rock. Although the movement of nitrogen from rock directly into living systems has been traditionally seen as insignificant compared with nitrogen fixed from the atmosphere, a recent study showed that this process may indeed be significant and should be includedin any study of the global nitrogen cycle.

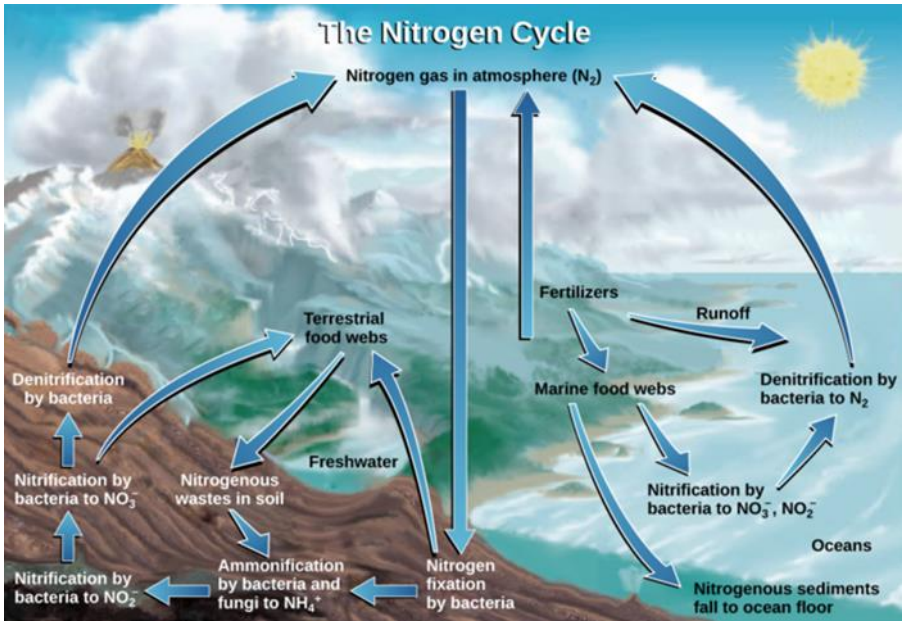


Fig. 6.12: Nitrogen fixation: Nitrogen enters the living world from the atmosphere via nitrogen-fixing bacteria. This nitrogen and nitrogenous waste from animals is then processed back into gaseous nitrogen by soil bacteria, which also supply terrestrial food webs with the organic nitrogen they need.

4.4.4.The Phosphorus Cycle

Phosphorus is an essential element of living things, but, in excess, it can cause damage to ecosystems.

Phosphorus is an essential nutrient for living processes. It is a major component of nucleic acid, both DNA and RNA; of phospholipids, the major component of cell membranes; and, as calcium phosphate, makes up the supportive components of our bones. Phosphorus is often the limiting nutrient (necessary for growth) in aquatic ecosystems.

Phosphorus occurs in nature as the phosphate ionPO_3^{4-}In addition to phosphate runoff as a result of human activity, natural surface runoff occurs when it is leached from phosphate-containing rock by weathering, thus sending phosphates into rivers, lakes, and the ocean. This rock has its origins in the ocean. Phosphate-containing ocean sediments form primarily from the bodies of ocean organisms and from their excretions. However, in remote regions, volcanic ash, aerosols, and mineral dust may also be significant phosphate sources. This sediment then is moved to land over geologic time by the uplifting of areas of the earth's surface.

Phosphorus is also reciprocally exchanged between phosphate dissolved in the ocean and marine ecosystems. The movement of phosphate from the ocean to the land and through the soil is extremely slow, with the average phosphate ion having an oceanic residence time between 20,000 and 100,000 years.

Excess phosphorus and nitrogen that enters these ecosystems from fertilizer runoff and from sewage causes excessive growth of microorganisms and depletes the dissolved oxygen, which leads to the death of many ecosystem fauna, such as shellfish and finfish. This process is responsible for dead zones in lakes and at the mouths of many major rivers.

A dead zone is an area within a freshwater or marine ecosystem where large areas are depleted of their normal flora and fauna. These zones can be caused by eutrophication, oil spills, dumping of toxic chemicals, and other human activities. The number of dead zones has been increasing for several years.

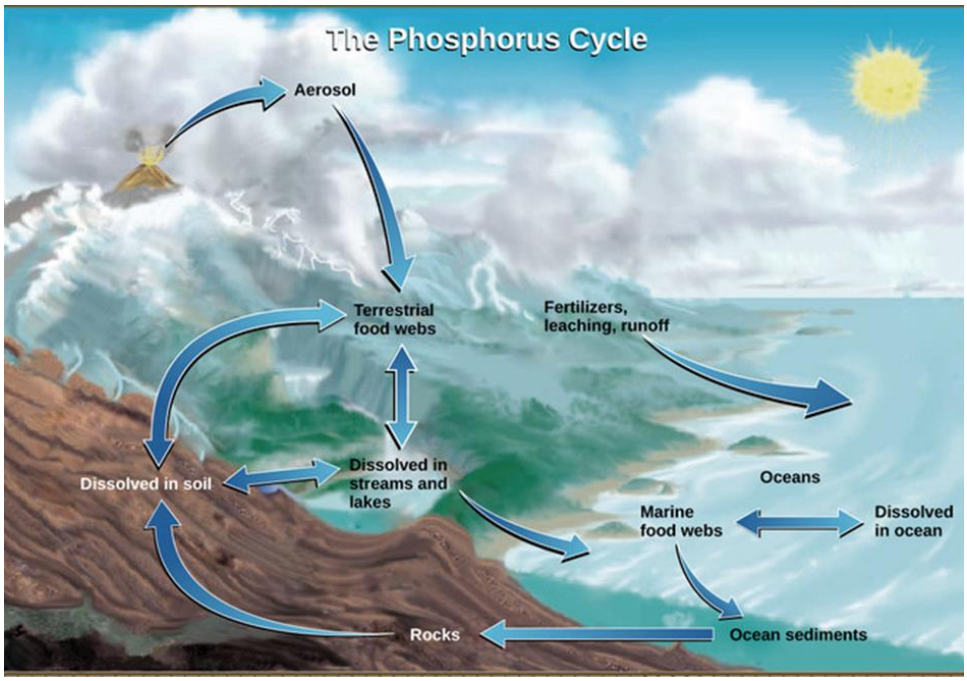


Fig.

Phosphorus cycle: In nature, phosphorus exists as the phosphate ion(PO_4^{3-}). Weathering of rocks and volcanic activity releases phosphate into the soil, water, and air, where it becomes

available to terrestrial food webs. Phosphate enters the oceans via surface runoff, groundwater flow, and river flow. Phosphate dissolved in ocean water cycles into marine food webs. Some phosphate from the marine food webs falls to the ocean floor, where it forms sediment.

4.4.5.The Sulfur Cycle

Sulfur is deposited on land as precipitation, fallout, and rock weathering, and reintroduced when organisms decompose. Sulfur is an essential element for the macromolecules of living things. As a part of the amino acid cysteine, it is involved in the formation of disulfide bonds within proteins, which help to determine their 3-D folding patterns and, hence, their functions. Sulfur cycles exist between the oceans, land, and atmosphere.

On land, sulfur is deposited in four major ways: precipitation, direct fallout from the atmosphere, rock weathering, and decomposition of organic materials. Atmospheric sulfur is found in the form of sulfur dioxide (SO_2). As rain falls through the atmosphere, sulfur is dissolved in the form of weak sulfuric acid (H_2SO_4), creating acid rain. Sulfur can also fall directly from the atmosphere in a process called fallout. The weathering of sulfur-containing rocks also releases sulfur into the soil. These rocks originate from ocean sediments that are moved to land by the geologic uplift. Terrestrial ecosystems can then make use of these soil sulfates (SO_4^{2-}). Upon the death and decomposition of these organisms, sulfur is released back into the atmosphere as hydrogen sulfide (H_2S) gas. Sulfur may also enter the atmosphere through geothermal vents.

Human activities have played a major role in altering the balance of the global sulfur cycle. The burning of large quantities of fossil fuels, especially from coal, releases large amounts of hydrogen sulfide gas into the atmosphere, creating acid rain. Acid rain is corrosive rain that causes damage to aquatic ecosystems and the natural environment by lowering the pH of lakes, which kills many of the resident fauna; it also affects the human-made environment through the chemical degradation of buildings. For example, many marble monuments, such as the Lincoln Memorial in Washington, DC, have suffered significant damage from acid rain over the years. These examples show the wide-ranging effects of human activities on our environment and the challenges that remain for our future.

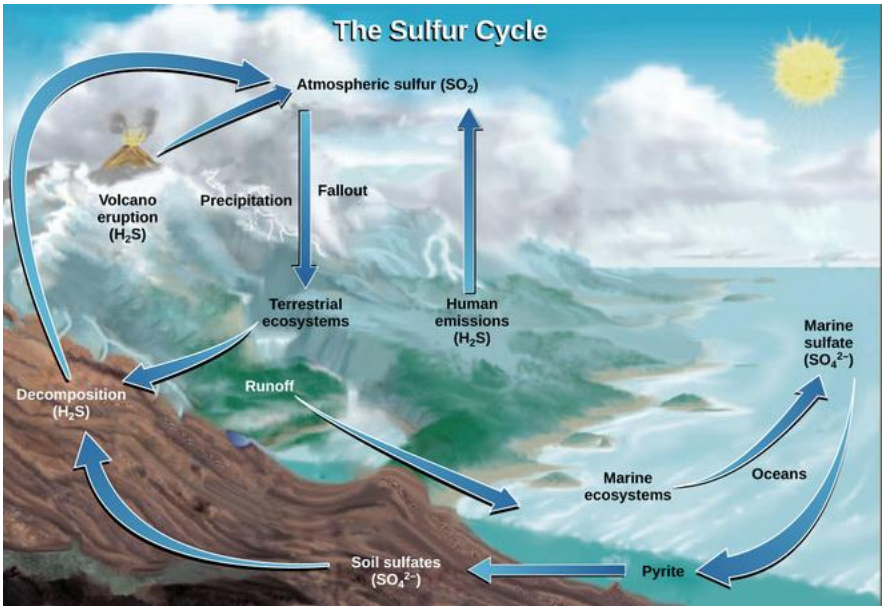


Fig.6.14

Sulfur cycle: Sulfur dioxide from the atmosphere becomes available to terrestrial and marine ecosystems when it is dissolved in precipitation as weak sulfuric acid or when it falls directly to the earth as fallout. Weathering of rocks also makes sulfates available to terrestrial ecosystems. Decomposition of living organisms returns sulfates to the ocean, soil, and atmosphere.

4.5. Summary

- Atmosphere, hydrosphere, lithosphere and biosphere are inter-linked and con-trol the life of the Earth. Atmospheric conditions for a short period and limited area is called weather.
- Composition of the earth: Crust, Mantle, Outer Core and Inner Core.
- Rocks and soil constitute the lithosphere.
- Soil is formed by the weathering process.
- Biosphere is denoted the realm if life if living organism and their interaction with the environment viz. atmosphere, hydrosphere and lithosphere
- The anthroposphere encompasses the total human presence throughout the Earth system including our culture, technology, built environment, and associated activities.

- Biogeochemical cycles describe the pathway through which the essential elements move through the biotic and abiotic components of the system and vice versa.
- Every biogeochemical cycle possess two components namely the reservoir and exchange pool.

4.6.Terminal questions

Q.1: What do you know about environmental segment?

Answer: ----------

Q.2: Discuss the atmosphere and hydrosphere

Answer: ----------

Q.3: How biosphere is interact with atmosphere, lithosphere and hydrosphere

Answer: ----------

Q.4: What is the anthroposphere? Discuss it briefly.

Answer: ----------

Q.5: What are the biogeochemical cycles? Discuss it role in ecosystem and environmental management.

Answer: ----------

Q.6: Discuss briefly of nitrogen and carbon cycles

Answer: ----------

4.7. Further suggested Readings

1. S.C. Sandra, "Environmental Science", A new Central Book Agency,2008

2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017
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4. V. K. Ahluwalia, "Environmental Science, Ane Books India, 2013S.
5. M.C. Dash, "Concepts of Environmental Management for Sustainable Develop Concepts of Environmental Management for Sustainable Development, I K International Publishing House Pvt. Ltd

Unit -5: Environmental Education

5.1. Introduction

Environmental education (EE) refers to organized efforts to teach how natural environments function, and particularly, how human beings can manage behavior and ecosystems to live sustainably. Environmental education is the process of teaching people about the natural world and the way that humans interact with it. This type of education seeks to develop knowledge, skills, and attitudes necessary to understand and appreciate the environment, and to recognize the value of biodiversity and ecosystems. It is a multi-disciplinary field integrating disciplines such as biology, chemistry, physics, ecology, earth science, atmospheric science, mathematics, and geography. The term often implies education within the school system, from primary to post-secondary. However, it sometimes includes all efforts to educate the public and other audiences, including print materials, websites, media campaigns, etc.

Objectives

- To discuss the environmental education
- To discuss the level of environmental education
- To Formal education and non formal environmental education
- To discuss about Environmental justice and environmentalism

5.2.Environmental education

Environmental education is a process that allows individuals to explore environmental issues, engage in problem solving, and take action to improve the environment. The environmental education is refers to develop the understanding of environmental awareness and quality of environment. As a result, individuals develop a deeper understanding of environmental issues and have the skills to make informed and responsible decisions. There are also ways that environmental education is taught outside the traditional classroom.It can take place in formal settings, such as schools and universities, as well as in informal settings, such as community organizations, parks, and museums. The goal of environmental education is to promote environmentally responsible behavior and attitudes inindividuals and communities, and to encourage participation in environmental decision-making processes. Through environmental education, people can learn about the impact of their actions on the environment and how to make informed decisions that support the health of the planet.

The environmental education the equal opportunity and situation for performing certain task and activities at all levels for solving environmental problems.

The components of environmental education are:

- Awareness and sensitivity to the environment and environmental challenges
- Knowledge and understanding of the environment and environmental challenges
- Attitudes of concern for the environment and motivation to improve or maintain environmental quality
- Skills to identify and help resolve environmental challenges
- Participation in activities that lead to the resolution of environmental challenges

The issue of environmental education has been thoroughly discussed national and international, seminar workshop and conferences. Environmental education must require to all for ecological balance of life. The chief objectives of environmental education is that individual and social groups should require awareness and knowledge, develop attitudes skill

and ability for solving environmental related problems. The prospective of environmental education should be integrated, interdisciplinary and holistic in character.

Today need for a new approach to education which cuts across various subjects in schools and higher level and add environmental education

The goal of environmental education in India to develop a world population that is aware of and concerned about total environmental and its associated problems. Recently number of guideline and principles has been developed for enhancing environmental education at all level in both formal and non formal level.

5.2.1.Objectives

The objectives of environmental education are broad in sense of nature. The systematic knowledge about the care should be taken in the explanation and utilization of natural resources for the development and progress of mankind is given through environmental education. The main task of environmental education is to improve quality of life and values.The environmental education has number of objectives that has formulated to help social groups and individuals. The main objectives of environmental education at the grass root level are to succeed in making individuals and communities understand the complex nature of the natural and the built environments. According to UNESCO (1971) the objectives of environmental education are

- **Awareness:** to develop awareness campaign for is environmental issues and total environmental, and its allied problems.
- **Skills:**Skills - to help individuals, groups and societies acquire the action competence or skills of environmental citizenship in order to be able to identify and anticipate environmental problems and work with others to resolve, minimize and prevent them.
- **Knowledge:**. to help individuals, groups and societies gain a variety of experiences in, and a basic understanding of, the knowledge and action competencies required for sustainable development. It also provides gain variety of experience and other require basic understanding of environment and associated problems.
- **Values** - to help individuals, groups and societies acquire feelings of concern for issues of sustainability as well as a set of values upon which they can make judgments about appropriate ways of acting individually and with others to promote sustainable development.

- **Attitude:** to develop set of value and feelings of concern for the environment and motivation for active participation in environmental related problems.
- **Evaluation ability:** to develop ability to monitor and assess the environmental related problems and other related programmes in terms of ecology, economic, social, aesthetic and environmental management.
- **Participation:** to provide opportunity to be actively involved at all in working toward the resolution of environmental problems.In addition, also provide individuals, groups and societies with opportunities to be actively involved in exercising their skills of environmental citizenship and be actively involved at all levels in working towards sustainable development.
- **Capability:** To develop the capability of using skills to fulfill the required aims, to realize and solve environmental problems through social, political, cultural and educational processes.
    - To enlighten the people on the physical components of the environment.
    - To inform them about their dependence on the environmental resources.
    - To enlighten them about the changes in the environment in the last decade and the consequences of their present actions

Newman (1981) has proposed the three level classification of environmental education for different disciplines such as

Environmental studies: that is concern with environmental disturbance and minimization of their impact through change in social sciences.

Environmental Science: it deals with the studies of process of water, air, soil and organisms which leads to pollution and cause environmental damage. It works on set parameters which can be considered for clean, safe and healthy for human and natural environment or ecosystem.

Environmental engineering: This is the study of technical process which is used to minimize the pollution and assessment of impact of environment.

5.2.2. Scope

The environmental science covers all field environmental education. This include the effects of man on environment - how he has exploited and devastated it, polluted it, but more

importantly how man can save itself from the problems which he has caused through the abuse, misuse and over-use of the resources provided by the nature. Environmental Education should not only focus on the effects of environmental degradation but very importantly the understanding of the fundamental causes. These should also include the examination of social and economic factors that aggravate environmental degradation.

Education from the environment involves the experiences gained from our surroundings. This includes the aesthetic value of the environment and the need to keep them as such. Education about environment involves the study of our environment to learn about its composition and working mechanism and its usefulness. This is an important component of environmental education since we have to learn about the environment before we can make it. Education for the environmental enables us to learn how to preserve the environment to enable us derives maximum benefit for the present generation as well as for future. This is the conservation aspect of environmental education.

5.2.3. Opportunity

The environmental education is that the public should become conscious, attain knowledge, change outlooks, and realize capabilities to combat real-life environmental problems. For this, the general public should be acquainted with integrated inter-disciplinary and holistic education. This is only possible with a new approach to education itself—which should be provided in schools and universities. The goals of environmental education as pointed out by the UNESCO is to create environmental awareness in the world population—an awareness about the whole environment and problems associated with it and generate commitment in people to work individually and in union towards solving existing problems and preventing new ones from emerging.

5.3. Levels of environmental education

Environmental education provides the opportunity and situations for performing certain task and actives at all levels for solving for solving environmental problems. Environmental education plans and generates the conductive environment for desirable changes in man. Levels of environmental education Reorienting education as a whole towards sustainability involves the various levels of formal, non-formal and informal education at all levels of society

5.3.1. Formal education

For education opportunity, the school, a college, institution etc, and has a well-defined and systematic curriculum. The NPE States: there should be needs to create consciousness about environmental to all age groups of peoples. It's should be initiate at beginning level of children education. Environmental consciousness should inform teaching in schools and colleges. This aspect will be integrated in the entire educational process. The four components are required to build up the social awareness about environmental education are awareness, exposure to real life situations, concepts of conservation and sustainable development. These can be further adjusted in terms of the requirement at primary, secondary and higher secondary levels. Awareness involves making the individual conscious about the physical, social and esthetic aspects of the environment.

5.3.1.1. Primary level

At primary level environmental education must be initiate and for these contents should be easy and concise way to easily understanding of children by using teaching strategy includes audio-visual and field visits.At primary level, the attempt is made to sensitize the child about environs. Emphasis should be mostly on building up awareness (75%), followed by real life situation (20%) and conservation (5%). It may be better than this education is providing to children not theoretical level but it may gives in behavioral level. Here gives more emphasis to children to know more about our nature and its imports for survivor of lives.

5.3.1.2. Lower secondary level:

Children become conscious about various aspects of environment. Interdisciplinary approaches must be adopted and so the emphases must be on increasing the knowledge of environmental problems.At the secondary level objectives must be real life experience, awareness and problem identification. In lower secondary stage onwards the focus on awareness will begin to decrease in favors of increased knowledge about real life situations conservation and sustainable development. In higher stage, the conversion will get a priority over other factors. The contents should be supplemented with general science. Teaching, practicals and field visits are also to be done. The emphasis must be on conservation, assimilation of knowledge, problem identification and action skills etc.

The objectives of environmental education at Primary and Secondary Levels include,

- To emphasize the relevance of science to daily life.
- To develop a scientific attitude in student
- To create an environmental conducive to greater reliance on the use of principles and practices of science.
- To develop an outlook which emphasizes the method employed in different disciplines of science.
- To know and understand true aspects of the environment in general
- To know and understand the interaction between mammals, between human and their environment and interaction between the various elements and components of the environment.
- Build understanding, awareness and sensitivity towards causes and efforts of the class that continuously take place in society the world around us.
- To build and develop skills in thinking, reasoning, enquiring, evaluating and making• decisions concerning human and the world around them.

5.3.1.3. College level

At college level, maximum emphasis should be on knowledge regarding sustainable development and conservation. The content must be college based on Science and Technology. Teaching practical's and action-oriented field work is to be done. The content must be college/university based on science and technology. At post graduate level, four major areas are recognized environmental engineering, conservation and management, environmental health,

social ecology. Teaching, practical and action oriented fieldwork is to done. At present environment finds a place only through the biology courses and there is no holistic approach. There is a high powered committee to suggest areas of environmental education at post graduate level. Basic environmental concepts and elements added to existing courses at undergraduate and postgraduate levels, for all students irrespective of their courses. New environmental units or modules introduced into a large number of courses can increase the depth and detail of environmental study.

5.3.2. Non-formal Environmental Education

It is designed for any age group working in social, economic and culturaldevelopment of the community. They form groups or clubs and organize exhibitions, public lectures, meetings, environmental campaigns. This can be done only through channels of adult education. Through programmes for adult education are already in progress and are duly emphasized by the New Education policy, the time has come to emphasis environmental education for sections like women, tribal's, agricultural, slum dwellers and residents of drought prone areas, voluntary agencies or non-government organizations have played important role in adult education. Information packs like posters, slides and audio-visual materials can be used. Special exhibitions in rural areas at the time of fairs and festivals should be arranged for creating environmental awareness. In our society where information spreads through personal encounter and by word of mouth. Audio-visual media have certain limitations. But media provide use and views for community leaders and opinion makers who in turn influence the beliefs and attitudes of others. For literature population print media like newspapers and magazines are effective. Important programmes should be shown on television to create awareness about environmental matters. But language is another problem, because most of these programmes are either in Hindi or English which are not easily understood by many people. So use of local languages will be effective for educating masses. There are over 200 non-government organization of which most are involved in environmental education and awareness. Kalpavriksh, Kerala SastraSahityaParishad, World wide fund for Nature (WWF-India), Bombay Natural History Society, Chipko Movement, Appiko Movement are some of the important NGOs which are important agents for creating awareness of environment. They act as a source of information work as pressure groups, and advise government and undertake education and research. The basic aim of environmental education is to make aware the people regarding the abiotic and

biotic environment and their resources. By environment aware people may use conserve and protect the valuable renewable and non renewable environment resources and by it sustainable development may be brought in practices.Environmental advocacy education focuses on empowering individuals and communities to take action and advocate for environmental issues. It may involve training in advocacy skills, organizing campaigns, and engaging in political processes to promote environmental change.The Sustainable development education emphasizes the interconnectedness of environmental, social, and economic systems. It seeks to promote sustainable practices and behaviors that balance the needs of the present with those of future generations.

Overall, environmental education can take many forms and can be tailored to meet the needs and interests of different audiences.

5.4. Importance of Environmental Education

Environmental Education is very important for the child and adult for self-fulfillment and social development. It helps in maintenance of life and health. In self-preservation and in the preservation of human race.

It helps to understand different food chains and the ecological balance in nature.

It helps to understand and appreciate how the environment is used for making a living and promoting material culture.

Environmental Education helps in appreciating and enjoying nature and society.

It stimulates concern for changing environment in a systematic manner for the long run as well as the immediate welfare of mankind.

It directs attention towards the problems of population explosion, exhaustion of natural resources and pollution of the environment and sheds light on methods of solving them.

The education for environmental awareness is essential for the younger generation as well as for the older generation. It also needs to cover both urban and rural populations. Hence, environmental education needs to be conveyed to the different categories of people through formal education systems, non-formal education systems and the use of mass media. Our country is highly diverse climatically, geographically, floristically, Faunistically, lingually, socially and

economically. Therefore, environmental education has to be essential location- specific. At the first level, specific attention must be paid to school going children and women's (about 50% of the population). They are to be made awareness of health, family planning, nutrition, rural development, slum improvement, sanitation, hygiene, water and food contamination etc. Nongovernment organizations have to play a significant role.

5.5. Environmental justice

Environmental justice is the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no population bears a disproportionate share of negative environmental consequences resulting from industrial, municipal, and commercial operations or from the execution of federal, state, and local laws; regulations; and policies. Meaningful involvement requires effective access to decision makers for all, and the ability in all communities to make informed decisions and take positive actions to produce environmental justice for themselves. Historically, the environmental justice movement has been one of grassroots activism focusing on the rights and liberties of people of color and low-income communities relative to the environment and particularly, in response to the disproportionate burden of industrial pollution and lack of regulatory enforcement in these communities.

Meaningful involvement means:

- People have an opportunity to participate in decisions about activities that may affect their environment and/or health;
- The public's contribution can influence the regulatory agency's decision;
- Community concerns will be considered in the decision making process; and
- Decision makers will seek out and facilitate the involvement of those potentially affected.

How can we work towards environmental justice?

To achieve environmental justice, environmental laws and policies need to be developed, implemented and enforced to protect everyone – regardless of race or income.At ClientEarth, we use the power of the law to change the system – informing, implementing and enforcing the law, advising decision-makers on policy and training legal and judicial professionals.We're fighting

to protect everyone's right to breathe clean air and using the law to hold governments to account for failing to take action to mitigate and adapt to climate change. We're also promoting the right to information and access to justice so the human rights of those most affected by environmental destruction are protected.

5.6. Environmentalism

Environmentalism is a social and political movement that advocates for the protection and preservation of the natural world and the promotion of sustainable practices to maintain the health of the planet. Environmentalism is concerned with a wide range of issues, including conservation of biodiversity and ecosystems, reduction of pollution and waste, climate change mitigation and adaptation, and the promotion of renewable energy and sustainable development. Environmentalism involves a range of activities, including scientific research, policy development, advocacy and activism, education and outreach, and community organizing. Environmentalists work to raise awareness of environmental issues, mobilize public support for environmental protection, and influence policy and decision-making at all levels of government and society. The origins of modern environmentalism can be traced back to the mid-twentieth century, with the publication of Rachel Carson's book "Silent Spring" in 1962. Since then, environmentalism has become a global movement, with millions of people around the world advocating for a healthier, more sustainable planet.

The environmental movement in India has a long and rich history, dating back to the 1970s. In that decade, concerns about pollution and environmental degradation led to the formation of several organizations that focused on environmental protection and conservation. One of the earliest and most influential of these organizations was the Chipko movement, which began in the 1970s in the state of Uttarakhand. This movement, led by local villagers, sought to protect the region's forests from commercial logging by hugging trees and forming human chains around them. In the years since, the environmental movement in India has grown and diversified, with a range of organizations and individuals advocating for a wide range of environmental issues. These issues include pollution, deforestation, climate change, biodiversity conservation, and sustainable development. Some of the most prominent environmental organizations in India include the Centre for Science and Environment, the Bombay Natural History Society, and the Wildlife Conservation Society India. These organizations work to promote environmental

awareness, research, policy development, and advocacy, and are involved in a range of activities, from scientific research to community organizing. The Indian government has also taken steps to address environmental issues, including the establishment of the Ministry of Environment, Forests, and Climate Change in 2014. However, environmental challenges in India remain significant, and there is ongoing work to promote greater environmental awareness and action at all levels of society.

5.7. Summary

Environmental education may best be defined as a process directed at creating awareness and understanding about environmental issues that leads to responsible individual and group actions. Successful environmental education focuses on processes that promote critical thinking, problem solving, and effective decision-making skills. Environmental education is a dynamic process. The priority of such education is to develop cautious mind of people about their total surrounding. Its main task is to impart proper knowledge and training to solve various problems of our environment systematically. In order to enable people to enjoy good health and a high quality of life, it is vital to prevent harmful effects to human health or damage to the environment caused by pollution of air, water and soil, noise, vibration, noxious smells etc. Environmental Education is a methodology in which people pick up familiarity with their surroundings and secure learning, abilities, values, experiences, and passion, all of which will empower them to act separately and aggregately and to take care of present and future environmental issues.

5.8. Terminal questions

Q.1: What is the environmental education? Discuss the objectives of environmental educations.

Answer:----------

Q.2: Discuss the environmental education in India.

Answer:----------

Q.3: Discuss about formal and non formal education in India.

Answer:----------

Q.4: Discuss the important of environmental education.

Answer:----------

Q.5: Discuss about Environmental justice and its limitations.

Answer:----------

Q.6: Write short notes on

a. Primary level of environmental education

b. Secondary level of environmental education

Answer:----------

5.9. Further suggested readings

1. C. Sandra, "Environmental Science", A new Central Book Agency,2008
2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017
3. NeerjNachiketa, Environment and Ecology: A Dynamic Approach, G.K. Publication Ltd, 2021
4. V. K. Ahluwalia, "Environmental Science, Ane Books India, 2013S.
5. M.C. Dash, "Concepts of Environmental Management for Sustainable Develop Concepts of Environmental Management for Sustainable Development, I K International Publishing House Pvt. Ltd.

Unit-6: Environmental Issues

6.1. Introduction

Humans have made a very impressive economic progress, especially during the past two centuries, in creating material and luxuries of life style. This progress has been achieved at a tremendous cost to the environment. Ever increasing exploitation of natural resources coupled with environmental degradation has reached a point that now threatens the well being and future of mankind. Environmental issues refer to problems that arise due to the detrimental impact of human activities on the natural world. These issues have become increasingly prevalent in recent years due to factors such as pollution, ozone-hole, greenhouse effect, desertification, loss of biodiversity, oil spills, nuclear disasters, hazardous waste management,*delete*are some of the global environmental problems that need immediate collective attention. Increased human activity, urbanization, industrialization are led to rapid deterioration of the environment. This has severely affected the life supporting system. A Various environment protection programs are being practiced at the individual, organizational and government levels with the aim of establishing a balance between man and the environment.

Objectives

- To discuss the integration of environmental concerns
- To discuss equality and integrity

- To discuss the causes and types of environmental issues
- To discuss the solutionmitigation plansfor environmental issues

6.2. Integration of environmental concerns

Our environment is constantly changing, andas our environment changes so does the*delete*need to become increasingly aware of the environmental issues that are causing environmental changes. With a massive increase in natural disasters, warming and cooling periods, and*delete*different types of weather patterns, people needsto be a lot more cautious with the way they lead their lives in conjunction with the types of environmental issues our planet is facing. Environmental issues are the harmful effects of human activities on the environment such as.....These include*delete*pollution, overpopulation, waste disposal, climate change, global warming, the greenhouse effect, etc.

The integration of environmental concerns refers to incorporating environmental considerations into decision-making processes across all sectors of society, including government, industry, and individuals. It involves recognizing the interconnectivity between environmental, social, and economic issues, and developing strategies that promote sustainable development. There are several ways in which environmental concerns can be integrated into decision-making processes:

- **Environmental impact assessments (EIAs):**

EIAs are the studiesto conductedandto*delete* evaluate the potential environmental impacts of proposed development projects. This helps to identifythepotential risks and to determine ways to minimize or mitigate those risks.....impacts.

- **Sustainable development goals (SDGs):**

The SDGs are a set of 17 goals adopted by the United Nations to promote sustainable development. These goals cover a wide range of issues, including poverty reduction, health, education, and environmental protection.

- **Corporate social responsibility (CSR):**

CSR refers to a company's responsibility to consider the impact of its activities on the environment, society, and the economy. Companies can integrate environmental concerns into

their decision-making processes by adopting sustainable practices and reducing their environmental footprint.

- **Environmental policies and regulations:**
  Governments can integrate environmental concerns into decision-making processes by implementing policies and regulations that promote environmental protection. This can include regulations on emissions, waste disposal, and the use of natural resources.
- **Education and awareness:**
- Education and awareness-raising campaigns can help to increase public understanding of environmental issues and promote individual actions that support environmental protection.

Overall, the integration of environmental concerns into decision-making processes is critical for promoting sustainable development and ensuring the long-term health and well-being of both people and the planet.

6.3. Equity and integrity of environment

The concepts of equity and integrity are important considerations when addressing environmental issues. Equity refers to fairness and justice in the distribution of environmental benefits and burdens. This means that everyone, regardless of their socioeconomic status or geographic location, should have equal access to clean air, water, and a healthy environment. Additionally, those who have contributed the least to environmental problems should not bear the greatest burden of their consequences. Integrity, on the other hand, refers to the preservation and protection of natural systems and processes. This means that the environment should be maintained in a way that ensures the long-term health and well-being of ecosystems, species, and the planet as a whole. This involves protecting biodiversity, minimizing pollution and***delete***waste, and reducing greenhouse gas emissions to mitigate the effects of climate change. Achieving both equity and integrity in the environment requires a commitment to social and environmental justice. This involves recognizing the disproportionate impacts of environmental problems on marginalized communities, and taking steps to ensure that these communities are not unfairly burdened by environmental degradation. It also involves recognizing the interconnectedness of social, economic, and environmental issues, and developing solutions that promote sustainable development for all. In conclusion, achieving equity and integrity in the environment requires a comprehensive approach that considers the social, economic, and environmental impacts of decision-making. By working towards a sustainable future that prioritizes both equity and integrity, we can ensure that future generations inherit a healthy and vibrant planet.

Types of environmental equality

Environmental equality refers to the fair distribution of environmental benefits and burdens across different groups of people. There are several types of environmental equality, including.

- **Distributive environmental equality**: This refers to the equal distribution of environmental benefits and burdens across different groups of people. It means that everyone should have access to clean air, water, and other natural resources.
- **Procedural environmental equality**: This refers to the fair and equitable processes

that are used to make decisions about environmental issues. It means that all stakeholders should have a say in the decision-making process and that their voices should be heard.

- **Inter-generational environmental equality**: This refers to the fair and equitable distribution of environmental benefits and burdens across different generations. It means that future generations should not be left with a degraded environment as a result of the actions of previous generations.
- **Intra-generational environmental equality**: This refers to the fair and equitable distribution of environmental benefits and burdens within a single generation. It means that vulnerable groups, such as low-income communities and minorities, should not bear a disproportionate burden of environmental harms.
- **Environmental justice:** This refers to the fair and equitable treatment of all people, regardless of their race, ethnicity,***delete***or socioeconomic status, with respect to environmental issues. It means that no group should be disproportionately affected by environmental harms, and that all people should have access to environmental benefits.

Types of Environmental integrity

Environmental integrity refers to the maintenance of ecological systems and processes, and the protection of biodiversity, natural resources, and ecosystem services. There are several types of environmental integrity, including:

- **Ecological integrity:** This refers to the maintenance of natural ecological systems and processes, and the protection of biodiversity, natural habitats, and ecosystem services. Biophysical integrity: This refers to the maintenance of natural physical systems and processes, such as soil quality, water quality, and air quality.
- **Cultural integrity:** This refers to the maintenance of traditional knowledge, practices, and beliefs that are related to the environment and that have been developed over generations.
- **Social integrity:** This refers to the maintenance of social systems and processes that are related to the environment, such as community-based natural resource

management and sustainable development.

- **Economic integrity**: This refers to the maintenance of economic systems and processes that are compatible with environmental sustainability, such as green economy and circular economy.
- **Legal integrity:** This refers to the maintenance of legal frameworks and systems that promote environmental protection, such as environmental laws and regulations, and the enforcement of environmental policies.

6.4. Cause and types of environmental issues

There are several causes of environmental issues, including human activities, natural disasters, and climate change. Some of the most significant causes of environmental problems include:

- **Human activities:**

The expansion of human populations, industrialization, and increased use of natural resources are major causes of environmental problems such as air and water pollution, habitat destruction, and climate change. Human activity has significantly altered the natural environment, leading to various environmental issues, such as climate change, deforestation, and pollution. The burning of fossil fuels for energy production and transportation has resulted in greenhouse gas emissions, leading to global warming and climate change. Deforestation, agriculture, and land-use changes have contributed to the loss of biodiversity and degradation of ecosystems. However, human activity can also have positive impacts on the environment, such as the development of renewable energy sources, sustainable agriculture practices, and conservation efforts. These positive actions can help to reduce the negative impacts of human activities on the environment and promote sustainability.

- **Natural disasters:**

A natural disaster is an event that occurs as a result of natural phenomenathatand causes significant damage to property and human life. Natural disasters such as hurricanes, earthquakes, and wildfires can have severe impacts on the environment, including soil erosion, loss of biodiversity, and the release of hazardous materials into the environment. Natural disasters can

have devastating effects on communities and countries, resulting in loss of life, destruction of infrastructure, displacement of people, and significant economic impacts. The impacts of natural disasters can be particularly severe in developing countries, where limited resources and infrastructure can exacerbate the effects of these events. Preparedness and planning are critical in mitigating the impacts of natural disasters. Governments and communities can take measures to prepare for these events, such as building disaster-resistant infrastructure, establishing early warning systems, and developing emergency response plans. These efforts can help to minimize the loss of life and damage to property caused by natural disasters.

Climate change:

It is also long-term shifts in global weather patterns and average temperatures that are primarily caused by human activities, including the burning of fossil fuels, deforestation, and agricultural practices. These activities release greenhouse gases, such as carbon dioxide and methane,*delete*into the atmosphere, trapping heat and causing the Earth's temperature to rise. Climate change is a significant environmental issue with far-reaching impacts, including rising sea levels, more frequent and intense natural disasters, loss of biodiversity, and causesnegative impacts on human health and livelihoods. These impacts are particularly severe in vulnerable communities and developing countries with limited resources to adapt to and mitigate the effects of climate change. Efforts to address climate change include reducing greenhouse gas emissions, increasing energy efficiency, promoting renewable energy sources, and developing sustainable land-use practices. International cooperation, such as the Paris Agreement, is also essential in addressing the global nature of climate change and promoting collective action towards reducing emissions and adapting to the impacts of climate change.

There are many types of environmental issues, some of which include:

- **Biodiversity loss:**

This refers to the decline in the variety of species and ecosystems due tothehuman activities such as habitat destruction, pollution, and climate change etc. Biodiversity loss has significant environmental and economic impacts, including the loss of ecosystem services such as air and water purification, nutrient cycling, and carbon sequestration. It also affects food security, as many crops depend on the pollination and pest control services provided by other organisms. Biodiversity loss can also result in the extinction of species, leading to the loss of genetic

diversity and potential medical and scientific discoveries. It has been recognized as a major environmental issue, and international efforts, such as the Convention on Biological Diversity, have been established to address this problem. Efforts to address biodiversity loss include habitat conservation and restoration, the establishment of protected areas, and the development of sustainable land-use practices. It also requires the promotion of public awareness and engagement in conservation efforts to foster a deeper appreciation for the value of biodiversity.

- **Water pollution:**

. Water pollution refers to the contamination of water bodies, such as lakes, rivers, oceans, and groundwater, caused by human activities. Water pollution also refers to the contamination of freshwater and marine environments by human activities such as industrial and agricultural practices, sewage disposal, and oil spills This pollution can come from various sources, such as industrial and agricultural practices, sewage discharge, and improper waste disposal. The impact of water pollution can be severe, including the loss of aquatic life, the spread of waterborne diseases, and the degradation of drinking water sources.

- **Air pollution:**

Air pollution refers to the presence of harmful substances in the Earth's atmosphere, primarily caused by human activities, such as the burning of fossil fuels, transportation, and industrial processes. These activities release pollutants such as nitrogen oxides, sulfur dioxide, and particulate matter into the air, leading to negative impacts on human health and the *delete*environment. Air pollution can have serious health effects, particularly on vulnerable populations such as children, the elderly, and those with pre-existing respiratory or cardiovascular conditions. Long-term exposure to air pollution can also increase the risk of chronic health conditions such as lung cancer, heart disease, and stroke. Environmental impacts of air pollution include acid rain, which can damage forests and aquatic ecosystems, and ozone depletion, which contributes to climate change and harms marine life. Efforts to address air pollution include regulation of emissions from industrial and transportation sources, promotion of clean energy and transportation, and public education and awareness. International cooperation, such as the Montreal Protocol, has also been critical in reducing air pollution and protecting the ozone layer.

- **Deforestation:**

This refers to the clearing of forests for human activities such as agriculture, logging, and urbanization, which can have significant impacts on biodiversity, climate, and soil quality. Deforestation has significant environmental and social impacts, including the loss of habitats for endangered species, increased greenhouse gas emissions, soil erosion, and decreased water quality. It also affects the livelihoods of local communities who rely on forest resources for their survival, including traditional medicines, food sources, and building materials. Efforts to address deforestation include forest conservation and restoration, the establishment of protected areas, and the development of sustainable land-use practices, such as agroforestry and community forestry. It also requires the promotion of public awareness and engagement in conservation efforts to foster a deeper appreciation for the value of forests.

Overall, environmental issues pose a significant threat to the health and well-being of both people and the planet. Addressing these issues requires a collective effort from governments, businesses, and individuals to reduce waste and emissions toconserve natural resources, and adopt environmentally friendly technologies.

6.5. Local regional and global environment issues and challenges

Environmental issues can occur at the local, regional, and global levels. Some of the most significant environmental challenges at each level include:

a) Local environmental issues and challenges:

Local environmental challenges can vary depending on the specific location, but some common issues include air and *delete,*water pollution, waste management, and habitat destruction. For example, urban areas often face air pollution and waste management challenges, while rural areas may experience soil erosion and water pollution due to agricultural practices.Local environmental issues and challenges can vary widely depending on the specific region and ecosystem, but some common ones include:

- **Pollution:**Local*delete*pollution can take many forms,*delete*includes including air, water, and soil pollution. In some areas, industrial or agricultural activities can lead to high levels of toxic substances in the environment, posing risks to both human and animal health.

- **Habitat destruction:** As urbanization and development continue to spread, natural habitats are increasingly destroyed or fragmented. This can have significant impacts on local wildlife populations and biodiversity.
- **Resource depletion:** Overexploitation of natural resources, such as groundwater or forests, can lead to depletion and degradation of these resources. This can affect the availability of essential resources for both human and animal populations.
- **Climate change:** The effects of climate change, such as rising temperatures, extreme weather events, and sea level rise, can have significant impacts on thelocal ecosystems, affecting the availability of water, food, and other resources.
- **Waste management:** Proper waste management is critical for protecting thelocal environments, but inadequate or improper waste disposal can lead to pollution and other environmental issues.

Addressing these challenges requires a coordinated effort from government, businesses, and individuals to promote sustainable practices and*delete* toprotect the natural environment. This can include efforts to reduce pollution, conserve natural habitats, promote sustainable resource use, and mitigate the effects of climate change.

b) Regional environmental issues and challenges:

Regional environmental challenges often have broader impacts than local issues and can involve multiple countries or regions. Some common regional challenges include deforestation, desertification, and water scarcity. For example, the Amazon rainforest is a critical global resource that is currently experiencing deforestation due to logging, agriculture, and mining activities. Regional environmental issues and challenges can vary widely depending on the specific region and ecosystem, but some common ones include:

- **Land degradation**: Land degradation is a significant environmental challenge in many regions, often caused by unsustainable land use practices such as deforestation, overgrazing, and poor agricultural practices.
- **Water pollution**: Water pollution is a growing problem in many regions, caused by a range of factors such as agricultural runoff, untreated sewage, and industrial activities.

- **Desertification:** Many regions are experiencing desertification, a process where previously fertile land becomes desert due to a combination of factors such as climate change, overgrazing, and deforestation.
- **Natural disasters:** Natural disasters such as floods, droughts, and wildfires are a significant environmental challenge in many regions, causing widespread damage to ecosystems and infrastructure.
- **Urbanization**: Rapid urbanization is a major environmental issue in many regions, leading to increased air and water pollution, habitat destruction, and strain on natural resources.

Addressing regional environmental challenges requires a*delete*coordinated efforts from government, businesses, and individuals to promote sustainable practices and protect the natural environment. This can include efforts to reduce pollution, conserve natural habitats, promote sustainable land use, and mitigate the effects of climate change.

c) Global environmental issues and challenges:

Global environmental challenges are theissues that have a worldwide impact and require international cooperation and action. These include climate change, biodiversity loss, and ocean acidification. Climate change, for example,*delete* is caused by the emission of greenhouse gases that trap heat in the atmosphere, resulting in rising temperatures and sea-level rise that affect all countries and regions.

Global environmental issues and challenges are complex and multifaceted, but some of the most pressing ones include:

- **Climate change:** The warming of the Earth's climate system, primarily caused by human activities such as burning fossil fuels and deforestation,which is one of the most urgent global environmental challenges. Climate change poses significant risks to ecosystems, human health, and the global economy.
- **Loss of biodiversity:** The rapid decline of species and ecosystems around the world is another critical global environmental issue. Habitat destruction, overexploitation, and climate change are all factors contributing to biodiversity loss.

- **Water scarcity:** Many regions around the world are facing water scarcity due to a combination of factors, including population growth, climate change, and unsustainable water use practices.
- **Air pollution:** Air pollution is a major health and environmental issue, affecting both developed and developing countries. Sources of air pollution include industrial and transportation activities, as well as indoor air pollution from cooking and heating fuels.
- **Waste management:** The production and disposal of waste is a growing global environmental issue, with significant impacts on both human health and the environment. Proper waste management practices are critical for protecting theecosystems and public health.

Addressing these environmental challenges requires a collaborative effort at all levels of society. Governments, businesses, and individuals must work together to reduce waste and emissions, conserve natural resources, and develop sustainable practices. This can involve implementing policies and regulations to protect the environment, adopting green technologies and practices, and increasing public awareness and education about environmental issues.

6.6.Solution for environmental issues

Addressing environmental issues requires a multi-faceted approach that involves individuals, businesses, and governments. Here are some solutions that can be implemented to address environmental issues.

- **Reduce, Reuse, and Recycle**:

Reduce, reuse, and recycle are three the fundamental principles of waste management that promote sustainable practices and toreduce the negative impacts of waste on the *delete* environment. It is the one of the most effective ways to reduce environmental impact is*delete*to reduce waste by consuming less and*delete*reusing and recycling products whenever possible. Reduce refers to the act of reducing the amount of waste produced in the first place. This can be achieved through the actions such as choosing to buy products with minimal packaging, bringing your reusable bags and containers when shopping, and avoiding single-use items like plastic straws and water bottlesetc. Reuse involves finding ways to use items again instead of throwing them away. This can be done by donating unwanted items to charity or using them in a creative

way, such as turning old clothes into cleaning rags or using glass jars as storage containers. Recycling is the process of converting waste materials into the new products. Recycling helps to conserve the natural resources, reduce the amount of waste sent to bylandfills, and save the energy. Common items that can be recycled include paper, plastic, glass, andmetals etc.

- **Adopt Sustainable Practices:**

Adopting sustainable practices in agriculture, industry, and transportation can help to reduce theemissions, conserve natural resources, and to protect the environment. This includes practices such as using renewable energy sources, reducing greenhouse gas emissions, and using eco-friendly technologies.

- **Protect Biodiversity:**

Protecting biodiversity can helptoensure the long-term health of ecosystems and support human well-being. This can be achieved through conservation efforts such as habitat protection, reforestation, and the *delete* preservation of endangered species. Biodiversity is the variety of life on Earth, from the smallest microorganisms to the largest mammals. It is essential for maintaining the health of ecosystems and theirservices they provide,*delete*such as clean air and water, food and medicine, and climate regulation. Protecting the biodiversity is crucial for maintaining the balance of the natural world and to ensure the survival of many species, including humans. There are several ways to protect biodiversity, including:

- ✓ **Conserving natural habitats:**Protecting natural habitats is crucial for the survival of many species. This can involves tocreating protected areas, such as national parks, and restoring degraded habitats.
- ✓ **Promoting sustainable land use practices:** Unsustainable land use practices, such as deforestation and overgrazing, are themajor threats to biodiversity. Promoting sustainable land use practices, such as agroforestry and sustainable agriculture, can help to protect the biodiversity.
- ✓ **Controlling invasive species:** Invasive species can cause the significant damage to ecosystems and threaten native species. Controlling and eradicating invasive species is essential fortoprotecting the biodiversity.
- ✓ **Addressing climate change:** Climate change poses a significant threat to the biodiversity, as it alters ecosystems and affects the distribution and survival of many

species. Reducing the greenhouse gas emissions andtopromotes theclimate-resilient practices thatcan help to protect the biodiversity.

- **Advocate for Policy Change:**

Governments play a critical role in addressing the environmental issues. Advocating for policy change at the local, national and international levels can helptoensure that laws and regulations to protect the environment andtopromote sustainable practices.

- **Increase Public Awareness and Education:**

Educating the public about environmental issues and promoting the sustainable practices can helptoraisethe awareness and to the encourage people to take anaction to protect the environment.

- **Support Sustainable Businesses:**

Supporting businesses that prioritize sustainability and ethical practices can help to promote a more sustainable economy and toreduce environmental impact.

Overall, addressing environmental issues requires a collective effort from individuals, businesses, and governments. By taking action to reduce the waste and emissions, protect biodiversity, and promote sustainable practices, we can create a healthier and more sustainable future for ourselves and for future generations.

6.7. Summary

Environmental issues and challenges affect diverse on and the health and well-being of both people and the planet. These issues are caused by thehuman activities, natural disasters, and climate change. Causes of environmental problems include the expansion of human populations, industrialization, and increased useover consumption ofthenatural resources. Some of the most significant environmental challenges include climate change, biodiversity loss, water and air pollution, deforestation, and desertification. These issues can occur at the local, regional, and global levels and require a collaborative effort from theindividuals, businesses, and governments to address them. Solutions to environmental challenges include reducing waste and emissions, adopting sustainable practices, protecting biodiversity, advocating for policy change, increasing public awareness and ,education, and supporting sustainable businesses.....sustainable

development. Addressing theenvironmental challenges requires collective efforts from all levels of society to create a healthier and more sustainable future for ourselves and future generations.

6.8. Terminal questions

Q.1 What do you understand about integration of environmental concerns?

Answer:----------

Q.2 Discuss the equality and integrity of environment.

Answer:----------

Q.3 Discuss about current environmental challenges and issues.

Answer:----------

Q.4 Discuss the possible way for the reduction of environmental issues.

Answer:----------

Q.5 Discuss about different challenges of environment.

Answer:----------

Q.6 Discuss the different global environmental challenges.

Answer:----------

6.9. Further suggested readings

1. S.C. Sandra, "Environmental Science", A new Central Book Agency,2008
2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017
3. NeerjNachiketa, Environment and Ecology: A Dynamic Approach, G.K. Publication Ltd, 2021
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Rajarshi Tandon Open University, Prayagraj

Fundaments of Environmental Sciences

Block- 3

Man and Environmental Sustainability

UNIT -7

Man and Environment

UNIT-8

Environmental and Human Health

UNIT-9

Environmental Sustainability

UGEVS-101N

Fundaments of Environmental Sciences

Rajarshi Tandon Open University, Prayagraj

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Unit-7: Man and Environment

7.1. Introduction

Man-environment relationships refer to the interactions and feedbacks between the human and the natural components and, consequently, to the linkages between the social and the geophysical systems. The field of man-environment relationship operates with a series of concept and notions. The relationship between man and the environment is complex and multifaceted, and has been a topic of discussion and debate for many years. On one hand, humans dependon the environment for survival, as we rely on natural resources such as air, water, and food to sustain ourselves. On the other hand, human activities can have a significant impact on the environment, including pollution, deforestation, and climate change. hroughout history, humans have altered the environment to meet their needs, sometimes with unintended consequences. For example, deforestation for agriculture or urbanization can lead to soil erosion, loss of biodiversity, and disruption of ecosystems. Similarly, pollution from industrial activities or transportation can harm human health and damage natural habitats. In recent years, there has been increasing awareness of the need to balance human needs with environmental protection. This has led to efforts to promote sustainability andtoreduce the impact of human activities on the environment. Sustainable practices aim to preserve the natural resources for future

generations, while minimizing negative impacts on the environment and promoting theeconomic development.

Objectives

- To discuss the man and environment relationship
- To known about population characteristics
- To know about mortality, Natality and biotic potential
- To discuss the impacts of human activity on environment

7.2. Concept of Population and Density

A population is generally groups of individual of particular species. They occupying a particular area at specific time, and interbreeding themselves. Members of a population often rely on the same resources, are subject to similar environmental constraints, and depend on the availability of other members to persist over time. Some ecologist has identifying two types of populations' i.e. mono specific population and poly specific population. The mono specific population is a population of individual species while the polyspecific population is more than one species. The population of individual species or group of organism of some species that living in particular geographic area and are capable of interbreeding. The polyspecific population is generally referred to as a community and the term population is used for the group of individual of any kind of species. The number of population is arises due to reproduction, active transport of individual by transport agencies. Under favorable condition, the group of individual increases in number and under unfavorable condition group of individual increases. An increase in number of individual of species results in consequences of concern to the species itself and also to interdependent species growing in area.

In ecology, the population of a certain species in a certain area can be estimated using the Lincoln index to calculate the total population of an area based on the number of individuals observed. A species can be randomly or stematically distributed throughout the different parts of the world, countries, cities, forests, ecosystems, etc. But a defined set living in a "very" specific geographic dimension is called a population. However, the ecological study of populations includes the following three main aspects;

i. Population characteristics
ii. Population dynamics
iii. Regulation of populations

Characteristics of Population

Population is characterized with some characteristics such as dispersion, fluctuation in number (density) sex ratio, nationality, mortality etc.

The population has the following characteristics:

Population Size and Density: Total size is generally expressed as the number of individuals in population. More informative are estimates of **density**, the number per unit area (or volume) of environment.

The population size (N) at any given place is determined by the processes of birth (B), death (D), new arrivals from outside or **immigration (I)** and going out or **emigration (E)**. Therefore, change in population size between an intervals of time Nt+1 is Nt (initial stage)+B-D+I-E.

Population Density: Density may be numerical density (number of individuals per unit area or volume) or biomass density (biomass per unit area or volume). When the size of individuals in the population is relatively uniform, as mammals, birds or insects then density is expressed in terms of number of individuals (numerical density). But, when the size of individuals is variable, such as true of fishes, trees or mixed populations (biomass density).

The patterns of distribution of organisms in nature are different it becomes important to distinguish between **crude density** and **specific (ecological)density**.

1. **Crude density.** It is the density (number or biomass) per unit total space.
2. **Specific** or **ecological** or **economic density.** It is the density (number or biomass) per unit of habitat space i.e. available area or volume that can **actually** be colonized by the population.
3. **Dispersion:** Dispersion is the spatial pattern of individuals in a population relative to one another. The three basic types of dispersion are:
4. **Regular Dispersion:** The individuals are more of less spaced at equal distance from one another. Animals with territorial behavior tend towards this dispersion.
5. **Randam Dispersion:**The position of one individual is unrelated to the positions of its neighbours. This is also relatively rare in nature.

6. **Clumped Dispersion:** Most populations exhibit this dispersion to some extent with individuals aggregated into patches interspersed with no or few individuals. Such aggregations may result from social aggregations.

Age structure

In most types of populations, individuals are of different age. The proportion of individuals in each age group is called age structure or age distribution of the population.

Age distribution is important, as it influence both, natality and mortality of the population. The ratio of the various age groups in a population determine the current reproductive status of the population, thus anticipating, its future, From an ecological view point there are three major ecological ages (age groups) in any population. These are, prereproductive, reproductive and postreproductive.

Age pyramids. The model representing geometrically the proportions of different age groups in the population of any organism is called age pyramid. The three hypothetical pyramid types are:

A pyramid with broad base. It indicates a high percentage of young individuals only few old individuals. thus in rapidly growing young population, birth rate is high and population growth may be exponential as in housefly, *Paramecium*, etc

*A bell-shaped polygon.*It indicates a stationary population having an equal number of young and middle aged individuals. It indicates a moderate proportion of young to old. As the rate growth becomes slow and stable, i.e., the prereproductive and reproductive age groups becomes more or less equal in size, post reproductive group remaining as the smallest, there results a bell-shaped structure.

a. **Urn-shaped** structure. It indicates a low percentage of young individuals. It shows a declining population. Such an urn-shaped figure is obtained when the birth rate is drastically reduced, the pre-reproductive group dwindles in proportion to the other age groups of the population.

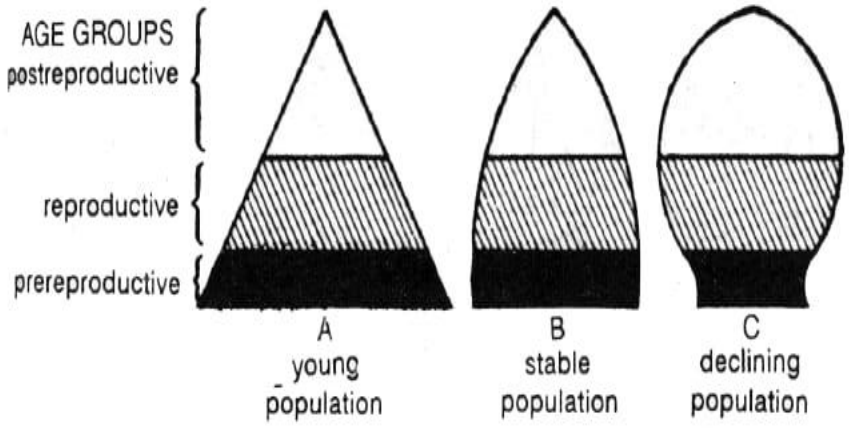

Fig. 7.1- Showing different types of age pyramid

7.3. Natality

Natality is a broader term covering the production of new individuals by birth, hatching, germination, or fission. The natality rate may be expressed as the number of organisms born per female unit time. In human population, the natality rate is equivalent to the 'birth-rate'/ **Natality (birth rate):** There are distinguished two types of natality:

1. **Maximum (absolute** or **potential** or **physiological) natality.** It is the theoretical maximum production of new individuals under ideal conditions (i.e. no ecological limiting factors, reproduction being limited only by physiological factors). It is a constant for a given population. This also called **fecundity rate**.

2. **Ecological or relisednatality.** It is also known simply as natality, which refers to population increase under an actual, existing specific condition. Thus it takes into account all possible existing environmental conditions. This is also designated as **fertility rate**.

Natality is expressed as

$\Delta N_n/\Delta t$= the absolute natality rate (B)

$\Delta N_n/N\Delta t$ =the specific natality rate (b) (natality rate per unit of population)

Where, N = intial number of organisms

n = new individuals in the population

t= time

Further the rate at which females produce offsprings is determined by the following three population characteristics:

1. Clutch size or the number of young produced on each occasion;
2. The time between one reproductive event and the next, and
3. The age of first reproduction.

Thus natality usually increases with the period of maturity and then falls again as the organism gets older. But there are some trees which continue to increase fruit production as they get older. Natality patterns differ in tropical and temperate populations.

7.4. Mortality (death rate):

Mortality means the rate of death of individuals in the population. It is a negative factor for population growth. A birth-death ratio ($100\times\frac{births}{deaths}$) is called **vital index.** For a population, the important thing is not which members die but which members survive. Thus survival rates are of much interest than the death rates. Survival rates are generally expressed by survivorship curves. Like natality, mortality may be of following types:

1. **Minimum mortality:** It is also called specific or potential mortality. Minimum mortality represents the theoretical minimum loss under ideal or non-limiting conditions. It may be constants for a population.
2. **Ecological mortality.** It is also called realized mortality. It is the actual loss of individuals under a given environment condition. Ecological mortality is not constant for a population and varies with population and environmental conditions, such as predation, disease and other ecological hazards.

i. **Survivorship curves.** Which plot the numbers of surviving to a particular age. There are following three types of survivorship curves which represent the different nature of survivors in different types of population:

a) **<u>Highly convex curves.</u>** (Pattern 1) in the figure, is characteristic of the species in which the population mortality rate is low until near the end of the life span thus, such species tend to live through out their life span , with low

mortality. Many species of large animals as deer, mountain sheep and man etc. show such curves.

b) **Highly concave curve**. This type of curve (pattern III) is the charaterists of such species where mortality rate is high during the young stages. Some birds, blacktail deer, oysters, sheel fish, oak trees, etc. exhibit pattern III type curve.

c) **Diagonal straight-line curve.** This type of curve (pattern IIb) indicates an age specific constant survivorship, i.e. a constant rate of mortality occurs at every age. Some animals such as hydra, gull, American robin, etc. exhibit this type of curve.

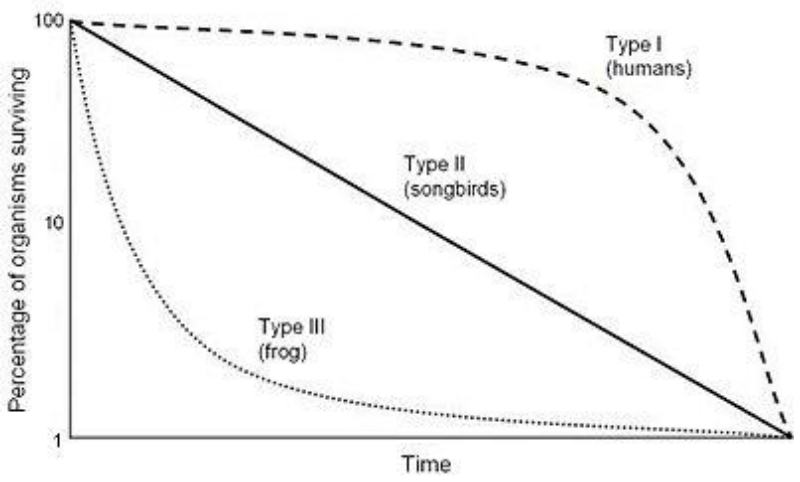

Fig 7.2.survivorship curve

In fact, no population in the real world has a constant age-specific survival rate throughtout the whole life span. Thus a slightly concave or sigmoid curve (pattern IIc) is characteristic of may birds, mice and rabbits. In them the mortality rate is high in the young but lower and almost constant in the adult (1 year or older). In some holometabolous insects (i.e. insects with complete metamorphosis), such as butterflies, the survival rate differs in successive life history stages and the curve becomes the stair-step type survivorship curve (curve IIa), the initial, middle and final steep segments represent the egg population and short lived adult stages and the two middle flatter segments represent larval and pupal stages which exhibit less mortality.

The survivorship curve of human population is highly convex. This has become possible because of increased medical care, better hygiene, improved nutrition and so on.

7.5. Biotic potential

The term of biotic potential, one is able to put together natality, mortality and age distribution. Chapman (1928) proposed the term biotic potential to designate maximum reproductive power. He defined it as "the inhercent property of an organism to reproduce, to survive, i.e. to increase in numbers. it is sort of the algebraic sum of the number of young produced at each reproduction, the number of reproduction in a given period of time, the sex ratio and their general ability to survive under given physical conditions".

Each population has the inherent power to grow. When the environment is growth rate (i.e. the population growth rate per individual) becomes constant and maximum for the existing conditions. The value of the growth rate under these favorable conditions is maximal, is characteristic of a particular population age structure, and is a single index of the inherent power of a population to grow. It may be designed by the symbol r, which is the exponent in the differential equation for population growth in an unlimited environment under specific physical conditions.

The index r is actually the difference between the instantaneous specifinatality rate (i.e. rate per time per individual) and the instantaneous specific death rate and may thus be expressed:

$$r=b-d$$

The overall population growth rate under unlimited environment conditions (*r*) depends on the age composition and the specific growth rates due to reproduction of component age groups. In a population with a stable age distribution, the reproductive capacity or growth rate is called the intrinsic rate of natural increases, represented by symbol r. Thus there may be several values of *r* for a species depending upon population structure. The maximum values of *r*is often called by the less specific but widely used expression **biotic potential** or reproductive potential.

7.6. Growth form of populations

K;;

Hklhj

hklh

7.7. Man and environment relationships

We know the surrounding or external condition in which organism lives is called environment. Our environment is made with combination of biotic and a biotic factor. Literally the very word 'Environment' comes from a French word 'Environner' which means 'to surround 'or 'to encircle'. The two words Man and environment are not new to the human history and the interrelation between them is well established. Thinking about the environment is as old as our first human ancestors. Their survival depended on knowledge of it. Concern for the environment is also not new. Since ancient times, people have known the importance of preserving it. Worshipping of trees and rivers, animals and the birds was not based on the superstition; but there was a hidden message preserving and protecting of the environment. However, human directly and indirectly depends on

- Temperature
- Shelter
- Natural resources = substances and energy sources needed for survival
- Renewable natural resources: can be replenished – Perpetually renewed: sunlight, wind, wave energy – Renew themselves over short periods: timber, water, soil •
- Nonrenewable natural resources: unavailable after depletion – These can be destroyed – Oil, coal, minerals
- Ecosystem services: arise from the normal functioning of natural services – Purify air and water, cycle nutrients, regulate climate – Pollinate plants, receive and recycle wastes.

The relationship between man and the environment can be seen in various ways, both positive and negative. Here are some examples:

Positive impact: Sustainable agriculture practices, such as using organic farming techniques, can promote soil health and biodiversity while reducing pollution and preserving water resources. Renewable energy sources, such as solar and wind power, can reduce greenhouse gas emissions and minimize the negative impact of human activities on the environment. Conservation efforts, such as protected areas and wildlife sanctuaries, can help preserve biodiversity and prevent the extinction of endangered species.

Negative impact: Industrialization and urbanization can cause pollution, deforestation, loss of biodiversity, and climate change.Overfishing and pollution can cause depletion of marine

resources and damage to marine ecosystems.Improper waste disposal can lead to environmental pollution, contamination of water sources, and the spread of diseases.

Environment is the complex of physical, chemical and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival." In the environment, as a result of interaction between the biotic and a biotic factor, an ecosystem is developed. The man is the important component of environment which influence by abiotic factors or influence to abiotic factors. However, man is depending on nature direct or indirect way and influence the ecological balance. The environment can significantly affect human activities, and vice versa, humans can shape and change the Earth's surface and its atmosphere. So in reference to man, the environment has two broad components viz. physical or natural environment and social environment of human race which is a by-product of economic, social, and political interactions. The physical environment control all course of human action Thus we can say that man and environment relationship refers to interaction and feedback between man and natural components. Today, the relationship between man and environmental is operate with series of concept and regulation. Man is the only living organism capable of modifying its surrounding environment according to the need. Other animals change according to the environment. Initially, man started hunting of animal and cutting of tree for food and shelter but with the time this desire get increases gradually and for his conforntness, man started converting the forest land into agriculture land for producing row material for industry and urbanization. But at present time due to population exploitation the agricultural landscape is also get converted into *kancreet*jungles. To increase his comforts he started disturbing each and every component of the environment. With the start of the industrial revolution the total scenario changed. Everything changed, the use fossil fuel for generation of power for running vehicles, many industries were started to produce the product which increase in pollution all type. Quantity of carbon dioxide emission increased tremendously which has started showing effect in the form of discharge of industrial waste and sewage. Major environmental issues arising due to human activities are global warming, acid rain, ozone depletion and population explosion. Emission of CO_2 and the other gases in atmosphere from fossil fuel burning and other human activities may raise the temperature of the earth's lower atmosphere several degrees by 2050. This would disrupt food production and flooding of low-lying coastal cities and croplands. The number of environmental changes and feedback and consequences is occurs day by day making environment more

complicated. It is time to all philopsher and subject expert to communicate about healthy relation of man and environment. Environmental Degradation Over the centuries we, Indians, have worshiped nature. We have lived in harmony with nature. However, of late, we have followed western countries past of conflict with nature. The result is that today, we observe and experience, over all environmental degradation. Any objective view of state of environment, of India or any developing countries would clearly show that 1) Soils are eroding 2) Forests retreat 3) Water quality is unsatisfactory. 4) Urban air quality is worse. 5) Watersheds are losing storage capacity. 6) Reservoirs are filled up with sediments. 7) Wildlife and their habitats are being eliminated. 8) Solids wastes pile up and smolder 9) Costal spawning grounds disappear.

The environment consists of both natural and human made systems. However, the natural is consisted by all living things and also influence by abiotic factors while the man made system that is built up by man is also directly and indirectly supported by natural environment. Due to change of human behavior around the world make different way to mentaing environmental health. However, a more practical definition of the environment is needed, because environmental health action generally tries to change not only the natural and physical environments but man is also play their crucial role.

A grave fear about the declining quality of the environment has been growing throughout the world, first among the scientists and more recently among the general public.

- The environmental crisis in the world has already started, and will continue to get worse if something is not done soon.
- Damage to the environment caused by mankind can be minimized or eliminated completely if certain steps are taken.
- Stopping the current environmental crisis in the world is critical to protecting the earth and all life on it.

The environmental crisis increasing day by due to increasing population, over exploitation of natural resources, deforestation of the rain forests, fossil fuel use, and garbage created by humans. In which industrial development which used for used for the human well being is main cause for environmental crisis/environmental disruptions which undermines the well- being. Some note worthy negative impacts of technology can be listed as under :

- Depletion of ozone layer

- Excessive use of pesticides and fertilizers
- Global warming causing
- Increasing pollution of air, water and soil
- Production of electromotive waves
- Exploitation of biodiversity and other natural resources etc.

7.8. Impacts of human activity on environment

Human totally depends on nature. They obtained food, folder and shelter from forest resources. Human activity has had an effect on the environment for thousands of years, from the time of our very earliest ancestors.In ancient period, human start hunting the animals for foods and cutting tree for folder and shelter, but with the binging of time and getting knowledge we have been modifying the environment around us through agriculture, travel and eventually through urbanization and commercial networks.

Man has been felling millions of tree for centuries to create pastures for his cattle and farms for agriculture without realising that by doing so he has been allowing rain and wind to erode soil. He without caring for the unintended consequences of his action has been opening the gate for floods to sweep, vast tracts of land causes dereliction. In industrial revolution, he is polluting air by allowing factories emit smoke which has increased carbon and sulfur content of the atmosphere. He has been dirtying rivers too by throwing effluents in them. He has got to be restrained from doing all this and from pushing the world further towards destruction. There should be no delaying in tackling the task of solving these environment problems as these problems have a cumulative impact. If there is delayed in remedial action will cost considerable more and the damage will become irreversible. Life will survive only as long as Earth survives. These challenges can overcome by a well planned and efficiently managed environment education program.

As his understanding increases day by this to make life easy his need and desires also increases gradually. Even Indian culture nature was warship by most of people and conserves it for future generation. With industrial revolution and population exploitation, human activities increases that alter the natural environment. Human actives know triggered lots of negatives impacts such as deforestation, pollution, fossil fuels, soil erosion, poor water and air quality etc. these negative impacts can effects human behavior and can prompt mass mitigations. The human

impact also refers to anthropogenic impact that changes the biophysical environmental and to ecosystems, biodiversity, and natural resources caused directly or indirectly by humans. The term anthropogenic designates an effect or object resulting from human activity.

Human activity have both positive and negative impact on natural environment, however, the human civilization and technology have affected our earth, altering our planet forever, but here we consider five tangible impacts of environment:

Overpopulation

Human overpopulation has been has been affecting the environment for hundreds of years and a concern for scientists since at least 1798. In 2017, over 15,000 scientists around the world issued a second warning to humanity which asserted that rapid human population growth is the "primary driver behind many ecological and even societal threats. Some scientists and environmentalists, posit that human population growth is devastating to biodiversity. Accommodating population growth has been a root cause for much of the impact we've had on our environment. Our food supply today can support more lives than ever, and advances in medical science have led to increasingly longer lifespans. But this reality has the profound side effect of reducing population turnover and leading to its rapid expansion.

Over Agriculture and Fishing

Agricultural practices and over utilization of cultivated land employed around the world. Used of chemical fertilizers and pesticides for more production have directly and indirectly have impact on environment. Ultimately, the environmental impact depends on the production practices of the system used by farmers. There are two types of indicators of environmental impact: "means-based", which is based on the farmer's production methods, and "effect-based", which is the impact that farming methods have on the farming system or on emissions to the environment. An example of a means-based indicator would be the quality of groundwater that is affected by the amount of nitrogen applied to the soil. An indicator reflecting the loss of nitrate to groundwater would be effect-based. Overfishing and lack of fishery management have negative impact on ocean environment such as by-catch and destruction of habitat such as coral reefs.

Over Irrigation

The environmental impact of irrigation includes the changes in quantity and quality of soil and water as a result of irrigation. Due to continuous irrigation activities it impact on environment that change the hydrological cycle

- the downstream river discharge is reduced
- the evaporation in the scheme is increased
- the groundwater recharge in the scheme is increased
- the level of the water table rises
- the drainage flow is increased.

7.9. Summary

The relationship between man and the environment is a complex and multifaceted one. It can have both positive and negative impacts, depending on the actions taken by humans. Examples of positive impacts include sustainable agriculture practices, renewable energy sources, and conservation efforts, while negative impacts can include industrialization, urbanization, overfishing, and pollution. To ensure a sustainable future, it is important to strike a balance between economic development and environmental conservation.

7.10. Terminal questions

Q.1: Writ the Population and Density.

Answer:----------

Q.2: Discuss about natality and mortality in brief.

Answer:----------

Q.3: What is the biotic potential?

Answer:----------

Q.4: Growth form of populations.

Answer:----------

Q.5: Discuss the Man-environment relationships.

Answer:----------

Q.6: Discuss the Impacts of human activity on environment.

Answer:----------

7.11. Further suggested readings

1. S.C. Bhatia and R. K. Gupta, Textbook of Renewable Energy", WPI Publishing-2019
2. Renu, Dhupper, "Textbook on Energy Resources and Management" CBS Publishers & Distributors-2015
3. Mahmood Zohoori, Advantages and Disadvantages of Green Technology; Goals, Challenges and Strengths, International Journal of Science and Engineering Applications, ISSN-2319-7560
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5. Sameer Sarkar, Fuel Technology, New Delhi, orient longman.

Unit-8: Environment and Human Health

Contents

8.1. Introduction

Environmental health examines the interaction between the environment and our health. Thus the environmental health refers to aspects of human health (including quality of life) that are determined by physical, chemical, biological, social and psychosocial factors in the environment. The human is directly and indirectly affected by environment because is governing factor for good health and prosperity. The environmental risk factors on health are extremely varied and complex in both severity and clinical significance. There are several environmental factors that have major impact on human healthin which the environmental pollutants is of which can cause health problems like respiratory diseases, heart disease, and some types of cancer such as exposer of heavy metal and toxic gases. These factors also responsible for environmental degradation. A better understanding of the economic costs of environment-related health loss can help to inform environmental policy design.

Objectives

- To discuss the environment and human health
- To discuss the disease causes by pollution
- To discuss the various environmental related diseases
- To discuss food and balance diet

8.2. Environment and human health

Human and environmental health is closely intertwined and dependent on each other. Human health refers to the state of complete physical, mental, and social well-being of a person, while environmental health refers to the quality of the physical and biological environment and how it affects human health. The relationship between human and environmental health is complex, and the health of one is often dependent on the other. Human health, defined as the complete state of physical, social, and mental well-being and not merely the absence of illness, disease, or infirmity, is as vital a resource as water, food, or energy. But environmental health is focused on the relationships between people and their environment; promotes human health and well-being; and fosters healthy and safe communities. Environmental health is a key part of any comprehensive public health system. It consists of three categories: health impacts, air quality, and water and sanitation. The health impacts category includes the environmental risk exposure indicator. There is lots of toxic elements spread in our surroundings and contaminate air, water, land and our atmosphere where we leave. Metals, pesticides and large number of complex organic chemicals which prepared man made activities, have direct and indirect impact on human health. They also degrade the quality of nature by increasing it concentration. There are many factors that affect both human and environmental health, including pollution, climate change, deforestation, and the depletion of natural resources. Exposure to pollutants such as air and water pollution, toxic chemicals, and radiation can have adverse effects on human health, including respiratory and cardiovascular diseases, cancer, and developmental disorders. Climate change can also affect human health by increasing the frequency and severity of natural disasters such as floods, droughts, and heat waves. On the other hand, environmental degradation such as deforestation, soil erosion, and the destruction of natural habitats can also have negative impacts on human health. These environmental issues can contribute to the spread of diseases such as malaria and dengue fever, and can also affect the availability and quality of food and water resources. To address the complex relationship between human and environmental health, it is

important to take a holistic approach that considers the interconnections between these two areas. This involves promoting sustainable practices that protect both human and environmental health, such as reducing carbon emissions, promoting renewable energy, conserving natural resources, and reducing waste and pollution. By promoting healthy environments, we can also promote healthy people, and vice versa.

The toxic study of chemical and physical agents that produce adverse response in biological systems with which interact. The contaminants some time present in nature for short time and some for long time. These toxic agent or toxicant that can produceadverse effects in a biological system may do this either by an alternation of normal function or the destruction of life. The facts of toxic chemicals are diverse after entry into the body in general, body physiological functions attempt to eliminate out the toxic substance through a variety of excretion pathways, otherwise toxicants are deposited in storage sites in our body. The chemical which found in food and water is

- Lead i.e. found in drinking water especially where there is combination of lead water pipe and acidic water.
- Nitrates in drinking water, some time convert into nitrates in the body.
- Trace pollutants in water supply may form agrochemicals
- Aluminum found in food and dirking water
- Arsenic and mercury etc.

8.3. Environmental pollution diseases

Environmental pollution can cause a range of health problems, including acute and chronic diseases. Exposure to environmental pollutants such as air pollution, water pollution, and toxic chemicals can lead to various diseases and health conditions. Here are some examples of environmental pollution-related diseases:

- **Respiratory Diseases**: Exposure to air pollution, particularly fine particulate matter, can cause respiratory problems such as asthma, chronic obstructive pulmonary disease (COPD), and lung cancer. Indoor air pollution caused by cooking and heating with solid fuels can also lead to respiratory diseases.

- **Cardiovascular Diseases:** Air pollution, especially from fine particulate matter, has been linked to an increased risk of cardiovascular diseases such as heart attacks, stroke, and arrhythmias.
- **Neurological Disorders:** Exposure to lead, mercury, and other toxic chemicals can lead to neurological disorders such as developmental delays, cognitive impairment, and behavioral disorders.
- **Reproductive and Developmental Problems:** Exposure to environmental pollutants such as pesticides, lead, and certain chemicals can cause reproductive and developmental problems such as infertility, miscarriage, birth defects, and developmental delays.
- **Cancer:** Environmental pollution is a major risk factor for cancer. Exposure to carcinogens such as air pollution, water pollution, and toxic chemicals can lead to various types of cancer such as lung, bladder, and liver cancer.
- **Infectious Diseases:** Poor environmental conditions such as lack of sanitation, contaminated water, and exposure to hazardous waste can increase the risk of infectious diseases such as cholera, typhoid, and hepatitis.

These are just a few examples of how environmental pollution can affect human health. It is important to address environmental pollution through policy and individual actions to prevent and reduce the risk of environmental pollution-related diseases.

8.4. Allergy by environmental contamination

Environmental contamination can trigger or worsen allergies in some people. Allergies occur when the body's immune system overreacts to substances that are usually harmless, such as pollen, dust mites, or animal dander. Exposure to environmental contaminants can exacerbate allergic reactions or trigger new allergies. Here are some examples of environmental contaminants that can cause or worsen allergies.

- **Airborne Allergens**: Air pollution and other airborne allergens such as pollen, dust, and mold can trigger allergic reactions in some people, causing symptoms such as sneezing, runny nose, itchy eyes, and coughing.
- **Chemicals and Irritants:** Exposure to chemicals and irritants such as cleaning products, pesticides, and cigarette smoke can worsen existing allergies or trigger new allergies.

- **Food Allergens:** Food allergies can be triggered by environmental contaminants such as pesticides or other chemicals that are used in food production.
- **Water Contamination:** Contaminated water can contain allergens such as mold, bacteria, and other pollutants that can trigger or worsen allergies.
- **Allergic Contact Dermatitis:** Exposure to environmental contaminants such as nickel, latex, or certain plants can cause allergic contact dermatitis, a type of skin rash that can be itchy and painful.

Preventing exposure to environmental contaminants is an important way to reduce the risk of allergies. This can be done by taking measures such as reducing exposure to air pollution, using natural and non-toxic cleaning products, and drinking clean and safe water. Individuals who have allergies should also take steps to manage their symptoms, such as avoiding allergens, taking medications as prescribed by their doctor, and seeking medical attention if symptoms become severe.

8.5. Respiratory disease by environmental pollution

Environmental pollution can cause respiratory diseases by exposing people to harmful particles and gases. Some examples of respiratory diseases caused or worsened by environmental pollution include:

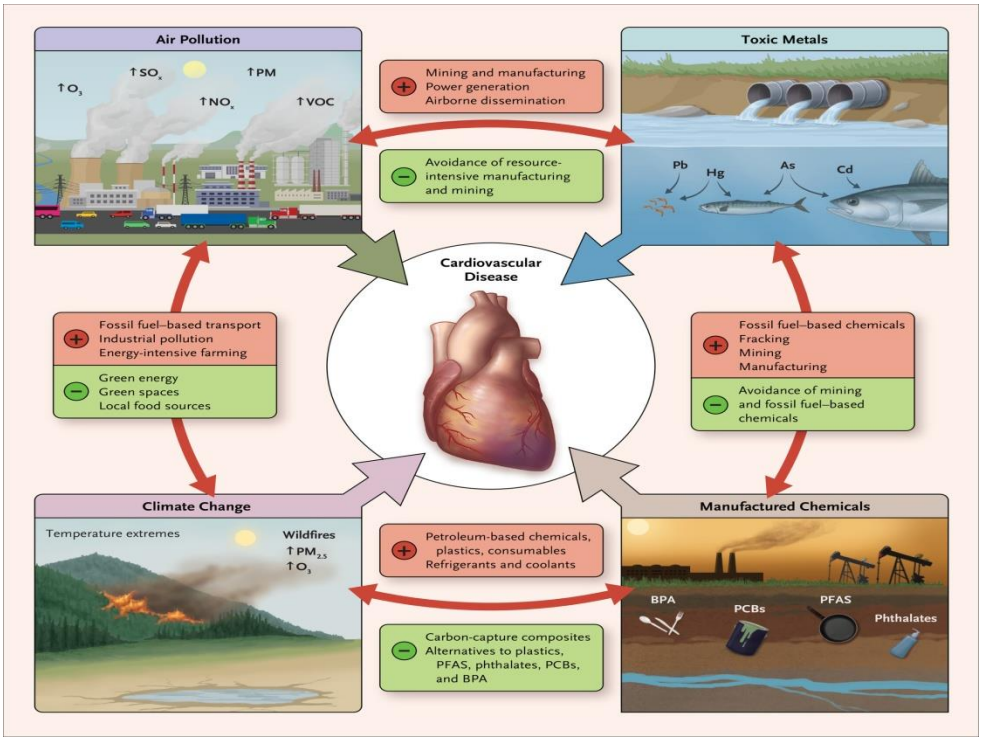
- **Asthma:** Asthma is a chronic respiratory disease that causes inflammation and narrowing of the airways, making it difficult to breathe. Air pollution, particularly fine particulate matter, can trigger asthma attacks and worsen symptoms.
- **Chronic Obstructive Pulmonary Disease (COPD):** COPD is a progressive lung disease that makes it difficult to breathe. Exposure to air pollution, especially from smoking and occupational exposure to dust and chemicals, is a major risk factor for COPD.
- **Lung Cancer:** Exposure to air pollution, particularly diesel exhaust, is a known risk factor for lung cancer. Lung cancer is the leading cause of cancer deaths worldwide.
- **Pneumonia:** Pneumonia is a respiratory infection that can be caused by bacteria, viruses, or fungi. Air pollution can weaken the immune system and increase the risk of pneumonia.
- **Rhinitis and Sinusitis:** Rhinitis and sinusitis are inflammation of the nose and sinuses, respectively. Exposure to air pollution and other environmental contaminants can worsen symptoms of these conditions.

- **Tuberculosis:** Tuberculosis is a bacterial infection that primarily affects the lungs. Exposure to air pollution and other environmental contaminants can weaken the immune system and increase the risk of tuberculosis.

Reducing exposure to environmental pollutants, particularly air pollution, is an important way to prevent and reduce the risk of respiratory diseases. This can be done by taking measures such as reducing emissions from vehicles and industry, using cleaner energy sources, and using protective equipment in the workplace. Individuals with respiratory diseases should also take steps to manage their symptoms, such as taking medications as prescribed by their doctor and avoiding exposure to environmental pollutants as much as possible.

8.6. Cardiovascular disease by environmental pollution

Environmental pollution can increase the risk of cardiovascular diseases by exposing people to harmful particles and gases that can enter the bloodstream and cause inflammation, oxidative stress, and damage to blood vessels. Here are some examples of cardiovascular diseases caused or worsened by environmental pollution:



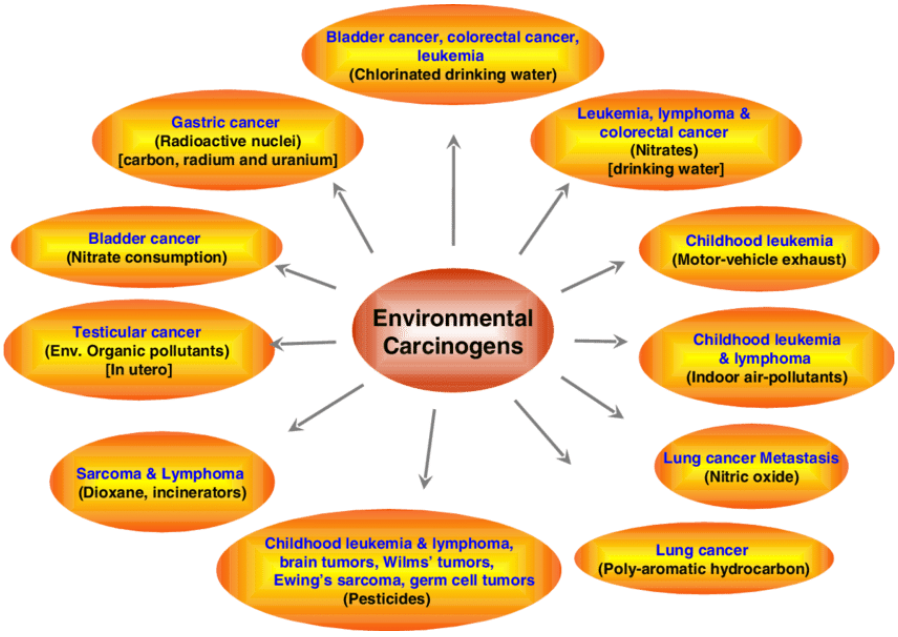
Source Pollution and the Heart | NEJM

- **Coronary Artery Disease:** Coronary artery disease is a condition in which the arteries that supply blood to the heart become narrowed or blocked. Exposure to air pollution, particularly fine particulate matter, has been linked to an increased risk of coronary artery disease.
- **Heart Attack:** A heart attack occurs when blood flow to the heart is blocked, leading to damage or death of heart muscle tissue. Exposure to air pollution has been linked to an increased risk of heart attack.
- **Stroke:** Stroke occurs when blood flow to the brain is blocked or reduced, leading to damage or death of brain tissue. Air pollution, particularly fine particulate matter, has been linked to an increased risk of stroke.
- **Arrhythmias:** Arrhythmias are abnormal heart rhythms that can be caused by various factors, including exposure to air pollution.
- **Hypertension:** Hypertension, or high blood pressure, is a major risk factor for cardiovascular diseases such as heart attack and stroke. Exposure to air pollution, particularly fine particulate matter, has been linked to an increased risk of hypertension.

Reducing exposure to environmental pollutants, particularly air pollution, is an important way to prevent and reduce the risk of cardiovascular diseases. This can be done by taking measures such as reducing emissions from vehicles and industry, using cleaner energy sources, and using protective equipment in the workplace. Individuals with cardiovascular diseases should also take steps to manage their condition, such as taking medications as prescribed by their doctor and avoiding exposure to environmental pollutants as much as possible.

8.7. Cancer due to environmental pollutants

Environmental pollutants can increase the risk of cancer by damaging DNA and other genetic material in cells, causing mutations and abnormal cell growth. Exposure to certain environmental pollutants has been linked to an increased risk of several types of cancer. Here are some examples:



- **Lung Cancer:** Exposure to air pollution, particularly fine particulate matter and diesel exhaust, is a known risk factor for lung cancer.
- **Bladder Cancer:** Exposure to certain industrial chemicals such as benzene, arsenic, and polycyclic aromatic hydrocarbons (PAHs) can increase the risk of bladder cancer.
- **Leukemia:** Exposure to benzene and other chemicals in the workplace can increase the risk of leukemia.
- **Liver Cancer:** Exposure to aflatoxins, which are produced by certain molds that grow on food crops, can increase the risk of liver cancer.
- **Skin Cancer:** Exposure to ultraviolet (UV) radiation from the sun and tanning beds is a major risk factor for skin cancer. Exposure to certain chemicals such as coal tar, creosote, and arsenic can also increase the risk of skin cancer.
- **Breast Cancer:** Exposure to certain chemicals such as polycyclic aromatic hydrocarbons (PAHs) and phthalates, which are found in plastics, can increase the risk of breast cancer.

Reducing exposure to environmental pollutants is an important way to prevent and reduce the risk of cancer. This can be done by taking measures such as reducing emissions from vehicles and industry, using cleaner energy sources, using protective equipment in the workplace, and avoiding exposure to harmful chemicals and UV radiation. Individuals should also take steps to protect themselves, such as wearing protective clothing and using sunscreen

when outdoors, eating a healthy diet, and avoiding tobacco and excessive alcohol consumption. Regular cancer screening and early detection can also improve outcomes for many types of cancer.

8.8. Personal hygiene

Personal hygiene refers to the habits and practices that individuals undertake to keep themselves clean and healthy. Good personal hygiene is essential for preventing the spread of infectious diseases and maintaining overall health and well-being. Here are some important aspects of personal hygiene:

- **Hand hygiene:** Regularly washing your hands with soap and water or using hand sanitizer can help prevent the spread of germs and bacteria.
- **Oral hygiene:** Brushing your teeth twice a day, flossing, and using mouthwash can help prevent tooth decay, gum disease, and bad breath.
- **Bathing and showering:** Regular bathing or showering helps remove dirt, sweat, and dead skin cells, which can reduce the risk of skin infections.
- **Hair care:** Regularly washing and brushing your hair can help maintain scalp health and prevent dandruff.
- **Nail care:** Keeping your nails clean and trimmed can prevent the spread of germs and bacteria.
- **Clothing and laundry:** Wearing clean clothes and regularly washing them can help prevent the spread of germs and bacteria.
- **Safe food handling:** Properly storing, preparing, and cooking food can prevent foodborne illnesses.
- **Safe sex practices:** Practicing safe sex can help prevent sexually transmitted infections (STIs).

By practicing good personal hygiene, individuals can protect themselves and others from the spread of infectious diseases and maintain overall health and well-being.

8.9. Balance diet

A balanced diet is an essential part of maintaining good health and preventing chronic diseases. A balanced diet is defined as a meal plan that contains all the essential nutrients in the

right proportions, including carbohydrates, proteins, fats, vitamins, minerals, and water. In this article, we will discuss what a balanced diet is, why it is important, and how to achieve it.

What is a balanced diet?

A balanced diet is a meal plan that provides the body with all the essential nutrients it needs to function correctly. The nutrients include carbohydrates, proteins, fats, vitamins, minerals, and water. These nutrients are essential for the body to carry out its daily functions and maintain good health.

- Carbohydrates provide energy to the body and are found in foods such as grains, fruits, vegetables, and legumes. Proteins are essential for building and repairing tissues and are found in foods such as meat, fish, poultry, eggs, and legumes. Fats are also necessary for the body to function correctly, but it is essential to choose healthy fats such as omega-3 and omega-6 fatty acids found in foods such as fish, nuts, and seeds.
- Vitamins and minerals are essential for the body's proper functioning and play a vital role in maintaining good health. Vitamins are found in fruits, vegetables, and dairy products, while minerals are found in fruits, vegetables, dairy products, and meat.

Why is a balanced diet important?

A balanced diet is important for maintaining good health and preventing chronic diseases such as obesity, diabetes, and heart disease. When the body does not receive the essential nutrients it needs, it can lead to malnutrition, which can cause various health problems. For example, a lack of vitamin D can lead to rickets, while a lack of iron can lead to anemia.

A balanced diet is also essential for maintaining a healthy weight. When the body receives the right amount of nutrients, it is less likely to crave unhealthy foods. Additionally, a balanced diet can improve mental health and reduce the risk of depression and anxiety.

How to achieve a balanced diet

- **Eat a variety of foods**

  To achieve a balanced diet, it is essential to eat a variety of foods from all food groups. Eating a variety of foods ensures that the body receives all the essential nutrients it needs

- **Eat in moderation**

Eating in moderation is also essential for achieving a balanced diet. Consuming too much of any food group can lead to an imbalance in the body's nutrients. Additionally, consuming too many calories can lead to weight gain and an increased risk of chronic diseases.

- **Choose healthy fats**

When choosing fats, it is essential to choose healthy fats such as omega-3 and omega-6 fatty acids. These fats are found in foods such as fish, nuts, and seeds. Saturated and trans fats should be limited as they can increase the risk of heart disease.

- **Increase fiber intake**

Fiber is essential for maintaining digestive health and preventing chronic diseases. Foods such as fruits, vegetables, whole grains, and legumes are high in fiber and should be included in a balanced diet

- **Limit sugar and salt intake**

Consuming too much sugar and salt can lead to an increased risk of chronic diseases such as heart disease and diabetes. It is essential to limit the consumption of processed foods that are high in sugar and salt.

- Drink plenty of water

Drinking plenty of water is essential for maintaining good health. Water is necessary for maintaining proper hydration and carrying out essential bodily functions. It is recommended to drink at least eight glasses of water a day.

Here is some food material that is the key components of a balanced diet:

- **Fruits and vegetables:** These are important sources of vitamins, minerals, fiber, and antioxidants. Aim to eat a variety of colorful fruits and vegetables every day.
- **Whole grains:** These are rich in fiber, vitamins, and minerals. Choose whole grain bread, pasta, rice, and cereals instead of refined grains.
- **Protein:** Choose lean sources of protein such as fish, poultry, beans, nuts, and seeds. Limit red meat and processed meats.
- **Dairy:** Choose low-fat or fat-free dairy products such as milk, yogurt, and cheese for calcium and other nutrients.

- **Fats:** Choose healthy fats such as olive oil, avocado, nuts, and seeds. Limit saturated and trans fats, which can increase the risk of heart disease.
- **Water:** Drink plenty of water every day to stay hydrated and support bodily functions.

It is also important to limit the intake of added sugars, sodium, and alcohol. A balanced diet can help maintain a healthy weight, reduce the risk of chronic diseases such as heart disease, diabetes, and cancer, and improve overall health and well-being.

8.10. Summary

Environmental health refers to the branch of public health that focuses on how the environment affects human health. Environmental pollution can have a significant impact on human health, causing respiratory diseases, cardiovascular diseases, allergies, and cancer. To prevent these negative health effects, it is important to reduce exposure to environmental pollutants through measures such as reducing emissions from industry and vehicles, using cleaner energy sources, and avoiding harmful chemicals. In addition, personal hygiene practices such as hand washing, oral hygiene, and safe food handling can help prevent the spread of infectious diseases. Eating a balanced diet that includes a variety of foods from all food groups in appropriate proportions can also help maintain good health. Overall, environmental health care requires a multi-faceted approach that involves individual actions, public policies, and societal changes to protect and promote human health in relation to the environment.

8.11. Terminal questions

Q.1 What do you understand by environmental health? Discuss briefly.

Answer:----------

Q.2 Discuss the air pollution diseases and it impact on human beings.

Answer:----------

Q.3 Discuss the causes of cancer and its treatments.

Answer:----------

Q.4 Discuss the cardio vascular diseases and its causes.

Answer:----------

Q.5 Discuss the respiratory disease and it rout of causes.

Answer:----------

Q.6 What do you understand by personal hygiene? Discuss briefly.

Answer:----------

8.12. Further suggested readings

1. S.C. Sandra, "Environmental Science", A new Central Book Agency,2008
2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017
3. NeerjNachiketa, Environment and Ecology: A Dynamic Approach, G.K. Publication Ltd, 2021
4. V. K. Ahluwalia, "Environmental Science, Ane Books India, 2013S.
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Unit-9: Environmental Sustainability

9.1. Introduction

The sustainability refers to the ability of an ecosystem or society to function and thrive over time without degrading the natural resources or compromising the well-being of future generations. It encompasses a broad range of environmental, economic, and social issues, and is closely related to concepts such as resilience, conservation, and responsible stewardship. n recent years, sustainability has become an increasingly important focus for businesses, governments, and individuals around the world, as concerns about climate change, resource depletion, and social inequality have grown. Many organizations have adopted sustainable practices and policies, such as reducing greenhouse gas emissions, using renewable energy sources, conserving water, and promoting social responsibility. Sustainability is also closely tied to the concept of sustainable development, which seeks to balance economic growth with environmental protection and social equity. Sustainable development aims to meet the needs of the present without compromising the ability of future generations to meet their own needs. However the sustainable development faces numerous challenges at different levels, including economic, social, and environmental. Here are some of the key challenges. Carrying capacity refers to the maximum number of individuals of a particular species that a given environment can support over a sustained period of time, without causing long-term damage to the environment or depleting its resources. The carrying capacity of an environment is determined by several factors, including the availability of resources such as food, water, and shelter, as well as environmental factors such as climate, temperature, and precipitation.

Objectives

- To discuss the sustainability of nature
- To discuss the sustainable development and its impact on nature
- To discuss the carrying capacity and it role on nature
- To discuss the challenges for sustainable development

9.2. Sustainability

The definition of “sustainability” is the study of how natural systems function, remain diverse and produce everything it needs for the ecology to remain in balance. It also acknowledges that human civilization takes resources to sustain our modern way of life. The sustainability refers to maintain or support a process continuously over time for protection and development of nature. The sustainability seeks to prevent the depletion of natural or physical resources, so that they will remain available for the long term.

The idea of sustainability as non-declining consumption is the concept of sustainability that is most widely used in economic analysis. However, constant consumption for indefinite time period into the future, at any rate other than zero, satisfying various constraints of social welfare maximization problem might not be sufficient to explain and address sustainability issues in totality.

Sustainability translates into the ethical concern for future generations and the need to incorporate this concern into current planning and decision making of economic activities. The concern for future generation affects the use of environmental resources in current production and also the current decision making process

The principle of sustainability is cover the concept of three pillars the economy, society, and the environment. All three pillars are mainly used as profit, people and planet.Economic sustainability refers to a company's ability to continue its operations over a long-term horizon. In order to be economically sustainable, a company must be able to ensure that it will have adequate resources, workers, and consumers for its products into the distant future. The sustainability integrates the all pillars of development means it means integrates the environmental, social, economic sector for the development. It also insuring environmental adaptability and residence means it maintaining and enhancing the stability capacity of the environmental system and accepting global responsibility.It alsoassumes me responsibility for environmental effect that occurs outside area of production units and other developmental activities. The sustainability work on to focus the future effect of any given policy or business practice on humans, ecosystem and the winder economy. Due to major change in existing policy it may cause problems. The change that is occurs due to anthropogenic activities, because global climate change, biodiversity loss, and pollution have become more widespread environmental problems. This activity is shifted to embrace sustainable practices and policies through adopting sustainable business practices and also increased investments in green technology.

9.2.1. Primary Goals of Sustainability

- The end of poverty and hunger
- Better standards of education and healthcare - particularly as it pertains to water quality and better sanitation
- To achieve gender equality
- Sustainable economic growth while promoting jobs and stronger economies

- All of the above and more while tackling the effects of climate change, pollution and other environmental factors that can harm and do harm people's health, livelihoods and lives.
- Sustainability to include health of the land, air and sea

The sustainability mainly emphasizes on the life support systems such as the atmosphere or soil that must be maintained for economic production or human life to even occurs. Thus we can say that the sustainability takes into account how we might live in harmony with the natural world around us, protecting it from damage and destruction. However, the social sustainability focuses on the human effects of economic system such as poverty, as well as to combat inequality etc. The sustainability is also including for energy generation as well as energy consumption. For that some new policy is also adding for energy generation form sustainable sources such as wind, hydropower and solar system. This policy should be to generate public goodwill, some companies of greenwashig means the practice of providing a false impression that makes a business seem more environmentally friendly than it is.

We now live in a modern, consumerist and largely urban existence throughout the developed world and we consume a lot of natural resources every day. In our urban centres, we consume more power than those who live in rural settings and urban centres use a lot more power than average, keeping our streets and civic buildings lit, to power our appliances, our heating and other public and household power requirements. That's not to say that sustainable living should only focus on people who live in urban centres though, there are improvements to be made everywhere - it is estimated that we use about 40% more resources every year than we can put back and that needs to change.

The cost cutting activities for sustainability is also occurs for that many companies have been criticized for cost-cutting measures that make it harder to evaluate their sustainability. For example, many companies might move some parts of their business to less-regulated markets, such as by off shoring production to obtain cheaper labor.

9.2.2. The key features of sustainability

- Sustainability is ability to maintain or support a process over time.
- Sustainability is often broken into three core concepts: economic, environmental, and social.
- Many businesses and governments have committed to sustainable goals, such as reducing their environmental footprints and conserving resources.

- Some investors are actively embracing sustainability investments, known as "green investments."
- Skeptics have accused some companies of "green washing," the practice of misleading the public to make a business seem more environmentally friendly than it is.

9.2.3. A Sustainable Future of sustainability

It is not yet clear what our sustainable future will look like but with emerging technologies and the improvement of older cleaner fuel sources, many people now look to a post fossil fuel world - including businesses. Since the 1950s, we have experienced unprecedented growth including intensive farming, a technological revolution and a massive increase in our power needs putting even greater pressure and strain on the planet's resources.

9.2.4. Challenges of Business Sustainability

The switch to sustainability can be difficult. The three major impediments for firms seeking to improve their environmental impacts: First, it is hard to actually understand the impact of any individual firm. Second, it is difficult to rank the environmental impact of some activities, and finally, it is difficult to predict how economic agents respond to changing incentives. Sustainable investing surveys over the past couple of years have suggested that half of investors say that sustainability is "fundamental" to investing strategy.

9.3. The Four Pillars of Sustainability

In 2005, the World Summit on Social Development identified three core areas that contribute to the philosophy and social science of sustainable development. The idea of sustainability is stand into three pillars: economic, environmental, and social also known informally as profits, planet, and people. The Brundtland Commission described it as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs. We must consider the future then, in making our decisions about the present.

The term sustainability is broadly used to indicate programs, initiatives and actions aimed at the preservation of a particular resource. However, it actually refers to four distinct areas: human, social, economic and environmental – known as the four pillars of sustainability.

9.3.1. Human sustainability

Human sustainability encompasses the development of skills and human capacity to support the functions and sustainability of the organization and to promote the wellbeing of

communities and society. Investments in the health and education systems, access to services, nutrition, knowledge and skills are all programs under the umbrella of human sustainability. Inadditon, natural resources and spaces available are limited so that and there is a need to balance continual growth with improvements to health and achieving economic wellbeing for everyone.

9.3.2. Economic sustainability

Economic sustainability refers to a company's ability to continue its operations over a long-term horizon. In order to be economically sustainable, a company must be able to ensure that it will have adequate resources, workers, and consumers for its products into the distant future. This is the issue that proves the most problematic as most people disagree on political ideology what is and is not economically sound, and how it will affect businesses and by extension, jobs and employability. It is also about providing incentives for businesses and other organizations to adhere to sustainability guidelines beyond their normal legislative requirements. The supply and demand market is consumerist in nature and modern life requires a lot of resources every single day for the sake of the environment, getting what we consume under control is the paramount issue. A sustainable state is one in which utility/consumption is non-declining through time and in which resources are managed so as to maintain production opportunities for the future. Economic development is about giving people what they want without compromising quality of life, especially in the developing world, and reducing the financial burden and “red tape” of doing the right thing.

9.3.3. Social sustainability

There are many facets to this pillar. Most importantly is awareness of and legislation protection of the health of people from pollution and other harmful activities of business and other organizations. It is also about maintaining access to basic resources without compromising the quality of life. The biggest hot topic for many people right now is sustainable housing and how we can better build the homes we live in from sustainable material. The biggest hot topic for many people right now is sustainable housing and how we can better build the homes we live in from sustainable material. The final element is education - encouraging people to participate in environmental sustainability and teaching them about the effects of environmental protection as well as warning of the dangers if we cannot achieve our goals

9.3.4. Environmental sustainability

Environmental protection is the third pillar and to many, the primary concern of the future of humanity. The environmental protected is needed to maintain sustainability that's why we can adopt the concept of recycling, reducing our power consumption by switching electronic devices off rather than using standby, by walking short journeys instead of taking the bus. In addition we can prevent pollution to keep their own carbon emissions low and also install renewable power sources in our homes and businesses. Its need to also adopted advanced and biotechnology to protect ecosystems, air quality, integrity and sustainability of our resources and focusing on the elements that place stress on the environment.

This principle of the four pillars of sustainability states that for complete sustainability problems to be solved in relation to all four pillars of sustainability and then need be maintained. Although in some cases these may overlap, it is important to identify the specific type of green business to focus on, as the four types present unique characteristics.

9.4. Sustainable development

The concept of sustainable development can be interpreted in many different ways, but at its core is an approach to development that looks to balance different, and often competing, needs against an awareness of the environmental, social and economic limitations we face as a society.The sustainable development is defined as an approach to developing or growing by using resources in a way that allows for them to renew or continue existing for others. Using recycled materials or renewable resources when building is an example of sustainable development.

Proponent of sustainable development has been trying to reconcile the urgent need of effective environment protection and conservation with economic development will the concept has been politically successful and bring sustainability in into the main stream development think country it remain controversial Sum of the advocates of sustainable development have org it is based understood as quantitative important in that case development means better than more and emphasizes on quality of life rather than material living standard they call for better most faster life and for the focus on value not things material with the result development I am understandable the natural capacity the sum total of resource is used of faster than it can be replenish sustainability required a human activities only use natural resource at the rate at which they can be replenished naturally.

9.4.1. History of Sustainable development

The sustainability concept became stronger and popularized in 1980s. The united Nation (UN) established a commission, the World Commission on the Environment and Development in 1983. It is commonly referred as the Brundtland Commission named after Gro Harlem Brundtland, the head of the commission and former Prime minister of Norway. The commission proposed the agenda to deal with the world environment problems and concern of human population related living condition, education, resources, international trade, population pressure and health.

The concept of sustainable development can be interpreted in many different ways, but at its core is an approach to development that looks to balance different, and often competing, needs against an awareness of the environmental, social and economic limitations we face as a society. The sustainable development is as an approach to economic planning that attends faster economic growth by using resources in a way that allows for them to renew or continue existing for others. According to the United Nations Brundtland Commission (1987), sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs. The sustainable development contains key ideas:

- The idea of 'needs', specifically the fundamental needs of the world's poor, to which abrogating need ought to be given.
- The possibility of restrictions forced by the condition of innovation and social association on the environment's capacity to meet present and future needs.
- Varieties of the Brundtland definition are ordinarily utilized as a part of national sustainable development procedures.

Living within our environmental limits is one of the central principles of sustainable development. One implication of not doing so is climate change. But the focus of sustainable development is far broader than just the environment. It's also about ensuring a strong, healthy and just society. This means meeting the diverse needs of all people in existing and future communities, promoting personal wellbeing, social cohesion and inclusion, and creating equal opportunity.

9.4.2. Principles of sustainable development

The sustainable development maintains the delicate balance between the human needs and preservingnatural resource and ecosystem. The sustainable development employee's economic growth together with the protection of environmental quality is reinforcing the others. This form of development is a state relationship between human and human activity and natural world, which does not damage the prospects for future generation to enjoy it quality of life at least as good as others. The sustainable development has three main principles:

a) **Economic:** Economic sustainability refers to practices that support long-term economic growth without negatively impacting social, environmental, and cultural aspects of the community. In addition economic sustainability includes the reduction of poverty through the optional and efficient use of natural resources. It maintaining high and stable levels of economic growth is one of the key objectives of sustainable development. Abandoning economic growth is not an option. But sustainable development is more than just economic growth. The quality of growth matters as well as the quantity.
b) **Environmental (Ecological):**Environmental sustainability is the ability to maintain an ecological balance in our planet's natural environment and conserve natural resources to support the wellbeing of current and future generations. Mainly it focuses on the

conservation and enhancement of physical and biological resource base avoiding overexploitation of renewable resources and depletion of non-renewable resources. In addition tobiological diversity, atmospheric stability and ecosystem services and functions are considered in environmental sustainability.

c) **Social:** It is related with socially sustainable system based on distributional equity, welfare of people, improving access to basic health and education service, gender equity, political accountability and participation. Social Sustainability and Inclusion focuses on the need to "put people first" in development processes. It also promotes social inclusion of the poor and vulnerable by empowering people, building cohesive and resilient societies, and making institutions accessible and accountable to citizens.It can be encouraged and supported by laws, information and shared ideas of equality and rights. Social sustainability incorporates the idea of sustainable development as defined by the United Nations sustainable development goals.

9.4.3. United Nations Conference on Environment and Development (UNCED):

The united nation Conference on Environment and Development (the Earth Summit) was held in Rio de Janeiro, 3-14 June, 1992. Most of the countries around the world signed the framework conventions on Climate change and the conventions on biological diversity and approved the Rio Declaration and the forest principles. It adapted Rio declaration and addenda 21, for achieving sustainable development in the 21st century. The Rio concept of sustainable development included:

1. Equal consideration of society, environment and economy.
2. International solidarity-consideration of the needs of future generation.
3. Intragenerational solidarity consideration of the need of poor

9.4.4. Sustainable consumption

Sustainable consumption requires us to achieve more with less current pattern of consumption and production in development. The developing countries cannot be implemented world wide the forest and fastest growing pressure on the global environment come from area such as household energy, water consumption, food consumption, transport and tourism. Earlier environmental policies focused mainly on pollution from domestic production activity now be need a wider focus across the whole life cycle of goods service and material. It will be of little use of reducing environmental impact within a country, when they are not followed by the

neighboring or other country. There are over 100 definitions of sustainable development but the sustainable development the best known is of the word commission on environment and development says that development is sustainable where meets the needs of the present without comprising the ability of future generation needs.

9.4.5. Needs for sustainable development

Needs for the sustainable development has emerged due to over consumption of resources and misuse of technology does for worldwide sustainable growth. There is a need for efficient and effective management of available resources in this field the production of environment friendly product that is a positive step with the industrialization and technology product of daily consumption which has no environmental heath damage.There is need to distinguish the more environmentally harmful consumer product from those which are less harmful, safe products have a more enough benign or harmless impact on environment right from the stage manufacturing through packaging distributing use disposal,reversibility and recycling.The environmental problem are multidimensional and varied with nature in developed and developing country the global problem which have their impact throughout the word are considered asextensive cultivation off land without taking adequate care of soil quality.There is several activity are responsible of degradation of environmental quality such as:

- Development of irrigation facilities without proper water management which leads which lead to waterlogging alkaline and soil.
- Improper use of pesticide fungicide herbicide a sector which cause Soil damage and biological balance.
- SSC new job underground water resulting into sleep for underground water level.
- SSC use of non degradable materials like plastic creates problem of west management discharge of industrial and municipal based in water body leads to problem like unmanaged water pollution automobile and industries have become a major source of pollution.
- The needs of sustainable development become more alarm when the quality of three basic necessities also didn't like quality of air, quality of water, and quality of food materials.

9.4.6. Sustainable development in India:

After independence, in India the developmental activity initiated and it carried out as per the requirement of basic needs of society such as security of food, water, shelter, health, educational, socio-cultural and political opportunities. Even about three-quarters of India‘s

population suffers from scarcity of one or the other kind which includes economic poverty, malnutrition, unhygienic drinking water and sanitation, unemployment and several other conditions which are lower than minimum standards of human rights and well-being.However, the natural ecosystem are under rapid degradation process due to major exploitation of biodiversity, fresh water body, change in land use patterns, alternation of air water and soil quality due pollution and excessive agricultural and transpotrionalactivities. India has become the world‘s third country having biggest ecological footprint (GFN and CII 2008). India‘s report on Millennium Development Goals (MDG) (figure 1) implementation (Govt. of India, 2011) contains a section on MDG7.

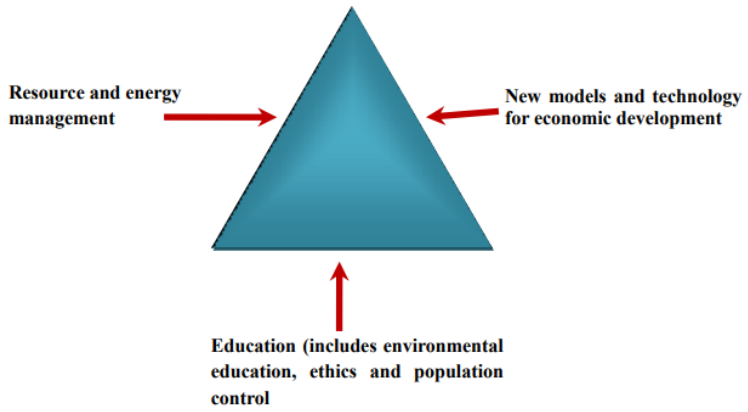

Fig.9.1. Model of sustainable development for India to meet the MDGs

9.5. Carrying capacity

Carrying capacity of the nature refers to the species' average population size in a particular habitat or ecosystem over a certain period of time without causing significance harm to the environment or depleting it natural resources.The carrying capacity of population size is varies depending on the specific ecosystem that governs by environmental factors like adequate food, shelter, water, and mates. If these needs are not met, the population will decrease until the resource rebounds. In other words it is the maximum number of individuals that can be supported by a resource under the given conditions. For example, the carrying capacity of particular forest may be limited by the amount of available food and habitat, as well as population and over fishing.

It is important for humans to consider the carrying capacity of nature when making decisions about resource use and development as exceeding the capacity can lead to environmental degradation.

9.5.1. Types of carrying capacity

Carrying capacity refers to the maximum number of individuals that a given environment can support over a sustained period of time. There are several different types of carrying capacity such as

- **Ecological carrying capacity:** This refers to the maximum number of organisms that a given ecosystem can support without causing long-term damage to the ecosystem.
- **Economic carrying capacity:**This refers to the maximum number of people that a given area can support without negatively impacting the local economy.
- **Social carrying capacity:** This refers to the maximum number of people that a given area can support without negatively impacting the social fabric of the community.
- **Cultural carrying capacity:** This refers to the maximum number of people that a given area can support without negatively impacting the cultural heritage of the community.
- **Technological carrying capacity:** This refers to the maximum number of people that a given area can support with the available technological resources and infrastructure.

All of these types of carrying capacity are important considerations when assessing the sustainability of a particular population or community in a given environment.

9.5.2. Factors effecting carrying capacity

We known the carrying capacity is the maximum population size of particular species they can be supported by given environment over a sustained period of time. Various factor can affects on the carrying capacity of a environment including

a. Available resources:

The available resources such as food, water, and shelter can great effects on the carrying capacity of environment when resources are limited the carrying capacity is deceases, as there is not enough to support a large population or community in any ecosystem.

b. Climate:

The climate can also have a significance impact on the carrying capacity of an environment. Extreme temperatures, drought, floods, and other weather events can decrease the availability of resources, making it more difficult for species to survive and reproduction.

c. Competition:

Competition between species for resources utilization can also affect the carrying capacity of environment. When two or more species rely on the some resources their populations may complete and this can limit the carrying capacity for each species.

d. Diseases:

Diseases outbreaks can significantly reduce the carrying capacity of environment. When disease affects a large portion of the population, it can quickly spread and cause widespread death, leading to a decrease in the carrying capacity of the environment.

e. Predation:

Predation can also have a significant impact on the carrying capacity of an environment. When predator populations are high, they can reduce the population sizes of prey species, limiting the carrying capacity of environment.

f. **Environmental factors:**

Environmental factors such as climate, temperature, and precipitation can also affect the carrying capacity of an ecosystem. For example, if an area experiences a prolonged drought, the availability of water may be greatly reduced, which can negatively impact the carrying capacity of the ecosystem.

g. **Human activity:**

Human activity, such as land development, deforestation, and pollution can have a significant impact on the carrying capacity of an ecosystem. For example, deforestation can lead to a loss of habitat for wildlife, which can reduce the carrying capacity of the ecosystem.

h. **Natural disasters:**

Natural disasters such as floods, wildfires, and earthquakes can also have a significant impact on the carrying capacity of an ecosystem. These events can destroy habitats, disrupt food chains, and reduce the availability of resources, all of which can reduce the carrying capacity of the ecosystem.

Understanding these factors is important for managing and conserving ecosystems and wildlife population.

9.6. Challenges for sustainable development

Sustainable development faces numerous challenges at different levels, including economic, social, and environmental. Here are some of the key challenges.

- **Climate change:** The increasing concentrations of greenhouse gases in the atmosphere is causing global warming and disrupting the climate. This presents a major challenge to sustainable development as it threatens ecosystems, food security, and human health.
- **Poverty and inequality:** Poverty and inequality remain widespread and are major barriers to sustainable development. Addressing these challenges requires investment in education, healthcare, and social welfare programs.
- **Unsustainable consumption patterns:** Unsustainable consumption patterns and production processes are contributing to the depletion of natural resources, pollution, and environmental degradation. Sustainable development requires that we adopt sustainable consumption and production patterns.
- **Loss of biodiversity:** Biodiversity loss and ecosystem degradation pose significant challenges to sustainable development. Preserving biodiversity and maintaining healthy ecosystems is essential for thesustainable development.
- **Water scarcity:** Water scarcity is a major challenge for sustainable development, particularly in arid and semi-arid regions. Sustainable management of water resources is essential for achieving sustainable development.
- **Political instability and conflict:** Political instability and conflict pose significant challenges to sustainable development, particularly in developing countries. Addressing these challenges requires a stable political environment and conflict resolution mechanisms.
- **Lack of access to clean energy:** Access to clean energy is critical for sustainable development, particularly in developing countries. Increasing access to renewable energy sources such as solar and wind power is essential for achieving sustainable development.
- **Infrastructure deficits:** Lack of adequate infrastructure, including roads, water and sanitation, and energy infrastructure, can hinder sustainable development. Investment in infrastructure is essential for achieving sustainable development.

These are just a few of the many challenges that sustainable development faces. Addressing these challenges requires collaboration and cooperation at local, national, and international levels, as well as investment in research, education, and technology.

9.7. Summary

Human creativity and activity has brought a breathtaking pace of technological innovations and scientific breakthroughs which has created a pressure on natural resources.

Overexploitation of natural resources has caused many environmental problems.Unsustainable developments ignores that the human managed systems degrade the natural resources by consuming non renewable resources and reducing the capacity of natural system to renew or recycle the resource. Caring for natural resources and promoting their sustainable use is an essential response of the world community to ensure its own survival and well being. Sustainable development has local and global dimensions. The sustainability from economic perspective is constant, or non-declining, consumption (or utility) where as ecologists are more concerned about properties of biosphere such as resilience and maintaining healthy equilibrium between man-made and natural processes. Ecologists' perspective is similar to the idea strong sustainability; whereas economists' are drawn towards the concept of weak sustainability.Various factors can affect the carrying capacity of an environment. Including resource availability, climate changes, completion and predation. Understanding these factors is important for managing and conserving ecosystems and wildlife population.

9.8. Terminal questions

Q.1. What is sustainability? Discuss the four pillars of sustainability.

Answer:----------

Q.2. Discuss the principles and goals of environmental sustainability and needs for environmental development.

Answer:----------

Q.3. What is the sustainable development? How it is used and how it implements.

Answer:----------

Q.4. What do you know about carring capacity? Discuss briefly about carring capacity of ecosystem.

Answer:----------

Q.5. Discuss the various challenges of sustainable developments.

Answer:----------

Q.6. Write the short notes on

Answer:----------

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a) Environmental or Ecological sustainability

b) Economic sustainability and development

Answer:----------

9.9. Further suggested readings

1. S.C. Sandra, "Environmental Science", A new Central Book Agency,2008
2. P.D. Sharma, "Ecology and Environment" Rastogi Publications, 2017
3. NeerjNachiketa, Environment and Ecology: A Dynamic Approach, G.K. Publication Ltd, 2021
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