Study material

on

Environmental education

(For three year diploma courses, strictly according to HSBTE syllabus)

Govt. Polytechnic Mandi Adampur

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1 Introduction to environmental education

1.1 DEFINITION

Generally the term environment is used two ways. Firstly the term refers to surroundings of an entity like a person, a family, a company, a school, a society or a place etc. has its environment. Here we refer to the home environment, the business environment, educational environment, the political environment and natural environment. Secondly the term environment is used by itself. Here it refers to the natural environment: the air, water, soil, plants, animals trees, rainfall, mountains, oceans etc. An entity always interact with its surrounding i.e. it influence and is influenced by its environment, either positively or negatively. For example, the natural environment surrounding ourselves affect us and we in turn have an impact (often a negative effect) on the environment in order to meet our need for space, shelter, food, medicines and energy etc.

The oxford advanced Learner's Dictionary defines 'environment' as the natural world in which people, animals and plants live. Ecology is a closely related term to environment and is defined as the science that deals with the ways the living organisms interact with other living organisms and their environment. Environmental science is the systematic and scientific study of our natural environment and our role in it.

Environmental studies or education can be defined as branch of study concerned with environmental issues. It has a broader coverage as compared to the environmental science and includes the social as well as institutional aspects related to the environment. It incorporates science where necessary, but at a level understandable to persons with non science background.

Some formal definitions of environmental education are as given below:

● Environmental Education is a process in which individuals gain awareness of their environment and acquire knowledge, skills, values, experiences, and also the determination, which will enable them to act - individually and collectively - to solve present and future environmental problems.

● Environmental education refers to organized efforts to teach about how natural environments function and, particularly, how human beings can manage their behavior and ecosystems in order to live sustainably

● Environmental education is a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, Tbilisi Declaration, 1978).

●Environmental education ‘prepares all citizens with essential skills that contribute to healthier, more environmentally sustainable and economically prosperous communities.’ (North American Association for Environmental Education NAAEE, 2008)

●“Environmental Education helps children and adults develop knowledge, values, skill and behaviours that help them meet present-day needs without compromising the well-being of future generations.”

1.1.1 Interdisciplinary nature of the subject

The subject of environment is interdisciplinary by its very nature. Here we study complex relationships that exist in our natural environment i.e. water, soil, air, ocean among plants, animals, and so on. The interactions are numerous and pertain to many different areas of knowledge. To understand and explain these complex interconnections we need inputs from botany, zoology, soil science, geography, oceanography, atmospheric science, economics, sociology, anthropology, ethics and so on.

1.1.2 Objectives of Environmental education

According to UNESCO (1971), the objectives of environmental education are:

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

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

(iii) Developing an attitude of concern for the environment.

(iv) Motivating public to participate in environment protection and environment improvement.

(v) Acquiring skills to help the concerned individuals in identifying and solving environmental problems.

(vi) Striving to attain harmony with Nature.

1.2 SCOPE OF ENVIRONMENTAL EDUCATION

The disciplines included in environmental education are environmental sciences, environmental engineering and environmental management.

(i) Environmental Science:

It deals with the scientific study of environmental system (air, water, soil and land), the inherent or induced changes on organisms and the environmental damages incurred as a result of human interaction with the environment.

(ii) Environmental Engineering:

It deals with the study of technical processes involved in the protection of environment from the potentially deleterious effects of human activity and improving the environmental quality for the health and well beings of humans.

(iii) Environmental Management:

It promotes due regard for physical, social and economic environment of the enterprise or projects. It encourages planned investment at the start of the production chain rather than forced investment in cleaning up at the end.

It generally covers the areas as environment and enterprise objectives, scope, and structure of the environment, interaction of nature, society and the enterprise, environment impact assessment, economics of pollution, prevention, environmental management standards etc.

1.3 IMPORTANCE OF ENVIRONMENTAL EDUCATION

The importance of environmental education are as follows:

(i) Environmental education help us to better understand the modern environmental concept like how to conserve biodiversity.

(ii) It make us aware and suggest ways to a more sustainable way of living. Non judicious and greedy approach to exploit natural resources has created danger of their depletion and non availability for future generations. Environmental education can help us to preserve these valuable resources for a longer time.

(iii) It educate us to use natural resources more efficiently.

(iv) The environmental education give us opportunity to know the behaviour of organism under natural conditions.

(v) It is important to know the interrelationship between organisms in populations and communities.

(vi) it is important to make aware and educate people regarding environmental issues and problems at local, national and international levels.

Exercises

Very short answer type questions.

Que 1. Define the term environment.

Que 2. Define environmental education.

Que 3. Define ecology.

Short answer type questions.

Que 1.The environmental education is an interdisciplinary field of knowledge. Justify the statement in short.

Que2. Write a short note on scope of environmental education.

Long answer type question

Que 1 Write a detailed note on importance of environmental education.

2 Basics of ecology

Ecology is defined as scientific study of relationships between living beings and their environment. The word "ecology" was coined in 1866 by the German scientist Ernst Haeckel (1834–1919). Ancient Greek philosophers such as Hippocrates and Aristotle laid the foundations of ecology in their Studies on Natural History. It is often considered a discipline of biology. Ecology is concerned with the study of organisms in various habitats viz. land, oceans, fresh water and air. Ecology can also be defined as the study of the structure and function of nature. Ecologist try to predict what will happen to organisms, populations or communities under a particular set of habitat. In ecology we study the concepts of ecosystem, spices, population and community. Some other relevant concepts of ecology are as follows. The biotic community and abiotic conditions. The edge effect that come into play in the transitional zone between ecosystems. First and second law of thermodynamics and their relevance to ecosystems. The role of producers, cosumers and decomposer in an ecosystem. We trace the flow of matter and energy in ecosystems and explain concepts like food chains, trophic levels and ecological pyramids, ecological succession, habitat and ecological niche water and mineral cycles.

2.1ECOSYSTEM

Living organisms cannot live in isolation. They live in an environment which supplies its material and energy requirements and provides other living conditions. The living organisms, together with the physical environment form an interacting system called the ecosystem. The term ecosystem was introduced by Sir A.G. Tansely in 1935. He defined ecosystem as “ the system resulting from the integration of all the living and non living factors of the environment.” Ecosystem is the fundamental concept of ecology. It is the basic unit in ecology and includes populations and communities each influencing the other. The ecosystem emphasizes relationships and interdependence. The parts of an ecosystem are operationally inseparable from the whole. An ecosystem can be natural or artificial, temporary or permanent. Some examples of ecosystem are a grassland, a forest, a tract in a forest, a single log, an edge of pond, a village, an aquarium etc. Thus any structural and functional unit of the environment that can be identified and studied is called ecosystem.

2.1.1 Structural aspects of ecosystem

Study of an ecosystem involves the understanding of a whole network of relationships consisting of various exchanges and interaction between the living and non living. Various structural components of an ecosystem are classified under two main categories.

(1) Biotic (living)

(2) Abiotic (non-living)

(1) Biotic components

They include the types, numbers and distribution of living organisms of an ecosystem. All organisms require energy to carry out their life processes and material for formation and maintenance of body. The organisms get energy and material form food. The biotic components of ecosystem are following.

Producers- All green plants prepare their foods by a process known as photosynthesis. They absorb Carbon dioxide and water from environment. The CO2 is fixed into glucose with the help of chlorophyll in presence of sun light. The glucose is later converted into complex carbohydrates, lipids and proteins. As the green plants are capable of producing food they are called producers. These are also known as autotrophs. The food prepared by green plants is used partly for their growth and maintenance and remaining part is stored for the future needs.

Consumesr- Some organisms are not able to produce their food by their own and depend on other organisms for their food. Such organisms are known as consumers. They are also called hetrotrophs. Consumers are divided into following three groups.

Herbivores:

Some organisms get their food directly from green plants and are called herbivores. For example cattle, deer, goat and sheep etc. They are also known as first order consumers or primary consumers.

Carnivores:

Some organisms feed on other consumers and known as carnivores. The carnivores are also called as second order consumers or secondary consumers. For example tiger, lion, etc.

Omnivores:

There are some organisms which feed on plants as well as animals are known as omnivores. Cat, dog, man etc.

Decomposers or detrivores- Some organisms are not capable of producing their foods instead they live on the dead and decaying plants or animals. They are consumer of a special kind and called as decomposer or detrivores. For example fungi, bacteria and many types of worms living on forest bed. Decomposers convert the organic matter of producers and consumers back into inorganic form. In this way matter is again available for use by producers. Detrivors and decomposers are essential for long term survival of a community. They play the vital role of completing the matter cycle. Without them, enormous wastes of plant litter, dead animal bodies, animal excreta and garbage would collect on earth. Also important nutrients like Nitrogen, Phosphorus and Potassium would remain indefinitely in dead matter. The producers would not get their nutrients and life would be impossible.

(2) Abiotic components: They are the non living factors prevailing in an ecosystem. The abiotic components consists of the kind, quantity and distribution of physical and chemical factors such as light, temperature, water, oxygen carbon, nitrogen and minerals.

2.1.2 Functional aspects of ecosystem

In nature the producers, consumers and decomposers interact with themselves as well as with abiotic components in various ways. Matter exchanges and energy flow are continuously taking place. In this way an ecosystem is no longer a static system but in a state of change and homoeostasis. In the ecosystem green plants go on producing organic matter or biomass thus trapping solar energy into chemical energy. Later passes from producers to herbivorous and then to carnivores. The processes of energy production and transfer from one trophic level to next are governed by laws of thermodynamics. The nutrients like nitrogen, sulphur, oxygen follows a cyclic path through abiotic and biotic components of the ecosystem. The major functional aspects of an ecosystem are elaborated as follows.

Food chain

All living organisms require food for getting energy and material for growth of their bodies. A food chain shows how each organism gets its food. It shows who is eating who in an ecosystem. We find two types of food chains in ecosystems.

Grazing food chain - The grazing food chain begins with the photosynthetic fixation of carbon dioxide by plants (primary producers) who produce sugars and other organic molecules. Once produced, these compounds can be used to create the various types of plant tissues. Primary consumers or herbivores form the second link in the grazing food chain. They gain their energy by consuming primary producers. Secondary consumers or primary carnivores, the third link in the chain, gain their energy by consuming herbivores. Tertiary consumers or secondary carnivores are animals that receive their organic energy by consuming primary carnivores. For example

Grass → Grass hoper → Toad → Snake → Hawk

Phytoplankton → Zooplankton → Small fish → large fish → Shark

Detritus food chain **–** The starting point for such food chains is the dead body of a plant or animal or their products. Detrivores feed on these dead organic matter. The predators of detrivores feed on them. The detritus food chain differs from the grazing food chain in several ways: Detrivores live in environments rich in scattered food particles (like the soil). Detritivores are less motile than herbivores or carnivores. The organisms making up this type of food chain are generally smaller (like algae, bacteria, fungi, insects, & centipedes). Decomposers process large amounts of organic matter, converting it back into its inorganic nutrient form. Examples of detrial food chain are given below.

Dead organic matter → Fungi → Bacteria

Fallen leaves → Soil mites → Insects → Frog

Trophic level

Each organism in an ecosystem is at a specific feeding stage called trophic level.The term comes from the Greek trophos, meaning nourishment. All producers are at first trophic level and are called autotrophos (self-feeding organisms) All other organisms that must consume organic matter for getting energy and for building their bodies are called hetertophs or consumers. Each step in a food chain represent a trophic level.

Food web

In an ecosystem food chains does not occur in isolation instead they operate in an interconnected way. A deer (herbivores) can consumes many types of plants or plant products. Many types of carnivores animals like tiger, lion, wolf etc can feed on deer. Ticks, mites, leeches and mosquitoes feed on herbivores and even on carnivores. In this way depending on choice and availability different organisms at each trophic level have food relationships with more than one organism at the lower levels. Thus these interconnected food chains where more than one organism have food relations with different organisms at different trophic levels, are collectively constitute a food web. Existence of food webs aid in stability of ecosystem by providing many alternate pathways for energy flow. Because of food web an organism can get its food from many organisms of the lower trophic level.

First law of thermodynamics

It states as "Energy can neither be created nor be destroyed." It can only be transformed from one form to another. For example, when petrol is burnt in car, the chemical energy of fuel is transformed into mechanical energy. From First law of thermodynamics it is concluded that an organism can not create energy for its requirements. The energy must be obtained from food it eats and chemical energy of food is to be converted into mechanical energy that it needs.

Second law of thermodynamics

This law talks about energy conversion. During any energy conversion some usable energy is lost into a less usable form (heat) that disperses into the environment. Since energy is being converted all the time, it follows that, in the Universe, the total amount of energy available to work decreases over time.

The second law is consistent with the first, there is never any change in the total amount of energy in the Universe. What decreases is the amount available to perform useful work.

Pyramid of energy flow

For most ecosystems, the main source of energy is the Sun. Producers trap solar energy and stores it as sugar, starch, fats and proteins. When primary consumers eat the producers, the energy also moves up the trophic level. The movement of energy is governed by 2nd law of thermodynamics and about 90 percent of energy is lost to the environment as unusable heat. As we move up the trophic level, the amount of usable energy available at each stage declines. This phenomenon is called as pyramid of energy flow. If the producer has 10,000 units of energy, the primary consumers receives only 1000 units and the secondary consumers gets only 100 units. The tertiary consumers is left with just 10 units. The energy flow is one directional and the loss at each stage is simply released into the environment.

Pyramid of biomass flow

Each trophic level contains a certain amount of biomass, which is the dry weight of all the matter contained in the organism at that level. As we move up trophic level, biomass decreases drastically. At each level, we lose 90-99 %of biomass. We call this a pyramid of biomass

2.1.3 Habitat and niche

Habitat is the area to which a species is biologically adapted to live. The habitat of a given species or population has certain characteristics physical and biological features like vegetation, climatic conditions, presence of water and moisture, soil type etc.

Ecological niche

There are predator-prey relationships among species, but they do not generally lead to the extermination of species. The reason is that each species in an ecosystem has found its habitat and its own ecological niche within the habitat.

This ecological niche is characterized by particular food habits, shelter-seeking methods, ways of nesting and reproduction etc, of the species. The niche include all aspects of the organism's existence-all the physical, chemical and biological factors that it needs in order to live and reproduce. Where the organism lives, what it eats, which organism eat it, how it competes with others, how it interact with its abiotic environment- all these aspects together make up the niche. When different species live in the same habitat, competition may be slight or even non-existent, because each has its own niche.

Some important definitions

Organism	An organism is any living thing- an animal, a plant, a microbe, a mosquito, a fish, a plant, a rabbit, an elephant and a human being all are organism.
Cell	A cell is the basic unit of life in organisms. An organism like a bacterium consists of a single cell, while most organisms have many cells.
Species	The organism in this world can be classified into different species. Human beings are one species, while roses are another. A species is a set of organisms that resemble one another in appearance and behavior. The organism in a species are potentially capable of reproducing naturally

	among themselves. Generally, organisms from different species do not interbreed and, even if they do, they do not produce fertile offspring.
Population	The member of a species living and interacting within a specific geographical region are together called a population. Neem tree in a forest, people in a country and Gold fish in a pond are example of a population. There is diversity in most natural populations. While there are broad similarities among the members, they do not all look exactly alike and they do not all behave in the same way. The term population refers only to those members of a certain species that live within a given area. The term species include all members of a certain kind, even they exist in different populations in widely separated areas.
Community	A community is the assemblage of all the interacting populations of different species existing in a geographical area. It is a complex interacting network of plants, animals and microbes. Each population plays a defined role in a community.
Biosphere	To understand what the biosphere is, we should first know what the earth is like. The earth has several spherical layer. The atmosphere is a thin envelope of air around the earth extending to about 50 km above its surface. That part of atmosphere up to a distance of 17 km above sea level is called the troposphere; it contains the planet's air. Above the troposphere is the stratosphere that contain ozone. it is this ozone that supports life by filtering out the harmful ultraviolet radiation from the Sun. The hydrosphere consists of the liquid water, ice, and water vapour, while the lithosphere is the earth's upper crest containing fossil fuel and minerals. Then we have the biosphere, in which all the living organisms interact with each other and with their environment. The biosphere include most of the hydrosphere, and parts of the lower and upper lithosphere. Thus the biosphere is that portion of the planet and its environment which can

	support life.
Boundary of an ecosystem	An ecosystem gradually merges with an adjoining one through a transitional zone called the ecotone. In the ecotone a mixture of species found in both the ecosystems exist. Often the ecotone have additional species not found in either ecosystem. Or the ecotone may have greater population densities of certain species than in either of the adjoining communities. This phenomenon is called the edge effect.

Biogeochemical cycles

We have discussed that energy flows through an ecosystem in one direction. Matter ,on the other hand, move through ecosystems in numerous cycles. The nutrients that organisms need to grow, live and reproduce are continuously taken from the abiotic environment, consumed and then recycled back to the environment.

There are several such biogeochemical cycles. Powered directly or indirectly by solar energy. They include the carbon, oxygen nitrogen, phosphorus and water cycles. With respect to matter earth is a closed system. Matter can not escapes from its boundaries.

Water cycle-The hydrologic or water cycle is powered by the Sun and gravity. Solar energy causes water to evaporates from the oceans, rivers, lakes and the other water bodies. Plants extract water from the soil through their roots and transport it to their leaves from where it evaporates. This process is called transpiration. Wind and air move vapour through the atmosphere. When the vapour cools, it condenses into tiny droplets that form clouds. The next stage is precipitation as rain or snow, mostly over the ocean and partly over land. The water that falls on the land may percolate through the soil and collect in aquifers, or it may flow back to oceans as run-off through the rivers and streams.

Carbon cycle- Carbon dioxide constitutes just 0.035% by volume of the atmosphere, and yet it is vital to life. Plants take carbon dioxide in the air and they use chlorophyll to gather energy from the Sun. from these inputs and water, plants make glucose as a basic building block. In this process of photosynthesis plants release oxygen. Animals breathe in this oxygen, digest their food (that cones from plants) and recombine i\the carbon and the oxygen to make carbon dioxide, which goes back to plants. This is called the carbon cycle.

When we burn fossil fuels like oil and coal, the carbon in the fuel combine with the atmospheric oxygen to form carbon dioxide. Since we burn a lot of oil, there are huge emission of carbon dioxide. This increase in carbon dioxide concentration upsets the carbon balance in the atmosphere. There are not enough growing of plants to absorb all the excess carbon dioxide. Things are made worse when forest are cut down and more and more trees are burnt.

Normally, carbon dioxide and other gases that surround the planet like a blanket and capture the heat. This green house effect is necessary upto a limit. The current excessive levels of carbon dioxide, however lead to a higher temperature and global warming. This results in climate change, which could lead to natural disasters like droughts and floods as well as a rise in the sea level.

Like the water and carbon cycles, there are also nitrogen, phosphorus, and sulphur cycles in nature.

2.1.4 Biomagnification

Biomagnification or biological magnification is the tendency of some undesirable chemicals like DDT, Mercury etc. to become concentrated in successive trophic levels. Biomagnification happen when organism at start of food chain stores a particular material over and above its concentration in surrounding soil or water. These pollutants find their way into producers as they absorb nutrients from the surrounding environment because of similarity in chemical structure with nutrients. With the passage of time the concentration of pollutant in producers reaches above that in surroundings. This is the starting point of biomagnification. When the producer are eaten up by consumers the pollutants are absorbed and stored inside bodies of consumers. In this way concentration of pollutants goes on building up inside the tissues of organisms at higher trophic levels. In some cases the biomagnification has proved lethal to the organisms. Some birds species have become extinct because of this phenomenon. The biomagnifications often occur with fat soluble pollutants and not with water soluble ones as fat remain stored inside fatty tissues of the animals while water is continuously lost to environment so pollutants are also eliminated from tissues.

2.2 BIODIVERSITY

Biodiversity of biological diversity refers to the number, verity and variability of living organisms and ecosystems. The term includes all the terrestrial, marine and other aquatic organisms. It also covers diversity within species, between species, as well as the variation among ecosystems. In addition the field of biodiversity is concerned with the complex ecological interrelationships of species. Biodiversity is the earth's primary life support system and is a precondition for human survival.

Species diversity

Species diversity refers to the number of plant and animals species in a community or an ecosystem. It varies a great deal between ecosystems. For example species diversity is very high in tropical rain forests and coral reefs and low in isolated islands.

Genetic diversity

It refers to the verity in the genetic make-up of individuals within a species.

Ecosystem diversity

It is the verity of habitat found in an area. It refers to the variety of forests, deserts, grassland, aquatic ecosystem, ect. that occur in an area.

Factors affecting degree of diversity

Habitat stress

Diversity is low in habitat under any stresses like harsh climate or pollution.

Geographic isolation

Diversity is less in an isolated region like an island. If a species on an island disappear due to random events, it can not be easily replaced. Organisms from the main land would find it difficult to reach the island and colonize it.

Dominance by one species

The dominant species consumes a disproportionate share of resources as a result many other species does not get chance to evolve and flourish.

Availability of ecological niches

A complex community offer a greater variety of niches than a simple community and it promote greater diversity.

Edge effect

There is greater diversity in ecotone or transitional zone.

Geographical history

Old and stable ecosystem like rainforest that have not experienced many changes have high diversity. An ecosystem like the Arctic has undergone many changes and this does not allow many species to establish themselves.

Significance of bio diversity

Biodiversity is of utmost significant for sustainability of human race as well ecosystems.

Following points will elaborate to fact in some detail.

1. Many types of grains, fruits, vegetables meat and fish are directly consumed by human beings as a food.
2. Goods of various kind like fuel, timber, paper, medicine and of our current food crops came from wild tropical plants. The majority of world's poor depends upon even now on traditional medicines derived from plants. Today hundred of plants are used in the traditional medicine of developing countries. The local people have a vast and unique knowledge of plants and their medicinal values. Many of new drugs developed by the pharmaceutical industry are also derived from plants and animals .Many pharmaceutical companies in industrialized countries depends heavily on plants in developing countries in their search for new drugs e.g. Rosy periwinkle from Medagascar for leukaemia, cinchona for malaria, Rauwolfia serpentine for hypertension, coca for anesthesia. Many useful microbes have been identified: while some are capable of cleaning of oil spills and toxic wastes while other can extract metals from ores. These are some examples of productive uses of biodiversity.
3. Recreation: the biodiversity of the planet enables activities like wildlife tourism, nature photography, trekking and bird watching.
4. Renetic resources: biotechnology and genetic engineering use the genes of organism to make new types of crops, medicine etc.
5. Aesthetic value: just being close to nature gives many of use enjoyment and even spiritual solace. Writers, poet, artist and composers drive inspiration from nature for their creative work.

From ecological point of view, every species has a value and role in nature. It has right to exist, whether or not it is known to be useful to humans.

Total number of species in the world

We do not know exactly how many species inhabit the earth. Estimate range from about 4-100 millions. The best guess is about 10-14 millions. Most of the species in the world are of insects and microbes not visible to the naked eye.

So far about 1.8 million species (excluding bacteria) have been identified, named and catalogued. These include 270000 plant species, 45000 vertebrates and 950000 insects. Roughly 10000 new species are identified every year.

Overall, our knowledge of species, biomes and ecosystem is poor. Even out of the identified species, only a third have been studied to any significant level. Among these, we understand the exact roles and interactions of just a small number of species.

Location of biodiversity

The vast majority of all species are found in the developing countries. About 50-75% of all the species are to be found in the tropical rain forests that account for just 6% of the land area. A handful of soil in a tropical forest contain hundred of species and more than a million individual organisms.

In the tropics and the subtropics, where most of developing countries are located, there has been evolutionary activity, giving rise to rich biodiversity. Biodiversity is less in the colder northern regions because of the recurrent ice ages there slowed down the proliferation of life form.

The 19 most bio-diverse nations of the world are listed in table given below

The mega bio-diversity countries of the world

Australia	Madagascar
Brazil	Malaysia
Cameroon	Mexico
China	Myanmar
Colombia	Peru
Costa rica	Philippines
Equador	South Africa
Ethiopia	Venezuela
India	Zaire
Indonesia	

Almost all the plants eaten today in Europe originated in the developing countries. Thus, genetic diversity needed to maintain the world agriculture system is mainly found in developing world. Most of medicinal plants are also found in these countries.

Level of boi-diversity in India

India is one of the 19 mega-biodiversity countries of the world and so far, about 70 percent of the total area has been surveyed for bio-diversity assessment. Till date 45000 wild species of plants and 81000 wild species of animals have been identified here. Together they represent 6.5 percent of the world's biodiversity. The rich biodiversity is attributed to the presence of a variety of ecosystems and climates. Of the plant found in India about 18% are endemic. At least 166 crop species 320 species of their wild relatives have originated in India. We also have a large variety of domesticated species. For example, the number of rice varieties alone ranges between 50000 and 60000.

Biogeographical classification of India

India has been divided into 10 biogeographic zones

1. trans-Himalayan: extension of the Tibetan Plateau including the high altitude cold desert in Ladakh and Lahaul-Spiti.
2. Himalyas: the entire mountain chain, diverse biotic provinces and biomes.
3. Gangetic Plain: the Gange river system.
4. North Eastrn zone: the plains and the non –Himalayan ranges
5. Desert: the arid ares west of Arawali Hill range, the salt desert of Gujrat and the sand desert of Rajasthan
6. Semi- arid zone: the area between the desert and the Deccan Plateau including the Aravalli range
7. Western Ghats: the hill ranges and plains running along the wertern coastline.
8. Deccan Peninsula:the south and south-central plateau, south of the river Tapti.
9. Islands: the Andaman and Nicobar Islands.
10. The coasts and the Lakshadweep Islands

Extinction of species

By extinction, we mean the complete disappearance of a species, that is not a single member of the extinct species is then found on earth. It is an irreversible loss and is called biological extinction. Before a species become biologically extinct, it goes through stages of local and ecological extinction. Local extinction means that the species is no longer to be found in the area that is once inhabited. It is, however, present elsewhere in the world. Ecological extinction of a species means that so few members of a species are left that the species can no longer play its normal ecological role in the community.

Extinction is the ultimate fate of all the species. Since multi-cellular organisms evolved on earth 570 millions years ago, about 30 billion species have lived on this planet. Today, there are only about 14 million of them. This means that 99.9% of all the species that have ever lived now extinct.

Over the life of earth, physical and environmental conditions have been changing, sometimes gradually and at other times rapidly. When such changes occur, the affected species must adapt itself, or move to a more favorable area, or become extinct.

Present rate of extinction of species

Before humankind became very active, the world was annually losing one out of every million species. In the early twentieth century, we were perhaps losing one species a year. Now, we are losing one to 100 species a day and soon the rate of extinction is likely to be 1000 each day. These are estimates, but it is definite that we are losing species rapidly. over the next 50 -100 years, as the population and resources use grow exponentially, the rate of biodiversity loss will also increase sharply. Biologists estimate that 20 percent of the current species will be gone by 2030 and 50 % by end of the centaury

Causes of biodiversity loss

The major causes for the decline in biodiversity are the following:

1. Destruction of biodiversity rich area like tropical forest.
2. Destruction of coral reefs and wetlands.
3. Ploughing of grasslands
4. Fresh water fish species threatened because dam and water withdrawals have radically altered river systems.
5. pollution of freshwater streams, lakes and marine habitats.

Impact of biodiversity loss

The poor people in the developing countries, who are dependent on biodiversity for their daily survival, will feel the impact first. Soon, however, the industrialized countries will also start experiencing the effects of this loss. Most of their food crops, medicines, textiles, spices, dyes and paper originate from plants in developing countries.,

The destruction of rain forests means that less carbon dioxide is absorbed and natural climate-control mechanisms are lost. This has a major impact on the world's climate.

SUSTAINABLE DEVELOPMENT

Sustainable development has been defined in many ways, but the most frequently quoted definition is from *Our Common Future*, also known as the Brundtland Report.

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:

the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given; and

the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."

All definitions of sustainable development require that we see the world as a system—a system that connects space; and a system that connects time.

When you think of the world as a system over space, you grow to understand that air pollution from North America affects air quality in Asia, and that pesticides sprayed in Argentina could harm fish stocks off the coast of Australia.

And when you think of the world as a system over time, you start to realize that the decisions our grandparents made about how to farm the land continue to affect agricultural practice today; and the economic policies we endorse today will have an impact on urban poverty when our children are adults.

We also understand that quality of life is a system, too. It's good to be physically healthy, but what if you are poor and don't have access to education? It's good to have a secure income, but what if the air in your part of the world is unclean? And it's good to have freedom of religious expression, but what if you can't feed your family?

The concept of sustainable development is rooted in this sort of systems thinking. It helps us understand ourselves and our world. The problems we face are complex and serious—and we can't address them in the same way we created them. But we *can* address them.

There are different domains identified for sustainable development, which are broadly defined in the four domains, ecology, economics, politics and culture- as used by the United Nations and a number of other international organizations.

Ecology

The ecological sustainability of human settlements is part of the relationship between humans and their natural, social and built environments. Also termed human ecology, this broadens the focus of sustainable development to include the domain of human health. Fundamental human needs such as the availability and quality of air, water, food and shelter are also the ecological foundations for sustainable development; addressing public health risk through investments in ecosystem services can be a powerful and transformative force for sustainable development which, in this sense, extends to all species.

Agriculture

Sustainable agriculture may be defined as consisting of environmentally friendly methods of farming that allow the production of crops or livestock without damage to human or natural systems. More specifically, it might be said to include preventing adverse effects to soil, water, biodiversity, surrounding or downstream resources—as well as to those working or living on the farm or in neighboring areas. Furthermore, the concept of sustainable agriculture extends intergenerationally, relating to passing on a conserved or improved natural resource, biotic, and economic base instead of one which has been depleted or polluted. Some important elements of sustainable agriculture are permaculture, agroforestry, mixed farming,multiple cropping, and crop rotation.

Numerous sustainability standards and certification systems have been established in recent years to meet development goals, thus offering consumer choices for sustainable agriculture practices. Well-known food standards include organic,Rainforest Alliance, fair trade, UTZ Certified, Bird Friendly, and the *Common Code for the Coffee Community*

Energy

Sustainable energy is the sustainable provision of energy that is clean and lasts for a long period of time. Unlike the fossil fuel that most of the countries are using, renewable energy only produces little or even no pollution. The most common types of renewable energy in developed countries like US are solar and wind energy, solar energy are commonly used on public parking meter, street lights and the roof of buildings. On the other hand, wind energy is expanding quickly in recent years.in America it generated 12,000 MW in 2013. The largest wind power station is in Texas and followed up by California. Household energy consumption can also be improved in a sustainable way, like using electronic with energy star logo, conserving water and energy.

Environment

Beyond ecology as the intersection of humans in the environment, environmental sustainability concerns the natural environment and how it endures and remains diverse and productive. Since Natural resources are derived from the environment, the state of air, water, and the climate are of particular concern. Environmental sustainability requires society to design activities to meet human needs while preserving the life support systems of the planet. This, for example, entails using water sustainably, utilizing renewable energy, and sustainable material supplies (e.g. harvesting wood from forests at a rate that maintains the biomass and biodiversity).

An "unsustainable situation" occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished. Sustainability requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. Inherently the concept of sustainable development is intertwined with the concept of carrying capacity. Theoretically, the long-term result of environmental degradation is the inability to sustain human life. Such degradation on a global scale should imply an increase in human death rate until population falls to what the degraded environment can support. If the degradation continues beyond a certain tipping pointor critical threshold it would lead to eventual extinction for humanity.

Transportation

Some western countries and United States are making transportation more sustainable in both long-term and short-term implementations. Since these countries are mostly highly automobile-orientated area, the main transit that people use is personal vehicles. Therefore, California is one of the highest greenhouse gases emission in the country. The federal government has to come up with some plans to reduce the total number of vehicle trips in order to lower greenhouse gases emission. Such as:

Improve public transit:

Larger coverage area should be brought under public transport system in order to provide more mobility and accessibility. Use new technology to provide a more reliable and responsive public transportation network. Organizations should provide ECO pass to employees.

Encourage walking and biking:

-Wider pedestrian pathway, bike share station in commercial downtown, locate parking lot far from the shopping center, limit on street parking, slower traffic lane in downtown area are some of measures to encourage walking and biking.

Increase the cost of car ownership and gas taxes:

-Increase parking fees/ toll fees, encourage people to drive more fuel efficient vehicles. It has been observed that poor people usually drive old cars that have low fuel efficiency. However, government can use the extra revenue collected from taxes and tolls to improve the public transportation and benefit the poor community.

Economics

It has been suggested that because of rural poverty and overexploitation, environmental resources should be treated as important economic assets, called natural capital. Economic development has traditionally required a growth in the gross domestic product. This model of unlimited personal and GDP growth may be over. Sustainable development may involve improvements in the quality of life for many but may necessitate a decrease in resource consumption. According to ecological economist Malte Faber, ecological economics is defined by its focus on nature, justice, and time. Issues of intergenerational equity, irreversibility of environmental change, uncertainty of long-term outcomes, and sustainable development guide ecological economic analysis and valuation.

A World Bank study from 1999 concluded that based on the theory of genuine savings, policymakers have many possible interventions to increase sustainability, in macroeconomics or purely environmental. A study conducted in 2001 noted that efficient policies for renewable energy and pollution are compatible with increasing human welfare, eventually reaching a golden-rule steady state. The study, *Interpreting Sustainability in Economic Terms*, found three pillars of sustainable development, interlinkage, intergenerational equity, and dynamic efficiency.

Business

The most broadly accepted criterion for corporate sustainability constitutes a firm's efficient use of natural capital. This eco-efficiency is usually calculated as the economic value added by a firm in relation to its aggregated ecological impact. This idea has been popularised by the World Business Council for Sustainable Development (WBCSD) under the following definition: "Eco-efficiency is achieved by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's carrying capacity."

Architecture

In sustainable architecture the recent movements of New Urbanism and New Classical Architecture promote a sustainable approach towards construction, that appreciates and develops smart growth, architectural tradition and classical design. This in contrast to modernist and globally uniform architecture, as well as opposing to solitary housing estates and suburban sprawl, with long commuting distances and large ecological footprints. Both trends started in the 1980s.

Sustainable development in Indian perspective

Sustainable development in India encompasses a variety of development schemes in social, cleantech (clean energy, clean water and sustainable agriculture) and human resources segments, having caught the attention of both Central and State governments and also public and private sectors.

In fact, India is expected to begin the greening of its national income accounting, making depletion in natural resources wealth a key component in its measurement of gross domestic product (GDP).

India's sustained efforts towards reducing greenhouse gases (GHG) will ensure that the country's per capita emission of GHG will continue to be low until 2030-31, and it is estimated that the per capita emission in 2031 will be lower than per capita global emission of GHG in 2005, according to a new study. Even in 2031, India's per capita GHG emissions would stay under four tonnes of CO_2, which is lower than the global per capita emission of 4.22 tonnes of CO_2 in 2005.

Major Achievements

The number of carbon credits issued for emission reduction projects in India is set to triple to 246 million by December 2012 from 72 million in November 2009, according to a CRISIL Research study.

This will cement India's second position in the global carbon credits market (technically called Certified Emission Reduction units or CERs). The growth in CER issuance will be driven by capacity additions in the renewable energy sector and by the eligibility of more renewable energy projects to issue CERs. Consequently, the share of renewable energy projects in Indian CERs will increase to 31 per cent.

CRISIL Research expects India's renewable energy capacity to increase to 20,000 megawatt (MW) by December 2012, from the current 15,542 MW.

The contribution of renewable energy to the power business in India has now reached 70 per cent, compared to 10 per cent in 2000, in terms of project numbers and dollar value, according to Anita George, Regional Industry Director, Asia Infrastructure and Natural Resources, International Finance Corporation (IFC).

Growth in use of green technologies has put India on the green-building leader board with countries such as the US. "About 2-3 per cent of all construction in India is green, as good as (in) the US. In the next two or three years, we want to bring it up to 10 per cent, which will put us on top," as per the Indian Green Building Council (IGBC).

The US$ 1.79 billion Indian lighting market is estimated to be growing at 18 per cent annually and switching rapidly to energy-efficient systems. In value terms, about US$ 425.58 million of the current market size belongs to the compact fluorescent lamp (CFL), according to Electrical Lamp and Component Manufacturers' Association of India (ELCOMA) statistics.

On the back of the incentive package for electric vehicles announced by the Ministry of New and Renewable Energy, average monthly sales of electric two-wheelers has risen 20 per cent, according to Sohinder Gill, Director, Society of Manufacturers of Electric Vehicles.

Backing the ‘polluter must pay’ principle to deal with the issue of residual pollution, Prime Minister Dr Manmohan Singh has endorsed proper enforcement of regulatory standards to prevent green damage. He also inaugurated the 'Delhi Sustainable Development Summit' (DSDS), organised by The Energy and Resource Institute (TERI), on February 3, 2011.

National Aluminium Company Limited (NALCO), the Navratna PSU, under the Union Ministry of Mines, Govt. of India, has become the first PSU in the country by implementing a pilot-cum-demonstration project on Carbon Sequestration in its captive power plant at Angul. The project is expected to go a long way towards addressing the issue of bringing down GHG, a NALCO spokesperson said.

Currently, India has 18,655 MW of installed renewable energy, accounting for a total of 11 per cent of the total capacity of 168,954 MW. The target includes adding 20,000 MW of solar energy by 2022, which would take the share of renewable energy in the total electricity generation capacity of the country to 15 per cent, said Dr Arun Tripathi, a director and a scientist at the ministry. He added that the Indian government's goal is that renewable energy should account for 30 per cent share of the total electricity capacity by 2032.

Investments

India expects investments to the tune of US$ 55 billion by 2015 in the renewable energy sector which is expected to produce 35 giga watt (GW) of power, according to Mr Debashish Majumdar, Chairman and Managing Director, Indian Renewable Energy Development Agency Ltd (IREDA).

According to a recent study on India attractiveness survey by Ernst & Young, Foreign Direct Investment (FDI) in Renewable Energy in India witnessed a 105 per cent rise. Wind energy is the fastest growing renewable energy sector and the FDI inflow in the sector has been increasing over the years.

Private equity investment in renewable energy sector picked up pace in the country from 2004. According to a report by 3i Network – IDFC, from a private equity investment of US$ 851 million in 2005, inflows into the renewable sector in India soared to US$ 2,136 million in 2008. Separately, a study by the Word Resources Institute recently estimated a renewable energy market of over US$ 2 billion a year in India.

Independent Power Producers (IPPs) in this sector appear to provide attractive investment opportunity for private equity funds as a result of policy and regulatory developments such as generation-based tariffs, renewable energy tariffs and the national solar mission. Companies such as Auro Mira Energy, Greenko, Orient Green Power and Green Infra have been cited in the report as some of the IPPs which received funding from investors such as IDFC PE, Axis PE, Baring PE and Global Environment Fund.

With the proposed commissioning of a 50 MW tidal power project off the coast of Gujarat in 2013, India is ready to place its first "seamark" that will be a first for Asia as well. London-based marine energy developer Atlantis Resources Corporation, along with Gujarat Power Corporation Ltd, has signed a memorandum of understanding (MoU) with the Gujarat government to start this project.

Exercises

Very short answer type questions

Que 1. What are two components of an ecosystem.

3 Pollution

AIR POLLUTION

Air pollution is said to exist if the levels of harmful gases, solids, or liquid present in atmosphere are high enough to affect humans, other organisms, buildings and monuments etc. pollution may have natural causes such as a forest fire or a volcanic eruption. However, our primary concern is with human activities, which today responsible for most of the air pollution.

Causes

The air pollutants broadly fall into two categories: primary air pollutant and secondary air pollutants. Primary air pollutants are harmful chemicals that are directly released from a source into the atmosphere. Secondary air pollutants are also harmful chemical, but they are produced in the atmosphere from chemical reactions involving primary pollutants.

Primary air pollutants include following:

1. Particulate matter, which include both solid particles and liquid suspensions. Soil particles, soot, lead, asbestos and sulphuric acid droplets are examples.
2. Oxides of carbon, nitrogen and sulphur.
3. Hydrocarbons like methane and benzene.

Secondary air pollutant include the following:

1. Ozone: it is a form of oxygen and a pollutant in the troposphere or the layer of the atmosphere closet to the earth's surface. It is a beneficial component of stratosphere.
2. Sulphur trioxide: This is formed when sulphur dioxide reacts with oxygen. In .turn sulphur trioxide combines with water to form sulphuric acid.

Outdoor air pollution

The sources of outdoor air pollution are as follows:

1.Burning of fossil fules in automobiles, domestic cooking, heating, in power stations and industries (primarily the chemical, metal and paper industries).

2.Mining activities leading to dust as well as fire.

3.burning nuclear fuel, biofules, tropical rain forest and waste of all kinds.

4. Natural emissions from animal and decaying organic matter.

Temporary, but severe, air pollution can occur due to disasters, such as earthquakes, volcanic eruptions, dust storm, toxic gas leaks (e.g. Bhopal Gas tragedy) and armed conflicts. Even festivals (Diwali with its crackers) can create air pollution. Dust storms typically occur in desert areas and from there they can spread to places thousands of kilometer away.

Role of auto mobiles in creating air pollution and other environmental problems

The private automobile is one of the most desired items of consumption today and demand for it seems insatiable. From about 50 millions in 1950, the number has increased to 530 in 2002. The automobile industry dominate the economy of many countries. The U.S. has 25% of all the cars in the world. Developing countries like India and china actively promote the production and private ownership of cars.

The automobiles contribute to a range of environmental problems: increasing air and noise pollution, adding to solid waste, accelerating global warming, taking a heavy toll on human life through accidents, using up natural non- renewal resources like oil and metals etc. lead pollution caused by automobiles has been a serious problems. Lead was added to petrol to prevent ‘knocking’ in engine it is however extremely poisonous and tend to accumulate in most biological systems. Excessive accumulation of lead in body can result in paralysis, blindness and even death. It can also affect the mental development of unborn children. The addition of lead to petrol is now banned in most countries.

Automobiles need roads and highways, the construction of which has many adverse environmental effects. They use up land and consumes resources like steel and cement, which again require heavy energy inputs to produce and also pollute environment. Congestion and traffic jams causes enormous loss of man-hours as well as fuel. In cities, automobiles emission is a major cause of smog.

Smog

Smog is a form of out door pollution and term was originally used to describe a combination of smoke, for and chemical pollutants that poisoned the air in industrialized cities. Now the term refer to the effects of air pollution not necessarily associated with smoke particles. It is used to describe air pollution that is localized in urban areas, where it reduces visibility.

Effects of outdoor air pollution

1. At low level air pollution irritates the eyes and cause inflammation of the respiratory tract. If a person already suffers from a respiratory illness, air pollution may lead to the condition becoming chronic at a later stage.

2. it can accentuate skin allergies.

3. many pollution also depress immune system, making the body more prone to infections.

4. Carbon monoxide from automobile emission can cause headaches at lower levels and mental impairment and even death at higher levels

5. Particulate matter can reduce visibility, soil cloths, corrode metals and erode buildings.

6. On large scale air pollution lead to acid rain, ozone layer depletion and global warming,

Control measures of outdoor air pollution

Out door air pollution can be reduced by following methods:

1. Adopting cleaner technologies

2. Reducing pollution at source

3. Implementing laws and regulation to make people pollute less.

4. introducing appropriate transport policies.

Automobile emission can be reduced through various means:

1. making cleaner and fuel- efficient cars.

2.Using lead free petrol in existing cars.

3. Introducing policies that encourage the building and use of mass transit system and discourage the use of personnel transport.

4. Shifting from diesel to natural gas as a fuel for trucks and buses.

Particulate matter in the air can be reduced by:

1. Fitting smokestacks with electrostatic precipitators, fabric filters, scrubbers or similar devices.

2. Sprinkling water on dry soil that is being excavated during road construction.

Causes and effects of indoor air pollution

Indoor air pollution is equally hazardous for human health. Pesticides, mosquito repellents, cleaning agents etc. used in urban households can cause toxic conditions. Building materials like asbestos, glass fibre, paints, glues and varnishes are all health hazards. They can cause irritation of eyes and skin, respiratory ailments and even cancer. Air-conditioned rooms and offices cause a broad spectrum of health complaints, because the sealed space accumulates various contaminants. Cigarette smoke affects both smoker and non-smokers the concentration of pollutants indoors maybe five times more than it is outdoors. The most common pollutant in urban interiors are cigarette smoke, gases from stove, formaldehyde (from carpet and furniture), pesticides, cleaning solvents and ozone (from photocopier). Organisms like viruses bacteria, fungi, dust mites and pollens also thrive in the many ducts found in office buildings.

Urban indoor pollution results in ailments like colds, influenza and upset stomach. Since these are common ailments, their connection with indoor pollution is often missed. Indoor pollution can also cause eye irritations, nausea, depression etc. collective called 'Sick building Syndrome' thousands of Indian software engineers, who works for long hours in rooms with artificial lighting and air conditioning, staring at cathode ray tube must surely facing these problems.

Noise pollution

Definition

Noise is defined as unwanted sound and it is an irritant and a source of stress. Most of the noise one hears originates from human activities.

Sources of noise

The main sources of noise are:

1.the transport sector: aircraft, trains, trucks, tractors, cars, three-sheelers and motor cycles contribute the maximum noise.

2. Industrial and construction machinery: Factory equipment, generators,pneumatic drills, road rollers and similar machinery make a lot of noise.

3. Special events: High volume sound from loudspeaker during pop music performances, marriage receptions, religious festivals, public meetings etc. contribute to noise pollution.

Measurement of noise

Sound is measured in decibels (db). It is not a linear, but a logarithmic scale. For example, a change from 40db to 80 db represents a 10,000- fold increase in loudness. When sound level reaches 140 db, our years hurt. However, long exposure to noise even at 85db can cause hearing loss.

Apart from loudness, the frequency or pitch or the noise also determine wheather it is harmful or not. A modified scale called decibel-A (dbA) takes pitch into account. Hearing loss begins if a person is exposed to noise levels of 80-90 dbA, for more than 8 hrs a day. A level of 140 dbA is painful and 180dbA could kill a person.

Table given below show typical intensity levels of common sources of sound.

Source	DbA	Source	DbA
Threshold of hearing	0	Food blender (1m)	90
Rustling of leaves	20	Subway (interior)	94
Quit whisper (1m)	30	Diesel truck (10m)	100
Quite home	40	Power mover(1m)	107
Quite street	50	Pneumatic riveter(1m)	115
Normal conversation	60	Chainsaw(1m)	117
Inside a car	70	Amplified Rock music (2m)	120
Loud singing (1m)	75	Jet engine(30m)	130
Automobile (8m)	80		
Motorcycle (10m)	88		

Effects of noise pollution

Prolonged exposure to loud noise cause permanent hearing loss. Loud noise can also have other ill effects like heart palpitation, pupil dilation or muscle contraction. Migraine headaches, nausea, dizziness, gastric ulcer and constriction of blood vessels are some of other possible outcomes.

Noise can cause serious damage to wildlife, especially in remote regions, where the normal noise level is low. The animals are adversely affected by noise pollution in following ways:

Hearing loss, affecting their ability to avoid predator.

Masking, which is the inability to hear important environmental cues and animal signals.

Non-auditory physiological

Control measures of noise pollution

Producing less noise is the best method of reducing this pollution. Almost all the machinery can be redesigned to reduce noise. Another way is to provide shield and noise-absorbing material. Ear plugs and earphones can shield the receiver from noise.

Water pollution

Pollutants of fresh water and their effects

Most of fresh water in the world, such as rivers, lake and ground water are already polluted. This is true even for remote areas like polar regions. Most of the pollution that ultimately reaches the ocean contaminates fresh water sources along the way. The main categories of water pollutants and their effects are as follows:

Sediments: Excessive amounts of soil particles are carried by flowing water, when there is soil erosion. Sediments cloud the water and reduce photosynthesis, clog reservoirs and channels, smother coral reefs, destroy the feeding grounds of fish and disrupt aquatic food webs.

Oxygen-demanding organic wastes: Animal manure, plant debris, sewage, waste from animal feedlots, paper mill and food processing facilities. Bacteria that decompose these wastes deplete oxygen and cause the death of fish and other aquatic organisms.

Infectious micro-organisms: Parasitic worms, viruses and organisms from infected organisms as well as human and animal wastes. These micro-organisms are responsible for water born diseases that kill thousands of adults and children primarily in developing countries.

Organic compounds: Synthetic chemical containing carbon from industrial effluents, surface run-off and cleaning agents. These chemicals cause many health problems in human and also harm fishes and other wild life.

Inorganic nutrients: Substances like nitrogen and phosphorus from animal waste, plant residues and fertilizer run-off. These nutrients can cause eutrophication and can affect infants and unborn babies (blue-baby syndrome)

Inorganic chemicals: Acid, salts and heavy metals such as lead and mercury from industrial effluents, surface run-off and household cleaning agents. They make water unfit for drinking or irrigation, harm fish and other aquatic organisms, cause many health problems for humans and lower crop yield.

Radioactive substance: Wastes from nuclear power plants, nuclear weapons producing facilities and from the mining and refining of uranium and other ores. Such substances cause cancer, birth defects, miscarriages etc.

Thermal pollution: Hot water from industrial processes. The heat lowers oxygen levels and make aquatic organism more vulnerable to diseases, parasites and toxic chemicals. Further when hot water is let in, the sudden increase in temperature causes thermal shock in aquatic organisms.

Sources of water pollutants

Point sources: The point sources refers to specific places such as sewage treatment plants and factories. They discharge pollutants into water bodies through pipes, sewer or ditches. Laws and rules can, however regulate the discharge from point sources.

Nonpoint sources: When pollutants enter the water body not from a single source but from several points over a large area it is a case of pollution from nonpoint sources. This is the case when rainwater flows across the soil. Picking up pollutants and carrying them into water bodies. Non-point sources include surface run-off, mining wastes, municipal wastes, construction sediments acid rain and soil erosion. Such non-point sources of pollution are difficult to control.

Treatment of polluted water and sewage

The first step in water treatment is the use of a chemical that makes suspended particles settle down. The water is then filtered and disinfected. The most common disinfectant is chlorine. Waste water, including sewage, goes through a number of stages of treatment. The primary treatment remove suspended particles by screening and settling. The secondary treatment use microorganisms to decompose the organic material in the waste water. After several hours the particle and bacteria are allowed to settle down as secondary sludge. The tertiary treatment is a complex biological and chemical process that removes the remaining pollutants, such as minerals, metals, organic compounds and viruses.

Measures to check industrial pollution of fresh water

Every litre of waste water discharged by an industrial pollutes on an average eight litres of fresh water. The total amount of water polluted in this manner is more than all the water in the largest river basins.

There are ways to reduce industrial pollution of freshwater:

1.Improving process technology to reduce water demand.

2 Using the same water in series for two or more successive stages in a process.

3 Reticulating process water indefinitely, adding only that quantity necessary to make up for unavoidable losses.

4 Harvesting rainwater to meet as many of the water requirements as possible.

Measuring the water quality

Here are the three ways in which water quality can be measured:

Biological oxygen demand (BOD): this parameter measures the degree of water pollution from oxygen-demanding wastes and plant nutrients. BOD is the amount of dissolved oxygen needed by the decomposers to break down the organic material present in a certain volume of water, when kept in darkness over a five- day incubation period. At 20˚C

BOD is a measured in parts per million (ppm): A BOD level of 1-2ppm is considered very good. It indicates that there is not much organic waste present in the water supply. A water with a BOD level of 3-5 ppm is considered moderately clean. Any water with a BOD level of 6-9 ppm is considered some what polluted with the presence of organic waste and the bacteria that decomposes this waste. At BOD levels of 10 ppm or more, the water supply is considered very polluted, containing large quantities of organic waste.

Presence of disease-causing organisms: The number of colonies of coliform bacteria present in a 100ml sample of water is another measure of water quality. There should be no coliform colonies in drinking water, while water in a swimming pool could have upto 200 colonies per 100 ml.

Chemical analysis: the presence of chemical like pesticides can be measured by analysis.

Soil pollution

Definition:

Soil pollution refers to any physical or chemical change in the soil conditions that may adversely affect the growth of plants and other organisms living in or on that soil.

Causes of soil pollution

Acid rain and excessive use of chemical fertilizers result's in the soil's inability to hold nutrients this in turn allow toxic pesticides or atmospheric fallout to rapidly seep into the groundwater or to run off into rivers and coastal waters. Some of the persistent pollutants remain in the soil and degrade it.

Most soil pollutants are agricultural chemicals, primarily fertilizers and pesticides. It is now known that these chemicals attach themselves to soil particles and persist for long in soil, continuously releasing contaminant into the surface water, ground water and topsoil. Dumping of waste (including garbage, untreated sewage, industrial effluents, nuclear waste, and mining waste) pollutes the soil when dangerous substances from the dumps leak into it.

Salts tend to accumulate in the soils of arid and semi arid regions. The little precipitation that falls evaporates quickly leaving behind salts. Salinization can also occur in any region due to the continued application of irrigation water containing some salts.

Effect of saline soil on plants:

Water always moves from an area of higher concentration to one of lower concentration. Normally, plants have a lower concentration of water than the surrounding soil and therefore water flows into plants. Saline soil, however, often has a lower concentration of water than plants. Consequently, water starts flowing out of the plant and into the soil and plant ultimately meet the death.

Control of soil pollution:

Dilution: it involve running large quantities of water through the soil to leach out the pollutants. This works only if the soil has good drainage properties. Even then, disposing of the water carrying the pollutants poses a problem. This method also requires lots of water.

In vapour extraction*:* In this method air is injected into the soil to remove organic compounds that evaporate quickly.

Bioremediation: this method cleans up the soil by introducing bacteria and other micro-organism.

Phytoremediation: it is the use of plants whose root absorb pollutants and store them in their stems and leaves.

RADIOACTIVE AND NUCLEAR POLLUTION

Radioactivity is a phenomenon of spontaneous emission of protons (alpha particles), electrons (beta particles) and gama rays (short wave electromagnetic waves) as a result of disintegration of atomic nuclei of some elements. Radioactive pollution a special form of physical pollution related to all major life-supporting systems-air, water and soil. People have been exposed to low levels of radiations from natural sources for several millennia. But danger from radiation exposure has increased in recent times.

Sources

Sources of environmental radiations are both natural and man-made. The former comprises of cosmic rays that reaches to earth’s surface from space and terrestrial radiations from radio-nuclides present in the earth’s crust. Many radio-nuclides such as radium 224, uranium 235, uranium 238, thorium 232, radon 222, potassium 40 and carbon 14 occur naturally in rocks, soil and water.

Man-made sources of radioactive pollution are production and explosion of nuclear weapons, nuclear power plants and fuels, preparation of radioactive isotopes, mining and refining of plutonium and thorium.

Nuclear weapons

The first atomic bomb was exploded in Nagasaki, followed by the second in Heroshima (Japan, 1945). Outcome was large scale destruction of innocent people, animals and plants. In spite of great suffering of 1945, the nuclear race by the big powers is still continuing unabated. The present stock pile of nuclear weapons has enough energy to completely destroy the earth many times.

Test of nuclear arms comprise the use of uranium 235 and plutonium 239 for fission and hydrogen and lithium as fusion material. Explosions are uncontrolled chain reactions. These give rise to very large neutron flux conditions that make other materials in the surrounding radioactive. These material include strontium 90, cesium 137, iodine 131, and unused explosive and activation products. The radioactive materials are transformed into gases and fine particles which are thrown high up into the atmosphere like a mushroom cloud. Radioactive particles are carried away by the wind and spread to wide areas. They settle down to cause water and soil pollution even in places far remote from the site of explosion. When rain drops containing radioactive particles fall on the ground radioactivity is transferred to the soil particles. From soil the radioactive substances entre to food chain affecting different forms of life including man. Water bodies receive radioactivity mainly through soluble products. The aquatic organisms absorb and accumulate them through food chains and ultimately they entre human beings.

Nuclear power plants and fuels

The main operation of a nuclear power plant includes introduction of the processed nuclear fuel, followed by fission, activation ant thermal processes. Both the fuel elements and coolants contribute to radiation pollution. The biggest problem, however, is the disposal of radioactive wastes which contain excess of fission and radioactive wastes which contain excess of fission and activation products. These wastes pose grave public health hazards where they are dumped. The radioactive nuclides are sources of radiation, especially when they become free and pass into the surroundings in any form. Inert gases and halogens escape as vapours and become potential pollutants of the environment as they settle on land or are washed into surface of water.

Other sources

A large number of radioactive isotopes such as ^{14}C,^{125}I,^{32}P and there compounds are widely used in scientific research. Waste waters containing these radioactive materials reaches the rivers and lakes through the sewers. Some of these isotopes such as radioactive iodine and phosphorus concentrate in slimes, sludges and microorganisms which entre human food chain through aquatic life. Human beings also voluntarily receive radiations from diagnostic X-rays, and radiation therapy for cancer. People working in nuclear reactors, fuel processors, power plants or living in their neighboring areas are also vulnerable to radiations exposure.

Effects of radioactive pollution

The effects of radioactive pollutants depends upon (i) half- life, (ii) energy releasing capacity, (iii) rate of diffusion and (iv) rate of deposition of the contaminant. Climatic conditions like wind, temperature and rainfall also determine their effects.

All organisms are affected from radiation pollution. In high doses radiation can cause almost instant death. In lower dose it can affect all organs seriously and impair their function. Long or repeated exposure can cause cancer and leukaemia and induce mutations. The deleterious genes can persist in human, animal and plant population and may affect their progeny.

Control of radioactive pollution

The peaceful uses of radioactive materials are so wide and effective that modern civilization cannot go without them. As there is no cure for radiation damage, all efforts should be made to prevent radioactive pollution. Leakages from reactors, careless handling, transport and use of radioactive fuel, fission products and radioisotopes have to be totally stopped. The safety measures should be strictly enforced. The waste disposal must be safe. Regular monitoring through frequent sampling and quantitative analysis has to be ensured in risk areas. Safety measures against accidents have to be strengthened and appropriate steps need to be takenagainst occupational exposure.

4 Solid waste management

Definition

Waste is any material that is not needed by the owner, producer or processor. Human, animals, other animals and all processes of production and consumption produce waste. It has always been a part of earth's ecosystem, but its nature and scale were such that the ecosystem could use this waste in its many cycles. In fact, there is no real waste in nature. The apparent waste from one process become an input in another.

Source of solid wastes

The main sources of solid wastes are as follows:

Domestic wastes: Sewage, wastewater contaminated by detergents ,dirt or grease, household garbage and bulky waste including packaging material, appliances, furniture, office equipment and used cars.

Factory waste: Solids and effluents from factories of all types; the worst polluters are slaughterhouses, breweries, tanneries, textile mill, paper mill, steel mill and most chemical industries.

Wastes from oil industries: oil spills, oil leaks,

Construction wastes: Material from buildings that are demolished or renovated and material discarded after completing a building.

Wastes from the extractive industries: Mining, quarrying and dredging create solid waste during extraction and slurries during processing.

Agriculture waste: Mostly organic waste from plants and animals.

Waste from food processing industries: organic solid waste from discarded food material.

Biomedical waste: It originate mainly in hospital and clinics and include amputed organs used needle, syringes, tubings and implants.

Nuclear wastes: Radioactive waste from nuclear power plants and the manufacture of nuclear weapons.

Apart from these regular sources, waste also comes from special events:

Waste left from natural disasters: Rubble from earthquakes, slag and ash from volcanoes, waste left behind by floods, cyclones and typoons.

Waste from war and conflicts: apart from dead bodies and destroyed buildings, war leave behind exploded and live shells, landmines etc.

Effects of soil waste on environment:

1 The toxic material from the solid waste pollute the soil. Water and air causing ecological disturbance and health problems to human and other living beings.

2 Solid wastes are normally dumped to landfill and burnt there to reduce the volume. The burning again release toxic chemical to environment.

3 The solid waste like used tyres and used cars in developed countries consumes large land resource near the cities.

Control of solid waste

In industrialized countries, household waste is separated into categories such as organic material, paper, glass and other containers etc. this separation is often done in homes by using different bins for the disposal of different items. In developing countries, waste is not separated, though some cities are trying to persuade the public to separate waste.

The simplest and most common method in the cities is to collect and dump the waste in a landfill. These landfills are located just outside the city. There are now thousands of landfill in the world with huge piles of the waste. In developed countries, there are separate piles of used cars and tyres. Many countries and cities shave run out of space for landfill.

In the poorer countries, rag pickers sift through the waste, collect the reusable and recyclable material and sell it to the scrap traders. Later send the material to recycling units.

5 Mining and deforestation

MINING

Mining is the extraction of valuable minerals or other geological materials from the earth from an orebody, lode, vein, seam, or reef, which forms the mineralized package of economic interest to the miner.

Ores recovered by mining include metals, coal, oil shale, gemstones, limestone, dimension stone, rock salt, potash, gravel, and clay. Mining is required to obtain any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory. Mining in a wider sense includes extraction of any non-renewable resource such as petroleum, natural gas, or even water.

Mining of stone and metal has been done since pre-historic times. Modern mining processes involve prospecting for ore bodies, analysis of the profit potential of a proposed mine, extraction of the desired materials, and final reclamation of the land after the mine is closed.

The nature of mining processes creates a potential negative impact on the environment both during the mining operations and for years after the mine is closed. This impact has led most of the world's nations to adopt regulations designed to moderate the negative effects of mining operations. Safety has long been a concern as well, and modern practices have improved safety in mines significantly.

Effects

Negative environmental effects of mining can include erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. In some cases, additional forest logging is done in the vicinity of mines to create space for the storage of the created debris and soil. Contamination resulting from leakage of chemicals can also affect the health of the local population if not properly controlled. Extreme examples of pollution from mining activities include coal fires, which can last for years or even decades, producing massive amounts of environmental damage.

Wastes from mining

Ore mills generate large amounts of waste, called tailings. For example, 99 tons of waste are generated per ton of copper, with even higher ratios in gold mining. These tailings can be toxic. Tailings, which are usually produced as a slurry, are most commonly dumped into ponds made from naturally existing valleys. These ponds are secured by impoundments (dams or embankment dams). In 2000 it was estimated that 3,500 tailings impoundments existed, and that every year, 2 to 5 major failures and 35 minor failures occurred for example, in the Marcopper mining disaster at least 2 million tons of tailings were released into a local river. Subaqueous tailings disposal is another option. The mining industry has argued that submarine tailings disposal (STD), which disposes of tailings in the sea, is ideal because it avoids the risks of tailings ponds; although the practice is illegal in the United States and Canada, it is used in the developing world.

The waste is classified as either sterile or mineralised, with acid generating potential, and the movement and storage of this material forms a major part of the mine planning process. When the mineralised package is determined by an economic cut-off, the near-grade mineralised waste is usually dumped separately with view to later treatment should market conditions change and it becomes economically viable. Civil engineering design parameters are used in the design of the waste dumps, and special conditions apply to high-rainfall areas and to seismically active areas. Waste dump designs must meet all regulatory requirements of the country in whose jurisdiction the mine is located. It is also common practice to rehabilitate dumps to an internationally acceptable standard, which in some cases means that higher standards than the local regulatory standard are applied.

Control

Mining companies in most countries are required to follow stringent environmental and rehabilitation codes in order to minimize environmental impact and avoid impacting human health. These codes and regulations all require the common steps of environmental impact assessment, development of environmental management plans, mine closure planning(which must be done before the start of mining operations), and environmental monitoring during operation and after closure. However, in some areas, particularly in the developing world, government regulations may not be well enforced.

For major mining companies and any company seeking international financing, there are a number of other mechanisms to enforce good environmental standards. These generally relate to financing standards such as the Equator Principles, IFC environmental standards, and criteria for Socially responsible investing. Mining companies have used this oversight from the financial sector to argue for some level of self-policing. In 1992, a Draft Code of Conduct for Transnational Corporations was proposed at the Rio Earth Summit by the UN Centre for Transnational Corporations (UNCTC), but the Business Council for Sustainable Development (BCSD) together with the International Chamber of Commerce (ICC) argued successfully for self-regulation instead.

This was followed by the Global Mining Initiative which was begun by nine of the largest metals and mining companies and which led to the formation of the International Council on Mining and Metals, whose purpose was to "act as a catalyst" in an effort to improve social and environmental performance in the mining and metals industry internationally. The mining industry has provided funding to various conservation groups, some of which have been working with conservation agendas that are at odds with an emerging acceptance of the rights of indigenous people – particularly the right to make land-use decisions.

Certification of mines with good practices occurs through the International Organization for Standardization (ISO). For example, ISO 9000 and ISO 14001, which certify an "auditable environmental management system", involve short inspections, although they have been accused of lacking rigor Certification is also available through Ceres' Global Reporting Initiative, but these reports are voluntary and unverified. Miscellaneous other certification programs exist for various projects, typically through nonprofit groups.

DEFORESTATION

Deforestation is the removal of a forest or stand of trees where the land is thereafter converted to a non-forest use. Examples of deforestation include conversion of forestland to farms, ranches, or urban use.

Deforestation occurs for many reasons: trees are cut down to be used or sold as fuel (sometimes in the form of charcoal) or timber, while cleared land is used as pasture for livestock, plantations of commodities and settlements. The removal of trees without sufficient reforestation has resulted in damage to habitat, biodiversity loss and aridity. It has adverse impacts on bio-sequestration of atmospheric carbon dioxide. Deforestation has also been used in war to deprive the enemy of cover for its forces and also vital resources. Modern examples of this were the use of Agent Orange by the British military in Malaya during the Malayan Emergency and the United States military in Vietnam during the Vietnam War. Deforested regions typically incur significant adverse soil erosion and frequently degrade into wasteland.

Disregard or ignorance of intrinsic value, lack of ascribed value, lax forest management and deficient environmental laws are some of the factors that allow deforestation to occur on a large scale. In many countries, deforestation, both naturally occurring and human induced, is an ongoing issue. Deforestation causes extinction, changes to climatic conditions ,desertification, and displacement of populations as observed by current conditions and in the past through the fossil record. More than half of all plant and land animal species in the world live in tropical forests.

Causes

According to the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, the overwhelming direct cause of deforestation is agriculture. Subsistence farming is responsible for 48% of deforestation; commercial agriculture is responsible for 32% of deforestation; industrial logging is responsible for 14% of deforestation and fuel wood removals make up 5% of deforestation.

Other causes of contemporary deforestation may include corruption of government institutions, the inequitable distribution of wealth and power, population growth and overpopulation, and urbanization. Globalization is often viewed as another root cause of deforestation, though there are cases in which the impacts of globalization (new flows of labor, capital, commodities, and ideas) have promoted localized forest recovery.

In 2000 the United Nations Food and Agriculture Organization (FAO) found that "the role of population dynamics in a local setting may vary from decisive to negligible," and that deforestation can result from "a combination of population pressure and stagnating economic, social and technological conditions."

The degradation of forest ecosystems has also been traced to economic incentives that make forest conversion appear more profitable than forest conservation. Many important forest functions have no markets, and hence, no economic value that is readily apparent to the forests' owners or the communities that rely on forests for their well-being. From the perspective of the developing world, the benefits of forest as carbon sinks or biodiversity reserves go primarily to richer developed nations and there is insufficient compensation for these services. Developing countries feel that some countries in the developed world, such as the United States of America, cut down their forests centuries ago and benefited greatly from this deforestation, and that it is hypocritical to deny developing countries the same opportunities: that the poor shouldn't have to bear the cost of preservation when the rich created the problem.

Some commentators have noted a shift in the drivers of deforestation over the past 30 years. Whereas deforestation was primarily driven by subsistence activities and government-sponsored development projects like transmigration in countries like Indonesia and colonization in Latin America, India, Java, and so on, during late 19th century and the earlier half of the 20th century. By the 1990s the majority of deforestation was caused by industrial factors, including extractive industries, large-scale cattle ranching, and extensive agriculture.

Effects of deforestation

Deforestation affects negatively majority of natural resources like atmosphere, water, soil, biodiversity and economy also.

Atmosphere

Deforestation is ongoing and is shaping climate and geography.

Deforestation is a contributor to global warming and is often cited as one of the major causes of the enhanced greenhouse effect. Tropical deforestation is responsible for approximately 20% of world greenhouse gas emissions. According to the Intergovernmental Panel on Climate Change deforestation, mainly in tropical areas, could account for up to one-third of total anthropogenic carbon dioxide emissions. But recent calculations suggest that carbon dioxide emissions from deforestation and forest degradation (excluding peatland emissions) contribute about 12% of total anthropogenic carbon dioxide emissions with a range from 6 to 17%. Deforestation causes carbon dioxide to linger in the atmosphere. As carbon dioxide accrues, it produces a layer in the atmosphere that traps radiation from the sun. The radiation converts to heat which causes global warming, which is better known as the greenhouse effect. Plants remove carbon in the form of carbon dioxide from the atmosphere during the process of photosynthesis, but release some carbon dioxide back into the atmosphere during normal respiration. Only when actively growing can a tree or forest remove carbon, by storing it in plant tissues. Both the decay and burning of wood releases much of this stored carbon back to the atmosphere. In order for forests to take up carbon, there must be a net accumulation of wood. One way is for the wood to be harvested and turned into long-lived products, with new young trees replacing them. Deforestation may also cause carbon stores held in soil to be released. Forests can be either sinks or sources depending upon environmental circumstances. Mature forests alternate between being net sinks and net sources of carbon dioxide.

Reducing emissions from deforestation and forest degradation (REDD) in developing countries has emerged as a new potential to complement ongoing climate policies. The idea consists in providing financial compensations for the reduction of greenhouse gas (GHG) emissions from deforestation and forest degradation".

Rainforests are widely believed by laymen to contribute a significant amount of the world's oxygen, although it is now accepted by scientists that rainforests contribute little net oxygen to the atmosphere and deforestation has only a minor effect on atmospheric oxygen levels. However, the incineration and burning of forest plants to clear land releases large amounts of CO_2, which contributes to global warming.] Scientists also state that tropical deforestation releases 1.5 billion tons of carbon each year into the atmosphere.

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Water

The water cycle is also affected by deforestation. Trees extract groundwater through their roots and release it into the atmosphere. When part of a forest is removed, the trees no longer transpire this water, resulting in a much drier climate. Deforestation reduces the content of water in the soil and groundwater as well as atmospheric moisture. The dry soil leads to lower water intake for the trees to extract. Deforestation reduces soil cohesion, so that erosion, flooding and landslides.

Shrinking forest cover lessens the landscape's capacity to intercept, retain and transpire precipitation. Instead of trapping precipitation, which then percolates to groundwater systems, deforested areas become sources of surface water runoff, which moves much faster than subsurface flows. That quicker transport of surface water can translate into flash flooding and more localized floods than would occur with the forest cover. Deforestation also contributes to decreased transpiration, which lessens atmospheric moisture which in some cases affects precipitation levels downwind from the deforested area, as water is not recycled to downwind forests, but is lost in runoff and returns directly to the oceans. According to one study, in deforested north and northwest China, the average annual precipitation decreased by one third between the 1950s and the 1980s.

Trees, and plants in general, affect the water cycle significantly:

Their canopies intercept a proportion of precipitation, which is then evaporated back to the atmosphere (canopy interception);

Their litter, stems and trunks slow down surface runoff;

Their roots create macropores – large conduits – in the soil that increase infiltration of water;Tthey contribute to terrestrial evaporation and reduce soil moisture via transpiration;

Their litter and other organic residue change soil properties that affect the capacity of soil to store water.

Their leaves control the humidity of the atmosphere by transpiring. 99% of the water absorbed by the roots moves up to the leaves and is transpired.

As a result, the presence or absence of trees can change the quantity of water on the surface, in the soil or groundwater, or in the atmosphere. This in turn changes erosion rates and the availability of water for either ecosystem functions or human services.

The forest may have little impact on flooding in the case of large rainfall events, which overwhelm the storage capacity of forest soil if the soils are at or close to saturation.

Tropical rainforests produce about 30% of our planet's fresh water.

Soil

Undisturbed forests have a very low rate of soil loss, approximately 2 metric tons per square kilometer (6 short tons per square mile). Deforestation generally increases rates of soil erosion, by increasing the amount of runoff and reducing the protection of the soil from tree litter. This can be an advantage in excessively leached tropical rain forest soils. Forestry operations themselves also increase erosion through the development of roads and the use of mechanized equipment.

China's Loess Plateau was cleared of forest millennia ago. Since then it has been eroding, creating dramatic incised valleys, and providing the sediment that gives the Yellow River its yellow color and that causes the flooding of the river in the lower reaches (hence the river's nickname 'China's sorrow').

Tree roots bind soil together, and if the soil is sufficiently shallow they act to keep the soil in place by also binding with underlying bedrock. Tree removal on steep slopes with shallow soil thus increases the risk of landslides, which can threaten people living nearby.

Biodiversity loss

Deforestation on a human scale results in decline in biodiversity,] and on a natural global scale is known to cause the extinction of many species. The removal or destruction of areas of forest cover has resulted in a degraded environment with reduced biodiversity. Forests support biodiversity, providing habitat for wildlife; moreover, forests foster medicinal conservation. With forest biotopes being irreplaceable source of new drugs (such as taxol), deforestation can destroygenetic variations (such as crop resistance) irretrievably.

Since the tropical rainforests are the most diverse ecosystems on Earth and about 80% of the world's known biodiversity could be found in tropical rainforests, removal or destruction of significant areas of forest cover has resulted in a degraded] environment with reduced biodiversity. A study inRondônia, Brazil, has shown that deforestation also removes the microbial community which is involved in the recycling of nutrients, the production of clean water and the removal of pollutants.

It has been estimated that we are losing 137 plant, animal and insect species every single day due to rainforest deforestation, which equates to 50,000 species a year. Others state that tropical rainforest deforestation is contributing to the ongoing Holocene mass extinction. The known extinction rates from deforestation rates are very low, approximately 1 species per year from mammals and birds which extrapolates to approximately 23,000 species per year for all species. Predictions have been made that more than 40% of the animal and plant species in Southeast Asia could be wiped out in the 21st century. Such predictions were called into question by 1995 data that show that within regions of Southeast Asia much of the original forest has been converted to monospecific plantations, but that potentially endangered species are few and tree flora remains widespread and stable.

Scientific understanding of the process of extinction is insufficient to accurately make predictions about the impact of deforestation on biodiversity. Most predictions of forestry related biodiversity loss are based on species-area models, with an underlying assumption that as the forest declines species diversity will decline similarly. However, many such models have been proven to be wrong and loss of habitat does not necessarily lead to large scale loss of species. Species-area models are known to over predict the number of species known to be threatened in areas where actual deforestation is ongoing, and greatly over predict the number of threatened species that are widespread.

A recent study of the Brazilian Amazon predicts that despite a lack of extinctions thus far, up to 90 percent of predicted extinctions will finally occur in the next 40 years.

Economic impact

Damage to forests and other aspects of nature could halve living standards for the world's poor and reduce global GDP by about 7% by 2050, a report concluded at the Convention on Biological Diversity (CBD) meeting in Bonn. Historically, utilization of forest products, including timber and fuel wood, has played a key role in human societies, comparable to the roles of water and cultivable land. Today, developed countries continue to utilize timber for building houses, and wood pulp for paper. In developing countries almost three billion people rely on wood for heating and cooking.

The forest products industry is a large part of the economy in both developed and developing countries. Short-term economic gains made by conversion of forest to agriculture, or over-exploitation of wood products, typically leads to loss of long-term income and long-term biological productivity. West Africa, Madagascar, Southeast Asia and many other regions have experienced lower revenue because of declining timber harvests. Illegal logging causes billions of dollars of losses to national economies annually.

The new procedures to get amounts of wood are causing more harm to the economy and overpower the amount of money spent by people employed in logging. According to a study, "in most areas studied, the various ventures that prompted deforestation rarely generated more than US$5 for every ton of carbon they released and frequently returned far less than US$1". The price on the European market for an offset tied to a one-ton reduction in carbon is 23 euro (about US$35).

Rapidly growing economies also have an effect on deforestation. Most pressure will come from the world's developing countries, which have the fastest-growing populations and most rapid economic (industrial) growth. In 1995, economic growth in developing countries reached nearly 6%, compared with the 2% growth rate for developed countries." As our human population grows, new homes, communities, and expansions of cities will occur. Connecting all of the new expansions will be roads, a very important part in our daily life. Rural roads promote economic development but also facilitate deforestation. About 90% of the deforestation has occurred within 100 km of roads in most parts of the Amazon.

Rates of deforestation

Global deforestation sharply accelerated around 1852. It has been estimated that about half of the Earth's mature tropical forests—between 7.5 million and 8 million km^2 (2.9 million to 3 million sq mi) of the original 15 million to 16 million km^2 (5.8 million to 6.2 million sq mi) that until 1947 covered the planet have now been destroyed. Some scientists have predicted that unless significant measures (such as seeking out and protecting old growth forests that have not been disturbed) are taken on a worldwide basis, by 2030 there will only be 10% remaining, with another 10% in a degraded condition 80% will have been lost, and with them hundreds of thousands of irreplaceable species. Some cartographers have attempted to illustrate the sheer scale of deforestation by country using a cartogram.

Estimates vary widely as to the extent of tropical deforestation. Scientists estimate that one fifth of the world's tropical rainforest was destroyed between 1960 and 1990. They claim that that rainforests 50 years ago covered 14% of the world's land surface, now only cover 5–7%, and that all tropical forests will be gone by the middle of the 21st century.

A 2002 analysis of satellite imagery suggested that the rate of deforestation in the humid tropics (approximately 5.8 million hectares per year) was roughly 23% lower than the most commonly quoted rates. Conversely, a newer analysis of satellite images reveals that deforestation of the Amazon rainforest is twice as fast as scientists previously estimated.

Some have argued that deforestation trends may follow a Kuznets curve, which if true would nonetheless fail to eliminate the risk of irreversible loss of non-economic forest values (for example, the extinction of species).

A 2005 report by the United Nations Food and Agriculture Organization (FAO) estimates that although the Earth's total forest area continues to decrease at about 13 million hectares per year, the global rate of deforestation has recently been slowing. Still others claim that rainforests are being destroyed at an ever-quickening pace. The London-based Rainforest Foundation notes that "the UN figure is based on a definition of forest as being an area with as little as 10% actual tree cover, which would therefore include areas that are actually savannah-like ecosystems and badly damaged forests."] Other critics of the FAO data point out that they do not distinguish between forest types, and that they are based largely on reporting from forestry departments of individual countries, which do not take into account unofficial activities like illegal logging.

Despite these uncertainties, there is agreement that destruction of rainforests remains a significant environmental problem. Up to 90% of West Africa's coastal rainforests have disappeared since 1900. In South Asia, about 88% of the rainforests have been lost. Much of what remains of the world's rainforests is in the Amazon basin, where the Amazon Rainforest covers approximately 4 million square kilometres. The regions with the highest tropical deforestation rate between 2000 and 2005 were Central America—which lost 1.3% of its forests each year—and tropical Asia. In Central America, two-thirds of lowland tropical forests have been turned into pasture since 1950 and 40% of all the rainforests have been lost in the last 40 years.]Brazil has lost 90–95% of its Mata Atlântica forest., Paraguay was losing its natural semi humid forests in the country's western regions at a rate of 15.000 hectares at a randomly studied 2-month period in 2010, Paraguay's parliament refused in 2009 to pass a law that would have stopped cutting of natural forests altogether.

Madagascar has lost 90% of its eastern rainforests. As of 2007, less than 1% of Haiti's forests remained. Mexico, India, the Philippines, Indonesia, Thailand,Burma, Malaysia, Bangladesh, China, Sri Lanka, Laos, Nigeria, the Democratic Republic of the Congo, Liberia, Guinea, Ghana and the Ivory Coast, have lost large areas of their rainforest. Several countries, notably Brazil, have declared their deforestation a national emergency. The World Wildlife Fund's ecoregion project catalogues habitat types throughout the world, including habitat loss such as deforestation, showing for example that even in the rich forests of parts of Canada such as the Mid-Continental Canadian forests of the prairie provinces half of the forest cover has been lost or altered.

Control of deforestation

Payments for conserving forests

In Bolivia, deforestation in upper river basins has caused environmental problems, including soil erosion and declining water quality. An innovative project to try and remedy this situation involves landholders in upstream areas being paid by downstream water users to conserve forests. The landholders receive US$20 to conserve the trees, avoid polluting livestock practices, and enhance the biodiversity and forest carbon on their land. They also receive US$30, which purchases a beehive, to compensate for conservation for two hectares of water-sustaining forest for five years. Honey revenue per hectare of forest is US$5 per year, so within five years, the landholder has sold US$50 of honey.[145] The project is being conducted by Fundación Natura Bolivia and Rare Conservation, with support from the Climate & Development Knowledge Network.

Farming

New methods are being developed to farm more intensively, such as high-yield hybrid crops, greenhouse, autonomous building gardens, and hydroponics. These methods are often dependent on chemical inputs to maintain necessary yields. In cyclic agriculture, cattle are grazed on farm land that is resting and rejuvenating. Cyclic agriculture actually increases the fertility of the soil. Intensive farming can also decrease soil nutrients by consuming at an accelerated rate the trace minerals needed for crop growth.[*citation needed*]The most promising approach, however, is the concept of food forests inpermaculture, which consists of agroforestal systems carefully designed to mimic natural forests, with an emphasis on plant and animal species of interest for food, timber and other uses. These systems have low dependence on fossil fuels andagro-chemicals, are highly self-maintaining, highly productive, and with strong positive impact on soil and water quality, andbiodiversity.

Monitoring deforestation

There are multiple methods that are appropriate and reliable for reducing and monitoring deforestation. One method is the “visual interpretation of aerial photos or satellite imagery that is labor-intensive but does not require high-level training in computer image processing or extensive computational resources”. Another method includes hot-spot analysis (that is, locations of rapid change) using expert opinion or coarse resolution satellite data to identify locations for detailed digital analysis with high resolution satellite images. Deforestation is typically assessed by quantifying the amount of area deforested, measured at the present time. From an environmental point of view, quantifying the damage and its possible consequences is a more important task, while conservation efforts are more focused on forested land protection and development of land-use alternatives to avoid continued deforestation. Deforestation rate and total area deforested, have been widely used for monitoring deforestation in many regions, including the Brazilian Amazon deforestation monitoring by INPE.

Forest management

Efforts to stop or slow deforestation have been attempted for many centuries because it has long been known that deforestation can cause environmental damage sufficient in some cases to cause societies to collapse. In Tonga, paramount rulers developed policies designed to prevent conflicts between short-term gains from converting forest to farmland and long-term problems forest loss would cause, while during the 17th and 18th centuries in Tokugawa, Japan, the shoguns developed a highly sophisticated system of long-term planning to stop and even reverse deforestation of the preceding centuries through substituting timber by other products and more efficient use of land that had been farmed for many centuries. In 16th-century Germany, landowners also developed silviculture to deal with the problem of deforestation. However, these policies tend to be limited to environments with *good rainfall*, *no dry season* and*very young soils* (through volcanism or glaciation). This is because on older and less fertile soils trees grow too slowly for silviculture to be economic, whilst in areas with a strong dry season there is always a risk of forest fires destroying a tree crop before it matures.

In the areas where "slash-and-burn" is practiced, switching to "slash-and-char" would prevent the rapid deforestation and subsequent degradation of soils. The biochar thus created, given back to the soil, is not only a durable carbon sequestration method, but it also is an extremely beneficial amendment to the soil. Mixed with biomass it brings the creation of terra preta, one of the richest soils on the planet and the only one known to regenerate itself.

Suatainable practice

Certification, as provided by global certification systems such as Programme for the Endorsement of Forest Certification and Forest Stewardship Council, contributes to tackling deforestation by creating market demand for timber from sustainably managed forests. According to the United Nations Food and Agriculture Organization (FAO), "A major condition for the adoption of sustainable forest management is a demand for products that are produced sustainably and consumer willingness to pay for the higher costs entailed. Certification represents a shift from regulatory approaches to market incentives to promote sustainable forest management. By promoting the positive attributes of forest products from sustainably managed forests, certification focuses on the demand side of environmental conservation." Rainforest Rescue argues that the standards of organizations like FSC are too closely connected to industry interests and therefore do not guarantee environmentally and socially responsible forest management. In reality, monitoring systems are inadequate and various cases of fraud have been documented worldwide.

Some nations have taken steps to help increase the amount of trees on Earth. In 1981, China created National Tree Planting Day Forest and forest coverage had now reached 16.55% of China's land mass, as against only 12% two decades ago.

Using fuel from bamboo rather than wood results in cleaner burning, and since bamboo matures much faster than wood, deforestation is reduced as supply can be replenished faster.

Reforestation

In many parts of the world, especially in East Asian countries, reforestation and afforestation are increasing the area of forested lands. The amount of woodland has increased in 22 of the world's 50 most forested nations. Asia as a whole gained 1 million hectares of forest between 2000 and 2005. Tropical forest in El Salvador expanded more than 20% between 1992 and 2001. Based on these trends, one study projects that global forest will increase by 10%—an area the size of India—by 2050.

In the People's Republic of China, where large scale destruction of forests has occurred, the government has in the past required that every able-bodied citizen between the ages of 11 and 60 plant three to five trees per year or do the equivalent amount of work in other forest services. The government claims that at least 1 billion trees have been planted in China every year since 1982. This is no longer required today, but March 12 of every year in China is the Planting Holiday. Also, it has introduced the Green Wall of China project, which aims to halt the expansion of the

Gobi desert through the planting of trees. However, due to the large percentage of trees dying off after planting (up to 75%), the project is not very successful. There has been a 47-million-hectare increase in forest area in China since the 1970s. The total number of trees amounted to be about 35 billion and 4.55% of China's land mass increased in forest coverage. The forest coverage was 12% two decades ago and now is 16.55%.

An ambitious proposal for China is the Aerially Delivered Re-forestation and Erosion Control System and the proposed Sahara Forest Project coupled with the Seawater Greenhouse.

In Western countries, increasing consumer demand for wood products that have been produced and harvested in a sustainable manner is causing forest landowners and forest industries to become increasingly accountable for their forest management and timber harvesting practices.

The Arbor Day Foundation's Rain Forest Rescue program is a charity that helps to prevent deforestation. The charity uses donated money to buy up and preserve rainforest land before the lumber companies can buy it. The Arbor Day Foundation then protects the land from deforestation. This also locks in the way of life of the primitive tribes living on the forest land. Organizations such as Community Forestry International, Cool Earth, The Nature Conservancy, World Wide Fund for Nature, Conservation International, African Conservation Foundation and Greenpeace also focus on preserving forest habitats. Greenpeace in particular has also mapped out the forests that are still intact and published this information on the internet. World Resources Institute in turn has made a simpler thematic map showing the amount of forests present just before the age of man (8000 years ago) and the current (reduced) levels of forest. These maps mark the amount of afforestation required to repair the damage caused by people.

Forest plantations

To meet the world's demand for wood, it has been suggested by forestry writers Botkins and Sedjo that high-yielding forestplantations are suitable. It has been calculated that plantations yielding 10 cubic meters per hectare annually could supply all the timber required for international trade on 5% of the world's existing forestland. By contrast, natural forests produce about 1–2 cubic meters per hectare; therefore, 5–10 times more forestland would be required to meet demand. Forester Chad Oliver has suggested a forest mosaic with high-yield forest lands interpersed with conservation land.

In the country of Senegal, on the western coast of Africa, a movement headed by youths has helped to plant over 6 million mangrove trees. The trees will protect local villages from storm damages and will provide a habitat for local wildlife. The project started in 2008, and already the Senegalese government has been asked to establish rules and regulations that would protect the new mangrove forests.

6 Environmental legislation

WATER (PREVENTION AND CONTROL OF POLLUTION) ACT 1974

The objective of the Act are to prevent and control water pollution and the maintenance or restoration of the wholesomeness of water. The Act defines water pollution as the contamination of water, alteration of its physical, chemical or biological properties or the discharge of any sewage or trade effluent or any other liquid, gaseous or solid substance into water, which may render such water harmful to public health or to domestic, commercial, industrial, agricultural or other legitimate uses or to the life and health of organisms.

The Act establishes an institutional structure for preventing and abating water pollution. It establishes standards for water quality and effluent discharge into water. polluting industries must seek permission to discharge waste into effluent bodies.

The Act's implementation is carried out through central pollution control board (CPCB)

AIR (PREVENTION AND CONTROL OF POLLUTION) ACT OF 1981

The objective of this Act is to provide necessary institutional machinery for the prevention, control and abatement of air pollution. The Act defines air pollution as the presence in the atmosphere of any solid, liquid or gaseous substance (including noise) in such concentrations as may be injurious to human beings, other organisms properties or the environment.

The provisions of the Act are to be implemented by the Central Pollution Control Board (CPCB) along with the various state boards. The Act lists a number of functions of the CPCB including: setting of air quality standards, collecting data on air pollution, organizing training and awareness programmes, establishing laboratories etc. The CPCB can specify air pollution control areas and set standards for vehicular emissions.

The Act lay down penalties for the violation of its provisions. This applies to companies and their owners and managers as well as to government departments. Citizens can file complaints with the CPCB.

ENVIRONMENT (PROTECTION) ACT OF 1986

The Act is an enabling law that provide the executive with powers to frame various rules and regulations. The Act authorizes the Central Government to protect and improve environmental quality, to control and reduce pollution from all sources and to restrict the establishment and operation of any industrial facility on environmental grounds.

The Act defines terms such as environment, environmental pollutant and hazardous substances.

According to the act, the Central Government has the power to:

Take measures to protect and improve the environment.

Give directions (for example, to close, prohibit, or regulate any industry, operation or process)

Make rules to regulate environmental pollution (air and water quality standards, prohibiting or restricting the handling of hazardous material etc.)

The chapter of the Act on the prevention, control and abatment of environmental pollution includes: controlling discharge of environmental pollutants, enforcing compliance with procedural safe guards, power of entry and inspection, power to take samples, setting up of environmental laboratories, appointing environmental analysts and prescription of penalties for contravening the Act.

For effective implementation of the Act, Environment (protection) Rules, 1986 are framed.

These rules set the standards for emission or discharge of environmental pollutants. In addition, more stringent standards may be laid down for specific industries orlocations.

There are rules prohibiting and restricting the location of industries and the carrying on of processes and operation in different areas. Factors to be taken into consideration include: the topographic and climatic features of an area, environmentally compatibility of land use. The net adverse impact likely to be caused by an industry, proximity to areas protected under various other laws, proximity to human settlements etc.

ROLE AND FUNCTION OF STATE POLLUTION CONTROL BOARD

water (prevention and control of pollution) act 1974, air (prevention and control of pollution) act of 1981 have enabled the state govt. to constitute state pollution control board. These boards have power to give necessary advice to state governments regarding prevention and control of air, water and noise pollution. They have powers to examine to any industrial unit or production process in order to control pollution and can pass necessary orders to take remedial measures to control the pollution by the industrial establishment. The boards are supposed to examine the premises of controlled pollution regularly or when need arises. They have powers to set standard regarding the levels and types of emissions caused by industries. They SPCB can set a laboratory or designate an already existing laboratory for this purpose.

State Governments after consulting with SPCB can announce controlled air pollution zones, and pass orders to ensure limited emissions from vehicles and may pass orders to shift the pollution causing industries from that zone.

Penalties

If a industry cause more emissions than the set standards by the SPCB, they management may be imposed with penalties for this. The board can approach to court of law to crub the pollution causing people or units.

ENVIRONMENTAL IMPACT ASSESSMENT

In 1994 Environmental impact Assessment was made mandatory for certain types of projects. The regulations require the project proponent to submit an EIA report, an environmental management plan, detail of the public hearing and a project report to Ministry of Environment and forests. There are 30 categories of projects that require an EIA, such as nuclear power, river valley projects, ports, harbours (except minor ports and harbours), all tourism projects between 200 and 500m of the High Water Line and at locations with elevation of more than 1000m with investment of more than Rs 50 millions, thermal power plants, mining projects (major minerals with lease of more than five hectares), highway projects.

The ministry's Impact assessment Agency evaluates EIA reports. The assessment is to be completed within 90 days of receipt of the requisite documents and data from the project authorities and completion of the public hearing and the decision must be conveyed within 30 days thereafter. The clearance granted is valid for a period of five years from the commencement of the construction or operation of the project.

7 Non-conventional energy resources

Solar energy

Sun is the source of a pure, non-polluting and inexhaustible energy. Solar energy comes from the thermonuclear fusion reaction constantly taking place in the Sun. all the radioactive and polluting byproducts of the reaction are safely left behind in the Sun.

Limitations of solar energy:

Solar energy is a diffuse source falling evenly over a vast area some limitations regarding use of Sun as a source of energy as following:

It is difficult to collect the solar energy.

It is not easy to convert it into more usable energy like electricity with the available technology.

When it is cloudy or when days are short consistent supply is not available. We have not a mechanism for effective storage of solar energy.

Though research is on its way to find cost effective ways of collection, conversion and storage of solar conversion.

Ways of utilizing solar energy: here are some ways in which solar energy is utilized now a days;

Solar water heater: this water heater is a simple and successful use of solar energy. It consist of a flat-plate collector, with a black bottom, a glass top and water tubes in between. The collector is placed in a suitable angle to catch the Sun's radiation. The bottom gets hot and the heat, which cannot escape through the glass, warms up water in the tubes. The insulated storage tank is placed above the collector, the cool water moves down into the tubes and the hot water moves into the tank by natural convection.

Photo-voltic cell

Cconversion of solar energy directly into electricity is brought about by a photo-voltic cell. Later consists of two layer of silicon. The lower layer has electrons that are easily lost and the upper one readily gains electrons. When Sun light strikes the cell, it dislodge electrons from the lower layer. This sets up an electric current. Through the circuit carrying the electrons to the upper layer. Each cell generates small amount of power but many cells, placed together to a panel generate enough power to run an appliance. The power from a solar panel is usually stored in a battery, to which appliance is connected. Thus the energy is generated and stored when sun shines on the panel and is used whenever needed. The direct current from the battery can be converted into alternating current through an inverter. In this way normal appliances like a fan or a television can be run on solar energy.

Photo-voltic cell are used in watches, pocket calculators, toys etc. Large solar panels can light up a house, run an irrigation pump, operate traffic lights and so on. Solar power is viable alternative in areas, where power lines cannot be taken because of high coast involved or the inaccessibility of these area. For example in Ladakh in the Himalyas electricity is generated using solar panels.

Wind energy

Wind energy produce electricity at low coast, the capital coast are also moderate and there are no emission. There are some limitations also with tabbing the wind energy like steady wind of a certain velocity is needed to generate electricity so every place is not suitable. Some form of backup is needed for the wind less days. It need high land use. There are some noise pollution and the monotonous view of hundreds of windmill is a visual pollution. In addition, there is the fear that windmill could interfere with the flight of migratory birds.

Hydro-energy

In order to get electricity from water a high dam is constructed over a river. The potential energy of water falling from a height runs the power generating turbine.

Advantages of hydro power: the cost of generation is low and there are no emissions. The reservoir can provide water for irrigation round the year and can be used for fishing and recreation. It also give drinking water to town and cities.

Disadvantages: Dams coast a lot of money and takes years to built. Most of the suitable rivers of the world have already been dammed and it is difficult to find new spots. The reservoir drowns large areas of farmland, wildlife habitat and places of historical and cultural importance. An example is the town Tehri, which was getting submerged in rising waters as a dam on the Bhagirathi river neared completion in mid-2004. Large dams also cause large-scale displacement of local communities. The people lose their lands and become environmental refugee. Often, compensation for the lost land is meager and often not given on time and resettlement is never satisfactory. Dams impede the migration of fish along the river and reduce the silt flowing downstream. The sediments pile up against dam and reduce its life. There is a worldwide movement against the building of large dams.

Bioenergy

Only 0.2% of solar energy that reaches earth's surface is converted into biomass. Yet this energy trapped annually in the biomass is about ten times the non-biomass energy from the other sources (conventional sources) used by the people world over. Bioenergy is the energy obtained from biological sources, broadly classified into animal energy and biofules. Coal, petroleum and natural gas are also of biological origin but are classified as fossil fuels.

Animal energy: animal energy is available in two form- Human Muscle Power (HMP) and Draught Animal Power (DAP). HMP is widely used by women in their domestic work and by small farmers, artisans and non-agricultural labourers. HMP forms a sizable part of the energy utilized. It continues to play an important part in the rural areas. The full potential of DAP can be effected through

1. Improvement of card designs.
2. Improvement of efficiency of drought animals through breeding.
3. Better management of grazing lands
4. Production of nutritious fodder.

Biofules: bio-fuels or fuels of biological origin have been used by man since the discovery of fire. Biofules are renewable source of energy. With improved technology it is possible to substantially replace fossil fuels by bio-fuels. Biofuels are obtained from

1. Wood
2. Agricultural, agro-industrial and animal wastes.
3. plants that produce alcohol, oil and petroleum.

Wood: wood has bee used buy man from the time he discovered fire. over half the global population still depends on wood for cooking and heating. The wood is also used as a fuel in many industries. The consumption of fuelwood in the world was estimated at 1.7 billion cubic meter in 1984.

Advantages of wood as fuel:

1. It is widely distributed source of renewable energy.
2. It can be harvested by unskilled labour, using simple equipments.
3. When perfectly dry, 99% of it is combustible.
4. It is a fuel which produces flame and is well-adapted to heating large surfaces.

Fuelwood crisis: At least two billion people depend on wood as domestic fuel. Of these 1.5 billion face difficulty in obtaining their meager average supply of 3kg per day. The fuelwood crisis is a vicious circle. The rising population and unequal economical growth of the developing countries not only put a high demand on fuelwood, but require additional agricultural land to grow food. This leads to deforestation. Later results in soil erosion and silting up of dams. This affects both agriculture and power supply. People use dung as fuel, depriving agriculture of valuable fertilizer. This practice further aggravates food shortage and the vicious circle keeps on turning.

Steps taken to meet the fuelwood crisis:

1.more fuelwood tree are to be grown i.e. to raise energy plantations.

2. efficiency of wood stoves must be increased through proper and socially accepted design.

3. Energy from wood must be extracted more efficiently through processes such as carbonization, pyrolysis and gasification.

Energy plantations: The establishment of energy plantations is one of the ways of assuring supply of firewood near the source of consumption. The advantages of energy plantations are:

1. Solar energy can be stored continuously
2. They are renewable.
3. They depend on available technology with minimum input.
4. Sufficient manpower is available for raising them
5. They are economical.
6. They are ecologically safe.

The key point related to the raising of energy plantation are

Mobilization of land resources: fuelwood plantation is to be done on village common land.

On the vacant strips on both side of road, canal and railway tracs.

On deforested area.

On wetlands etc.

Selection of species: While selecting suitable species for fuelwood is it to be kept in mind that in addition to providing fuelwood they should other products like fruit, seeds, fodder, green manure, tannins and medicinal products.

Development of agro- technology for energy plantation: to maximize yield, technique of growing individual species in specific habitats must be worked out. Cultivating grasses and fodder crops along with fuelwood species ensures maximum land use.

Utilizing waste material for energy

Waste biogas is produced by man as a result of agricultural, industrial and household activities. In developing countries 28% population uses dung and crop residue as cooking fuel. A more efficient way to use dung as fuel is by production of biogas. Anaerobic fermentation of dung yields fuel as well as fertilizer. Using waste material to produce biogas than using them dorect as fuel of fertilizer has many advantages:

As a storable energy source which can be used more efficiently.

This source of energy has wider applications than the traditional energy sources which are used in generating it.

The process of producing biogas results in the formation of a stabilized residue that retain the fertilizer value of original material.

It reduces faecal pathogens and improves sanitation.

It reduces the chances of transfer of pathogens from one year's crop residue to the subsequent crop.

Biological sources for obtaining oil and petroleum

Petroleum plants

Some plants of family Euphorbiaceae produce latex. The liquid hydrocarbons present in latex of such plants are a promising substitute for liquid fuels. Other promising families are Asclepiadaceae and Apocynaceae. The commercial production of petroleum substitutes through plants is still in itsinfancy.

Alcohol fuel

Ethanol can be used as a fuel for automobiles either as 10-15 percent blend with petrol (Gasohol) or as entire fuel. The existing petrol engines have been modified to burn Gasohol. Raising crops like sugarcane, potato, maize, sugarbeet and tapioca for production of ethanol is known as energy cropping. Brazile has successfully utilized alcohol as motor fuel. Although the technology of alcohol production is well developed it has many problems in its applications.

8 Current environmental issues

GLOBAL WARMING

Normally, carbon dioxide and other gases that surround the planet let the radiation from the Sun reach earth, but prevent some of the heat from being reflected back out again. Without these green house gases, earth would be far colder and largely covered with ice. The problem comes when the amount of these gases exceed a certain limit. By burning fossil fuels, we release huge quantities of carbon dioxide into the atmosphere. Concurrently, deforestation also releases carbon trapped in the tissues of the trees. At the same time, loss of trees reduces the earth's capacity to absorb carbon dioxide through photosynthesis. Natural processes like volcanic eruptions and earthquake- induced fires also contribute to carbon dioxide emissions.

Methane, released from swamps, human and animal waste and garbage dumps is also a greenhouse gas and its concentration in the atmosphere is increasing. Similarly, human activities are causing a rapid increase in the amounts of 30 other greenhouse gases in the atmosphere. The abnormal increase in the concentration of these gases lead to higher temperatures and global warming. The average temperatures around the world have risen by about 0.5ºC since the beginning of the twentieth century. If emissions continue at the current rate, a temperature rise of 1.5ºC to 4.5 ºC is likely by 2030.

Major contributors of green house gases: most of the green house gas emission come from the northern hemisphere. U.S. being the biggest contributor. Russia is also a major source. European countries also produce substantial amounts of greenhouse gases, but they are also trying to reduce emissions Developing countries are fast catching up with developed countries regarding emission of greenhouse gases. Chine and India are industrializing rapidly and their emissions are likely to double within the next two decades.

Effects of global warming; an increase of just 1.5ºC in global temperature could cause changes greater than anything experienced during the last 10000 years. Regional and seasonal weather pattern will change, with longer warm periods and shorter cold seasons.

Extreme weather conditions like floods and droughts are likely to occur more often. The effects are already noticeable. There have been an unprecedented number of natural disasters in the 1990s. during that decade whether related damage was five times greater than in the 1980s. More such events will accelerate soil erosion and deforestation, which could disrupt world agriculture and threaten food security. The ocean will become warmer, its waters will expand and sea levels will rise. The possible melting of ice caps will add to the problem. Coastal areas will be flooded in places like Netherlands, Egypt, Bangladesh and Indonesia, necessitating the evacuation of large populations. Small islands like those of the Maldives and many of the islands in the South Pacific could disappear. Thousands of animal and plant species will go extinct, unable to adjust quickly enough to the new conditions. Polar species may be the first to go, followed by those in coastal zones everywhere.

In nut shell catastrophes awaits in the near future of earth if current rate of emission of greenhouse gases continue.

Initiative to control global warming: it is unlikely to stop global warming, but we can reduce its adverse effects. Immediate and drastic reduction of emission are urgently needed. Energy conservation, promotion of renewable energy sources, cleaner and fewer automobiles, greater support for public transportation, reduced deforestation, cleaner technologies and similar measures are urgently needed.

GREEN HOUSE EFFECT

The greenhouse effect is a process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases, and is re-radiated in all directions. Since part of this re-radiation is back towards the surface and the lower atmosphere, it results in an elevation of the average surface temperature above what it would be in the absence of the gases.

Solar radiation at the frequencies of visible light largely passes through the atmosphere to warm the planetary surface, which then emits this energy at the lower frequencies of infrared thermal radiation. Infrared radiation is absorbed by greenhouse gases, which in turn re-radiate much of the energy to the surface and lower atmosphere. The mechanism is named after the effect of solar radiation passing through glass and warming a greenhouse, but the way it retains heat is fundamentally different as a greenhouse works by reducing airflow, isolating the warm air inside the structure so that heat is not lost by convection.

If an ideal thermally conductive blackbody were the same distance from the Sun as the Earth is, it would have a temperature of about 5.3 °C. However, since the Earth reflects about 30% of the incoming sunlight, this idealized planet's effective temperature (the temperature of a blackbody that would emit the same amount of radiation) would be about −18 °C. The surface temperature of this hypothetical planet is 33 °C below Earth's actual surface temperature of approximately 14 °C. The mechanism that produces this difference between the actual surface temperature and the effective temperature is due to the atmosphere and is known as the greenhouse effect.

Earth's natural greenhouse effect makes life as we know it possible. However, human activities, primarily the burning of fossil fuels and clearing of forests, have intensified the natural greenhouse effect, causing global warming.

The existence of the greenhouse effect was argued for by Joseph Fourier in 1824. The argument and the evidence was further strengthened by Claude Pouillet in 1827 and 1838, and reasoned from experimental observations by John Tyndall in 1859, and more fully quantified by Svante Arrhenius in 1896.

In 1917 Alexander Graham Bell wrote "[The unchecked burning of fossil fuels] would have a sort of greenhouse effect", and "The net result is the greenhouse becomes a sort of hot-house." Bell went on to also advocate for the use of alternate energy sources, such as solar energy.

mechanism

The Earth receives energy from the Sun in the form UV, visible, and near IR radiation, most of which passes through the atmosphere without being absorbed. Of the total amount of energy available at the top of the atmosphere (TOA), about 50% is absorbed at the Earth's surface. Because it is warm, the surface radiates far IR thermal radiation that consists of wavelengths that are predominantly much longer than the wavelengths that were absorbed (the overlap between the incident solar spectrum and the terrestrial thermal spectrum is small enough to be neglected for most purposes). Most of this thermal radiation is absorbed by the atmosphere and re-radiated both upwards and downwards; that radiated downwards is absorbed by the Earth's surface. This trapping of long-wavelength thermal radiation leads to a higher equilibrium temperature than if the atmosphere were absent.

This highly simplified picture of the basic mechanism needs to be qualified in a number of ways, none of which affect the fundamental process.

The incoming radiation from the Sun is mostly in the form of visible light and nearby wavelengths, largely in the range 0.2–4 μm, corresponding to the Sun's radiative temperature of 6,000 K. Almost half the radiation is in the form of "visible" light, which our eyes are adapted to use.

About 50% of the Sun's energy is absorbed at the Earth's surface and the rest is reflected or absorbed by the atmosphere. The reflection of light back into space—largely by clouds—does not much affect the basic mechanism; this light, effectively, is lost to the system.

The absorbed energy warms the surface. Simple presentations of the greenhouse effect, such as the idealized greenhouse model, show this heat being lost as thermal radiation. The reality is more complex: the atmosphere near the surface is largely opaque to thermal radiation (with important exceptions for "window" bands), and most heat loss from the surface is by sensible heat andlatent heat transport. Radiative energy losses become increasingly important higher in the atmosphere largely because of the decreasing concentration of water vapor, an important greenhouse gas. It is more realistic to think of the greenhouse effect as applying to a "surface" in the mid-troposphere, which is effectively coupled to the surface by a lapse rate.

The simple picture assumes a steady state. In the real world there is the diurnal cycle as well as seasonal cycles and weather. Solar heating only applies during daytime. During the night, the atmosphere cools somewhat, but not greatly, because its emissivity is low, and during the day the atmosphere warms. Diurnal temperature changes decrease with height in the atmosphere.

Within the region where radiative effects are important the description given by the idealized greenhouse model becomes realistic: The surface of the Earth, warmed to a temperature around 255 K, radiates long-wavelength, infrared heat in the range 4–100 μm. At these wavelengths, greenhouse gases that were largely transparent to incoming solar radiation are more absorbent. Each layer of atmosphere with greenhouses gases absorbs some of the heat being radiated upwards from lower layers. It re-radiates in all directions, both upwards and downwards; in equilibrium (by definition) the same amount as it has absorbed. This results in more warmth below. Increasing the concentration of the gases increases the amount of absorption and re-radiation, and thereby further warms the layers and ultimately the surface below.

Greenhouse gases—including most diatomic gases with two different atoms (such as carbon monoxide, CO) and all gases with three or more atoms—are able to absorb and emit infrared radiation. Though more than 99% of the dry atmosphere is IR transparent (because the main constituents—N_2, O_2, and Ar—are not able to directly absorb or emit infrared radiation), intermolecular collisions cause the energy absorbed and emitted by the greenhouse gases to be shared with the other, non-IR-active, gases.

Green house gases

By their percentage contribution to the greenhouse effect on Earth the four major gases are

Water vapor, 36–70%

Carbon dioxide, 9–26%

Methane, 4–9%

Ozone, 3–7%

The major non-gas contributor to the Earth's greenhouse effect, clouds, also absorb and emit infrared radiation and thus have an effect on radiative properties of the atmosphere.

Role in climate change

Strengthening of the greenhouse effect through human activities is known as the enhanced (or anthropogenic) greenhouse effect. This increase in radiative forcing from human activity is attributable mainly to increased atmospheric carbon dioxide levels. According to the latest Assessment Report from the Intergovernmental Panel on Climate Change, "*most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations*".

CO_2 is produced by fossil fuel burning and other activities such as cement production and tropical deforestation. Measurements of CO_2 from the Mauna Loa observatory show that concentrations have increased from about 313 ppm in 1960 to about 389 ppm in 2010. It reached the 400ppm milestone on May 9, 2013. The current observed amount of CO_2exceeds the geological record maxima (~300 ppm) from ice core data. The effect of combustion-produced carbon dioxide on the global climate, a special case of the greenhouse effect first described in 1896 by Svante Arrhenius, has also been called the Callendar effect.

Over the past 800,000 years, ice core data shows that carbon dioxide has varied from values as low as 180 parts per million (ppm) to the pre-industrial level of 270ppm. Paleoclimatologists consider variations in carbon dioxide concentration to be a fundamental factor influencing climate variations over this time scale.

Real green house

The "greenhouse effect" of the atmosphere is named by analogy to greenhouseswhich get warmer in sunlight, but the mechanism by which the atmosphere retains heat is different. A greenhouse works primarily by allowing sunlight to warm surfaces inside the structure, but then preventing absorbed heat from leaving the structure through convection, i.e. sensible heat transport. The "greenhouse effect" heats the Earth because greenhouse gases absorb outgoing radiative energy, heating the atmosphere which then emits radiative energy with some of it going back towards the Earth.

A greenhouse is built of any material that passes sunlight, usually glass, or plastic. It mainly heats up because the Sun warms the ground inside, which then warms the air in the greenhouse. The air continues to heat because it is confined within the greenhouse, unlike the environment outside the greenhouse where warm air near the surface rises and mixes with cooler air aloft. This can be demonstrated by opening a small window near the roof of a greenhouse: the temperature will drop considerably. It has also been demonstrated experimentally (R. W. Wood, 1909) that a "greenhouse" with a cover of rock salt (which is transparent to infra red) heats up an enclosure similarly to one with a glass cover. Thus greenhouses work primarily by preventing convective cooling.

In contrast, the greenhouse effect heats the Earth because rather than retaining (sensible) heat by physically preventing movement of the air, greenhouse gases act to warm the Earth by re-radiating some of the energy back towards the surface. This process may exist in real greenhouses, but is comparatively unimportant there.

OZONE LAYER DEPLETION

Ozone exist in the stratosphere. The ozone layer of atmosphere absorbs most of the harmful ultraviolet radiation from the Sun. the ozone shield is thus essential to protect life. Depleting the ozone layer allows more ultra violet rays to reach the earth. The result is an increase in skin cancers, eye cataract, weakened immune system, reduced plant yields, damage to ocean ecosystems and reduce fishing yields and adverse effects on animals.

Causes of ozone depletion: in the 1970s scientists discovered that when chlorofluorocarbons (CFCs) used as refrigerant and aerosol propellants, finally break apart in the atmosphere and release chlorine atoms, they cause ozone depletion. Bromine atoms released by halons (used in fire extinguishers) have the same effect.

The ozone layer over the Antartic has steadily weakened since measurement started in the early 1980s. the land area under the ozone- depleted atmosphere has increased steadily to more than 20 million sq km in the early 1090s and has varied between 20 and 29 million sq. km since then. In 2000, the area of the ozone hole reached a record 29 million sq km.

While no hole has appeared elsewhere, the arctic spring has seen the ozone layer over the North pole thinning by upto 30 % the depletion over Europe and other high altitude varies between 5 and 30 percent.

Efforts to control the ozone layer depletion: Intergovernmental negotiations for an international agreement to phase out ozone- depleting substances started in 1981 and concluded with the Vienna Convention for the Protection of the Ozone Layer in March 1985. the Vienna Convection encourages intergovernmental cooperation on research, systematic observation of the ozone layer, monitoring of CFC production and the exchange of information. The Convention commits the signatories to taking general measures to protect human health and the environment against human activities that modify the ozone layer.

In May 1985, British scientists published their discovery of sever ozone depletion in the Antarctica. Their findings were confirmed by American satellite observations and offered first proof f severe ozone depletion. The discovery of Ozone hole shocked the world. It is regarded as one of the major environmental disasters of the twentieth century.

Governments now recognized the need for stronger measures to reduce the production and consumption of a number of CFCs and several halons. As a result, the Montreal Protocol on Substances that Deplete the ozone Layer was adopted in September 1987.

Ninety-six chemicals are presently controlled by the Montreal Protocol and are subject to phase-out schedules under it.

Results of control measures for ozone layer depletion: the Montreal Protocol is working. However, even with full compliance with the Protocol by all parties, the ozone layer will remain particularly vulnerable during the next decade or so.

In 1986 the total consumption of CFCs worldwide was about 1.1 million Ozone Depleting Potential (ODP) tons; by 2001 this had come down to about 110,000 tons. It has been calculated that without Montreal Protocol, global consumption would have reached about three millions tons in year 2010 and eight million tons in 2060, resulting massive ozone layer depletion. Without Montreal Protocol, there would have been a doubling of UV-B radiation reaching the Earth in the north mid- latitudes and a quadrupling of the amount in the South. The amount of ozone depleting chemicals in the atmosphere would have been five times greater. The implications of this would have been horrendous: 19 million more cases of cancer and 130 million more cases of eye cataracts.

Scientist predict that ozone depletion will reach its worst point during the next few years and then gradually decline until the ozone layer returns to normal in around 2050, assuming that the Montreal Protocol is fully implemented.

The success of ozone protection has been possible because science and industry have been able to develop and commercialize alternatives to ozone- depleting chemicals. Developed countries ended the use of CFCs faster and with less cost than was originally anticipated.

RECYCLING OF MATERIAL

Recycling is a process to change (waste) materials into new products to prevent wastage of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from land filling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to plastic production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse and Recycle" waste hierarchy.

There are some ISO standards related to recycling such as ISO 15270:2008 for plastics waste and ISO 14001:2004 for environmental management control of recycling practice.

Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics. The composting or other reuse of biodegradable waste—such as food or garden waste—is also considered recycling. Materials to be recycled are either brought to a collection center or picked up from the curbside, then sorted, cleaned, and reprocessed into new materials bound for manufacturing.

In the strictest sense, recycling of a material would produce a fresh supply of the same material—for example, used office paper would be converted into new office paper, or used foamed polystyrene into new polystyrene. However, this is often difficult or too expensive (compared with producing the same product from raw materials or other sources), so "recycling" of many products or materials involves their reuse in producing different materials (e.g., paperboard) instead. Another form of recycling is the salvage of certain materials from complex products, either due to their intrinsic value (e.g., lead from car batteries, or gold from computer components), or due to their hazardous nature (e.g., removal and reuse of mercury from various items). Critics dispute the net economic and environmental benefits of recycling over its costs, and suggest that proponents of recycling often make matters worse and suffer from confirmation bias. Specifically, critics argue that the costs and energy used in collection and transportation detract from (and outweigh) the costs and energy saved in the production process; also that the jobs produced by the recycling industry can be a poor trade for the jobs lost in logging, mining, and other industries associated with virgin production; and that materials such as paper pulp can only be recycled a few times before material degradation prevents further recycling. Proponents of recycling dispute each of these claims, and the validity of arguments from both sides has led to enduring controversy.

History

Recycling has been a common practice for most of human history, with recorded advocates as far back as Plato in 400 BC. During periods when resources were scarce, archaeological studies of ancient waste dumps show less household waste (such as ash, broken tools and pottery)—implying more waste was being recycled in the absence of new material.

In pre-industrial times, there is evidence of scrap bronze and other metals being collected in Europe and melted down for perpetual reuse. In Britain dust and ash from wood and coal fires was collected by 'dustmen' and downcycled as a base material used in brick making. The main driver for these types of recycling was the economic advantage of obtaining recycled feedstock instead of acquiring virgin material, as well as a lack of public waste removal in ever more densely populated areas. In 1813, Benjamin Law developed the process of turning rags into 'shoddy' and 'mungo' wool in Batley, Yorkshire. This material combined recycled fibres with virgin wool. The West Yorkshire shoddy industry in towns such as Batley and Dewsbury, lasted from the early 19th century to at least 1914.

Industrialization spurred demand for affordable materials; aside from rags, ferrous scrap metals were coveted as they were cheaper to acquire than was virgin ore. Railroads both purchased and sold scrap metal in the 19th century, and the growing steel and automobile industries purchased scrap in the early 20th century. Many secondary goods were collected, processed, and sold by peddlers who combed dumps, city streets, and went door to door looking for discarded machinery, pots, pans, and other sources of metal. By World War I, thousands of such peddlers roamed the streets of American cities, taking advantage of market forces to recycle post-consumer materials back into industrial production.

Beverage bottles were recycled with a refundable deposit at some drink manufacturers in Great Britain and Ireland around 1800, notably Schweppes. An official recycling system with refundable deposits was established in Sweden for bottles in 1884 and aluminium beverage cans in 1982, by law, leading to a recycling rate for beverage containers of 84–99 percent depending on type, and average use of a glass bottle is over 20 refills.

Wartime

Recycling was a highlight throughout World War II. During the war, financial constraints and significant material shortages due to war efforts made it necessary for countries to reuse goods and recycle materials. It was these resource shortages caused by the world wars, and other such world-changing occurrences that greatly encouraged recycling. The struggles of war claimed much of the material resources available, leaving little for the civilian population. It became necessary for most homes to recycle their waste, as recycling offered an extra source of materials allowing people to make the most of what was available to them. Recycling materials that were used in the household, meant more resources were available to support war efforts. This in turn meant a better chance of victory at war. Massive government promotion campaigns were carried out in World War II in every country involved in the war, urging citizens to donate metals and conserve fibre, as a matter of significant patriotic importance.

Post-war

A considerable investment in recycling occurred in the 1970s, due to rising energy costs. Recycling aluminium uses only 5% of the energy required by virgin production; glass, paper and metals have less dramatic but very significant energy savings when recycled feedstock is used.

As of 2014, the European Union has about 50% of world share of the waste and recycling industries, with over 60,000 companies employing 500,000 persons, with a turnover of €24 billion. Countries have to reach recycling rates of at least 50%, while the lead countries are around 65% and the EU average is 39% as of 2013.

Legislation regarding supply of recyclate

For a recycling program to work, having a large, stable supply of recyclable material is crucial. Three legislative options have been used to create such a supply: mandatory recycling collection, container deposit legislation, and refuse bans. Mandatory collection laws set recycling targets for cities to aim for, usually in the form that a certain percentage of a material must be diverted from the city's waste stream by a target date. The city is then responsible for working to meet this target.

Container deposit legislation involves offering a refund for the return of certain containers, typically glass, plastic, and metal. When a product in such a container is purchased, a small surcharge is added to the price. This surcharge can be reclaimed by the consumer if the container is returned to a collection point. These programs have been very successful, often resulting in an 80 percent recycling rate. A third method of increase supply of recyclates is to ban the disposal of certain materials as waste, often including used oil, old batteries, tires and garden waste. One aim of this method is to create a viable economy for proper disposal of banned products. Care must be taken that enough of these recycling services exist, or such bans simply lead to increased illegal dumping.

Recyclate

Recyclate is a raw material that is sent to, and processed in a waste recycling plant or materials recovery facility which will be used to form new products. The material is collected in various methods and delivered to a facility where it undergoes re-manufacturing so that it can used in the production of new materials or products. For example, plastic bottles that are collected can be re-used and made into plastic pellets, a new product.

Quality of recyclate

The quality of recyclates is recognized as one of the principal challenges that needs to be addressed for the success of a long term vision of a green economy and achieving zero waste. Recyclate quality is generally referring to how much of the raw material is made up of target material compared to the amount of non-target material and other non- recyclable material. Only target material is likely to be recycled, so a higher amount of non-target and non-recyclable material will reduce the quantity of recycling product.] A high proportion of non-target and non-recyclable material can make it more difficult for re-processors to achieve 'high-quality' recycling. If the recyclate is of poor quality, it is more likely to end up being down-cycled or, in more extreme cases, sent to other recovery options or landfill. For example, to facilitate the re-manufacturing of clear glass products there are tight restrictions for colored glass going into the re-melt process.

The quality of recyclate not only supports high quality recycling, it can deliver significant environmental benefits by reducing, reusing, and keeping products out of landfills. High quality recycling can help support growth in the economy by maximizing the economic value of the waste material collected. Higher income levels from the sale of quality recyclates can return value which can be significant to local governments, households and businesses. Pursuing high quality recycling can also provide consumer and business confidence in the waste and resource management sector and may encourage investment in that sector.

There are many actions along the recycling supply chain that can influence and affect the material quality of recyclate. It begins with the waste producers who place non-target and non-recyclable wastes in recycling collection. This can affect the quality of final recyclate streams or require further efforts to discard those materials at later stages in the recycling process. The different collection systems can result in different levels of contamination. Depending on which materials are collected together, extra effort is required to sort this material back into separate streams and can significantly reduce the quality of the final product. Transportation and the compaction of materials can make it more difficult to separate material back into separate waste streams. Sorting facilities are not one hundred per cent effective in separating materials, despite improvements in technology and quality recyclate which can see a loss in recyclate quality. The storage of materials outside where the product can become wet can cause problems for re-processors. Reprocessing facilities may require further sorting steps to further reduce the amount of non-target and non-recyclable material. Each action along the recycling path plays a part in the quality of recyclate.

Recycling consumer wastes

Collection

A number of different systems have been implemented to collect recyclates from the general waste stream. These systems lie along the spectrum of trade-off between public convenience and government ease and expense. The three main categories of collection are "drop-off centres," "buy-back centres," and "curbside collection".

Drop-off centres

Drop-off centres require the waste producer to carry the recyclates to a central location, either an installed or mobile collection station or the reprocessing plant itself. They are the easiest type of collection to establish, but suffer from low and unpredictable throughput.

Buy-back centres

Buy-back centres differ in that the cleaned recyclates are purchased, thus providing a clear incentive for use and creating a stable supply. The post-processed material can then be sold on, hopefully creating a profit. Unfortunately, government subsidies are necessary to make buy-back centres a viable enterprise, as according to the United States' National Waste & Recycling Association, it costs on average US$50 to process a ton of material, which can only be resold for US$30.

Curbside collection

Curbside collection encompasses many subtly different systems, which differ mostly on where in the process the recyclates are sorted and cleaned. The main categories are mixed waste collection, commingled recyclables and source separation. A waste collection vehicle generally picks up the waste.

At one end of the spectrum is mixed waste collection, in which all recyclates are collected mixed in with the rest of the waste, and the desired material is then sorted out and cleaned at a central sorting facility. This results in a large amount of recyclable waste, paper especially, being too soiled to reprocess, but has advantages as well: the city need not pay for a separate collection of recyclates and no public education is needed. Any changes to which materials are recyclable is easy to accommodate as all sorting happens in a central location.

In a commingled or single-stream system, all recyclables for collection are mixed but kept separate from other waste. This greatly reduces the need for post-collection cleaning but does require public education on what materials are recyclable.

Source separation is the other extreme, where each material is cleaned and sorted prior to collection. This method requires the least post-collection sorting and produces the purest recyclates, but incurs additional operating costs for collection of each separate material. An extensive public education program is also required, which must be successful if recyclate contamination is to be avoided.

Source separation used to be the preferred method due to the high sorting costs incurred by commingled (mixed waste) collection. Advances in sorting technology (see sorting below), however, have lowered this overhead substantially—many areas which had developed source separation programs have since switched to comingled collection.

Distributed Recycling

For some waste materials such as plastic, recent technical devices called recyclebots enable a form of distributed recycling. Preliminary life-cycle analysis(LCA) indicates that such distributed recycling of HDPE to make filament of 3-D printers in rural regions is energetically favorable to either using virgin resin or conventional recycling processes because of reductions in transportation energy.

Sorting

Once commingled recyclates are collected and delivered to a central collection facility, the different types of materials must be sorted. This is done in a series of stages, many of which involve automated processes such that a truckload of material can be fully sorted in less than an hour. Some plants can now sort the materials automatically, known as single-stream recycling. In plants a variety of materials are sorted such as paper, different types of plastics, glass, metals, food scraps, and most types of batteries. A 30 percent increase in recycling rates has been seen in the areas where these plants exist.

Initially, the commingled recyclates are removed from the collection vehicle and placed on a conveyor belt spread out in a single layer. Large pieces of corrugated fiberboard and plastic bags are removed by hand at this stage, as they can cause later machinery to jam.

Next, automated machinery separates the recyclates by weight, splitting lighter paper and plastic from heavier glass and metal. Cardboard is removed from the mixed paper, and the most common types of plastic, PET (#1) and HDPE (#2), are collected. This separation is usually done by hand, but has become automated in some sorting centers: a spectroscopic scanner is used to differentiate between different types of paper and plastic based on the absorbed wavelengths, and subsequently divert each material into the proper collection channel.

Strong magnets are used to separate out ferrous metals, such as iron, steel, andtin-plated steel cans ("tin cans"). Nonferrous metals are ejected by magnetic eddy currents in which a rotating magnetic field induces an electric current around the aluminium cans, which in turn creates a magnetic eddy current inside the cans. This magnetic eddy current is repulsed by a large magnetic field, and the cans are ejected from the rest of the recyclate stream.

Finally, glass is sorted on the basis of its color: brown, amber, green, or clear. It may either be sorted by hand, or via an automated machine that uses colored filters to detect different colors. Glass fragments smaller that 10mm across cannot be sorted automatically, and are mixed together as 'glass fines'.

This process of recycling as well as reusing the recycled material proves to be advantageous for many reasons as it reduces amount of waste sent to landfills, conserves natural resources, saves energy, reduces greenhouse gas emissions, and helps create new jobs. Recycled materials can also be converted into new products that can be consumed again such as paper, plastic, and glass.

The City and County of San Francisco's Department of the Environment offers one of the best recycling programs to support its city-wide goal of Zero Waste by 2020.] San Francisco's refuse hauler, Recology, operates an effective recyclables sorting facility in San Francisco, which helped San Francisco reach a record-breaking diversion rate of 80%.

Rinsing

Food packaging should no longer contain any organic matter (organic matter found in these needs to be placed in a biodegradable waste bin or can be buried in your garden). Since no trace of biodegradable material is best kept in the packaging before placing it in a trash bag, some packaging also needs to be rinsed.

Recycling of industrial waste

Although many government programs are concentrated on recycling at home, a large portion of waste is generated by industry. The focus of many recycling programs done by industry is the cost-effectiveness of recycling. The ubiquitous nature of cardboard packaging makes cardboard a commonly recycled waste product by companies that deal heavily in packaged goods, like retail stores, warehouses, and distributors of goods. Other industries deal in niche or specialized products, depending on the nature of the waste materials that are present.

The glass, lumber, wood pulp, and paper manufacturers all deal directly in commonly recycled materials. However, old rubber tires may be collected and recycled by independent tire dealers for a profit.

Levels of metals recycling are generally low. In 2010, the International Resource Panel, hosted by the United Nations Environment Programme (UNEP) published reports on metal stocks that

exist within society and their recycling rates. The Panel reported that the increase in the use of metals during the 20th and into the 21st century has led to a substantial shift in metal stocks from below ground to use in applications within society above ground. For example, the in-use stock of copper in the USA grew from 73 to 238 kg per capita between 1932 and 1999.
The report authors observed that, as metals are inherently recyclable, the metals stocks in society can serve as huge mines above ground (the term "urban mining" has been coined with this idea in mind). However, they found that the recycling rates of many metals are very low. The report warned that the recycling rates of some rare metals used in applications such as mobile phones, battery packs for hybrid cars and fuel cells, are so low that unless future end-of-life recycling rates are dramatically stepped up these critical metals will become unavailable for use in modern technology.
The military recycles some metals. The U.S. Navy's Ship Disposal Program uses ship breaking to reclaim the steel of old vessels. Ships may also be sunk to create an artificial reef. Uranium is a very dense metal that has qualities superior to lead and titanium for many military and industrial uses. The uranium left over from processing it into nuclear weapons and fuel for nuclear reactors is called depleted uranium, and it is used by all branches of the U.S. military use for armour-piercing shells and shielding.
The construction industry may recycle concrete and old road surface pavement, selling their waste materials for profit.
Some industries, like the renewable energy industry and solar photovoltaic technology in particular, are being proactive in setting up recycling policies even before there is considerable volume to their waste streams, anticipating future demand during their rapid growth.
Recycling of plastics is more difficult, as most programs can't reach the necessary level of quality. Recycling of PVC often results in down cycling of the material, which means only products of lower quality standard can be made with the recycled material. A new approach which allows an equal level of quality is the Vinyloop process. It was used after the London Olympics 2012 to fulfill the PVC Policy.

E-waste recycling

E-waste is a growing problem, accounting for 20-50 million metric tons of global waste per year according to the EPA. Many recyclers do not recycle e-waste or do not do so responsibly. The e-Stewards certification was created to ensure recyclers are held to the highest standards for environmental responsibility and to give consumers an easy way to identify responsible recyclers. e-Cycle, LLC, was the first mobile recycling company to be e-Stewards certified.

Plastic recycling

Plastic recycling is the process of recovering scrap or waste plastic and reprocessing the material into useful products, sometimes completely different in form from their original state. For instance, this could mean melting down soft drink bottles and then casting them as plastic chairs and tables.

Physical Recycling

Some plastics are remelted to form new plastic objects, for example PET water bottles can be converted into clothing grade polyester. A disadvantage of this type of recycling is that in each use and recycling cycle the molecular weight of the polymer can change further and the levels of unwanted substances in the plastic can increase.

Chemical Recycling

For some polymers it is possible to convert them back into monomers, for example PET can be treated with an alcohol and a catalyst to form a dialkyl terephthalate. The terephthalate diester can be used with ethylene glycol to form a new polyester polymer. Thus it is possible to make the pure polymer again.

Waste Plastic Pyrolysis to fuel oil

Another process involves the conversion of assorted polymers into petroleum by a much less precise thermal depolymerization process. Such a process would be able to accept almost any polymer or mix of polymers, including thermoset materials such as vulcanized rubber tires and the biopolymers in feathers and other agricultural waste. Like natural petroleum, the chemicals produced can be made into fuels as well as polymers. RESEM Technology plant of this type exists in Carthage, Missouri, USA, using turkey waste as input material. Gasification is a similar process, but is not technically recycling since polymers are not likely to become the result. Plastic Pyrolysis can convert petroleum based waste streams such as plastics into quality fuels, carbons. Given below is the list of suitable plastic raw materials for pyrolysis:

Mixed plastic (HDPE, LDPE, PE, PP, Nylon, Teflon, PS, ABS, FRP etc.)Mixed waste plastic from waste paper mill. Multi Layered Plastic

Recycling codes

In order to meet recyclers' needs while providing manufacturers a consistent, uniform system, a coding system is developed. The recycling code for plastics was introduced in 1988 by plastics industry through the Society of the Plastics Industry, Inc.[35] Because municipal recycling programs traditionally have targeted packaging—primarily bottles and containers—the resin coding system offered a means of identifying the resin content of bottles and containers commonly found in the residential waste stream.[36]

Plastic products are printed with numbers 1–7 depending on the type of resin. Type 1 plastic, PET (or PETE): polyethylene terephthalate, is commonly found in soft drink and water bottles. Type 2, HDPE: high-density polyethylene is found in most hard plastics such as milk jugs, laundry detergent bottles, and some dishware. Type 3, PVC or V (vinyl), includes items like shampoo bottles, shower curtains, hoola hoops, credit cards, wire jacketing, medical equipment, siding, and piping. Type 4, called LDPE, or low-density polyethylene, is found in shopping bags, squeezable bottles, tote bags, clothing, furniture, and carpet. Type 5 is PP which stands for polypropylene and makes up syrup bottles, straws, Tupperware, and some automotive parts. Type 6 is PS: polystyrene and makes up meat trays, egg cartons, clamshell containers and compact disc cases. Type 7 includes all other plastics like bulletproof materials, 3- and 5-gallon water bottles, and sunglasses. Types 1 and 2 are the most commonly recycled.

ENVIRONMENTAL ETHICS

Environmental ethics is the part of environmental philosophy which considers extending the traditional boundaries of ethics from solely including humans to including the non-human world. It exerts influence on a large range of disciplines including environmental law, environmental sociology, ecotheology, ecological economics, ecology and environmental geography.

There are many ethical decisions that human beings make with respect to the environment. For example:

Should we continue to clear cut forests for the sake of human consumption?

Why should we continue to propagate our species, and life itself?

Should we continue to make gasoline powered vehicles?

What environmental obligations do we need to keep for future generations?

Is it right for humans to knowingly cause the extinction of a species for the convenience of humanity?

How should we best use and conserve the space environment to secure and expand life?

The academic field of environmental ethics grew up in response to the work of scientists such as Rachel Carson and events such as the first Earth Day in 1970, when environmentalists started urging philosophers to consider the philosophical aspects of environmental problems. Two papers published in *Science* had a crucial impact: Lynn White's "The Historical Roots of our Ecologic Crisis" (March 1967) and Garrett Hardin's "The Tragedy of the Commons" (December 1968).

Marshall's categories of environmental ethics

There have been a number of scholars who've tried to categorise the various ways the natural environment is valued. Alan Marshall and Michael Smith are two examples of this, as cited by Peter Vardy in "The Puzzle of Ethics". For Marshall, three general ethical approaches have emerged over the last 40 years. Marshall uses the following terms to describe them: Libertarian Extension, the Ecologic Extension and Conservation Ethics.

Libertarian extension

Marshall’s Libertarian extension echoes a civil liberty approach (i.e. a commitment to extend equal rights to all members of a community). In environmentalism, though, the community is generally thought to consist of non-humans as well as humans.

Andrew Brennan was an advocate of ecologic humanism (eco-humanism), the argument that all ontological entities, animate and in-animate, can be given ethical worth purely on the basis that they exist. The work of Arne Næss and his collaborator Sessions also falls under the libertarian extension, although they preferred the term "deep ecology". Deep ecology is the argument for the intrinsic value or inherent worth of the environment – the view that it is valuable in itself. Their argument, incidentally, falls under both the libertarian extension and the ecologic extension.

Peter Singer's work can be categorized under Marshall's 'libertarian extension'. He reasoned that the "expanding circle of moral worth" should be redrawn to include the rights of non-human animals, and to not do so would be guilty of speciesism. Singer found it difficult to accept the argument from intrinsic worth of a-biotic or "non-sentient" (non-conscious) entities, and concluded in his first edition of "Practical Ethics" that they should not be included in the expanding circle of moral worth. This approach is essentially then, bio-centric. However, in a later edition of "Practical Ethics" after the work of Næss and Sessions, Singer admits that, although unconvinced by deep ecology, the argument from intrinsic value of non-sentient entities is plausible, but at best problematic. Singer advocated a humanist ethics.

Ecologic extension

Alan Marshall's category of ecologic extension places emphasis not on human rights but on the recognition of the fundamental interdependence of all biological (and some abiological) entities and their essential diversity. Whereas Libertarian Extension can be thought of as flowing from a political reflection of the natural world, Ecologic Extension is best thought of as a scientific reflection of the natural world. Ecological Extension is roughly the same classification of Smith's eco-holism, and it argues for the intrinsic value inherent in collective ecological entities like ecosystems or the global environment as a whole entity. Holmes Rolston, among others, has taken this approach.

This category might include James Lovelock's Gaia hypothesis; the theory that the planet earth alters its geo-physiological structure over time in order to ensure the continuation of an equilibrium of evolving organic and inorganic matter. The planet is characterized as a unified, holistic entity with ethical worth of which the human race is of no particular significance in the long run.

Conservation ethics

Marshall's category of 'conservation ethics' is an extension of use-value into the non-human biological world. It focuses only on the worth of the environment in terms of its utility or usefulness to humans. It contrasts the intrinsic value ideas of 'deep ecology', hence is often referred to as 'shallow ecology', and generally argues for the preservation of the environment on the basis that it has extrinsic value – instrumental to the welfare of human beings. Conservation is therefore a means to an end and purely concerned with mankind and inter-generational considerations. It could be argued that it is this ethic that formed the underlying arguments proposed by Governments at the Kyoto summit in 1997 and three agreements reached in Rio in 1992.

Humanist theories

Following the bio-centric and eco-holist theory distinctions, Michael Smith further classifies Humanist theories as those that require a set of criteria for moral status and ethical worth, such as sentience. This applies to the work of Peter Singer who advocated a hierarchy of value similar to the one devised by Aristotle which relies on the ability to reason. This was Singer's solution to the problem that arises when attempting to determine the interests of a non-sentient entity such as a garden weed.

Singer also advocated the preservation of "world heritage sites," unspoilt parts of the world that acquire a "scarcity value" as they diminish over time. Their preservation is a bequest for future generations as they have been inherited from our ancestors and should be passed down to future generations so they can have the opportunity to decide whether to enjoy unspoilt countryside or an entirely urban landscape. A good example of a world heritage site would be the tropical rainforest, a very specialist ecosystem that has taken centuries to evolve. Clearing the rainforest for farmland often fails due to soil conditions, and once disturbed, can take thousands of years to regenerate.

Applied theology

The Christian world view sees the universe as created by God, and humankind accountable to God for the use of the resources entrusted to humankind. Ultimate values are seen in the light of being valuable to God. This applies both in breadth of scope - caring for people (Matthew 25) and environmental issues, e.g. environmental health (Deuteronomy 22.8; 23.12-14) - and dynamic motivation, the love of Christ controlling (2 Corinthians 5.14f) and dealing with the underlying spiritual disease of sin, which shows itself in selfishness and thoughtlessness. In many countries this relationship of accountability is symbolised at harvest thanksgiving. (B.T. Adeney : Global Ethics in New Dictionary of Christian Ethics and Pastoral Theology 1995 Leicester)

Anthropocentrism

Anthropocentrism simply places humans at the centre of the universe; the human race must always be its own primary concern. It has become customary in the Western tradition to consider only our species when considering the environmental ethics of a situation. Therefore, everything else in existence should be evaluated in terms of its utility for us, thus committing speciesism. All environmental studies should include an assessment of the intrinsic value of non-human beings. In fact, based on this very assumption, a philosophical article has explored recently the possibility of humans' willing extinction as a gesture toward other beings. The authors refer to the idea as a thought experiment that should not be understood as a call for action.

What anthropocentric theories do not allow for is the fact that a system of ethics formulated from a human perspective may not be entirely accurate; humans are not necessarily the centre of reality. The philosopher Baruch Spinoza argued that we tend to assess things wrongly in terms of their usefulness to us. Spinoza reasoned that if we were to look at things objectively we would discover that everything in the universe has a unique value. Likewise, it is possible that a human-centred or anthropocentric/androcentric ethic is not an accurate depiction of reality, and there is a bigger picture that we may or may not be able to understand from a human perspective.

Peter Vardy distinguished between two types of anthropocentrism. A strong thesis anthropocentric ethic argues that humans are at the center of reality and it is right for them to be so. Weak anthropocentrism, however, argues that reality can only be interpreted from a human point of view, thus humans have to be at the centre of reality as they see it.

Another point of view has been developed by Bryan Norton, who has become one of the essential actors of environmental ethics through his launching of what has become one of its dominant trends: environmental pragmatism. Environmental pragmatism refuses to take a stance in the dispute between the defenders of anthropocentrist ethics and the supporters of non anthropocentrist ethics. Instead, Norton prefers to distinguish between *strong anthropocentrism* and *weak-or extended-anthropocentrism* and develops the idea that only the latter is capable of not underestimating the diversity of instrumental values that humans may derive from the natural world.

A recent view relates anthropocentrism to the future of life. Biotic ethics are based on the human identity as part of gene/protein organic life whose effective purpose is self-propagation. This implies a human purpose to secure and propagate life. Humans are central because only we can secure life beyond the duration of the Sun, possibly for trillions of eons. Biotic ethics values life itself, as embodied in biological structures and processes. Humans are special because we can secure the future of life on cosmological scales. In particular, humans can continue sentient life that enjoys its existence, adding further motivation to propagate life. Humans can secure the future of life, and this future can give human existence a cosmic purpose.

Status of the field

Environmental ethics became a subject of sustained academic philosophic reflection in the 1970s. Throughout the 1980s it remained marginalized within the discipline of philosophy, attracting the attention of a fairly small group of thinkers spread across the world.

Only after 1990 did the field gain institutional recognition at programs such as Colorado State University, the University of Montana, Bowling Green State University, and the University of North Texas. In 1991, Schumacher College of Dartington, England, was founded and now provides an MSc in Holistic Science.

These programs began to offer a masters degree with a specialty in environmental ethics/philosophy. Beginning in 2005 the Department of Philosophy and Religion Studies at the University of North Texas offered a PhD program with a concentration in environmental ethics/philosophy.

In Germany, the University of Greifswald has recently established an international program in Landscape Ecology & Nature Conservation with a strong focus on environmental ethics. In 2009, the University of Munich and Deutsches Museumfounded the Rachel Carson Center for Environment and Society, an international, interdisciplinary center for research and education in the environmental humanities.

RAIN WATER HARVESTING

Rainwater harvesting is the accumulation and deposition of rainwater for reuse before it reaches the aquifer. Uses include water for garden, water for livestock, water for irrigation, and indoor heating for houses etc. In many places the water collected is just redirected to a deep pit with percolation. The harvested water can be used as drinking water as well as for storage and other purpose like irrigation.

Advantages

Rainwater harvesting provides an independent water supply during regional water restrictions and in developed countries is often used to supplement the main supply. It provides water when there is a drought, can help mitigate flooding of low-lying areas, and reduces demand on wells which may enable ground water levels to be sustained. It also helps in the availability of potable water as rainwater is substantially free of salinity and other salts.

Quality

The concentration of contaminants is reduced significantly by diverting the initial flow of run-off water to waste.[1] Improved water quality can also be obtained by using a floating draw-off mechanism (rather than from the base of the tank) and by using a series of tanks, with draw from the last in series. The stored rainwater may need to be analyzed properly before use in a way appropriate to ensure its safe use

The quality of collected rainwater is generally better than that of surface water. Contamination is always possible by airborne dust and mists, bird feces, and other debris, so some treatment may be necessary, depending on how the water will be used.

System setup

Rainwater harvesting systems can be installed with minimal skills. The system should be sized to meet the water demand throughout the dry season since it must be big enough to support daily water consumption. Specifically, the rainfall capturing area such as a building roof must be large enough to maintain adequate flow. The water storage tank size should be large enough to contain the captured water.

Rain water harvesting by freshwater flooded forests

Rain water harvesting is possible by growing fresh water flooded forests without losing the income from the used /submerged land. The main purpose of the rain water harvesting is to utilize the locally available rain water to meet water requirements throughout the year without the need of huge capital expenditure. This would facilitate availability of uncontaminated water for domestic, industrial and irrigation needs.

New approaches

Instead of using the roof for catchment, the RainSaucer, which looks like an upside down umbrella, collects rain straight from the sky. This decreases the potential for contamination and makes potable water for developing countries a potential application. Other applications of this free standing rainwater collection approach are sustainable gardening and small plot farming.

A Dutch invention called the Groasis Waterbox is also useful for growing trees with harvested and stored dew and rainwater.

History

Around the third century BC, the farming communities in Baluchistan (in present-dayPakistan, Afghanistan and Iran), and Kutch (in present-day India) used rainwater harvesting for irrigation.

In ancient Tamil Nadu (India), rainwater harvesting was done by Chola kings. Rainwater from the Brihadeeswarar temple was collected in Sivaganga tank. During the later Chola period, the Vīrānam tank was built (1011 to 1037 CE) in Cuddalore district of Tamil Nadu to store water for drinking and irrigation purposes. Vīrānam is a 16-kilometre (9.9 mi) long tank with a storage capacity of 1,465,000,000 cubic feet (41,500,000 m^3).

Rainwater harvesting was done in the Indian states of Madhya Pradesh, Maharashtra, and Chhattisgarh in the olden days. Ratanpur, in the state of Chhattisgarh, had around 150 ponds. Most of the tanks or ponds were utilised in agriculture works.

Present day

Currently in China and Brazil rooftop rainwater harvesting is being practiced for providing drinking water, domestic water, water for livestock, water for small irrigation and a way to replenish ground water levels. Gansu province in China and semi-arid north east Brazil have the largest rooftop rainwater harvesting projects ongoing.

In Bermuda, the law requires all new construction to include rainwater harvesting adequate for the residents.

The U.S. Virgin Islands have a similar law.

In Senegal and Guinea-Bissau, the houses of the Diola-people are frequently equipped with homebrew rainwater harvesters made from local, organic materials.

In the Irrawaddy Delta of Myanmar, the groundwater is saline and communities rely on mud-lined rainwater ponds to meet their drinking water needs throughout the dry season. Some of these ponds are centuries old and are treated with great reverence and respect.

In the United States: until 2009 in Colorado, water rights laws almost completely restricted rainwater harvesting; a property owner who captured rainwater was deemed to be stealing it from those who have rights to take water from the watershed. Now, residential well owners that meet certain criteria may obtain a permit to install a *rooftop precipitation collection system* (SB 09-080). Up to 10 large scale pilot studies may also be permitted (HB 09-1129). The main factor in persuading the Colorado Legislature to change the law was a 2007 study that found that in an average year, 97% of the precipitation that fell in Douglas County, in the southern suburbs of Denver, never reached a stream—it was used by plants or evaporated on the ground. In Colorado you cannot even drill a water well unless you have at least 35 acres. In New Mexico, rainwater catchment is mandatory for new dwellings in Santa Fe. Texas offers a sales tax exemption on the purchase of rainwater harvesting equipment. Both Texas and Ohio allow the practice even for potable purposes. Oklahoma passed the Water for 2060 Act in 2012, to promote pilot projects for rainwater and gray water use among other water saving techniques.

In Beijing, some housing societies are now adding rain water in their main water sources after proper treatment.

In Ireland, Professor Micheal Mcginley established a project to design a rain water harvesting prototype in the Biosystems design Challenge Module at University College Dublin

India

In the state of Tamil Nadu, rainwater harvesting was made compulsory for every building to avoid ground water depletion. It proved excellent results within five years, and every states took it as role model. Since its implementation,Chennai saw a 50 percent rise in water level in five years and the water quality significantly improved.

In Rajasthan, rainwater harvesting has traditionally been practiced by the people of the Thar Desert. There are many ancient water harvesting systems in Rajasthan, which have now been revived .Water harvesting systems are widely used in other areas of Rajasthan as well, for example the chauka system from the Jaipur district

Kerala:

At present, in Pune (in Maharashtra), rainwater harvesting is compulsory for any new society to be registered.

An attempt has been made at Dept. of Chemical Engineering, IISc, Bangalore [1] to harvest rainwater using upper surface of a solar still, which was used for water distillation.

Sri Lanka

Rainwater harvesting has been a popular method of obtaining water for agriculture and for drinking purposes in rural homes.

The legislation to promote rainwater harvesting was enacted through the Urban Development Authority (Amendment) Act, No. 36 of 2007.

Lanka rainwater harvesting forum is leading the Sri Lanka's initiative.

United Kingdom

In the United Kingdom, water butts are often found in domestic gardens to collect rainwater, which is then used to water the garden. However, the British government's Code For Sustainable Homes encourages fitting large underground tanks to new-build homes to collect rainwater for flushing toilets, washing clothes, watering the garden, and washing cars. This reduces by 50% the amount of mains water used by the home.

Israel

The Southwest Center for the Study of Hospital and Healthcare Systems in cooperation with Rotary International is sponsoring a rainwater harvesting model program across the country. The first rainwater catchment system was installed at an elementary school in Lod, Israel. The project is looking to expand to Haifa in its third phase. The Southwest Center has also partnered with the Water Resources Action Project (WRAP) of Washington D.C. WRAP currently has rainwater harvesting projects in the West Bank.

MAINTENANCE OF GROUNDWATER

Groundwater is the water located beneath the earth's surface in soil pore spaces and in the fractures of rock formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is recharged from, and eventually flows to, the surface naturally; natural discharge often occurs at springs and seeps, and can form oases or wetlands. Groundwater is also often withdrawn for agricultural, municipal, and industrial use by constructing and operating extraction wells. The study of the distribution and movement of groundwater is hydrogeology, also called groundwater hydrology.

Typically, groundwater is thought of as liquid water flowing through shallow aquifers, but, in the technical sense, it can also include soil moisture, permafrost (frozen soil), immobile water in very low permeability bedrock, and deep geothermal or oil formation water. Groundwater is hypothesized to provide lubrication that can possibly influence the movement of faults. It is likely that much of the Earth's subsurface contains some water, which may be mixed with other fluids in some instances. Groundwater may not be confined only to the Earth. The formation of some of the landforms observed on Mars may have been influenced by groundwater. There is also evidence that liquid water may also exist in the subsurface of Jupiter's moon Europa.

Aquifer

An *aquifer* is a layer of porous substrate that contains and transmits groundwater. When water can flow directly between the surface and the saturated zone of an aquifer, the aquifer is unconfined. The deeper parts of unconfined aquifers are usually more saturated since gravity causes water to flow downward.

The upper level of this saturated layer of an unconfined aquifer is called the *water table* or *phreatic surface*. Below the water table, where in general all pore spaces are saturated with water, is the phreatic zone.

Substrate with low porosity that permits limited transmission of groundwater is known as an *aquitard*. An *aquiclude* is a substrate with porosity that is so low it is virtually impermeable to groundwater.

A *confined aquifer* is an aquifer that is overlain by a relatively impermeable layer of rock or substrate such as an aquiclude or aquitard. If a confined aquifer follows a downward grade from its *recharge zone*, groundwater can become pressurized as it flows. This can create artesian wells that flow freely without the need of a pump and rise to a higher elevation than the static water table at the above, unconfined, aquifer.

The characteristics of aquifers vary with the geology and structure of the substrate and topography in which they occur. In general, the more productive aquifers occur in sedimentary geologic formations. By comparison, weathered and fractured crystalline rocks yield smaller quantities of groundwater in many environments. Unconsolidated to poorly cemented alluvial materials that have accumulated as valley-filling sediments in major river valleys and geologically subsiding structural basins are included among the most productive sources of groundwater.

Polluted ground water is less visible, but more difficult to clean up, than pollution in rivers and lakes. Ground water pollution most often results from improper disposal of wastes on land. Major sources include industrial and household chemicals and garbage landfills, industrial waste lagoons, tailings and process wastewater from mines, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic systems. Polluted groundwater is mapped by sampling soils and groundwater near suspected or known sources of pollution, to determine the extent of the pollution, and to aid in the design of groundwater remediation systems. Preventing groundwater pollution near potential sources such as landfills requires lining the bottom of a landfill with watertight materials, collecting any leachate with drains, and keeping rainwater off any potential contaminants, along with regular monitoring of nearby groundwater to verify that contaminants have not leaked into the groundwater.

The danger of pollution of municipal supplies is minimized by locating wells in areas of deep ground water and impermeable soils, and careful testing and monitoring of the aquifer and nearby potential pollution sources.

Certain problems have beset the use of groundwater around the world. Just as river waters have been over-used andpolluted in many parts of the world, so too have aquifers. The big difference is that aquifers are out of sight. The other major problem is that water management agencies, when calculating the "sustainable yield" of aquifer and river water, have often counted the same water twice, once in the aquifer, and once in its connected river. This problem, although understood for centuries, has persisted, partly through inertia within government agencies. In Australia, for example, prior to the statutory reforms initiated by the Council of Australian Governments water reform framework in the 1990s, many Australian states managed groundwater and surface water through separate government agencies, an approach beset by rivalry and poor communication.

In general, the time lags inherent in the dynamic response of groundwater to development have been ignored by water management agencies, decades after scientific understanding of the issue was consolidated. In brief, the effects of groundwater overdraft (although undeniably real) may take decades or centuries to manifest themselves. In a classic study in 1982, Bredehoeft and colleagues[7] modeled a situation where groundwater extraction in an intermontane basin withdrew the entire annual recharge, leaving 'nothing' for the natural groundwater-dependent vegetation community. Even when the borefield was situated close to the vegetation, 30% of the original vegetation demand could still be met by the lag inherent in the system after 100 years. By year 500, this had reduced to 0%, signalling complete death of the groundwater-dependent vegetation. The science has been available to make these calculations for decades; however, in general water management agencies have ignored effects that will appear outside the rough timeframe of political elections (3 to 5 years). Marios Sophocleous argued strongly that management agencies must define and use appropriate timeframes in groundwater planning. This will mean calculating groundwater withdrawal permits based on predicted effects decades, sometimes centuries in the future.

As water moves through the landscape, it collects soluble salts, mainly sodium chloride. Where such water enters the atmosphere through evapotranspiration, these salts are left behind.

In irrigation districts, poor drainage of soils and surface aquifers can result in water tables' coming to the surface in low-lying areas. Major land degradation problems of soil salinity and water logging result, combined with increasing levels of salt in surface waters. As a consequence, major damage has occurred to local economies and environments.

Four important effects are worthy of brief mention. First, flood mitigation schemes, intended to protect infrastructure built on floodplains, have had the unintended consequence of reducing aquifer recharge associated with natural flooding. Second, prolonged depletion of groundwater in extensive aquifers can result in land subsidence, with associated infrastructure damage – as well as, third, saline intrusion. Fourth, draining acid sulphate soils, often found in low-lying coastal plains, can result in acidification and pollution of formerly freshwater and estuarine streams.

Another cause for concern is that groundwater drawdown from over-allocated aquifers has the potential to cause severe damage to both terrestrial and aquatic ecosystems – in some cases very conspicuously but in others quite imperceptibly because of the extended period over which the damage occurs.

Groundwater is a highly useful and often abundant resource. However, over-use, or**overdraft**, can cause major problems to human users and to the environment. The most evident problem (as far as human groundwater use is concerned) is a lowering of the water table beyond the reach of existing wells. As a consequence, wells must be drilled deeper to reach the groundwater; in some places (e.g., California, Texas, and India) the water table has dropped hundreds of feet because of extensive well pumping. In the Punjab region of India, for example, groundwater levels have dropped 10 meters since 1979, and the rate of depletion is accelerating.[13] A lowered water table may, in turn, cause other problems such as groundwater-related subsidence and saltwater intrusion.

Groundwater is also ecologically important. The importance of groundwater to ecosystems is often overlooked, even by freshwater biologists and ecologists. Groundwaters sustain rivers, wetlands, and lakes, as well as subterranean ecosystems within karst or alluvial aquifers.

Not all ecosystems need groundwater, of course. Some terrestrial ecosystems – for example, those of the open deserts and similar arid environments – exist on irregular rainfall and the moisture it delivers to the soil, supplemented by moisture in the air. While there are other terrestrial ecosystems in more hospitable environments where groundwater plays no central role, groundwater is in fact fundamental to many of the world's major ecosystems. Water flows between groundwaters and surface waters. Most rivers, lakes, and wetlands are fed by, and (at other places or times) feed groundwater, to varying degrees. Groundwater feeds soil moisture through percolation, and many terrestrial vegetation communities depend directly on either groundwater or the percolated soil moisture above the aquifer for at least part of each year. Hyporheic zones (the mixing zone of streamwater and groundwater) and riparian zones are examples of ecotones largely or totally dependent on groundwater.

Subsidence

Subsidence occurs when too much water is pumped out from underground, deflating the space below the above-surface, and thus causing the ground to collapse. The result can look like craters on plots of land. This occurs because, in its natural equilibrium state, the hydraulic pressure of groundwater in the pore spaces of the aquifer and the aquitard supports some of the weight of the overlying sediments. When groundwater is removed from aquifers by excessive pumping, pore pressures in the aquifer drop and compression of the aquifer may occur. This compression may be partially recoverable if pressures rebound, but much of it is not. When the aquifer gets compressed, it may cause land subsidence, a drop in the ground surface. The city of New Orleans, Louisiana is actually below sea level today, and its subsidence is partly caused by removal of groundwater from the various aquifer/aquitard systems beneath it. In the first half of the 20th century, the city of San Jose, California dropped 13 feet from land subsidence caused by overpumping; this subsidence has been halted with improved groundwater management.

Seawater intrusion

In general, in very humid or undeveloped regions, the shape of the water table mimics the slope of the surface. The recharge zone of an aquifer near the seacoast is likely to be inland, often at considerable distance. In these coastal areas, a lowered water table may induce sea water to reverse the flow toward the land. Sea water moving inland is called a saltwater intrusion. In alternative fashion, salt from mineral beds may leach into the groundwater of its own accord.

Pollution of ground water

Water pollution of groundwater, from pollutants released to the ground that can work their way down into groundwater, can create a contaminant plume within an aquifer. Movement of water and dispersion within the aquifer spreads the pollutant over a wider area, its advancing boundary often called a plume edge, which can then intersect with groundwater wells or daylight into surface water such as seeps andsprings, making the water supplies unsafe for humans and wildlife. The interaction of groundwater contamination with surface waters is analyzed by use of hydrology transport models.

The stratigraphy of the area plays an important role in the transport of these pollutants. An area can have layers of sandy soil, fractured bedrock, clay, or hardpan. Areas of karst topography on limestone bedrock are sometimes vulnerable to surface pollution from groundwater. Earthquake faults can also be entry routes for downward contaminant entry. Water table conditions are of great importance for drinking water supplies, agricultural irrigation, waste disposal (including nuclear waste), wildlife habitat, and other ecological issues.

In the US, upon commercial real estate property transactions both groundwater and soil are the subjects of scrutiny, with aPhase I Environmental Site Assessment normally being prepared to investigate and disclose potential pollution issues. In the San Fernando Valley of California, real estate contracts for property transfer below the Santa Susana Field Laboratory(SSFL) and eastward have clauses releasing the seller from liability for groundwater contamination consequences from existing or future pollution of the Valley Aquifer.

Love Canal was one of the most widely known examples of groundwater pollution. In 1978, residents of the Love Canal neighborhood in upstate New York noticed high rates of cancer and an alarming number of birth defects. This was eventually traced to organic solvents and dioxins from an industrial landfill that the neighborhood had been built over and around, which had then infiltrated into the water supply and evaporated in basements to further contaminate the air. Eight hundred families were reimbursed for their homes and moved, after extensive legal battles and media coverage.

Another example of widespread groundwater pollution is in the Ganges Plain of northern India and Bangladesh where severe contamination of groundwater by naturally occurring arsenic affects 25% of water wells in the shallower of two regional aquifers. The pollution occurs because aquifer sediments contain organic matter that generates anaerobicconditions in the aquifer. These conditions result in the microbial dissolution of iron oxides in the sediment and, thus, the release of the arsenic, normally strongly bound to iron oxides, into the water. As a consequence, arsenic-rich groundwater is often iron-rich, although secondary processes often obscure the association of dissolved arsenic and dissolved iron.

ACID RAIN

When atmospheric water droplet combine with a range of man-made chemical air pollutants, acid rain is formed. Other form of precipitation like snow may also be acidic for similar reasons. The main pollutants involved are oxide of nitrogen and sulphur. In nature volcanoes, fires and decomposing matter emits these substances in small amounts. However, since the advent of the industrial revolution, human activities have been releasing such pollutants in large quantities. Such emissions are very high in the major industrial centres and have been increasing rapidly since the mid-twentieth century.

Automobiles, coal and oil fired power stations are major sources of acid-forming compounds. In fact, any burning of coal, oil and (to a lesser extent) natural gas produces these compounds. Acid rain ultimately falls on the ground, some time hundreds of kilometers from the area in which it is formed and generally one to four days later. The effects of such acid rain are generally quite damaging.

Effect of acid rain: when soil is acidified, it lead to a loss of productivity. The acidification damage plant roots and they are not able to draw enough nutrients to survive and grow.

When trees, particularly conifers are exposed to acid rain for several years, they begins to lose their leaves and die. This is one of several reasons for the decline of forests in Europe North America and Japan. Plants like orchids, likens and mosses are particularly sensitive to acid fallout. Acid rain harms people directly when they breath in the acidic air. Acid rain can also harm people indirectly when they eat fish caught in affected lakes or rivers.

Old buildings are also threatened by acid rain. Acid fallout has caused the famous St. Paul's Cathedral in London to decay more I the last 50 years than it has I the previous two centuries. Some famous statues, such as Lincoln Memorial and Michaelangelo's statues of Marcus Aurelius, have started deteriorating because of the effects of acid rain. The same is true of many historic building in Europe. The Taj Mahal is also threatened by acid rain caused by factories in Agra. Thanks to the orders of the Supreme court many of these industries have been shifted of closed down.

A side effect of acid rain is the leaching of aluminium out of the soil into water bodies. Aluminium is toxic for fish and the birds that prey on them. Sometimes acidification leads to the leaching of cadmium and this can also have adverse effects on animals.

CARBON CREDITS

A **carbon credit** is a generic term for any tradable certificate or permit representing the right to emit one tonne of carbon dioxide or the mass of another greenhouse gas with a carbon dioxide equivalent (tCO_2e) equivalent to one tonne of carbon dioxide.

Carbon credits and carbon markets are a component of national and international attempts to mitigate the growth in concentrations of greenhouse gases (GHGs). One carbon credit is equal to one metric tonne of carbon dioxide, or in some markets, carbon dioxide equivalent gases. Carbon trading is an application of an emissions trading approach. Greenhouse gas emissions are capped and then markets are used to allocate the emissions among the group of regulated sources.

The goal is to allow market mechanisms to drive industrial and commercial processes in the direction of low emissions or less carbon intensive approaches than those used when there is no cost to emitting carbon dioxideand other GHGs into the atmosphere. Since GHG mitigation projects generate credits, this approach can be used to finance carbon reduction schemesbetween trading partners and around the world.

There are also many companies that sell carbon credits to commercial and individual customers who are interested in lowering their carbon footprint on a voluntary basis. These carbon off setters purchase the credits from an investment fund or a carbon development company that has aggregated the credits from individual projects. Buyers and sellers can also use an exchange platform to trade, such as the Carbon Trade Exchange, which is like a stock exchange for carbon credits. The quality of the credits is based in part on the validation process and sophistication of the fund or development company that acted as the sponsor to the carbon project. This is reflected in their price; voluntary units typically have less value than the units sold through the rigorously validatedClean Development Mechanism.

Definition

The Collins English Dictionary defines a carbon credit as "*a certificate showing that a government or company has paid to have a certain amount of carbon dioxide removed from the* *environment*". The Environment Protection Authority of Victoria defines a carbon credit as a "*generic term to assign a value to a reduction or offset of greenhouse gas emissions.. usually equivalent to one tonne of carbon dioxide equivalent (CO2-e).*"

The Investopedia Inc investment dictionary defines a carbon credit as a "*permit that allows the holder to emit one ton of carbon dioxide*"..which "*can be traded in the international market at their current market price*".

Types

There are two main markets for carbon credits; Compliance Market credits Secondary / Verified Market credits (VERs)

Background

The burning of fossil fuels is a major source of greenhouse gas emissions, especially for power, cement, steel, textile, fertilizer and many other industries which rely on fossil fuels (coal, electricity derived from coal, natural gas and oil). The major greenhouse gases emitted by these industries are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons(HFCs), etc., all of which increase the atmosphere's ability to trap infrared energy and thus affect the climate.

The concept of carbon credits came into existence as a result of increasing awareness of the need for controlling emissions. The IPCC (Intergovernmental Panel on Climate Change) has observed that:

Policies that provide a real or implicit price of carbon could create incentives for producers and consumers to significantly invest in low-GHG products, technologies and processes. Such policies could include economic instruments, government funding and regulation,

while noting that a tradable permit system is one of the policy instruments that has been shown to be environmentally effective in the industrial sector, as long as there are reasonable levels of predictability over the initial allocation mechanism and long-term price.

The mechanism was formalized in the Kyoto Protocol, an international agreement between more than 170 countries, and the market mechanisms were agreed through the subsequent Marrakesh Accords. The mechanism adopted was similar to the successful US Acid Rain Program to reduce some industrial pollutants.

Emission allowances

Under the Kyoto Protocol, the 'caps' or quotas for Greenhouse gases for the developed Annex 1 countries are known as **Assigned Amounts** and are listed in Annex B. The quantity of the initial assigned amount is denominated in individual units, called Assigned amount units (AAUs), each of which represents an allowance to emit one metric tonne of carbon dioxide equivalent, and these are entered into the country's national registry.

In turn, these countries set quotas on the emissions of installations run by local business and other organizations, generically termed 'operators'. Countries manage this through their national registries, which are required to be validated and monitored for compliance by the UNFCCC.[11] Each operator has an allowance of credits, where each unit gives the owner the right to emit one metric tonne of carbon dioxide or other equivalent greenhouse gas. Operators that have not used up their quotas can sell their unused allowances as carbon credits, while businesses that are about to exceed their quotas can buy the extra allowances as credits, privately or on the open market. As demand for energy grows over time, the total emissions must still stay within the cap, but it allows industry some flexibility and predictability in its planning to accommodate this.

By permitting allowances to be bought and sold, an operator can seek out the most cost-effective way of reducing its emissions, either by investing in 'cleaner' machinery and practices or by purchasing emissions from another operator who already has excess 'capacity'.

Since 2005, the Kyoto mechanism has been adopted for CO_2 trading by all the countries within the European Union under its European Trading Scheme (EU ETS) with the European Commission as its validating authority. From 2008, EU participants must link with the other developed countries who ratified Annex I of the protocol, and trade the six most significant anthropogenic greenhouse gases. In the United States, which has not ratified Kyoto, and Australia, whose ratification came into force in March 2008, similar schemes are being considered.

Kyoto's 'Flexible mechanisms'

A tradable credit can be an emissions allowance or an assigned amount unit which was originally allocated or auctioned by the national administrators of a Kyoto-compliant cap-and-trade scheme, or it can be an offset of emissions. Such offsetting and mitigating activities can occur in any developing country which has ratified the Kyoto Protocol, and has a national agreement in place to validate its carbon project through one of the UNFCCC's approved mechanisms. Once approved, these units are termed Certified Emission Reductions, or CERs. The Protocol allows these projects to be constructed and credited in advance of the Kyoto trading period.

The Kyoto Protocol provides for three mechanisms that enable countries or operators in developed countries to acquire greenhouse gas reduction credits·

- Under Joint Implementation (JI) a developed country with relatively high costs of domestic greenhouse reduction would set up a project in another developed country.
- Under the Clean Development Mechanism (CDM) a developed country can 'sponsor' a greenhouse gas reduction project in a developing country where the cost of greenhouse gas reduction project activities is usually much lower, but the atmospheric effect is globally equivalent. The developed country would be given credits for meeting its emission reduction targets, while the developing country would receive the capital investment and clean technology or beneficialchange in land use.
- Under International Emissions Trading (IET) countries can trade in the international carbon credit market to cover their shortfall in Assigned amount units. Countries with surplus units can sell them to countries that are exceeding their emission targets under Annex B of the Kyoto Protocol.

These carbon projects can be created by a national government or by an operator within the country. In reality, most of the transactions are not performed by national governments directly, but by operators who have been set quotas by their country.

Emission markets

For trading purposes, one allowance or CER is considered equivalent to one metric ton of CO_2 emissions. These allowances can be sold privately or in the international market at the prevailing market price. These trade and settle internationally and hence allow allowances to be transferred between countries. Each international transfer is validated by the UNFCCC. Each transfer of ownership within the European Union is additionally validated by the European Commission.

Climate exchanges have been established to provide a spot market in allowances, as well as futures and options market to help discover a market price and maintain liquidity. Carbon prices are normally quoted in Euros per tonne of carbon dioxide or its equivalent (CO_2e). Other greenhouse gasses can also be traded, but are quoted as standard multiples of carbon dioxide with respect to their global warming potential. These features reduce the quota's financial impact on business, while ensuring that the quotas are met at a national and international level.

Currently there are five exchanges trading in carbon allowances: the European Climate Exchange, NASDAQ OMX Commodities Europe, PowerNext, Commodity Exchange Bratislava and the European Energy Exchange. NASDAQ OMX Commodities Europe listed a contract to trade offsets generated by a CDM carbon project called Certified Emission Reductions (CERs). Many companies now engage in emissions abatement, offsetting, and sequestration programs to generate credits that can be sold on one of the exchanges. At least one private electronic market has been established in 2008: CantorCO2e. Carbon credits at Commodity Exchange Bratislava are traded at special platform - Carbon place.

Managing emissions is one of the fastest-growing segments in financial services in the City of London with a market estimated to be worth about €30 billion in 2007. Louis Redshaw, head of environmental markets at Barclays Capital predicts that "Carbon will be the world's biggest commodity market, and it could become the world's biggest market overall.

Food technology 5th semester 2nd Sessional

Environmental education

MM 25

Note all questions are compulsory

Que 1 Very short answer type questions 5X2

(a) Define noise pollution.

(b) Define soil pollution.

(c) Define waste.

(d) What are wastes from food processing industries.

(e) Define water pollution.

Que 2 Short ans type questions 3X5

(a) Write a note on sources of noise pollution.

(b) Write a note on causes of soil pollution

(c) Write a note on sources of solid waste.