

## UNIT-I

### DEFINITIONS OF ENVIRONMENT

Word 'environment' is most commonly used describing "natural" environment and means the sum of all living and non-living things that surround an organism, or group of organisms. Environment includes all elements, factors, and conditions that have some impact on growth and development of certain organism. Environment includes both biotic and abiotic factors that have influence on observed organism. Abiotic factors such as light, temperature, water, atmospheric gases combine with biotic factors (all surrounding living species). Environment often changes after some time and therefore many organisms have ability to adapt to these changes. However tolerance range is not the same with all species and exposure to environmental conditions at the limit of an certain organism's tolerance range represents environmental stress.

Environmentalism is very important political and social movement with goal to protect nature environment by emphasizing importance of nature role in protection of the environment in combination with various actions and policies oriented to nature preservation. Environmentalism is movement connected with environmental scientists and many of their goals. Some of these goals include:

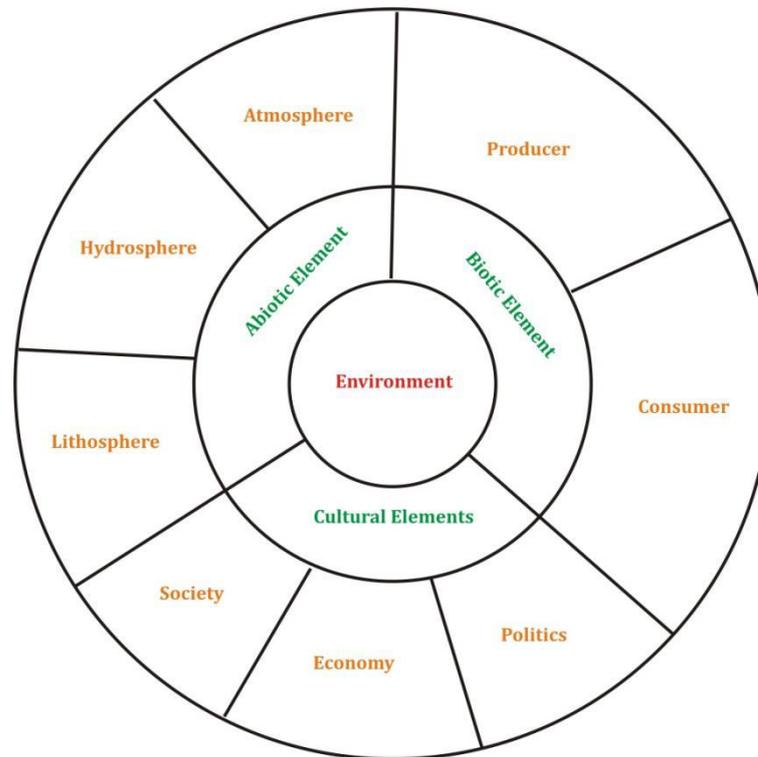
1. to reduce world consumption of fossil fuels-
2. to reduce and clean up all sorts of pollution (air, sea, river...) with future goal of zero pollution
3. emphasis on clean, alternative energy sources that have low carbon emissions
4. sustainable use of water, land, and other scarce resources
5. preservation of existing endangered species
6. protection of biodiversity

1. the aggregate of surrounding things, conditions, or influences; surroundings; milieu.
2. Ecology . the air, water, minerals, organisms, and all other external factors surrounding and affecting a given organism at any time.

An environment is what surrounds a thing or an item. The environment is the surrounding. It could be a physical element - physical environment, that includes the built environment, natural environment - air conditions, water, land, atmosphere etc or it could be human environment - people surrounding the item or thing. This is also known as the social environment and includes elements like the spiritual environment, emotional environment, home, family etc. The environment is a fluid dynamic thing,

The environment is defined as the whole physical and biological systems in which man and other organisms live. Environmental studies involves every issue that affects living organisms. Various interacting components of environment are biology, geology, chemistry, physics, engineering, sociology, health and economics. Positive and realistic planning is needed to balance them. Therefore, environmental science is essentially a multidisciplinary approach.

### Composition of Environment



### Importance of ENVIRONMENT

Our life-support system's health is maintained by all the species that make-up the bio-sphere—from the smallest to the largest (our biodiversity). The survival of all these species are interconnected and dependent on each other. Bacteria and insects break down organic material to produce soil and nutrients so plants can grow. Plants provide oxygen and food for animals and many other benefits. Bees, other insects, and animals pollinate the plants so they can reproduce and keep the cycle going. They also maintain the health of plants and spread their seeds. The actual processes that take place between species and the environment are extremely complex and vulnerable. If humanity causes the extinction of one species--it's really the extinction of many species and the decline of our life-support system, for ourselves and future generations. God's gift must not be taken for granted—it must be cared for. If not; humanity will face the grim consequences of its actions.

Humanity has neglected to factor into the economic equation the tremendous benefits nature provides. Because the environment is our life-support system, it's impossible to truly estimate its value (it's priceless). However, economists and environmental scientists have estimated in dollars what it would cost us to accomplish the services nature provides. Using multiple data bases, they estimate, that nature provides \$33 trillion dollars worth of services every year—that's nearly twice the annual Gross National Product or GNP of all the countries in the world combined) For example, forests prevent soil erosion, landslides, and flooding; maintain the purity of the air and water; affect local and global rainfall; temper climatic fluctuations; and promote watersheds and biodiversity. By retaining the proper moisture content within their foliage and soil, healthy forests prevent local fires from becoming widespread. Unfortunately, this moisture content is declining from over harvesting and fragmentation. Consequently, large-scale fires are becoming increasingly prevalent throughout the world. Other ecosystems like mangroves, wetlands, grasslands, shrubs, deserts, oceans, coral reefs, tundra-arctic regions, and so on provide similar and unique benefits.

Biodiversity provides problem-solving raw materials for shelter and useful products, creates medicines, and allows us to pollinate and maintain healthy crops from being infested with harmful insects and diseases (without the need or hazards of chemicals or genetic engineering, which kill beneficial insects, additional wildlife, and plants). Although tropical forests contain some of the highest

concentration of biodiversity on the planet, we destructively log more than 10 million acres of these forests each year (that's approximately the size of a football field every 4 seconds) and efforts to promote sustainable forestry are largely failing.<sup>2</sup> Scientists agree that the best way to protect biodiversity is to protect and maintain habitat large enough to accommodate a healthy ecosystem—tolerating small fragmented habitats will not preserve ecosystems or their biodiversity.

Approximately 40% of all prescriptions in the U.S. are either based on or synthesized from natural compounds found in microorganisms, plants, and animals.<sup>3</sup> The economic value provided by just plant-based anticancer drugs in the U.S. is over \$250 billion annually.' In addition to nature providing us with penicillin, aspirin, morphine, and steroids; the medicine Taxol, which fights breast and ovarian cancer, comes from the bark of the pacific yew tree; the foxglove plant provides the drug digitalis which boosts the pumping action of weak hearts; and the rosy periwinkle plant is used to fight Hodgkin's disease and childhood leukemia. Other candidates providing promising medicines include deep-sea sponges, tropical cone snails, dogfish sharks, the bark of the Holarrhena tree (found in Asia and Africa), and the plant Chonemerpha macrophylla (located in the foothills of the Himalayas). A microbe found in the hot springs of Yellowstone National Park provided an enzyme for mass-producing DNA. Physician and biochemist Michael Zasloff, "There's so much we don't know about the natural world...And we're destroying large parts of it before we even appreciate our ignorance."

**The National Geographic Society writes:**

The fragile balance of plants and animals that share the Earth took millions of years to develop. Some life-forms have persisted in nearly their original state, surviving episodes of mass extinction. Some, like ourselves, are relative newcomers. The ones that have perished will not return. Neither will the thousands of species that are disappearing—each year due to large part to such human influences as habitat destruction, introduction of invasive species, and overharvesting. If we continue reducing Earth's biodiversity at this rate, the consequences will be profound. The web of life connects the smallest bacterium to the giant redwood and the whale when we put that web in peril, we become agents of calamity.

Furthermore, religions around the world have long understood that the beauty, diversity, and wonder of nature is humanity's physical link with God—encouraging us to develop a spiritual relationship with our Creator. The destruction of this link and our life-support system should enrage all of humanity—especially religious groups—stewards of God's creation.

People who believe exponential growth can go on forever in a finite world is either a madman or an economist --Kenneth Boulding

**Concept of ECOLOGY**

- Ecology (oekologies) - proposed by German biologist - Ernst Haeckel (1869). Greek work oikos-house (place to live), logos-discourse or study.
- Ecology: Relationships between organisms or groups of organisms to their environment.

Ecology (from Greek: oikos, "house; -logia, "study of") is the scientific study of the relations that living organisms have with respect to each other and their natural environment. Topics of interest to ecologists include the composition, distribution, amount (biomass), number, and changing states of organisms within and among ecosystems.

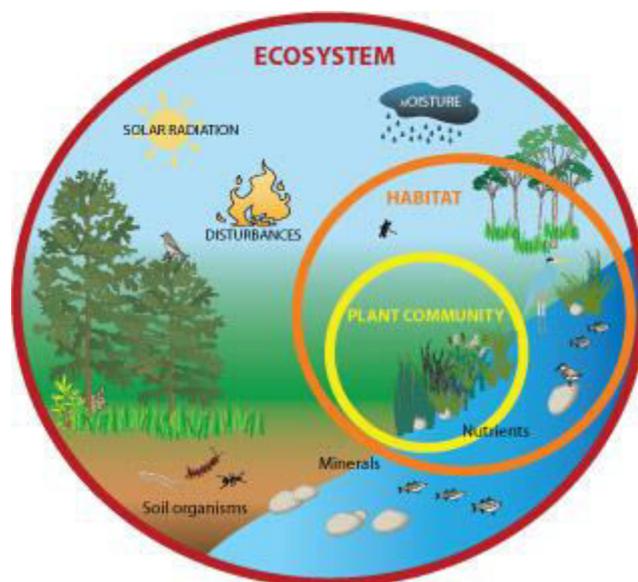
**Ecosystems are composed of dynamically interacting parts including organisms,**

the communities they make up, and the non-living components of their environment. Ecosystem processes, such as primary production, pedogenesis, nutrient cycling, and various niche construction activities, regulate the flux of energy and matter through an environment. These processes are sustained by the biodiversity within them. Biodiversity refers to the varieties of species in ecosystems,

the genetic variations they contain, and the processes that are functionally enriched by the diversity of ecological interactions. Ecology is an interdisciplinary branch of biology. The word "ecology" ("Okologie") was coined in 1866 by the German scientist Ernst Haeckel (1834-191). Ancient Greek philosophers such as Hippocrates and Aristotle laid the foundations of ecology in their studies on natural history. Modern ecology transformed into a more rigorous science in the late 19th century. Evolutionary concepts on adaptation and natural selection became cornerstones of modern ecological theory. Ecology is not synonymous with environment, environmentalism, natural history, or environmental science. It is closely related to physiology, evolutionary biology, genetics, and ethnology. An understanding of how biodiversity affects ecological function is an important focus area in ecological studies. Ecologists seek to explain:

- Life processes and adaptations
- Distribution and abundance of organisms.
- The movement of materials and energy through living communities
- The succession development of ecosystems, and
- The abundance and-distribution of biodiversity-in the content of environment.

Ecology is a human science as well There are many practical applications of ecology in conservation biology, wetland management natural resource management (agriculture, forestry, fisheries), city planning (urban ecology), community health, economics, basic and applied science, and human social interaction (human ecology). Ecosystems maintain biophysical feedback mechanisms that modulate metabolic rates and evolutionary dynamics' between living (biotic) and nonliving (abiotic) components of the planet. Ecosystems sustain life-supporting functions and produce natural capital through the regulation of continental climates, global biogeochemical cycles, water filtration, soils, food, fibers, medicines, erosion control, and many other natural features of scientific, historical, economic, or intrinsic value.



### Environmental Pollution

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy such as noise, heat or light. Pollutants the components of Pollution, can be either foreign substances/energies or naturally occurring contaminants. Pollution is often classed as point source or nonpoint source pollution.

Pollution has been found to be present widely in the environment. There are a number of effects of this:

- Biomagnification describes situations where toxins (such as heavy metals) may pass through trophic levels, becoming exponentially more concentrated in the process.
- Carbon dioxide emissions cause ocean acidification, the ongoing decrease in the pH of the Earth's oceans as CO<sub>2</sub> becomes dissolved.
- The emission of greenhouse gases leads to global warming which affects ecosystems in many ways.
- Invasive species can out-compete native species and reduce biodiversity. Invasive plants can contribute debris and biomass (allelopathy) that can alter soil and chemical compositions of an environment, often reducing native species competitiveness.
- Nitrogen oxides are removed from the air by rain and fertilize land which can change the species composition of ecosystems.
- Smog and haze can reduce the amount of sunlight received by plants to carry out photosynthesis and leads to the production of stratospheric ozone which damages plants.
- Soil can become infertile and unsuitable for plants. This will affect other organisms in the food web.
- Sulfur dioxide and nitrogen oxides can cause acid rain which lowers the pH value of soil.

#### **A. Introduction and definition of environmental pollution —**

We know that, a living organism cannot live by itself. Organisms interact among themselves. Hence, all organisms, such as plants, animals and human beings, as well as the physical surroundings with whom we interact; form a part of our environment. All these constituents of the environment are dependent upon each other. Thus, they maintain balance in nature; As we are the only organisms try to modify environment to fulfill our needs; it is our responsibility to take necessary steps to control the environmental imbalances.

The environmental imbalance gives rise to various environmental problems. Some of the environmental problems are pollution, soil erosion leading to floods, salt deserts and sea recedes, desertification, landslides, change of river directions, extinction of species, and vulnerable ecosystem in place of more complex and stable ecosystems, depletion of natural resources, waste accumulation; deforestation, thinning of ozone layer and global warming. The environmental problems are visualized in terms of pollution, growth in population, development, industrialization, unplanned urbanization etc. Rapid migration and increase in population in the urban areas has also led to traffic congestion, water shortages, solid waste, and air, water and noise pollution are common noticeable problems in almost all the urban areas since last few years.

Environmental pollution is defined as the undesirable change in physical, chemical and biological characteristics of our air, land and water. As a result of over-population, rapid industrializations, and other human activities like agriculture and deforestation etc., earth became loaded with diverse pollutants that were released as by-products. Pollutants are generally grouped under two classes:

- (a) Biodegradable pollutants - Biodegradable pollutants are broken down by the activity of micro-organisms and enter into the biogeochemical cycles. Examples of such pollutants are domestic waste products, urine and faecal matter, sewage, agricultural residue, paper, wood and cloth etc.
- (b) Non-Biodegradable pollutants - Non-biodegradable pollutants are stronger chemical bondages, do not break down into simpler and harmless products. These include various insecticides and other pesticides, mercury, lead, arsenic, aluminum, plastics, radioactive waste etc.

#### **Public participation**

Public participation in environmental decision-making has become an indelible feature of many environmental regulatory systems world-wide over the past few decades. Individuals and organizations affected by development approvals, pollution licenses, land use plans and other types of regulatory processes have increasingly demanded greater consultation, and more transparent and accountable decisions. Parliamentary democracy ratified through periodic electoral contests is widely

viewed as insufficient to provide meaningful public input into day-to-day environmental decision-making. Governing elites' hostility to independent protest and community self-expression has encouraged the creation of 'surrogate political processes', wherein citizens' views are channeled into and considered in alternate administrative and judicial structures. In these structures, public participation assumes a variety of forms. It can occur through education, information dissemination, advisory or review boards, public advocacy, public hearings and submissions, and even litigator. By these means, public participation may assist decision-makers to understand and identify public interest concerns while formulating environmental policies. Greater citizen input may promote environmental justice and help integrate ecological and social considerations in governmental decisions. Further, participation may enhance the accountability, and thus acceptability, of environmental decisions. This may lead to less litigation, fewer delays and generally better implementation, of decisions. Thus, as Lawrence Tribe once warned, the way policy decisions are made has important implementations for the-outcomes-of those decisions Public participation is particularly significant in the context of sustainable development. Sustainability depends largely on the way economic, social and environmental considerations have been integrated in decision-making. The principles of inter and intra generational equity in sustainable development discourse reflect the centrality of public involvement and social justice.

Implementation of the precautionary principle, another part of sustainability discourse, also depends on public, input into the assessment of acceptable risks. Environmental threats, such as climate change or genetically modified organisms, are often characterized by scientific and technical uncertainties and risks for which people often hold very different and competing preferences. Public participation can help assess these uncertainties and risks, and weigh them against perceived benefits. Several interrelated factors have fuelled the growth of participatory processes in decision-making. The first is increased public awareness and concern about the relationships between ecological health and human well-being. Secondly, the growth of human rights in legal and political systems has heightened people's expectations of participation in policy-making.

Thirdly, the prevailing concerns of the international community for 'good governance' and the strengthening of civil societies have contributed to increasing interest in the use of participatory mechanisms. Also, weaknesses in the legitimacy of the state and lack of trust in governments have fuelled popular demands for more grass-roots, direct involvement in decisions.

Different models have been proffered to analyze the range of forms of public participation. One model, known as Arnstein's 'ladder', shows the spectrum of participation opportunities, beginning with mere notification, and extending to consultation and even joint decision-making power. The lowest levels of participation may effectively amount to non-participation. The Highest level of participation, says Arnstein, is where the public has the power to negotiate with decision-makers and to veto. Proposed decisions. Another model of participation distinguishes between 'top-down' and 'bottom-up' approaches. The former is where the government initiates participation, the latter where communities do so. Thirdly, some commentators distinguish between substantive and procedural dimensions of participation. Participatory rights may derive from substantive human rights, such as a right to live in a healthy, unpolluted environment, and may be enshrined in a constitution or statutory bill of rights. By contrast, procedural rights concern the methods of decision-making, and typically encompass public consultation, information provision and access to the courts. Substantive and procedural rights are often intertwined: for instance, a substantive right to a healthy environment usually requires procedural rights to be heard in decisions that might affect those substantive rights.

Law plays a crucial role in all these approaches. Open-ended discursive experiences based on custom or current controversy may be too fragile and insufficient to sustain the desired policy and political transformation. Law can provide two remedial functions in this respect. First, through decision rules and procedures it can enable democratic will to emerge. Secondly through its ability to codify norms and structure institutions, it can effectively channel this political power throughout society, as a force

for social coordination. In other words, law creates a structure for participation that helps crystallize and protect society's environmental goals.

### **Public Awareness**

After the scientific and industrial revolution in the recent past, there has been immense impact of man on his environment. Man has failed to realize that any new factor upsets the balance of the ecosystem as a whole/the environment.

Huge industrial installations every year. introduction of the faster mode of transport, sprouting up large crowded cities (urbanization), changing the food habits, deforestation and decreasing the agricultural land, the main outcomes of the modern civilization: wide spread use of insecticides, pesticides, improper use of fertilizers and chemicals in environment are some others contributing factors which challenged the life of man. animals specially birds and other organisms.

Industries are causing much danger to man's life (causing air pollution), Similarly water pollution, soil pollution, marine pollution, noise pollution, global warming, effects of nuclear hazards etc are some major factors for which public awareness is necessary.

The Active co-operation of every one, at every level of social organizations, scientist-educationists, social workers, politicians, administrators and public is needed for issues concerning environment. Individuals collectively make a society or a state.

Movements, which begin at gram root levels, effects the ideologies and policies of a country or the nation as a whole more effectively than the policies introduced from top to downwards.

When the opinion of the public will change. it will affect the govt. policies, which transform in to actions. Therefore little efforts on the part of each individual shall add up to introduce significant improvements of the environment.

Over exploitation of natural resources is a basic concern for everybody. Food shortage we increase in frequency and severity if population growth, soil erosion and nutrient depletions we continue at the existing rate. Therefore, it is our duty and we can accept the family planning schemes this will not only reduce the population but also solve the problems of food and rehabilitation.

Burning fossil fuels (oil, coal and natural gas), we release carbon-dioxide and other heat absorbing; gases, that cause global warming and may bring about sea level rise and catastrophic climatic changes.

Acid rain is the result of it. Chlorinated compounds such as chlorofluorocarbons used in refrigerator and air conditioner also contribute to global warming as well as damaging the stratospheric ozone that protect us from cancer causing ultraviolet radiations in sunlight. Now a day's everybody talks about environment but how many of us are serious about it. How many of us (from all walks of life) have clear concepts of environment. There must be planning about the effects and control measures of environmental pollution. Govt. should initiate and help by awareness campaigns to save environment.

There should not be the political propoganda but should be the integral part of our educational programmes. By writing on walls the word "save water", "save oil" is not enough for Govt. or people.

We should opt some programmes relating to it. We should discourage to use fuel vehicles, until it is not necessary. For short routes, we should use bicycle; on foot. We should accompany the four seated or so with others over use of water, for cleaning and other purposes should be decreased."

Rain water harvesting is another example for using the rain water instead flowing out. Any government at its own level cannot achieve the goals of sustainable development until the public has a participatory role in it.—

It is only possible only when public aware about the ecological and environmental issues. For example ban the littering of polythene cannot be successful until the public understands the environmental implications of the same.

Public should understand about the fact that if we degrading our environment, we are harming ourselves. This is the duty of we educated people to educate the others about the adverse effect of environment.

For the first time, the attention of general public was attracted at global level when "Earth Summit" in 1992 was held in Rio de Janeiro on environment and development. Later on another world summit on "Sustainable Developmental Johannesburg in 2002 was also held to discuss the environment and aware the public to save the environment.

In these directions, United Nations has organized several conferences in different parts of the world (Stockholm 1972, Vienna 1985, Montreal 1987, Brazil 1992 etc) to work out the action plan from time to time for, fighting with menace of environmental pollution. We should keep the earth green and alive as it provides shelter, food and protective cover. The soil degradation, soil erosion, deforestation, losing wetlands, land conversion etc. are the measure issues which force ourselves to think and aware the public in this regard. Because human himself is responsible for these environmental deterioration. Therefore, it is necessary to check all these destructive processes. Govt. also doing some efforts on national level but still much more has to be done.

The marine ecosystem includes the oceans, seas, sea shores, bays and summaries of the world. The physical factors like waves, tides, currents, salinities, temperature, pressures and sunlight dominate life in the ocean and determine the makeup of biological communities.

These communities have significant effect on biomass, leakage from oil tankers, oil drilling, catchment area (coastline) and rivers polluted the sea water, which effects sensitive flora and fauna, various species of invertebrate, mammals, coral reefs, fishes and other organisms. A Diesel vehicle emits particles in their exhaust which have a diameter less than 10 microns (PM-10). It is easily inhaled. Any amount of these particles in the air is dangerous for health (particularly effects lungs). In India about 20 million people are asthmatics. Mine waste and effluents from mining and metallurgical industries give a number of physical and chemical problems to human beings. Certain other industries like paper and pulp industries, fertilizer industries, explosive industries, soap and detergent industries, chemical industries, food processing industries, textile, tannery, leather, and petroleum industries release/dischARGE undesirable and harmful constituents which are responsible for air and water pollution, causes great public concern. Sewage begins to cause nuisance as it starts to become stale. It is therefore necessary to dispose it off as soon as possible. Proper methods of disposal and its treatment should be applied otherwise causes the chronic diseases. When sewage is applied continuously on a part of land, the pores or voids of the soil are clogged and free circulation of air is prevented. As a result anaerobic conditions are developed in place of aerobic conditions and the land is not capable of taking further sewage load. At this stage, decomposition of sewage takes place offensive gases are produced. This is called the sewage sickness-of land.— --People should aware The noise which is increasing pollution is one of the important factors of environment due to population's explosion, rapid industrializations and urbanizations. We should know the consequences of noise pollutions. Ear drum damage when exposed to very loud and sudden noise. Noise pollution affects human health, comfort and efficiency. It causes contraction of blood vessels, high blood pressure, mental distress, high cholesterol, heart attacks, neurological problems, birth defects, abortion etc. The department of environment realized the importance of creating a sound research base for scientific studies relating to environmental problems. Environmental protection act was introduced in 1976 as the 42nd amendment act in the constitution. Only by celebrating "World Environmental Day" we cannot get rid of this concern. Govt. alone cannot do anything until unless every citizen is aware of the environmental pollution & their effects. This is the time to make aware and motivate each and every individual for environmental consciousness.

### **HARMFUL EFFECTS OF RADIATION POLLUTION**

As radioactive materials decay they produce ionizing radiation, which can damage any living tissue in the human body, notes the U.S. Environmental Protection Agency (EPA). Radioactive materials may be found in microwave ovens, medical X-ray machines and radon gas. However, the most dangerous source of radiation may be nuclear weapons, which can release isotopes that remain in the atmosphere for 100 years- ,Nuclear accidents can create environmental pollution, which is particularly devastating.

#### **Contaminated Water:**

Nuclear accidents may produce fallout which can pollute water supplies for years after the incident, warns the World Health Organization (WHO). The 1986 explosion of a nuclear reactor generator Chernobyl (Ukraine) created a large radioactive cloud which polluted existing water supplies and produced contaminated rain in nine by countries.

#### **Contaminated Soil and Plants:**

Nuclear radiation can contaminate soil, leading to plants which contain radiation and pose a health threat to individuals. Researchers explored the Marshall Islands, an area widely known for nuclear bomb testing by the U.S. military in the 1950s and 1960s. They found that current soil samples and local foods, including coconut meat, contained radiation levels significant enough to pose a health risk to individuals.

**Cancer:** the Chernobyl explosion led to increased prevalence of cancer in young children in Belarus the Russian Federation, and in the U.S. According to the Greenpeace 2006 report, "Chernobyl Catastrophe Consequences on Human Health," over 2 billion people have been exposed to the radioactive fallout, which will result in 250,020 cases of cancer, nearly half of them fatal.

**Brain Damage :**High exposure to radiation early on in gestation can have damaging effects on the brain, notes the U.S. Centers for Disease Control (CDC). Infants between the eighth and 15th weeks a pre whiney who were exposed to the atomic bombs dropped on Hiroshima and Nagasaki during World War 11 were discovered to have a great incidence of brain damage, with side effects including lower IQs and, in some cases, severe mental retardation.

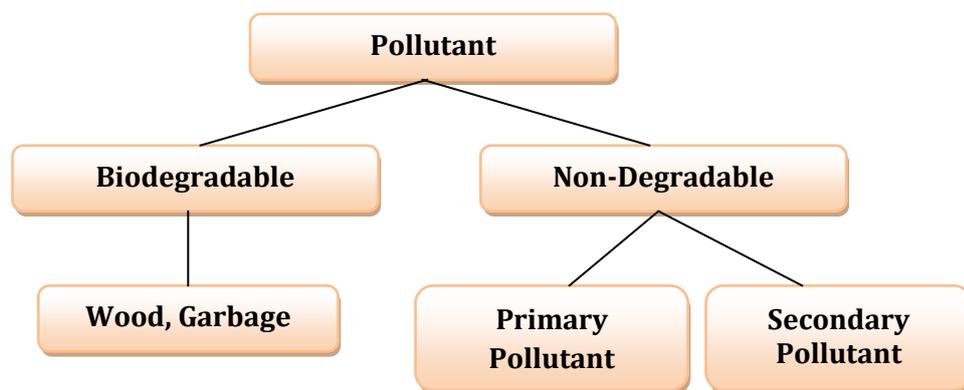
## UNIT-II

### ENVIRONMENTAL POLLUTION

#### WHAT IS POLLUTION

- Pollution is the introduction of harmful substances or products into the environment
- We will be examining following parts of pollution.
  - Water Pollution
  - Air Pollution
  - Land Pollution
  - Noise Pollution
  - Thermal Pollution
  - Nuclear Pollution

#### Types of Pollutant



#### WATER POLLUTION:

##### CAUSES

- Factors that contribute to water pollution can be categorized into two different groups
  - Point sources
  - Non-point sources
- Point sources are the easiest to identify and control
- Non point sources are ambiguously defined and harder to control

##### POINT SOURCES

- Some point sources of water pollution include
  - Waste products from factories
  - Waste from sewage system
  - Waste from power plants
  - Waste from underground coalmines
  - Waste from oil wells
- They are called point sources because they are direct sources of water pollution and can be reduced and monitored

##### NON-POINT SOURCES

- The term non-point source encompasses a large range of sources such as:
  - when rain or snow moves through the ground and picks up pollutants as it moves towards a major body of water
  - the runoff of fertilizers from farm animals and crop land
  - air pollutants getting washed or deposited to earth
  - storm water drainage from lawns, parking lots, and streets

#### AIR POLLUTION:

#### CAUSES

- One of the main causes of air pollution is the release of carbon dioxide into the atmosphere, this happens because of Deforestation and fossil fuel burning
- Sulfur dioxide is another air pollutant and is released into the atmosphere by the burning of sulfur containing compounds of fossil fuels. Sulfur oxides are very dangerous to humans at a high concentration. Sulfur in the atmosphere is responsible for acid rain
- Chlorofluorocarbons (CFCs) also contribute to air pollution by reducing the amount of ozone in the stratosphere. CFCs come from a variety of places such as:
  - the burning of plastic foam items
  - leaking refrigerator equipment
  - spray cans

#### NATURAL AIR POLLUTANTS

- Natural air pollutants can include:
  - Smoke from wild fires
  - Methane released from live stock
  - Volcanic eruptions

#### NOISE POLLUTION -

##### Causes -

- Means of Transportation,
- Industries
- Home Appliances
- Means of Recreation
- Social & religious activity
- Defense equipment
- Mining

##### Effect -

- At the level of audible sound
- At the level of physiology
- At the level of behavior

#### THERMAL POLLUTION -

##### Causes -

- Electricity production plants
- Industrialization
- Traffic
- Nuclear explosion & testing
- Wars
- Deforestation

##### Effect -

- Effect on human being
- Effect on animals
- Effect on vegetation
- Effect on weather and climate

#### NUCLEAR POLLUTION -

##### Causes -

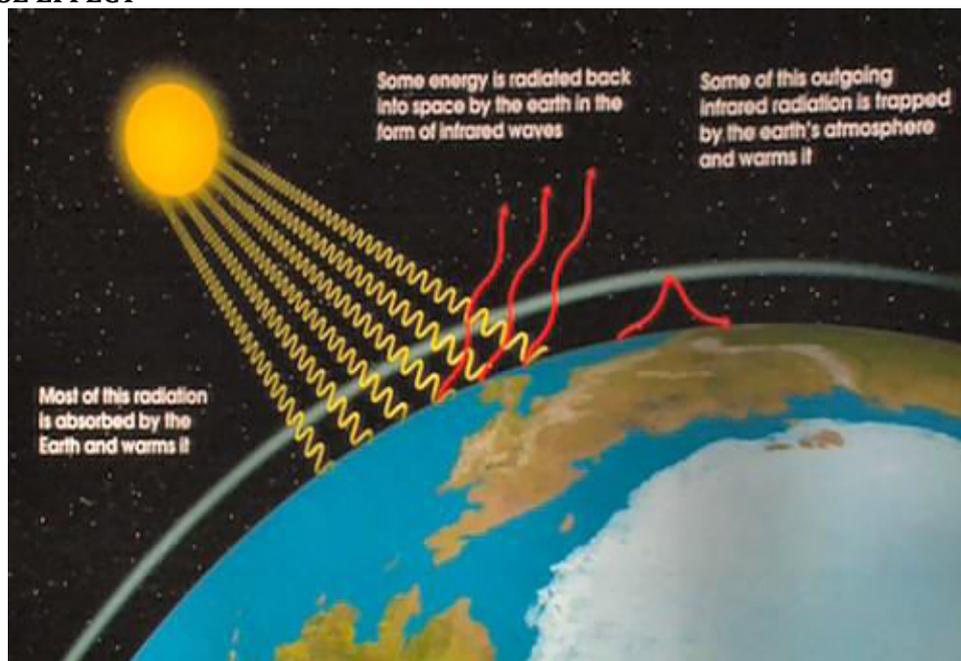
- Natural radiation like sunlight & inhabited radioactive elements & their isotopes
- Nuclear explosion & testing
- Atomic furnaces and fuels
- Atomic power houses
- Nuclear weapons

- Medical technology
- Effect –
- Effect on human being
  - Effect on animals
  - Effect on vegetation
  - Effect on weather and climate

### CONSEQUENCES

- CO<sub>2</sub> is a good transmitter of sunlight, but it also partially restricts infrared radiation going back from the earth into space, which produces the so-called greenhouse effect that prevents a drastic cooling of the Earth during the night
- Increasing the amount of CO<sub>2</sub> in the atmosphere reinforces this effect and is expected to result in a warming of the Earth's surface
- CO<sub>2</sub> in atmosphere → GLOBAL WARMING
- Sulfur dioxide, nitrogen oxides, ozone and peroxyacetyl nitrates (PANs), cause direct damage to leaves of crop plants and trees when they enter leaf pores (stomates)
- Chronic exposure of leaves and needles to air pollutants can also break down the waxy coating that helps prevent excessive water loss and damage from diseases, pests, drought and frost
- "In the midwestern United States crop losses of wheat, corn, soybeans, and peanuts from damage by ozone and acid deposition amount to about \$5 billion a year". (Miller 498)

### GREEN HOUSE EFFECT



### ACID RAIN

- When emissions of sulfur dioxide and nitric oxide from stationary sources are transported long distances by winds, they form secondary pollutants such as nitrogen dioxide, nitric acid vapor, and droplets containing solutions of sulfuric acid, sulfate, and nitrate salts
- These chemicals descend to the earth's surface in wet form as rain or snow and in dry form as a gases fog, dew, or solid particles, it is known as acid rain or acid deposition

### SMOG

- With the introduction of petroleum to replace coal economies in countries, photochemical smog has become predominant in many cities, which are located in sunny, warm, and dry climates with many motor vehicles
- Worst episodes of photochemical smog tends to occur in summer

### **LAND POLLUTION:**

#### **CAUSES**

- Four Main causes of land pollution
  - Construction
  - Agriculture
  - Domestic waste
  - Industrial Waste

#### **CONSTRUCTION**

- Buildings take up resources and land, the trees are chopped down and used to make buildings
- Takes away from places for animals and other organisms to live

#### **AGRICULTURE**

- As there are more and more people inhabiting the earth, food is in higher demand and so forests are chopped down and turned into farmland
- In addition, herbicides, pesticides, artificial fertilizers, animal manure (poop) are washed into the soil and pollute it

#### **DOMESTIC WASTE**

- Tons of domestic waste is dumped every day. Some waste from homes, offices and industries can be recycled or burnt in incinerators
- There is still a lot of garbage, such as refrigerators and washing machines that are dumped in landfills simply because they cannot be reused in anyway, nor recycled

#### **INDUSTRIAL WASTE**

- Plastics factories, chemical plants, oil refineries, nuclear waste disposal activity, large animal farms, coal-fired power plants, metals production factories and other heavy industry all contribute to land pollution

#### **CONSEQUENCES**

- Land pollution exterminates wild life
- Acid rain kills trees and other plants
- The vegetation that provides food and shelter is destroyed
- Land pollution can seriously disrupt the balance of nature, and, in extreme cases, can cause human fatalities
- Pesticides can damage crops; kill vegetation; and poison birds, animals, and fish. Most pesticides kill or damage life forms other than those intended. For example, pesticides used in an effort to control or destroy undesirable vegetation and insects often destroy birds and small animals. Some life forms develop immunity to pesticides used to destroy them

#### **WAYS TO STOP POLLUTION**

- You can help to reduce global air pollution and climate change by:
  - Driving a car that gets at least 35 mpg
  - Walking, biking, and using public transportation
  - Using CFL bulbs over incandescent bulbs
  - Buying only energy efficient appliances
  - Recycling newspaper, aluminum, and others

- Planting trees!
- Avoid purchasing products that contain CFCs
- Supporting much stricter clean air laws and enforcement of international treaties to reduce ozone depletion and slow global warming

#### **NOISE POLLUTION:**

The word noise is derived from the Latin word nausea meaning seasickness. Like its root meaning, noise has a negative effect to human health and well-being. Noise resulting from road traffic, jet planes, jet skis, garbage trucks, construction equipment, manufacturing processes, lawn mowers, leaf blowers, and boom boxes, to name a few, are among the audible litter that are routinely broadcast into the air (Noise, Noise Pollution and Clearinghouse). They interfere with sleep, concentration, communication, and recreation. The potential health effects of noise pollution are numerous, pervasive, persistent, and medically and socially significant. Health problems related to noise include hearing loss, stress, high blood pressure, sleep loss, distraction and lost productivity, and a general reduction in the quality of life and opportunities for tranquility. Noise is among the most pervasive pollutants today, its more severe and widespread than ever before, and it will continue to increase in magnitude and severity because of population growth, urbanization, and the associated growth in the use of increasingly powerful, varied, and highly mobile sources of noise. However, strategies such as noise mitigation and its three distinct methods: control, path control and receptor shielding (Noise Mitigation) can reduce environmental noise.

#### **CAUSES**

We are bombarded with sound even when we live in rural areas. From crop dusters to large farm equipment, we have plenty of sound in the country. In the urban areas, we not only have sound that is produced at unnatural decibel levels, the sound is reflected from hard surfaces that form at every kind of angle. We go to theaters and concerts where the ability to magnify sound has developed in incredible ways. We listen on headphones, where sound is not only concentrated, but the waves pound the eardrums with persistent and unnatural force.

Living next to airports, anywhere in the flight path of departing planes, and near maintenance facilities where engine run ups can blast sound for miles, is another source of unnatural and massive sound. Freeways, busy streets, moving trains, even the noise levels in hospital intensive care rooms, where a patient should be able to expect some peace and quiet are insane.

Sound pollution has resulted in days where there is virtually no period of time when some sound is not expected to intrude into our homes and lives.

The decibel measurement system is a very complicated matter, so for acoustic measurement, the amount of pressure on the eardrum is the important factor.

A decibel level of 225 is considered to be deafening. The most common source of that much sound is an aircraft taking off.

At a level of 130, pain begins. level 130 is also considered to be deafening. Close proximity to pneumatic concrete drills is the most common experience.

At level 110-120, fireworks displays, close proximity to trains, leaf blowers, music concerts, and thunder are recognizable sounds. 110 is the lowest level that is considered to be deafening. Between 90 and 110, we have far more common items: some sirens, passing trucks, trucks without mufflers, car horns, and lawn mowers. The category is "Very Loud".

Between 70 and 90, noise is "loud", and includes noisy restaurants and offices, vacuum cleaners, flush toilets.

### **EFFECT**

Noise has a big impact on people all day every day. But with people not noticing it, makes it hard for anyone to do anything about it. It is causing many different problems to people mentally, socially, and physically. There are many ways to help or prevent it, but these changes are not immediately visible, so they are left unattended to.

Exposure to very loud sounds that are enjoyable, and not technically noise to the listener, can lead to hearing impairment. A survey of hearing was tested among youngsters between the ages of 6 and 19. They found that 1 out of 8 of them suffered a noise-related hearing problem. Teens attend dances, equip vehicles with systems, and even work in loud fast food restaurants. Noises are especially bothersome at night when one is trying to sleep, which is vital to good health. Noise from snowmobiles, jet skis, and supersonic jets has also intruded on the environment, affecting animals' abilities to communicate, protect their young, and mate.

### **MENTAL HEALTH:**

Noise pollution is not believed to be a cause of mental illness, but it is assumed to accelerate and intensify the development of latent mental disorders. Some of these cases would be : anxiety, stress, nervousness, nausea, headache, emotional instability, argumentativeness, sexual impotence, changes in mood, and increase in social conflicts. The news media regularly report violent behavior arising out of disputes over noise which in many cases these disputes ended in injury or death.

### **SOCIAL HEALTH:**

Noise is a prominent feature of the environment including noise from transport, industry, and neighbors. Exposure to transport noise disturbs sleep in the laboratory, but not generally in field studies where adaptation occurs. Noise interferes in complex task performances, modifies social behavior and causes annoyance.

### **PREVENTION**

Follow the below given steps for controlling and preventing noise pollution.

- Control of Noise pollution at Source
- Noise producing industries, railway stations, aerodrome, etc. should be located far away from the residential areas.
- We should play various music systems such as stereos, television, etc. at low volume.
- We should not use loud speakers during night. Even during time they should be used at low volumes.
- Various machines should be well maintained so that they produce less sound.
- It is observed that certain persons blow horns of their vehicles unnecessarily, or remove silencers of the exhaust pipes of vehicles. Such practices produce lot of noise and should be avoided.
- Laws should be framed so that the persons producing unnecessary noise are punished.

Control of Noise Pollution by obstructing the path of Noise

- By constructing soundproof buildings, the menace of sound pollution can be minimized.
- Plants also help in controlling noise pollution because they absorb high frequency sound waves. Thus, planting trees along the roads help in controlling noise pollution.

### **THERMAL POLLUTION:**

Thermal pollution is generally defined as the discharge of heated water into aquatic biomes. But thermal pollution also covers releases of colder than normal water into the aquatic biomes. The general effect is to raise or lower the temperature of the aquatic biome in ways that kill off life that is sensitive

to higher temperatures. If the heated water from industrial operations contains chemicals or radiation that is toxic to life in aquatic biomes, then the problem is compounded.

#### CAUSES

The most common human, or anthropogenic, causes of thermal pollution are coolant release from power production and manufacturing plants, urban runoff from storm drains that carry surface runoff from roads and warmer surfaces, and releases of colder than normal water from reservoirs into rivers and waterways.

In the industrial area, petroleum refineries, pulp/paper mills, chemical plants, steel mills and smelters are the big contributors to thermal heat pollution.

Natural causes include geothermal and volcanic activity, either under the oceans and seas or from above ground lava flow. Lightening strikes can also introduce massive amounts of heat, and the natural progress of warmer currents into colder biomes occur.

#### EFFECT

The effects of thermal pollution include damage to larvae and eggs of fish in rivers where there is a limited tolerance for temperature change. The other effects are on the biodiversity of aquatic biomes due to killing off of some species that are not resistant to temperature change, which disrupts the balance of the food and light chains for plants, fish, bacteria, and microscopic life forms. Fish and macroinvertebrates are most susceptible to temperature changes, as they have the most limited tolerance for sudden excessive heat and cold.

Heat affects the metabolic rate and enzymatic activity of aquatic animals, leading to more eating, which can upset the balance in food availability.

Dissolved oxygen and other chemical changes to the structure of the water are another effect of heat thermal pollution. The heat tends to decrease the amount of dissolved oxygen in the water. Another effect is that living entities attempt to migrate when their environment is untenable. The increased migration of life forms to areas that had a perfect balance can create a fight for limited resources, once the population increases.

#### PREVENTION

What can be done about anthropogenic thermal pollution? There are cooling ponds and towers that store and transition the water to more acceptable temperatures before release. There is also recycling of the heated water to direct it to areas where heat is needed.

Following are the means to reduce thermal pollution:

1. Theoretically, when efficiency of any heat engine is equal to 1.0 then it will convert 100% of heat energy to mechanical energy. So there will be no loss of heat to the environment. This is practically impossible. Rather, we should aim at maximizing the efficiency of heat engines (steam, IC, nuclear etc) so that heat loss is minimum.
2. Reduce mechanical friction in any rotating parts.
3. Avoid consuming energy more than necessity. Burn less coal, oil or gas.
4. Promote use of more nuclear energy because it will not generate Carbon di oxide.
5. One of the major cause of Global warming is increasing concentration of Carbon di oxide, leading to more green house effect. On the other hand, green plants have got the capacity to absorb Carbon di oxide. In the photo synthesis plants take water, sunlight and carbon di oxide to prpduce their food. So, plant as many trees as possible. Massive plantation is the only solution for reducing global carbon di oxide level. Indirect effect of plantation is, It will reduce soil temperature, cause more rains, some of the carbon di oxide shall be dissolved in rain and shall go to the sea - which will ultimately form carbonate rocks and will help in the flora and fauna of the marine life.
5. If we can follow these, certainly we shall be successful in reducing thermal pollution and will be able to prevent the glaciers from melting and rising of sea levels.

Thermal can be prevented very easily. Most of the people who cause thermal pollution are big factories which use the water then pour it back in the ocean. To prevent this all they have to do is just cool the water before they put it back in the ocean.

### **NUCLEAR POLLUTION:**

The **environmental impact of nuclear power** results from the nuclear fuel cycle, operation, and the effects of nuclear accidents.

The routine health risks and greenhouse gas emissions from nuclear fission power are small relative to those associated with coal, but there are "catastrophic risks"<sup>[1]</sup> such as the possibility of over-heated fuel releasing massive quantities of fission products to the environment. The public is sensitive to these risks and there has been considerable public opposition to nuclear power. The 1979 Three Mile Island accident and 1986 Chernobyl disaster, along with high construction costs, ended the rapid growth of global nuclear power capacity.

A major EU funded research study known as ExterneE, or Externalities of Energy, undertaken over the period of 1995 to 2005 found that the environmental and health costs of nuclear power, per unit of energy delivered, was €0.0019/kWh. This is lower than that of many renewable sources including the environmental impact caused by biomass use and the manufacture of photovoltaic solar panels, and was over thirty times lower than coals impact of €0.06/kWh, or 6 cents/kWh. However the energy source of the lowest external costs associated with it was found to be wind power at €0.0009/kWh, which is an environmental and health impact just under half the price of Nuclear power.

In March 2011 an earthquake and tsunami caused damage that led to explosions and partial meltdowns at the Fukushima I Nuclear Power Plant in Japan. Concerns about the possibility of a large scale radiation leak resulted in 20 km exclusion zone being set up around the power plant and people within the 20–30 km zone being advised to stay indoors. John Price, a former member of the Safety Policy Unit at the UK's National Nuclear Corporation, has said that it "might be 100 years before melting fuel rods can be safely removed from Japan's Fukushima nuclear plant"

### **Waste streams**

Nuclear power has at least four waste streams that may harm the environment:

1. they create spent nuclear fuel at the reactor site (including plutonium waste)
2. they produce tailings at uranium mines and mills
3. during operation they routinely release small amounts of radioactive isotopes
4. during accidents they can release large quantities of dangerous radioactive materials

The nuclear fuel cycle involves some of the most dangerous elements and isotopes known to humankind, including more than 100 dangerous radionuclides and carcinogens such as strontium-90, iodine 131 and cesium -137, which are the same toxins found in the fall out of nuclear weapons".

### **Radioactive waste**

#### **High-level waste**

Around 20–30 tons of high-level waste are produced per year per nuclear reactor.<sup>[6]</sup> The world's nuclear fleet creates about 10,000 metric tons of high-level spent nuclear fuel each year.<sup>[7]</sup> Several methods have been suggested for final disposal of high-level waste, including deep burial in stable geological structures, transmutation, and removal to space. So far, none of these methods have been implemented.<sup>[8]</sup> There is an "international consensus on the advisability of storing nuclear waste in deep underground repositories",<sup>[9]</sup> but no country in the world has yet opened such a site.<sup>[9][10][11][12][13]</sup> There are some 65,000 tons of nuclear waste now in temporary storage throughout the U.S., but in 2009, President Obama "halted work on a permanent repository at Yucca Mountain in Nevada, following years of controversy and legal wrangling".

Nuclear reprocessing may reduce the volume of high-level waste, but by itself does not reduce radioactivity or heat generation and therefore does not eliminate the need for a geological waste repository. Reprocessing has been politically controversial because of the potential to contribute to nuclear proliferation, the potential vulnerability to nuclear terrorism, the political challenges of repository siting (a problem that applies equally to direct disposal of spent fuel), and because of its high

cost compared to the once-through fuel cycle. The Obama administration has disallowed reprocessing of nuclear waste, citing nuclear proliferation concerns.<sup>1</sup>

Nine U.S. states have "explicit moratoria on new nuclear power" until a long-term storage solution emerges.

#### **Other waste**

Moderate amounts of low-level waste are produced through chemical and volume control system (CVCS). This includes gas, liquid, and solid waste produced through the process of purifying the water through evaporation. Liquid waste is reprocessed continuously, and gas waste is filtered, compressed, stored to allow decay, diluted, and then discharged. The rate at which this is allowed is regulated and studies must prove that such discharge does not violate dose limits to a member of the public (see radioactive effluent emissions).

Solid waste can be disposed of simply by placing it where it will not be disturbed for a few years. There are three low-level waste disposal sites in the United States in South Carolina, Utah, and Washington. Solid waste from the CVCS is combined with solid radwaste that comes from handling materials before it is buried off-site.

#### **Power plant emissions**

##### **Radioactive gases and effluents**

Most commercial nuclear power plants release gaseous and liquid radiological effluents into the environment as a byproduct of the Chemical Volume Control System, which are monitored in the US by the EPA and the NRC. Civilians living within 50 miles (80 km) of a nuclear power plant typically receive about 0.1  $\mu\text{Sv}$  per year. For comparison, the average person living at or above sea level receives at least 260  $\mu\text{Sv}$  from cosmic radiation.

The total amount of radioactivity released through this method depends on the power plant, the regulatory requirements, and the plant's performance. Atmospheric dispersion models combined with pathway models are employed to accurately approximate the dose to a member of the public from the effluents emitted. Effluent monitoring is conducted continuously at the plant.

#### **DISASTER MANAGEMENT**

'Disaster management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters

#### **Types of disasters**

There is no country that is immune from disaster, though vulnerability to disaster varies. There are four main types of disaster.

- **Natural disasters.** These disasters include floods, hurricanes, earthquakes and volcano eruptions that can have immediate impacts on human health, as well as secondary impacts causing further death and suffering from floods causing landslides, earthquakes resulting in fires, tsunamis causing widespread flooding and typhoons sinking ferries
- **Environmental emergencies.** These emergencies include technological or industrial accidents, usually involving hazardous material, and occur where these materials are produced, used or transported. Large forest fires are generally included in this definition because they tend to be caused by humans.
- **Complex emergencies.** These emergencies involve a break-down of authority, looting and attacks on strategic installations. Complex emergencies include conflict situations and war.
- **Pandemic emergencies.** These emergencies involve a sudden onset of a contagious disease that affects health but also disrupts services and businesses, bringing economic and social costs.

Any disaster can interrupt essential services, such as the provision of health care, electricity, water, sewage/garbage removal, transportation and communications. The interruption can seriously affect the health, social and economic networks of local communities and countries. Disasters have a major and long-lasting impact on people long after the immediate effect has been mitigated. Poorly planned relief activities can have a significant negative impact not only on the disaster victims but also on

donors and relief agencies. So it is important that physical therapists join established programmes rather than attempting individual efforts.

Local, regional, national and (where necessary) international organisations are all involved in mounting a humanitarian response to disasters. Each will have a prepared disaster management plan. These plans cover prevention, preparedness, relief and recovery (see below).

### **Disaster prevention**

These are activities designed to provide permanent protection from disasters. Not all disasters, particularly natural disasters, can be prevented, but the risk of loss of life and injury can be mitigated with good evacuation plans, environmental planning and design standards. In January 2005, 168 Governments adopted a 10-year global plan for natural disaster risk reduction called the Hyogo Framework. It offers guiding principles, priorities for action, and practical means for achieving disaster resilience for vulnerable communities.

### **Disaster preparedness**

These activities are designed to minimize loss of life and damage – for example by removing people and property from a threatened location and by facilitating timely and effective rescue, relief and rehabilitation. Preparedness is the main way of reducing the impact of disasters. Community-based preparedness and management should be a high priority in physical therapy practice management.

### **Disaster relief**

This is a coordinated multi-agency response to reduce the impact of a disaster and its long-term results. Relief activities include rescue, relocation, providing food and water, preventing disease and disability, repairing vital services such as telecommunications and transport, providing temporary shelter and emergency health care.

### **Disaster recovery**

Once emergency needs have been met and the initial crisis is over, the people affected and the communities that support them are still vulnerable. Recovery activities include rebuilding infrastructure, health care and rehabilitation. These should blend with development activities, such as building human resources for health and developing policies and practices to avoid similar situations in future.

Disaster management is linked with sustainable development, particularly in relation to vulnerable people such as those with disabilities, elderly people, children and other marginalised groups.

Myths and Realities of Disaster Assistance summarises some of the common misunderstandings about disaster management.

## **FLOODS**

A **flood** is an overflow of water that submerges land.<sup>[1]</sup> The European Union (EU) Floods Directive defines a flood as a covering by water of land not normally covered by water.<sup>[2]</sup> In the sense of "flowing water", the word may also be applied to the inflow of the tide. Flooding may result from the volume of water within a body of water, such as a river or lake, which overflows or breaks levees, with the result that some of the water escapes its usual boundaries,<sup>[3]</sup> or may be due to accumulation of rainwater on saturated ground in an area flood.

While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, it is not a significant flood unless such escapes of water endanger land areas used by man like a village, city or other inhabited area.

Floods can also occur in rivers, when flow exceeds the capacity of the river channel, particularly at bends or meanders. Floods often cause damage to homes and businesses if they are placed in natural flood plains of rivers. While flood damage can be virtually eliminated by moving away from rivers and other bodies of water, since time out of mind, people have lived and worked by the water to seek sustenance and capitalize on the gains of cheap and easy travel and commerce by being near water.

That humans continue to inhabit areas threatened by flood damage is evidence that the perceived value of living near the water exceeds the cost of repeated periodic flooding.

The word "flood" comes from the Old English *flod*, a word common to Germanic languages (compare German *Flut*, Dutch *vloed* from the same root as is seen in *flow*, *float*; also compare with Latin *fluctus*, *flumen*). Deluge myths are mythical stories of a great flood sent by a deity or deities to destroy civilization as an act of divine retribution, and are featured in the mythology of many cultures.

### Principal types and causes

#### Areal

- Floods often happen over flat or low-lying areas when the ground is saturated and water either cannot run off, or cannot run off quickly enough to stop accumulating. This may be later followed by a river flood as water moves away from the areal floodplain into local rivers and streams.
- Floods can occur if water accumulates across an impermeable surface (e.g. from rainfall) and cannot rapidly dissipate (i.e. gentle orientation or low evaporation).
- A series of storms moving over the same area can cause areal flash flooding.
- A muddy flood is produced by an accumulation of runoff generated on cropland. Sediments are then detached by runoff and carried as suspended matter or bed load. Muddy runoff is more likely detected when it reaches inhabited areas. Muddy floods are therefore a hill slope process, and confusion with mudflows produced by mass movements should be avoided.

#### Reverie

- **Slow kinds:** Runoff from sustained rainfall or rapid snow melt exceeding the capacity of a river's channel. Causes include heavy rains from monsoons, hurricanes and tropical depressions, foreign winds and warm rain affecting snow pack. Unexpected drainage obstructions such as landslides, ice, or debris can cause slow flooding upstream of the obstruction.
- **Fast kinds:** include river flash floods resulting from convective precipitation (intense thunderstorms) or sudden release from an upstream impoundment created behind a dam, landslide, or glacier.
- Dam-building beavers can flood low-lying urban and rural areas, often causing significant damage.

#### Estuarine

- Commonly caused by a combination of sea tidal surges caused by storm-force winds and high river stages due to heavy rain.

#### Coastal

- Caused by severe sea storms, or as a result of another hazard (e.g. tsunami or hurricane). A storm surge, from either a tropical cyclone or an extratropical cyclone, falls within this category.

#### Catastrophic

- Caused by a significant and unexpected event e.g. dam breakage, or as a result of another hazard (e.g. earthquake or volcanic eruption). See outburst flood.

#### Human-induced

- Accidental damage by workmen to tunnels or pipes.

#### Effects

##### Primary effects

- Physical damage – damage to structures, including bridges, buildings, sewerage systems, roadways, and canals.

##### Secondary effects

- *Water supplies* – Contamination of water. Clean drinking water will become scarce.
- *Diseases* – Unhygienic conditions. Spread of water-borne diseases.

- *Crops and food supplies* – Shortage of food crops can be caused due to loss of entire harvest.<sup>[4]</sup> However, lowlands near rivers depend upon river silt deposited by floods in order to add nutrients to the local soil.
- *Trees* – Non-tolerant species can die from suffocation.<sup>[5]</sup>
- *Transport* – Transport links destroyed, so hard to get emergency aid to those who need it.

#### Tertiary and long-term effects

- Economic – economic hardship due to temporary decline in tourism, rebuilding costs, food shortage leading to price increase, etc.
- Psychological – flooding can be highly traumatic for individuals, in particular where deaths, serious injuries and loss of property occurs.

### EARTHQUAKE

An **earthquake** (also known as a **quake**, **tremor** or **temblor**) is the result of a sudden release of energy in the Earth's crust that creates seismic waves. The **seismicity**, **seismism** or **seismic activity** of an area refers to the frequency, type and size of earthquakes experienced over a period of time. Earthquakes are measured using observations from seismometers. The moment magnitude is the most common scale on which earthquakes larger than approximately 5 are reported for the entire globe. The more numerous earthquakes smaller than magnitude 5 reported by national seismological observatories are measured mostly on the local magnitude scale, also referred to as the Richter scale. These two scales are numerically similar over their range of validity. Magnitude 3 or lower earthquakes are mostly almost imperceptible and magnitude 7 and over potentially cause serious damage over large areas, depending on their depth. The largest earthquakes in historic times have been of magnitude slightly over 9, although there is no limit to the possible magnitude. The most recent large earthquake of magnitude 9.0 or larger was a 9.0 magnitude earthquake in Japan in 2011 (as of March 2011), and it was the largest Japanese earthquake since records began. Intensity of shaking is measured on the modified Mercalli scale. The shallower an earthquake, the more damage to structures it causes, all else being equal.<sup>[1]</sup>

At the Earth's surface, earthquakes manifest themselves by shaking and sometimes displacement of the ground. When the epicenter of a large earthquake is located offshore, the seabed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides, and occasionally volcanic activity.

In its most general sense, the word *earthquake* is used to describe any seismic event — whether natural or caused by humans — that generates seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activity, landslides, mine blasts, and nuclear tests. An earthquake's point of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

#### Measuring and locating earthquakes

Earthquakes can be recorded by seismometers up to great distances, because seismic waves travel through the whole Earth's interior. The absolute magnitude of a quake is conventionally reported by numbers on the Moment magnitude scale (formerly Richter scale, magnitude 7 causing serious damage over large areas), whereas the felt magnitude is reported using the modified Mercalli intensity scale (intensity II–XII).

Every tremor produces different types of seismic waves, which travel through rock with different velocities:

- Longitudinal P-waves (shock- or pressure waves)
- Transverse S-waves (both body waves)
- Surface waves — (Rayleigh and Love waves)

Propagation velocity of the seismic waves ranges from approx. 3 km/s up to 13 km/s, depending on the density and elasticity of the medium. In the Earth's interior the shock- or P waves travel much faster than the S waves (approx. relation 1.7 : 1). The differences in travel time from the epicentre to the

observatory are a measure of the distance and can be used to image both sources of quakes and structures within the Earth. Also the depth of the hypocenter can be computed roughly.

In solid rock P-waves travel at about 6 to 7 km per second; the velocity increases within the deep mantle to ~13 km/s. The velocity of S-waves ranges from 2–3 km/s in light sediments and 4–5 km/s in the Earth's crust up to 7 km/s in the deep mantle. As a consequence, the first waves of a distant earthquake arrive at an observatory via the Earth's mantle.

**Rule of thumb:** On the average, the kilometer distance to the earthquake is the number of seconds between the P and S wave **times 8**.<sup>[44]</sup> Slight deviations are caused by inhomogeneities of subsurface structure. By such analyses of seismograms the Earth's core was located in 1913 by Beno Gutenberg. Earthquakes are not only categorized by their magnitude but also by the place where they occur. The world is divided into 754 Flinn-Engdahl regions (F-E regions), which are based on political and geographical boundaries as well as seismic activity. More active zones are divided into smaller F-E regions whereas less active zones belong to larger F-E regions.

### Effects of earthquakes

1755 copper engraving depicting Lisbon in ruins and in flames after the 1755 Lisbon earthquake, which killed an estimated 60,000 people. A tsunami overwhelms the ships in the harbor.

The effects of earthquakes include, but are not limited to, the following:

### Shaking and ground rupture

Damaged buildings in Port-au-Prince, Haiti, January 2010.

Shaking and ground rupture are the main effects created by earthquakes, principally resulting in more or less severe damage to buildings and other rigid structures. The severity of the local effects depends on the complex combination of the earthquake magnitude, the distance from the epicenter, and the local geological and geomorphological conditions, which may amplify or reduce wave propagation.<sup>[45]</sup> The ground-shaking is measured by ground acceleration.

Specific local geological, geomorphological, and geostructural features can induce high levels of shaking on the ground surface even from low-intensity earthquakes. This effect is called site or local amplification. It is principally due to the transfer of the seismic motion from hard deep soils to soft superficial soils and to effects of seismic energy focalization owing to typical geometrical setting of the deposits.

Ground rupture is a visible breaking and displacement of the Earth's surface along the trace of the fault, which may be of the order of several metres in the case of major earthquakes. Ground rupture is a major risk for large engineering structures such as dams, bridges and nuclear power stations and requires careful mapping of existing faults to identify any which are likely to break the ground surface within the life of the structure.<sup>[46]</sup>

### Landslides and avalanches

Earthquakes, along with severe storms, volcanic activity, coastal wave attack, and wildfires, can produce slope instability leading to landslides, a major geological hazard. Landslide danger may persist while emergency personnel are attempting rescue.<sup>[47]</sup>

### Fires

Fires of the 1906 San Francisco earthquake

Earthquakes can cause fires by damaging electrical power or gas lines. In the event of water mains rupturing and a loss of pressure, it may also become difficult to stop the spread of a fire once it has started. For example, more deaths in the 1906 San Francisco earthquake were caused by fire than by the earthquake itself.<sup>[48]</sup>

### Soil liquefaction

Main article: Soil liquefaction

Soil liquefaction occurs when, because of the shaking, water-saturated granular material (such as sand) temporarily loses its strength and transforms from a solid to a liquid. Soil liquefaction may cause rigid

structures, like buildings and bridges, to tilt or sink into the liquefied deposits. This can be a devastating effect of earthquakes. For example, in the 1964 Alaska earthquake, soil liquefaction caused many buildings to sink into the ground, eventually collapsing upon themselves.<sup>[49]</sup>

### **Tsunami**

The tsunami of the 2004 Indian Ocean earthquake

A large ferry boat rests inland amidst destroyed houses after a 9.0 earthquake and subsequent tsunami struck Japan in March 2011.

Main article: Tsunami

Tsunamis are long-wavelength, long-period sea waves produced by the sudden or abrupt movement of large volumes of water. In the open ocean the distance between wave crests can surpass 100 kilometers (62 mi), and the wave periods can vary from five minutes to one hour. Such tsunamis travel 600-800 kilometers per hour (373-497 miles per hour), depending on water depth. Large waves produced by an earthquake or a submarine landslide can overrun nearby coastal areas in a matter of minutes. Tsunamis can also travel thousands of kilometers across open ocean and wreak destruction on far shores hours after the earthquake that generated them.<sup>[50]</sup>

Ordinarily, subduction earthquakes under magnitude 7.5 on the Richter scale do not cause tsunamis, although some instances of this have been recorded. Most destructive tsunamis are caused by earthquakes of magnitude 7.5 or more.<sup>[50]</sup>

### **Floods**

A flood is an overflow of any amount of water that reaches land.<sup>[51]</sup> Floods occur usually when the volume of water within a body of water, such as a river or lake, exceeds the total capacity of the formation, and as a result some of the water flows or sits outside of the normal perimeter of the body. However, floods may be secondary effects of earthquakes, if dams are damaged. Earthquakes may cause landslips to dam rivers, which collapse and cause floods.<sup>[52]</sup>

The terrain below the Sarez Lake in Tajikistan is in danger of catastrophic flood if the landslide dam formed by the earthquake, known as the Usoi Dam, were to fail during a future earthquake. Impact projections suggest the flood could affect roughly 5 million people.<sup>[53]</sup>

### **Human impacts**

An earthquake may cause injury and loss of life, road and bridge damage, general property damage (which may or may not be covered by earthquake insurance), and collapse or destabilization (potentially leading to future collapse) of buildings. The aftermath may bring disease, lack of basic necessities, and higher insurance premiums.

### **CYCLONE**

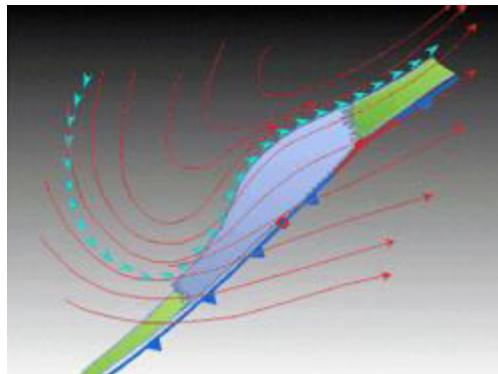
In meteorology, a **cyclone** is an area of closed, circular fluid motion rotating in the same direction as the Earth.<sup>[1][2]</sup> This is usually characterized by inward spiraling winds that rotate counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere of the Earth. Most large-scale cyclonic circulations are centered on areas of low atmospheric pressure.<sup>[3][4]</sup> The largest low-pressure systems are cold-core polar cyclones and extratropical cyclones which lie on the synoptic scale. According to NHC glossary, warm-core cyclones such as tropical cyclones and subtropical cyclones also lies within synoptic scale.<sup>[5]</sup> Mesocyclones, tornadoes and dust devils lie within the smaller mesoscale.<sup>[6]</sup> Upper level cyclones can exist without the presence of a surface low, and can pinch off from the base of the Tropical Upper Tropospheric Trough during the summer months in the Northern Hemisphere. Cyclones have also been seen on extraterrestrial planets, such as Mars and Neptune.<sup>[7][8]</sup> Cyclogenesis describes the process of cyclone formation and intensification.<sup>[9]</sup> Extratropical cyclones form as waves in large regions of enhanced mid-latitude temperature contrasts called baroclinic zones. These zones contract to form weather fronts as the cyclonic circulation closes and intensifies. Later in their life cycle, cyclones occlude as cold core systems. A cyclone's track is guided over the course of its 2 to 6 day life cycle by the steering flow of the cancer or subtropical jet stream.

Weather fronts separate two masses of air of different densities and are associated with the most prominent meteorological phenomena. Air masses separated by a front may differ in temperature or humidity. Strong cold fronts typically feature narrow bands of thunderstorms and severe weather, and may on occasion be preceded by squall lines or dry lines. They form west of the circulation center and generally move from west to east. Warm fronts form east of the cyclone center and are usually preceded by stratiform precipitation and fog. They move poleward ahead of the cyclone path. Occluded fronts form late in the cyclone life cycle near the center of the cyclone and often wrap around the storm center.

### Structure

There are a number of structural characteristics common to all cyclones. The cyclones have high pressure outside and low pressure inside. A cyclone is a low pressure area.<sup>[13]</sup> A cyclone's center (often known in a mature tropical cyclone as the eye), is the area of lowest atmospheric pressure in the region.<sup>[13]</sup> Near the center, the pressure gradient force (from the pressure in the center of the cyclone compared to the pressure outside the cyclone) and the force from the Coriolis effect must be in an approximate balance, or the cyclone would collapse on itself as a result of the difference in pressure.<sup>[14]</sup> Because of the Coriolis effect, the wind flow around a large cyclone is counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.<sup>[15]</sup> Cyclonic circulation is sometimes referred to as *contra solem*. In the Northern Hemisphere, the fastest winds relative to the surface of the Earth therefore occur on the eastern side of a northward-moving cyclone and on the northern side of a westward-moving one; the opposite occurs in the Southern Hemisphere.<sup>[16]</sup> (The wind flow around an anticyclone, on the other hand, is clockwise in the northern hemisphere, and counterclockwise in the southern hemisphere.)

### Formation



The initial extratropical low pressure area forms at the location of the red dot on the image. It is usually perpendicular (at a right angle to) the leaf-like cloud formation seen on satellite during the early stage of cyclogenesis. The location of the axis of the upper level jet stream is in light blue.

Tropical cyclones form when the energy released by the condensation of moisture in rising air causes a positive feedback loop over warm ocean waters.<sup>[17]</sup>

Cyclogenesis is the development or strengthening of cyclonic circulation in the atmosphere (a low pressure area).<sup>[9]</sup> Cyclogenesis is an umbrella term for several different processes, all of which result in the development of some sort of cyclone. It can occur at various scales, from the microscale to the synoptic scale.

Extratropical cyclones form as waves along weather fronts before occluding later in their life cycle as cold core cyclones.

Tropical cyclones form due to latent heat driven by significant thunderstorm activity, and are warm core.

Mesocyclones form as warm core cyclones over land, and can lead to tornado formation.<sup>[11]</sup> Waterspouts can also form from mesocyclones, but more often develop from environments of high instability and low vertical wind shear.<sup>[12]</sup> Cyclogenesis is the opposite of cyclolysis, and has an anticyclonic (high pressure system) equivalent which deals with the formation of high pressure areas—Anticyclogenesis.

The surface low has a variety of ways of forming. Topography can force a surface low when dense low-level high pressure system ridges in east of a north-south mountain barrier. Mesoscale convective systems can spawn surface lows which are initially warm core.<sup>1</sup> The disturbance can grow into a wave-like formation along the front and the low will be positioned at the crest. Around the low, flow will become cyclonic, by definition. This rotational flow will push polar air equatorward west of the low via its trailing cold front, and warmer air will push poleward low via the warm front. Usually the cold front will move at a quicker pace than the warm front and “catch up” with it due to the slow erosion of higher density airmass located out ahead of the cyclone and the higher density airmass sweeping in behind the cyclone, usually resulting in a narrowing warm sector. At this point an occluded front forms where the warm air mass is pushed upwards into a trough of warm air aloft, which is also known as a trowal.

Tropical cyclogenesis is the technical term describing the development and strengthening of a tropical cyclone in the atmosphere. The mechanisms through which tropical cyclogenesis occurs are distinctly different from those through which mid-latitude cyclogenesis occurs. Tropical cyclogenesis involves the development of a warm-core cyclone, due to significant convection in a favorable atmospheric environment. There are six main requirements for tropical cyclogenesis: sufficiently warm sea surface temperatures, atmospheric instability, high humidity in the lower to middle levels of the troposphere, enough Coriolis force to develop a low pressure center, a preexisting low level focus or disturbance, and low vertical wind shear. An average of 86 tropical cyclones of tropical storm intensity form annually worldwide, with 47 reaching hurricane/typhoon strength, and 20 becoming intense tropical cyclones (at least Category 3 intensity on the Saffir–Simpson Hurricane Scale)

### LANDSLIDES

A **landslide** or **landslip** is a geological phenomenon which includes a wide range of ground movement, such as rockfalls, deep failure of slopes and shallow debris flows, which can occur in offshore, coastal and onshore environments. Although the action of gravity is the primary driving force for a landslide to occur, there are other contributing factors affecting the original slope stability. Typically, pre-conditional factors build up specific sub-surface conditions that make the area/slope prone to failure, whereas the actual landslide often requires a trigger before being released.

### Causes

The Mameyes Landslide, in the Mameyes neighborhood of barrio Portugués Urbano in Ponce, Puerto Rico, which buried more than 100 homes, was caused by extensive accumulation of rains and, according to some sources, lightning.

Landslides occur when the stability of a slope changes from a stable to an unstable condition. A change in the stability of a slope can be caused by a number of factors, acting together or alone. Natural causes of landslides include:

- groundwater (porewater) pressure acting to destabilize the slope
- Loss or absence of vertical vegetative structure, soil nutrients, and soil structure (e.g. after a wildfire)
- erosion of the toe of a slope by rivers or ocean waves
- weakening of a slope through saturation by snowmelt, glaciers melting, or heavy rains
- earthquakes adding loads to barely stable slope
- earthquake-caused liquefaction destabilizing slopes
- volcanic eruptions

### Landslides are aggravated by human activities, Human causes include:

- deforestation, cultivation and construction, which destabilize the already fragile slopes
- vibrations from machinery or traffic
- blasting
- earthwork which alters the shape of a slope, or which imposes new loads on an existing slope
- in shallow soils, the removal of deep-rooted vegetation that binds colluvium to bedrock
- Construction, agricultural or forestry activities (logging) which change the amount of water which infiltrates the soil