Water Resource File

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Fresh Water

Are you aware that only about 2.5 percent of the water on the Earth can be drunk? The balance 97.5 percent is salt water that we cannot use unless it is desalinated. Of the 2.5 percent that we can use, about three-fourths is frozen in the ice caps and glaciers, leaving just one quarter for household use. Fresh water is found in lakes, rivers, streams, underground, and glaciers.

The world is heading towards a freshwater crisis due mainly due to its mismanagement. This crisis is already evident in many parts of the world, varying in scale and intensity depending on the time of the year, climate, and location. Another reason for the depletion of freshwater resources, particularly groundwater resources, is a rapidly increasing human population. Recognizing the importance of water resources to the planet's future, the United Nations General Assembly proclaimed the year 2003 the International Year of Freshwater. This will provide an opportunity to raise awareness, motivate people, and mobilize resources in order to manage water in a sustainable way.

Forms of water

Water is found in three different forms - liquid, solid or gas, depending on the temperature but it constantly changes from one form to another. Changes in temperature will determine which of these forms predominates in a particular area.

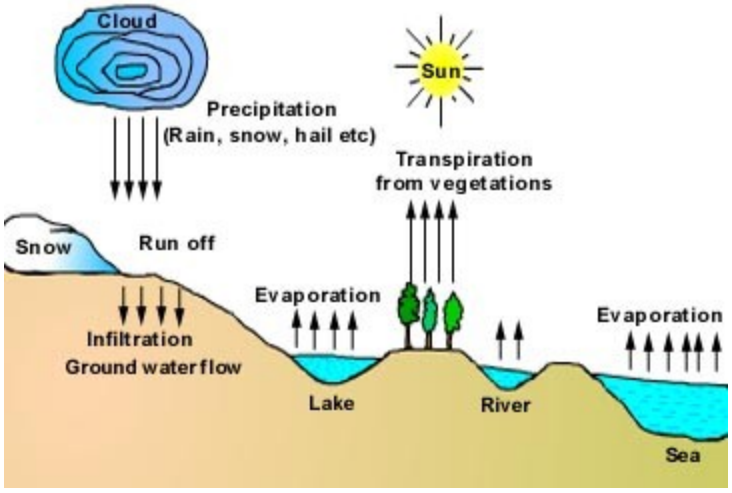
Liquid
Water is usually encountered in the liquid state, because this is its natural state when temperatures are between 0° C and 100° C. 'Fresh' or drinking water is found as groundwater in underground aquifers, and on the surface in ponds, lakes, and rivers. Seas and oceans account for 97% of all water on Earth; but their waters contain dissolved salts and are therefore unfit to drink. In regions of young volcanic activity, hot water emerges from the earth in hot springs (examples are Garampani in Assam and Badrinath in Uttaranchal). How does this phenomenon occur? Surface water percolates downward through the rocks below the Earth's surface to high-temperature regions surrounding a magma reservoir, either active, or recently solidified but still hot. There the water is heated, becomes less dense, and rises back to the surface through fissures and cracks.

Solid
Ice is the frozen form of water. It occurs when temperatures are below 0°C (32°F). For a given mass, ice occupies 9% more volume than water, which is why when water enters cracks in rocks and freezes it causes the rocks to crack and split. Being less dense than water, ice floats. This property of ice is vital to aquatic life in cold regions. As the temperature drops, ice forms a protective, insulating layer on the surfaces of streams, pools and other water bodies, allowing water to remain liquid in the layers beneath and life to survive. Glaciers, icebergs, and ice caps are all frozen water.

Gas
Water is found in the atmosphere in its gaseous form, water vapour. Steam is nothing but vapourized water. In certain hot water springs called geysers, jets of steam and hot water rise one hundred feet or more from the ground. Geysers are found in Iceland, the North Island of New Zealand and in USA's Yellowstone National Park.

Water cycle

The different water sources of the earth get their water supply from precipitation, while this precipitation in itself is the evaporation from these sources. Water is lost to the atmosphere as vapour from the earth, it condenses and then precipitates back in the form of rain, snow, hail, dew, frost or sleet. This is the hydrologic cycle that continues forever thereby maintaining a balance between the two.



Sources of water

Glaciers

Glaciers are large sheets of ice that flow down very high mountains and are often the source of snow-fed rivers. Glaciers, found mainly in places such as Antarctica and Greenland, cover almost 10% of the earth's landmass, varying in size. A glacier begins life as snowflakes. As more snow falls and gathers, the weight of the snow on top compresses the lower layers to form ice. The pile of snow and ice becomes thicker and heavier till the point when the layer of ice at the very bottom melts under the pressure. It re-freezes almost at once; but the process is repeated over and over, and as a result the entire mass begins to slide downhill slowly along the rock surface. A glacier has an enormous impact on the topography of the area, pushing aside boulders, cutting through rocks, and denting its path as it moves.

Most of the world's glaciers are found at the Poles, but they exist on all of the world's continents, even Africa. Australia doesn't have any glaciers; however, it is considered part of Oceania, which includes several Pacific island chains and the large islands of Papua New Guinea and New Zealand. Both of these islands have glaciers. Glaciers require very specific geographical and climatic conditions. Most are found in regions of high snowfall in winter and cool temperatures in summer. The amount of precipitation (whether in the form of snowfall, freezing rain, avalanches, or wind-drifted snow) is important to glacier survival. In areas such as Siberia and parts of Antarctica, the lack of adequate precipitation prevents glacier development.

Some facts

- At presently, about 10% of the world's land area is covered with glaciers.
- Glaciers store about 75% of the world's freshwater.
- Glacierized areas cover over 15,000,000 square kilometres.
- In the United States, glaciers cover over 75,000 square kilometres, with most of the glaciers

located in Alaska.
- During the last Ice Age, glaciers covered 32% of the total land area.
- If all land ice melted, the sea level would rise approximately 70 metres worldwide.
- North America's longest glacier is the Bering Glacier in Alaska, measuring 204 kilometres long.
- The Malaspina Glacier in Alaska is the world's largest piedmont glacier, covering over 8,000 square kilometres and measuring over 193 kilometers across at its widest point.

In India, glaciers are found in the Himalayas. There are about 15,000 glaciers flowing through these mountains, covering about 17% of the mountain area and supporting numerous perennial rivers such as the Ganga, Indus, and Brahmaputra. Some well-known glaciers are described below.

Dokriyani
This glacier is believed to be as old as the Himalayan Mountains. Dokriani 'Bamak' is a well-developed medium sized glacier of the Bhagirathi basin. The glacier is 5 km long and flows in a northwest direction terminating at an elevation of 3,800 m. It originates at an altitude of 13 000 feet in Uttaranchal's Garhwal district. It is one of the most studied glaciers in the world. A recent study says that it has been shrinking by a few metres every year.

Gangotri
This is located in Uttaranchal's Tehri Garhwal. One of the oldest glaciers in the Chaukhamba range, it is where the river Ganga originates. The Gangotri is not a single valley glacier, but a combination of several other glaciers that are fed to it and form a huge mass of ice. The glacier covers 28km and terminates at Gaumukh (4,000m).

Pindari
This is one of the most beautiful glaciers in the Kumaon hills and is known as the Jewel of Kumaon. iIt is located at a height of 13 000 feet above sea level between the Nanda Devi and Nandakot peaks and terminates at an altitude of 3,627 m. It is 5 km long, the snout is about 6 m high and 2.5 m wide and above the snout, the glacier extends for about 3m. The Pinder River that emerges from the Pindari glacier drains the valley.

Zemu
The Zemu glacier is the largest and most famous glacier in the eastern Himalayas, with a length of about 26 km. It is located in northwestern Sikkim in a U-shaped valley at the base of the Kanchenjunga massif. The Teesta river has its source in this glacier.
Many tributary glaciers feed the trunk glacier.

Siachen
This is the largest glacier in the world outside the Polar regions, stretching over a length of about 72 km. It lies in the extreme north- central part of Jammu and Kashmir near the border of India and Tibet, on the north-facing slopes of the Karakoram Range, and feeds the Shaksgam river that flows into Tibet. The glacier can be approached from Skardu in Ladakh. To the east of the Siachen lies a group of three glaciers known as the Rimo North, Central, and South. Between them, these glaciers have almost 700 square km of ice, which, at places, is 100 m deep. Altogether, the glaciers contain about 200 cubic kilometres of ice.

Rivers

Most ancient civilizations grew along the banks of rivers. Even today, millions of people all over the world live on the banks of rivers and depend on them for their survival. All of us have seen a river - large or small, either flowing through our town, or somewhere else. Rivers are nothing more than surface water flowing down from a higher altitude to a lower altitude due to the pull of gravity. One river might have its source in a glacier, another in a spring or a lake. Rivers carry

dissolved minerals, organic compounds, small grains of sand, gravel, and other material as they flow downstream. Rivers begin as small streams, which grow wider as smaller streams and rivers join them along their course across theland. Eventually they flow into seas or oceans. Most rivers With the exception of the Nile, flow towards the Equator. The flow in most rivers is not uniform, which means that sometimes there are floods and sometimes no water flows in them. Flood control projects attempt to reduce the variation in flow.

Unfortunately most of the world's major rivers are heavily polluted, but two of the world's largest river systems-the Amazon, that drains a vast area of South America and the Congo in sub-Saharan Africa- remain relatively healthy. This is because both have few industries and a small human population in their watersheds.

Some facts about rivers

- The Nile, 6695 km long, and the Amazon 6437 km long, are the world's two longest rivers. Sometimes, measurements of their lengths can vary according to the criteria used for measurement.
- An Arab philosopher and physician Avicenna suggested, nearly 1000 years ago, that landscapes changed largely as a result of the action of running water. His views were largely ignored until the 16th century.

- The longest river in Asia is the Yangtze, which is 5472 km long.
- The world's highest waterfall are the Angel Falls in Venezuela, 979 m high, over 780 m of which is an uninterrupted drop.

Rivers in India

India has a large number of rivers that are lifelines for the millions living along their banks. These rivers can be categorized into four groups:

- Rivers that flow down from the Himalayas and are supplied by melting snow and glaciers. This is why these are perennial, that is, they never dry up during the year
- The Deccan Plateau rivers, which depend on rainfall for their water
- The coastal rivers, especially those on the west coast, which are short and do not retain water throughout the year
- The rivers in the inland drainage basin of west Rajasthan, which depend on the rains. These rivers normally drain towards silt lakes or flow into the sand.

The major rivers in India are described here:

Ganga

This is considered the holiest of all the great rivers of India. It has its source at the Gangotri glacier, where it flows from the cave Goumukh, as the Bhagirathi, which then joins the River Alaknanda as it flows towards Devaprayag. The largest tributary of the river is the Ghaghara, which flows from the northern Nepal region and joins it before Patna in Bihar. Another major tributary is the Yamuna originating in the Yamunotri glacier, and flows through Delhi and Agra. Others are the Gomti, Gandak, Son, Kosi, Chambal, Sarda, etc. The Ganga is the lifeline for more than 500 million people living along its banks. The water of the river Ganges is considered so sacred that people keep it in their homes for use in prayers on important occasions such as at the time of death.

Most cities along the river do not have sewage treatment plants and those that do have them can handle only part of the waste water. Millions of tonnes of untreated sewage are dumped daily into the river from the cities that lie along its banks. Bathing and washing also contribute to the pollution as most of the soap that is used is made from chemical substances. The river is also

polluted by human and animal faeces. Industrial units that lie along the banks of the river discharge all the waste into the river and only a few of them have proper treatment facilities.

Yamuna
Rising from the Yamunotri glacier in the Tehri Garhwal District in the Himalayas, the Yamuna flows for about 1380 km almost parallel to the Ganga till they meet at Allahabad. It flows through a number of important towns, Delhi, Mathura, Brindaban, and Agra to name some. Since ancient times, the Doab region, where the Ganga and the Yamuna flow, has been considered one of the most fertile areas in the subcontinent. Today however, this majestic river is polluted with domestic waste, silt, and industrial waste. The 22-km stretch between Wazirabad and the Okhla barrage in Delhi is only 2% of the catchment area, but it contributes about 80% of the river's total pollution load. The Hindon Canal also discharges waste from Uttar Pradesh in this stretch. Among the many casualties are birds and fish. There was a time when bird watchers had identified as many as 30 species of birds near the Yamuna, many of them exotic, such as the red-crested pochard and the godwit.

Brahmaputra
This mighty river rises in western Tibet in the Manasarovar region. It flows eastwards through the Himalayas, curves back across Arunachal Pradesh and Assam, then turns south to join the Padma and Ganga in Bangladesh and finally enters the Bay of Bengal. It is known by different names in different regions: as it flows through Tibet it is known as the Tsangpo., In the north-eastern states of Arunachal Pradesh and Assam, it is known as the Siang or Dihang. It is longer and more voluminous than the Ganga, and gushes down with enormous force for most of its course through the mountain regions and the forests of north-east India. A unique feature of this river is that it is navigable even at a height of 10 000 feet.

When compared to the other major rivers in India, the Brahmaputra is less polluted but it has its own problems: petroleum refining units contribute most of the industrial pollution load into the basin along with other medium and small industries. The main problem facing the river basin is that of constant flooding. Floods have been occurring more often in recent years with deforestation, and other human activities being the major causes.

Indus
Known as the Sindhu in ancient times, the Indus was the cradle of India's great Indus Valley civilization. It has its source near Manasarovar close to southwestern Tibet, at an altitude of 16,000 feet and flows westward, through the Himalayas into Ladakh, and then through Sind and Punjab in Pakistan into the Arabian Sea.

After flowing eleven miles beyond Leh, the Indus is joined by its first tributary, the Zanskar. When it enters the plains, its famous five tributaries - the Jhelum, Chenab, Ravi, Beas, and Sutlej - that give Punjab its name (land of the five rivers) join it.

The name India is said to have its roots in Sindhu (Indus), the great river that constitutes the most imposing feature of that part of the subcontinent, home to some of the earliest civilizations. The river Sindhu has been invoked numerous times in the Vedic literature together with those of other gods and goddesses.

Narmada
This is the largest west-flowing river in India and originates from the Mekhala range in Shahdol district, Madhya Pradesh. It flows 1300 km west through the states of Madhya Pradesh and Gujarat before draining into the Gulf of Khambhat in the Arabian Sea. It is said to be one of the most beautiful rivers in India. In terms of its catchment area it is the seventh largest among the fourteen major river basins in the country. It is stated in the Matsya Purana that the mere sight of

the river washes away all sins. With many short tributaries flowing into it from north and south, the Narmada basin forms a very important topographic feature of peninsular India.

About 20% of the population along the river lives in the urban areas and the rest in the rural areas: Jabalpur, Hoshangabad, and Khargone in Madhya Pradesh, and Bharuch in Gujarat are some important cities located on the banks.

The major cause of pollution is run-off from agricultural activities yet the pollution level is estimated to be lower than in other major rivers.

Mahanadi
This river is considered the lifeline of Orissa, through which it flows. It originates in south-eastern Madhya Pradesh near Raipur. In the upper drainage basin of the Mahanadi, which is centred on the Chhattisgarh Plain, periodic droughts contrast with the situation in the delta region where floods may damage the crops in what is known as the rice bowl of Orissa. The Hirakud Dam, constructed in the middle reaches of the Mahanadi, has helped in alleviating these adverse effects by creating a reservoir.

Godavari
This river originates in the Sahyadri range to the northeast of Mumbai in Maharashtra. It flows through that state and Andhra Pradesh before entering the Bay of Bengal. Its drainage basin is one of the largest in the country, second in size only to that of the Ganga; its delta on the east coast is also one of the country's main rice-growing areas. Despite the large catchment area the water available is only moderate because of the medium levels of annual rainfall.

Kaveri
The Kaveri is worshipped as a jeeva-nadi or perennial river. It has its origin in Talakaveri in the Kanara district of Karnataka and flows sounthwards through Tamil Nadu and Karnataka. The waters of the river have been a source of irrigation since antiquity; in the early 1990s, an estimated 95 percent of the Kaveri was diverted for agricultural use before it emptyied into the Bay of Bengal.

Lakes

A lake is a low-lying part of the Earth's surface in which rainwater, surface water run-off, outflow from a river, and water from other sources accumulates. There is a great variety of lakes on Earth: there are freshwater lakes and saltwater lakes, ranging in size from small fish-ponds to huge waterbodies such as Lake Superior in USA which is the world's largest freshwater lake. The Caspian Sea in Europe and the Sambhar lake in Rajasthan are examples of saltwater lakes. India has a large number of lakes spread all over the country, from Kashmir to Kerala and from Rajasthan to Assam. Among the better-known fresh water lakes in India are the Dal lake in Srinagar and the Nainital lake. Whether natural or manmade, all lakes are major sources of water. Lakes are homes to a large variety of aquatic life, with one notable exception: the Dead Sea, a saltwater lake in Israel does not have any form of life. There is too much salt in its water to sustain life.

Almost half of the world's lakes are degraded, depleted, and contaminated mainly by human activities. The main causes are inflow of domestic sewage, agricultural run-off, discharge of industrial effluents, over-fishing, introduction of exotic species and habitat degradation from population growth, expansion of cities. As more water is withdrawn for human use and more of it is returned to lakes and rivers badly polluted there is less available to maintain vital freshwater ecosystems. The deepest lake is Lake Baikal in Siberia, Russia. The deepest point of the lake is known as the Olkhon Crevice; it has a depth of 5,370 feet.

- The largest saline lake is the Caspian Sea, spread over parts of Iran, Russia, Turkmenistan, Azerbaijan, and Kazakhstan with a surface area of 1 43 560 square miles and an estimated volume of 21 500 cubic miles.

- The most threatened lake in terms of size is the Aral Sea, which has shrunk due to extraction of water for irrigation.

Some Indian lakes

Keoladeo National Park
This is an important habitat for waterfowl. It is the only wintering site in India for the central and western Asian population of Siberian cranes, a highly endangered species. The population of Siberian Cranes has decreased in the last two decades. In a programme now underway, reared Siberian crane chicks are being brought to Keoladeo from USA and Siberia. Loktak Lake. The measures undertaken for the conservation of Loktak Lake so far, include afforestation of indigenous species including fruit trees; control of silt; catchment area treatment; removal of floating lands locally called phumdis in some pockets of the lake; and generating awareness about the values and functions of the wetland. Several measures have been adopted to control the prolific growth of phumdis and water hyacinth. Weevils have been introduced for biological control of water hyacinth.

Harike Lake
This wetland sustains a large number of waterfowl. Demarcation of the wetland has been attempted, and fencing has been carried out of some ponds. Afforestation of catchment area has been carried out in some critical areas to control siltation. One of the major problems faced by this wetland is the prolific growth of water hyacinth

Wular Lake
This wetland is the source of drinking water for Srinagar, and also acts as an absorption basin for floodwater. It is an important waterfowl habitat. However, Wular Lake is subject to heavy siltation due to loss of vegetal cover in the surrounding area.

Sambhar Lake
Located in the arid zone of Rajasthan, the Sambhar Lake is one of the largest inland saline lakes in India. This wetland is one of the most important wintering areas for flamingoes and pelicans. Salt extraction is one of the major activities in the wetland.

The Bhoj Wetland in Bhopal, Madhya Pradesh
It consists of two man-made lakes (upper and lower lakes). The upper lake was created in the 11th century by constructing an earthen dam across the Kolans river and the lower lake was constructed nearly two centuries ago.

The wetland supports a wide variety of flora and fauna. Diverse flora provide ideal habitat for a large number of avifauna. Biotic interaction and natural selection have led to the development of a characteristic relationship between vegetation and the avifauna.

Deepor Beel
This is a permanent freshwater lake, in a former channel of the Brahmaputra river, south-west of Guwahati city. It is a large natural wetland having great biological and environmental importance and is also the only major storm water storage basin for Guwahati. The beel is endowed with rich floral and faunal diversity. In addition to a huge congregation of residential water birds, the Deepor ecosystem harbours a large number of migratory waterfowl each year. It is now threatened with large scale encroachment, brick making factory and soil cutting within the beel ecosystem, and construction of railway line along the southern boundary of the beel.

The Hussain Sagar Lake
This is one of the largest man-made lakes in Asia, located in the heart of Hyderabad, contributing to its immense beauty. It is a sprawling artificial lake that holds water perennially. It was built during the reign of Ibrahim Qutub Shah in 1562, on a tributary of the river Musi.

The Tso Morari Lake
This is one of the largest in the Ladakh region and is almost like an inland sea. Situated at an elevation of about 4,900m, it is about 22km long, with a width varying from 5 to 7km and a depth of more than 30 m at the deepest point.

The lake is probably a leftover from the Ice Age, formed by the melt waters of the ice masses left behind by the retreating glaciers. The waters from the surrounding areas drained into the lake. The huge amounts of water present in the beginning evaporated very fast in the desert-like atmosphere and what was fresh water became brackish and finally salty, unfit for human consumption.

One of the most spectacular lakes in Ladakh is the Pangong Tso, which lies across the Changla Pass from Leh. At an altitude of almost 4,500 metres, the Pangong Tso is only 8 km wide at its broadest point, but is an amazing 134km long. The Pangong is considered to be the longest lake in Ladakh. It is a saltwater lake formed in much the same way as the Tso Morari lake during the Ice Age.

Groundwater

The importance of groundwater for the existence of human society cannot be overemphasized. Groundwater is the major source of drinking water in both urban and rural India. Besides, it is an important source of water for the agricultural and the industrial sector. Water utilization projections for 2000 put the groundwater usage at about 50%. Being an important and integral part of the hydrological cycle, its availability depends on the rainfall and recharge conditions. Till recently it had been considered a dependable source of uncontaminated water.

Water Pollution

As far as the quality of groundwater is concerned, many states in the country have been identified as endemic to fluorosis due to abundance in naturally occurring fluoride-bearing minerals. These are Andhra Pradesh, Gujarat, Haryana, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Karnataka, Madhya Pradesh, Maharastra, Bihar, and Delhi. Nearly half million people in India suffer from ailments due to excess of fluoride in drinking water. In some districts of Assam and Orissa, groundwater has high iron content. About 31% of the total area of Rajasthan comes under saline groundwater. Groundwater is saline in almost all of the Bhakra Canal in Punjab and the lift canal system in south-western Haryana. Similarly high levels of arsenic in groundwater have been reported in the shallow aquifers in some districts of West Bengal. Certain places in Haryana, Gujarat, and Andhra Pradesh were also found to have dangerously high levels of mercury.

Causes of groundwater depletion and contamination

Groundwater is an integral part of the environment, and hence cannot be looked upon in isolation. There has been a lack of adequate attention to water conservation, efficiency in water use, water re-use, groundwater recharge, and ecosystem sustainability. An uncontrolled use of the borewell technology has led to the extraction of groundwater at such a high rate that often recharge is not sufficient. The causes of low water availability in many regions are also directly linked to the reducing forest cover and soil degradation.

Pollution of groundwater resources has become a major problem today. The pollution of air, water, and land has an affect on the pollution and contamination of groundwater. The solid, liquid, and the gaseous waste that is generated, if not treated properly, results in pollution of the environment; this affects groundwater too due to the hydraulic connectivity in the hydrological cycle. For example, when the air is polluted, rainfall will settle many pollutants on the ground, which can then seep into and contaminate the groundwater resources. Water extraction without proper recharge and leaching of pollutants from pesticides and fertilizers into the aquifers has polluted groundwater supplies. In addition, leachates from agriculture, industrial waste, and the municipal solid waste have also polluted surface- and ground-water. Some 45 million people the world over are affected by water pollution marked by excess fluoride, arsenic, iron, or the ingress of salt water.

Among the most dangerous of all water pollutants is fuel oil. Oil spills from tankers at sea or leaks from underground storage tanks on land are very difficult to control as oil tends to spread very fast, affecting a large area in a very short time. They are a major menace to the environment as they cause severe damage to surrounding ecosystems. Oil spills at sea decrease the oxygen level in the water and cause grave harm to the creatures living in the sea.

In the urban areas water gets contaminated in many different ways, some of the most common reasons being leaky water pipe joints in areas where the water pipe and sewage line pass close together. Sometimes the water gets polluted at source due to various reasons and mainly due to inflow of sewage into the source. The other sources of groundwater contamination are pesticides, sewage, household chemicals and unmindful disposal of garbage.

What can and should be done

It is important to realize that groundwater is not a resource that could be utilized unmindfully simply because it is available in abundant quantities. Problems and issues such as water logging, salinity, agricultural toxins, and industrial effluents, all need to be properly looked into.

Other than legislation and checks to conserve and improve the quality of groundwater, society itself plays a very important role. During the last decade there has been a rising awareness among the common people on the need for conservation and development of groundwater. Water use has to be integrated effectively with water regeneration, as was done in many traditional technologies.

Renovation of forest tanks in drought-prone regions will have a significant impact on wildlife and forest cover. Similarly, in some urban cities there is a need to regenerate groundwater aquifers because of the high degree of dependence on them for drinking water. Rainwater harvesting schemes have been taken up in many cities and even made compulsory in some of them. Temple tanks need to be renovated and urban wetlands protected. All these will contribute to a rise in the groundwater level and a reduction of salt water ingress. Community awareness and management of freshwater resources should be enhanced. The government should implement effective groundwater legislation and regulations through self-regulation by communities and local institutions. External support agencies should support freshwater resource management. Environmental restoration should be promoted along with household water security.

No single action whether community based, legislation, traditional water harvesting systems, or reliance on market forces will in itself alleviate the crisis in India. The effective answer to the freshwater crisis is to integrate conservation and development activities – from water extraction to water management – at the local level; making communities aware and involving them fully is therefore critical for success. All this will ultimately pave the way for combining conservation of the environment with the basic needs of people.

Effects of water pollution

It is a well-known fact that clean water is absolutely essential for healthy living. Adequate supply of fresh and clean drinking water is a basic need for all human beings on the earth, yet it has been observed that millions of people worldwide are deprived of this.

Freshwater resources all over the world are threatened not only by over exploitation and poor management but also by ecological degradation. The main source of freshwater pollution can be attributed to discharge of untreated waste, dumping of industrial effluent, and run-off from agricultural fields. Industrial growth, urbanization and the increasing use of synthetic organic substances have serious and adverse impacts on freshwater bodies. It is a generally accepted fact that the developed countries suffer from problems of chemical discharge into the water sources mainly groundwater, while developing countries face problems of agricultural run-off in water sources. Polluted water like chemicals in drinking water causes problem to health and leads to water-borne diseases which can be prevented by taking measures can be taken even at the household level.

The effects of water pollution are not only devastating to people but also to animals, fish, and birds. Polluted water is unsuitable for drinking, recreation, agriculture, and industry. It diminishes the aesthetic quality of lakes and rivers. More seriously, contaminated water destroys aquatic life and reduces its reproductive ability. Eventually, it is a hazard to human health. Nobody can escape the effects of water pollution.

The individual and the community can help minimize water pollution. By simple housekeeping and management practices the amount of waste generated can be minimized.

Water conservation

When Neil Armstrong saw the Earth from the Moon, it appeared blue! This is because water covers more than two-thirds of the Earth's surface. But fresh water represents less than 0.5% of the total water on Earth. The rest is either in the form of seawater or locked up in icecaps or the soil, which is why one often hears of water scarcity in many areas.

Water is continuously moving around the earth and constantly changing its form. It evaporates from land and water bodies and is also produced by all forms of life on Earth. This water vapour moves through the atmosphere, condenses to form clouds and precipitates as rain and snow. In time, the water returns to where it came from, and the process begins all over again. Although water is constantly moving, its total quantity on Earth's surface is constant.

The demand for water has increased over the years and this has led to water scarcity in many parts of the world. The situation is aggravated by the problem of water pollution or contamination. India is heading towards a freshwater crisis mainly due to improper management of water resources and environmental degradation, which has lead to a lack of access to safe water supply to millions of people. This freshwater crisis is already evident in many parts of India, varying in scale and intensity depending mainly on the time of the year.

During the past two decades, the water level in several parts of the country has been falling rapidly due to an increase in extraction. The number of wells drilled for irrigation of both food and cash crops have rapidly and indiscriminately increased. India's rapidly rising population and changing lifestyles has also increased the domestic need for water. The water requirement for the industry also shows an overall increase. Intense competition among users — agriculture, industry, and domestic sectors — is driving the groundwater table lower.

Worldwide, the consumption of water is doubling every 20 years - more than twice the rate of increase in population.

A large amount of water is wasted in agriculture, industry, and urban areas. It has been estimated that with available technologies and better operational practices, agricultural water demand could be cut by about 50%, and that in urban areas by about 33% without affecting the quality or economics of life. But most governments do not have adequate laws or regulations to protect their water systems.

Due to the increase in population there has been a rise in the demand for food, space for housing, consumer products, etc., which has in turn resulted in increased industrialization, urbanization, and demands in agriculture thereby leading to both river and groundwater contamination.

Some interesting facts about water

- The Pacific ocean is the biggest ocean covering approximately 32.6% of the Earth's surface.
- The Arctic ocean is the smallest ocean.
- 75% of the earth's surface is covered with water.
- More than 97% of the earth's water is in its oceans.
- About 2% of the available drinking water is frozen leaving only 1% for drinking.
- The world's average rainfall is about 850 mm.
- Water regulates the Earth's temperature. It also regulates the temperature of the human body, carries nutrients and oxygen to cells, cushions joints, protects organs and tissues, and removes waste.
- 60% - 75% of the adult human body is water - 82% of blood is water; 70% of the brain and 90% of the lungs are made up of water.
- Blood in animals and sap in plants is composed mainly of water.
- To cook 1 cup of rice you need 2 cups of water but to wash the pan in which it has been cooked you need 4-5 litres of water.
- A dripping tap can waste up to 6 litres of water in a day.
- More than half the creatures on the Earth are found under water.
- Life on earth probably originated in water.
- In the summer our bodies require about 2 litres of water daily. Here is the water content of some foods (approximate) - 95% in tomato, 91% in spinach, 91% in milk, 85% in apples and 80% in potatoes.
- 10% of the earth's surface is covered with ice.

There are more than one billion people particularly in North Africa and Western and South Asia, who lack access to a steady supply of clean water.

Access to water and sanitation, so crucial to human well-being and development, has now become a priority for the international community. To underscore the need for immediate action, the United Nations has designated 2003 as the International Year of Freshwater.

The importance given to water in ancient India is reflected in several hymns of the Vedas and epics and narratives from other valuable works such as the Arthasastra of Kautilya.

Urban wetlands

Through the ages, urban wetlands have been the lifeline of most cities in India. They were preserved and looked after by the people as their main source of water supply for drinking and irrigation. These wetlands are found all over the country and are either natural or built by people.

Over the years, they have gradually depleted, leading to a number of problems in urban areas such as flooding, water scarcity, and water logging.

Tanks were constructed in the catchment areas of cities that were not located near a river or a large lake. Rainwater or run-off would collect during the monsoons and be stored for the rest of the year in these tanks and lakes. The city would get its water supply from these.

In southern India, the towns were built around a temple, which always had a tank at the centre. Wells were located in the tank, which served as a link with the aquifers. There were innumerable tanks dug by the rulers, most of which have been destroyed. In fact, in some areas tank building by the ruler was considered a noble deed.

In Karnataka, the Hoysalas built tanks all over the state. Some of these still exist. Festivals were organized around tanks; cleaning and de-silting the tanks were a part of the rituals.

But over the years, human activity steadily destroyed these wetlands. In Bangalore, the city bus terminus has been built on the Dharmambudhi tank. A part of the Sampangi tank has given way to the Kanteerva stadium and the remaining to a housing colony. Another lake was filled up to house the city market.

- Pollution levels in the Hussain Sagar Lake in Hyderabad has been going up over the years. There are more than a thousand polluting industries located around the lake, a large number of them pharmaceutical industries. Untreated effluents from the industries and domestic sewage have deteriorated the water quality in the lake. The lake gets little chance to rejuvenate itself as a run-off happens only once a year during the monsoons, whereas pollutants flow in throughout the year.
- The Cholas were well known for the construction of tanks in the state of Tamil Nadu. But today, despite heavy rains, Chennai reels under severe water crisis along with flooding. A number of housing colonies have been built on tanks and over the years the numbers are increasing. This is the case in most large cities in the country.

- In Calcutta wetlands, both artificial and natural, have been a part of the city system. The main drainage for the city has been the Hooghly River; but the incline of the city is eastwards and this has led to the creation of the East Calcutta Wetlands. The Salt Lake is one of the largest wetlands in the city and serves as a flood cushion for the city. Calcutta has no sewage treatment plant. The sewage is treated in the sewage-fed fisheries; the process is cost-effective and lasting. A number of the fisheries purify this water through a series of sedimentation tanks and use the water for fish cultivation and agriculture.

- Indore's water needs were met by a large numbers of wells and tanks located all around the city. But over the last few years, the tanks have gradually dried up, including the largest of them, the Yashwant Sagar Lake. Vegetable and fruit cultivation along the banks of the lake has caused pollution due to run-offs from the fields. This has caused eutrophication and contamination.

- There are no rivers in the vicinity of Bhopal and the city depends entirely on lakes to meet the water needs of the city. Over the years, these lakes have become polluted due to the dumping of sewage into them. The government recently announced the Bhuj Wetland Project, a scheme to prevent the flow of liquid and solid waste into the lakes and also to de-silt them. More than 2000 ha of land around the upper lakes, which feed water to the lower ones, is to come under plantation.

Once upon a time, these urban wetlands maintained a steady supply of water for the city, recharged the groundwater, cooled the city, and prevented flood as they were a natural drainage system. Over the years, these very tanks and wetlands have been neglected, encroached upon either to accommodate more houses or to dump waste. This has caused large-scale water crisis and monsoon flooding and water logging, leading to misery and disease. These wetlands that have been protected for centuries are now being ravaged and destroyed in the name of development. People in the urban areas must learn to live in harmony with nature in their own habitat. The wetlands, the green belts, and the flora and fauna of these areas have to be preserved for urban areas to survive and remain healthy.

Rainwater harvesting

In urban areas, the construction of houses, footpaths and roads has left little exposed earth for water to soak in. In parts of the rural areas of India, floodwater quickly flows to the rivers, which then dry up soon after the rains stop. If this water can be held back, it can seep into the ground and recharge the groundwater supply.

This has become a very popular method of conserving water especially in the urban areas. Rainwater harvesting essentially means collecting rainwater on the roofs of building and storing it underground for later use. Not only does this recharging arrest groundwater depletion, it also raises the declining water table and can help augment water supply. Rainwater harvesting and artificial recharging are becoming very important issues. It is essential to stop the decline in groundwater levels, arrest sea-water ingress, i.e. prevent sea-water from moving landward, and conserve surface water run-off during the rainy season.

Town planners and civic authority in many cities in India are introducing bylaws making rainwater harvesting compulsory in all new structures. No water or sewage connection would be given if a new building did not have provisions for rainwater harvesting. Such rules should also be implemented in all the other cities to ensure a rise in the groundwater level. Realizing the importance of recharging groundwater, the CGWB (Central Ground Water Board) is taking steps to encourage it through rainwater harvesting in the capital and elsewhere. A number of government buildings have been asked to go in for water harvesting in Delhi and other cities of India.

All you need for a water harvesting system is rain, and a place to collect it! Typically, rain is collected on rooftops and other surfaces, and the water is carried down to where it can be used immediately or stored. You can direct water run-off from this surface to plants, trees or lawns or even to the aquifer.

Some of the benefits of rainwater harvesting are as follows

- Increases water availability
- Checks the declining water table
- Is environmentally friendly
- Improves the quality of groundwater through the dilution of fluoride, nitrate, and salinity
- Prevents soil erosion and flooding especially in urban areas

Rainwater harvesting: a success story

Once Cherrapunji was famous because it received the largest volume of rainfall in the world It still does but ironically, experiences acute water shortages. This is mainly the result of extensive deforestation and because proper methods of conserving rainwater are not used. There has been extensive soil erosion and often, despite the heavy rainfall and its location in the green hills of Meghalaya, one can see stretches of hillside devoid of trees and greenery. People have to walk long distances to collect water.

In the area surrounding the River Ruparel in Rajasthan, the story is different - this is an example of proper water conservation. The site does not receive even half the rainfall received by Cherrapunji, but proper management and conservation have meant that more water is available than in Cherrapunji.

The water level in the river began declining due to extensive deforestation and agricultural activities along the banks and, by the 1980s, a drought-like situation began to spread. Under the guidance of some NGOs (non-government organizations), the women living in the area were encouraged to take the initiative in building johads (round ponds) and dams to hold back rainwater. Gradually, water began coming back as proper methods of conserving and harvesting rainwater were followed. The revival of the river has transformed the ecology of the place and the lives of the people living along its banks. Their relationship with their natural environment has been strengthened. It has proved that humankind is not the master of the environment, but a part of it. If human beings put in an effort, the damage caused by us can be undone.

Agriculture

Conservation of water in the agricultural sector is essential since water is necessary for the growth of plants and crops. A depleting water table and a rise in salinity due to overuse of chemical fertilizers and pesticides has made matters serious. Various methods of water harvesting and recharging have been and are being applied all over the world to tackle the problem. In areas where rainfall is low and water is scarce, the local people have used simple techniques that are suited to their region and reduce the demand for water.

- In India's arid and semi-arid areas, the 'tank' system is traditionally the backbone of agricultural production. Tanks are constructed either by bunding or by excavating the ground and collecting rainwater.
- Rajasthan, located in the Great Indian Desert, receives hardly any rainfall, but people have adapted to the harsh conditions by collecting whatever rain falls. Large bunds to create reservoirs known as khadin, dams called johads, tanks, and other methods were applied to check water flow and accumulate run-off. At the end of the monsoon season, water from these structures was used to cultivate crops. Similar systems were developed in other parts of the country. These are known by various local names ¾ jal talais in Uttar Pradesh, the haveli system in Madhya Pradesh, ahar in Bihar, and so on.

Water conservation in ancient India

Our ancient religious texts and epics give a good insight into the water storage and conservation systems that prevailed in those days. Over the years rising populations, growing industrialization, and expanding agriculture have pushed up the demand for water. Efforts have been made to collect water by building dams and reservoirs and digging wells; some countries have also tried to recycle and desalinate (remove salts) water. Water conservation has become the need of the day. The idea of ground water recharging by harvesting rainwater is gaining importance in many cities.

In the forests, water seeps gently into the ground as vegetation breaks the fall. This groundwater in turn feeds wells, lakes, and rivers. Protecting forests means protecting water 'catchments'. In ancient India, people believed that forests were the 'mothers' of rivers and worshipped the sources of these water bodies.

Some ancient Indian methods of water conservation

The Indus Valley Civilization, that flourished along the banks of the river Indus and other parts of western and northern India about 5,000 years ago, had one of the most sophisticated urban water supply and sewage systems in the world. The fact that the people were well acquainted with hygiene can be seen from the covered drains running beneath the streets of the ruins at both

Mohenjodaro and Harappa. Another very good example is the well-planned city of Dholavira, on Khadir Bet, a low plateau in the Rann in Gujarat. One of the oldest water harvesting systems is found about 130 km from Pune along Naneghat in the Western Ghats. A large number of tanks were cut in the rocks to provide drinking water to tradesmen who used to travel along this ancient trade route. Each fort in the area had its own water harvesting and storage system in the form of rock-cut cisterns, ponds, tanks and wells that are still in use today. A large number of forts like Raigad had tanks that supplied water.

- In ancient times, houses in parts of western Rajasthan were built so that each had a rooftop water harvesting system. Rainwater from these rooftops was directed into underground tanks. This system can be seen even today in all the forts, palaces and houses of the region.

- Underground baked earthen pipes and tunnels to maintain the flow of water and to transport it to distant places, are still functional at Burhanpur in Madhya Pradesh, Golkunda and Bijapur in Karnataka, and Aurangabad in Maharashtra.

Reducing water demand
Simple techniques can be used to reduce the demand for water. The underlying principle is that only part of the rainfall or irrigation water is taken up by plants, the rest percolates into the deep groundwater, or is lost by evaporation from the surface. Therefore, by improving the efficiency of water use, and by reducing its loss due to evaporation, we can reduce water demand.
There are numerous methods to reduce such losses and to improve soil moisture. Some of them are listed below.

- Mulching, i.e., the application of organic or inorganic material such as plant debris, compost, etc., slows down the surface run-off, improves the soil moisture, reduces evaporation losses and improves soil fertility.
- Soil covered by crops, slows down run-off and minimizes evaporation losses. Hence, fields should not be left bare for long periods of time.
- Ploughing helps to move the soil around. As a consequence it retains more water thereby reducing evaporation.
- Shelter belts of trees and bushes along the edge of agricultural fields slow down the wind speed and reduce evaporation and erosion.
- Planting of trees, grass, and bushes breaks the force of rain and helps rainwater penetrate the soil.
- Fog and dew contain substantial amounts of water that can be used directly by adapted plant species. Artificial surfaces such as netting-surfaced traps or polyethylene sheets can be exposed to fog and dew. The resulting water can be used for crops.
- Contour farming is adopted in hilly areas and in lowland areas for paddy fields. Farmers recognize the efficiency of contour-based systems for conserving soil and water.
- Salt-resistant varieties of crops have also been developed recently. Because these grow in saline areas, overall agricultural productivity is increased without making additional demands on freshwater sources. Thus, this is a good water conservation strategy.
- Transfer of water from surplus areas to deficit areas by inter-linking water systems through canals, etc.
- Desalination technologies such as distillation, electro-dialysis and reverse osmosis are available.
- Use of efficient watering systems such as drip irrigation and sprinklers will reduce the water consumption by plants.

Impact of our lifestyle on water

Water is precious because life could not exist without it. Life was born as a result of water, from plants to animals to humans. Despite Earth's appearance of watery abundance, less than one percent of the water on Earth is actually fresh and usable. Nature's water-recycling process,

known as the water cycle, has kept the amount of water on Earth about the same for millions of years.

All living things depend on water for survival. Plants need water to make food and grow. Many animals and plants live in water. People need water for cooking, bathing, transportation, recreation, and for growing crops and making products. Without water, there would be no food to eat, no clothes to wear, and no toys to play with. In fact, our bodies are all made of water. Without water, we wouldn't exist!

The most important step in the direction of finding solutions to issues of water and environmental conservation is to change people's attitudes and habits¾this includes each one of us. Conserve water because it is the right thing to do. We can follow some of the simple things that have been listed below and contribute to water conservation.

- Try to do one thing each day that will result in saving water. Don't worry if the savings are minimal¾every drop counts! You can make a difference.
- Remember to use only the amount you actually need.
- Form a group of water-conscious people and encourage your friends and neighbours to be part of this group. Promote water conservation in community newsletters and on bulletin boards. Encourage your friends, neighbours and co-workers to also contribute.
- Encourage your family to keep looking for new ways to conserve water in and around your home.
- Make sure that your home is leak-free. Many homes have leaking pipes that go unnoticed.
- Do not leave the tap running while you are brushing your teeth or soaping your face.
- See that there are no leaks in the toilet tank. You can check this by adding colour to the tank. If there is a leak, colour will appear in the toilet bowl within 30 minutes. (Flush as soon as the test is done, since food colouring may stain the tank.)
- Avoid flushing the toilet unnecessarily. Put a brick or any other device that occupies space to cut down on the amount of water needed for each flush.
- When washing the car, use water from a bucket and not a hosepipe.
- Do not throw away water that has been used for washing vegetables, rice or dals¾use it to water plants or to clean the floors, etc
- You can store water in a variety of ways. A simple method is to place a drum on a raised platform directly under the rainwater collection source. You can also collect water in a bucket during the rainy season.

What you can do to conserve water

- Use only as much water as you require.
- Close the taps well after use.
- While brushing your teeth do not leave the tap running, open it only when you require it.
- See that there are no leaking taps. Get a plumber to come in and seal all leaks.
- Use a washing machine that does not consume too much water.
- Do not leave the taps running while washing dishes and clothes.
- Install small shower heads to reduce the flow of the water.
- Water in which the vegetables and fruits have been washed can be used to water the flowers and ornamental potted plants.
- At the end of the day if you have water left in your water bottle do not throw it away, pour it over some plants.

Life in water

Acid waters may wipe out some of the smallest animals in Earth's oceans.

What's in a scoop of seawater? You might think that a scoop of water couldn't hold much. Think again. Loads of living things swim, float, and splash around in a small scoop.

Now, you will not see these creatures bathing in a dipper of water. That's because many of them are too small to see with the unaided eye. Others are almost clear, or transparent, so you can't see them either. Combined, all these creatures are called marine microfauna. They are the smallest animals in the sea.

A microscope reveals this normally hidden world. Bug-like creatures dart about. Nearly clear worms float by. Crinkled critters are sprinkled through the water. Big-eyed baby crabs crawl by.

These are a few of the millions of mini mites that abound in Earth's oceans. Yet these creatures may be heading for trouble. Let's explore this small world.

Water world

Four oceans cover most of Earth's surface. They are, from largest to smallest, the Pacific Ocean, Atlantic Ocean, Indian Ocean, and Arctic Ocean. The Pacific Ocean alone is 15 times larger than the United States. All four oceans combined are twice the size of Earth's dry land.

The four oceans are all connected. Water from one ocean flows into the others. So they are often combined and called the ocean. The ocean isn't the same everywhere, though. Many different habitats make it up.

Life abounds in the habitats located near the surface of the ocean. There, sunlight warms ocean water. Near the Equator, colorful coral reefs rise from the seafloor. In other areas, towering kelp forests sprout.

Little sunlight reaches below 200 meters (656 feet). Without sunlight, the water is very cold. Still, some sea creatures make their homes in the deepest parts of the ocean.

Many creatures live around volcanic vents, for example. A volcanic vent marks a volcano on the ocean floor. These vents warm the ocean floor, creating hot spots in the deepest and darkest parts of the ocean. Fish and other sea creatures live throughout the ocean. Sharks and rays live near the surface. Whales and giant squid live in deeper waters. Anglerfish live in some of the deepest waters.

It is a small world

Lilliputian life-forms also make their homes almost everywhere in the ocean. They even outnumber their larger neighbors. For example, scientists recently found 20,000 kinds of bacteria in one liter (about a quart) of seawater.

Bacteria aren't the only tiny tots in the vast ocean. Some of these critters wear shells. Others are jelly-like blobs. Some swim. Others float. Tiny sea dwellers include baby squid, octopuses, and fish. There are also wee animals called copepods.

Not all of these teensy critters stay small. Some join forces to work together. Take the blue button. It is related to the jellyfish. While it looks like one animal, it isn't. Many small animals combine to make the blue button.

Each of the arms that make up the blue button has a different job. For example, some catch prey. Other arms digest the prey.

Links in the food chain

Other pint-size sea creatures simply grow up. A swordfish starts out small, but it grows into a hungry predator. An adult swordfish can be three meters (ten feet) long. It swims along, looking for smaller prey.

All the critters in the sea are part of the ocean food chain. A food chain is made of the plants and animals that eat one another.

Because of their size, the tiny critters are near the bottom of the food chain. For example, the giant whale shark feasts on these puny animals. It slurps in mouthfuls of water. It then forces the water out its gills. As the water flows out through the gills, the shark swallows the bitty beasties in `the water.

The whale shark and other animals that eat this way are called filter feeders. That's because the sharks have filters in their bodies that trap marine microfauna.

Acid Bath

Large predators are just one of the problems marine microfauna face. An invisible gas is changing the water in which they live.

Cars and factories make carbon dioxide gas. Most of this gas rises into Earth's atmosphere. There it acts like a blanket, trapping the sun's heat and causing global warming. Global warming is the worldwide rise in Earth's average temperature.

The gas also causes problems in seawater. The ocean soaks up about a third of the carbon dioxide pumped into the skies. That's about 25 million tons of carbon dioxide each day.

Carbon dioxide makes an acid when it mixes with water. That acid makes it harder for animals to make shells and skeletons. This is especially true for the smallest sea creatures.

If more of the gas fills the ocean, small snails and other creatures that wear shells may not be able to survive. That will mean less food for the animals that eat shellfish. Many animals could starve and die.

It may seem hard to believe that what people do on land can affect sea creatures. Yet it can. More and more, scientists are learning that all living things are connected. That includes us. Human actions can mean big changes for even the tiny animals in our oceans.

Corals

Corals are small, sedentary marine animals that occur in dense colonies in warm shallow waters of oceans. Reef-building corals are scattered throughout the tropical and subtropical western Atlantic and Indo-Pacific oceans, generally between 30 degrees North and 30 degrees South latitudes.

Coral reefs are formed by the skeleton remains of many generations of stony corals. Massive reef structures are built over thousands of years by tiny coral polyps aided by minute algae (zooxanthellae) that live in their tissues, calcifying algae, and other organisms that secrete calcium carbonate and adhesives. Reef- building corals are generally found at depths of less than 46 m, where there is sunlight and clear water through which the sunlight penetrates better. Reef-

building corals, along with the algae, require warm ocean temperatures (20–28° C) and are therefore found along the eastern shores of major land masses where the water is warmer. These reefs are amongst the earth's oldest living communities of plants and animals. They vary in shape, size and colour.

Coral ecosystem

Coral reefs are sometimes referred to as 'tropical rainforests of the deep' since they are one of the most diverse, productive, and beautiful marine ecosystems in the world. The extraordinary diversity of reefs makes them biologically important and, like rainforests, they have provided valuable scientific insights into the nature of underwater ecology. It is a diverse collection of species that interact with each other and the physical environment. The sun is the initial source of energy for this ecosystem. They are considered to be one of the most sensitive to any change. When they are environmentally stressed they lose much of the algae that gives them the colour along with other pigments. When this happens the corals appear white in colour and are referred to as bleached.

Excessive growth and accumulation of phytoplankton and seaweed would be detrimental to coral vitality and diversity, and low nutrient conditions are needed to prevent this. Diverse and abundant populations of grazing fish and invertebrates also keep the growth down.

Creatures found on coral reefs

The coral reef ecosystem is a diverse collection of species that interact with each other and the physical environment. The numerous species residing and depending on coral reefs represent a bank containing the genetic diversity necessary for adaptation to changes in the environment. Sponges have been an important part of the coral reef ecosystem. Sea anemones provide shelter to the fish and other creatures in the reefs. Fishes play a vital role in the reef's food web, acting as both predators and prey. Bryozoans are microscopic invertebrates that form branching colonies over coral skeletons and reef debris, cementing the reef structure.

The reef is also home to a variety of worms, shrimps, crabs, lobsters, starfish, sea cucumbers, and sea urchins. Octopuses, squids, clams, scallops, marine snails, and also some species of sharks, skates, and rays live on or near the reef. Some sea turtles frequent reef areas. Green, loggerhead, and hawksbill sea turtles live in the warm waters of the Great Barrier Reef.

The predators

The crown of thorns, a starfish, is a well- known predator of coral. Large numbers of these starfish can devastate reefs, leaving behind only the calcium carbonate skeletons. Parrotfish use chisel-like teeth to nibble on hard corals and eat the algae within the coral. Eels are one of the reef's largest predators and feed on the small fishes, octopuses, shrimps, and crabs.

Types of reefs

There are three types of reefs: the fringing reef, the barrier reef, and the atoll.

- Fringing reefs border shorelines of continents and islands in tropical seas.
- Barrier reefs occur farther offshore. The Great Barrier Reef off northern Australia in the Indo-Pacific is the largest barrier reef in the world. This reef stretches more than 2000 km.

- Atolls are reefs that surround a central lagoon. The result is several low coral islands around a lagoon. Atolls commonly occur in the Indo-Pacific region.

Importance of corals and coral reefs

- Corals remove and recycle carbon dioxide. Excessive amounts of this gas contribute to global warming.
- Reefs shelter land from harsh ocean storms and floods by breaking the force of the waves, thereby allowing mangroves and seagrass to flourish.
- Reefs provide resources for fisheries.
- They attract millions of tourists every year.
- The coral reef is an intricate ecosystem and contains a diverse collection of organisms. Without the reef, these organisms would die.
- Coral skeletons are being used as bone substitutes in reconstructive bone surgery.
- The coral reef provides a living laboratory for both students and scientists.

Major threats to coral reefs

- Deforestation, construction, and other activities have led to silt or sand covering the corals, smothering them, and preventing light from passing through.
- Mangroves and seagrass that normally act as filters for sediment are being rapidly destroyed.
- Prawn harvesters have destroyed large areas of corals to create artificial prawn farms.
- Fishing with explosives have reduced nearby coral to lifeless rubble.
- Overfishing makes this problem even worse because the fish that would normally eat the algae have been captured and killed.
- Commercial fishing fleets often use cyanide and other poisons to stun and capture valuable reef fish. This poisons not only the fish but the coral polyps and other creatures in the area as well. In the Philippines, less than 10% of the coral reefs remain healthy due to extensive fishing.
- Trash dumped into the water can also kill coral reef life.
- Fertilizers and sewage dumped into coastal waters encourage rapid algae growth which chokes coral polyps, cutting off their supply of light and oxygen. This appears to be the case in some parts of the Great Barrier Reef.
- Careless boating, diving, fishing, and other recreational uses of coral reef areas can cause damage to coral reefs.
- Coral reefs are also threatened by global warming. There has been an unprecedented increase in the number of coral bleaching events during the past 2 decades (which have had some of the warmest years in history). When ocean temperatures get too high, coral lose the symbiotic algae inside them, causing them to turn white, or ‘bleach’, and eventually die.
- While coral reefs are sensitive to environmental changes, they appear to be able to recover effectively from physical disturbance or temporary pollution events provided the water quality is generally high. For example, the corals in Kaneohe Bay, Hawaii, for the most part recovered from severe overgrowth of algae after sewage inputs were diverted away from the Bay.