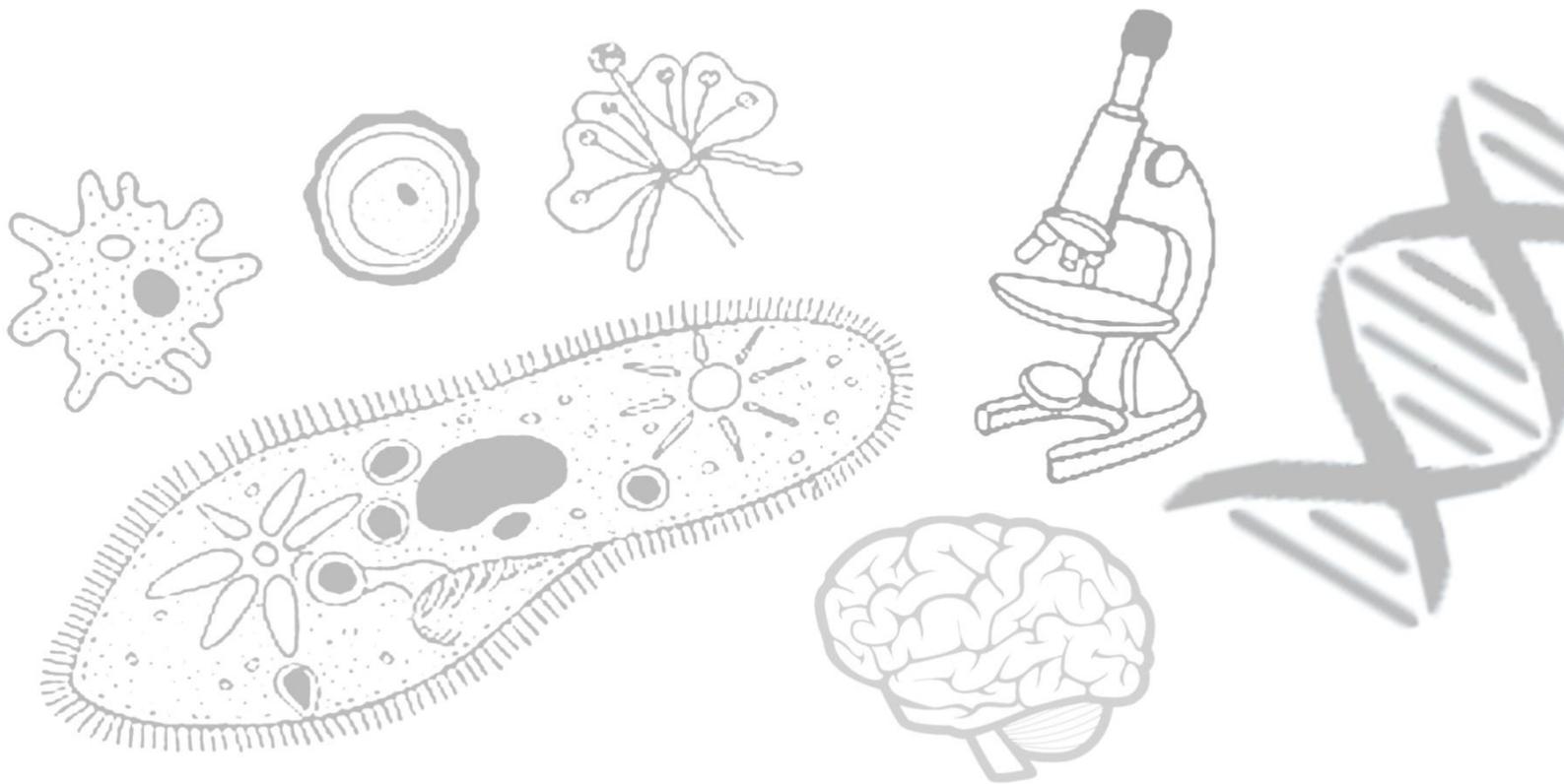


# BIOLOGY



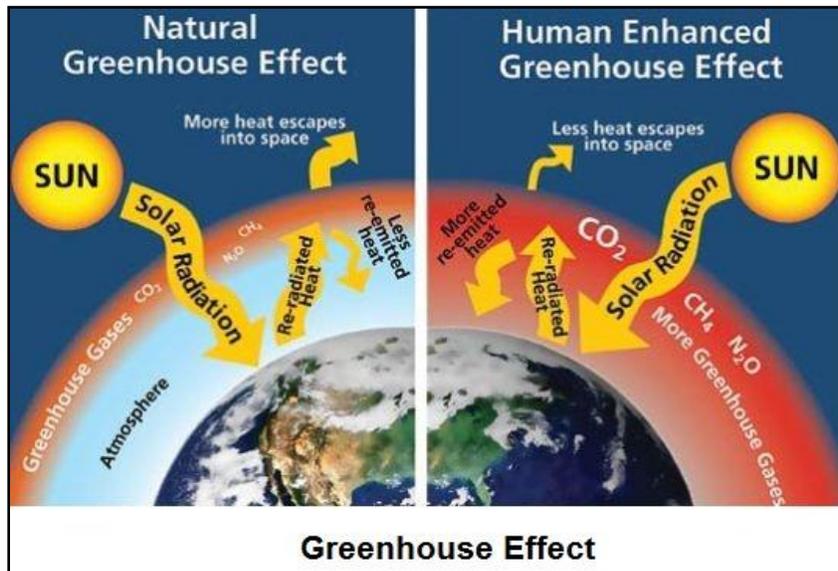
# Greenhouse Effect, Ozone Depletion and Deforestation

## Contents

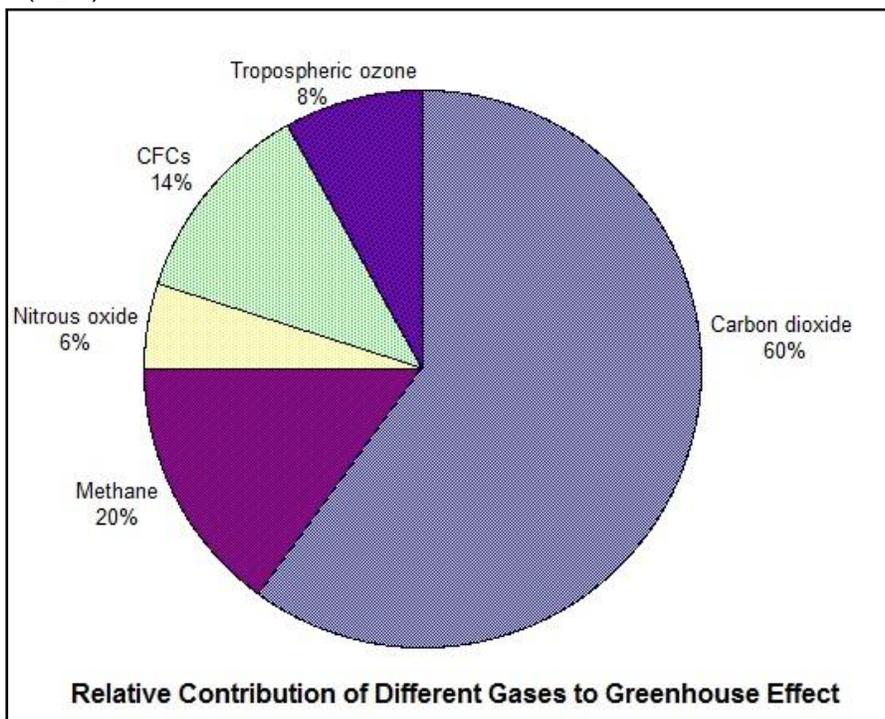
Greenhouse Effect.....	3
Ozone Depletion.....	7
Improper Resource Utilisation and Maintenance.....	10
Deforestation .....	12

## Greenhouse Effect

- A greenhouse is a small glass house. The glass panels allow sunlight to enter but do not allow the heat to escape from the greenhouse. This helps in growing plants in the greenhouse.
- Similarly, the greenhouse effect is a natural process which warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected to space and the rest is absorbed and reradiated by greenhouse gases.



- Gases which are transparent to solar radiations but retain and partially reflect long-wave heat radiations are called greenhouse gases (GHGs). They are also called radiatively active gases.
- The various greenhouse gases are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), chlorofluorocarbons (CFCs) and nitrous oxide (N<sub>2</sub>O).



- These gases prevent a significant amount of long-wave radiations emitted by the Earth to escape into space and radiate a part of this energy back to the Earth. This phenomenon is called green flux.

- Because of greenhouse flux, the mean annual temperature of the Earth is 15°C, which will fall to -18°C in its absence.
- In recent years, the concentration of greenhouse gases has increased, resulting in an enhanced greenhouse effect with a rise in the mean global temperature. It is called global warming.

Greenhouse gases	Pre-industrial concentration	Concentration in 2000
Carbon dioxide (CO <sub>2</sub> )	280 ppm	368 ppm
Methane (CH <sub>4</sub> )	700 ppb	1750 ppb
Nitrous oxide (N <sub>2</sub> O)	270 ppb	316 ppb
Chlorofluorocarbons (CFCs)	0	282 ppt

## Effects of Greenhouse Effect

### Increase in CO<sub>2</sub> concentration

- There has been a significant rise in CO<sub>2</sub> concentration from 316 ppm in 1959 to about 374 ppm in 2001.
- This increases the rate of photosynthesis and lowers the rate of transpiration in plants.

### Global Warming

- Overall rise in CO<sub>2</sub> has led to greater retention of solar radiation in the atmosphere causing global warming.

### Effect on Atmosphere

- Cooling in the stratosphere tends to increase the size of ozone holes, while cooling in the thermosphere disrupts radio communication and further warms the troposphere.

### Effect on Weather and Climate

- Odd climate changes like the El Nino effect would become common.
- Moisture-carrying capacity of air increases.
- Pattern of air mass movement changes.

### Changes in Sea Level

- Rise in temperature will raise the sea level because of the thermal expansion of sea water and the melting of glaciers and the Greenland ice sheet.

### Effects on Living Beings

- Rise in temperature will result in a decline in sensitive tree species resulting in the conversion of forests into scrub vegetation.

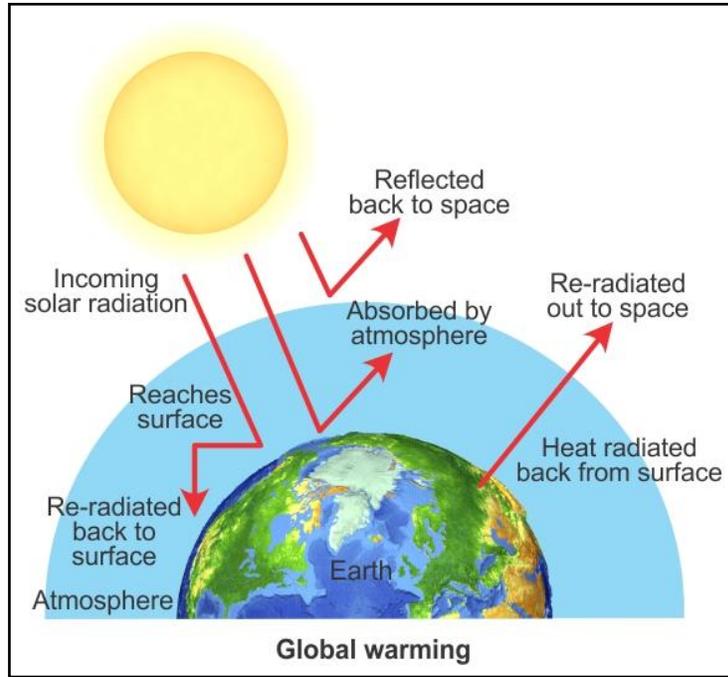
### Effect on Food Production

- Rise in temperature is detrimental to crop productivity because of an increase in respiration, greater growth of weeds and eruption of diseases and pests.

**Global Warming**

**What is global warming?**

- Global warming is the increase in the Earth's average temperature because of the effect of greenhouse gases which trap the heat which would otherwise escape from the Earth's atmosphere.



**Effects of global warming**

- Rise in the sea level because of the melting of glaciers and the thermal expansion of water
- Rise in temperature
- Change in rainfall patterns
- Destruction of crops and forests
- Spread of water-borne and insect-borne diseases
- Loss of biodiversity



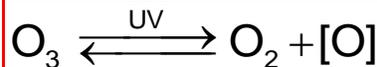
<b>Control measures for global warming</b>	<ul style="list-style-type: none"><li>○ Reduce the use of fossil fuels</li><li>○ Reforestation</li><li>○ Carbon sequestration</li><li>○ Shifting to renewable sources of energy such as solar power, wind power and hydel power</li><li>○ Complete replacement of CFCs with substitutes which have little effect on ozone and global warming</li><li>○ Reduction in the use of nitrogen fertilisers and relying more on nitrogen fixation</li><li>○ Improving the efficiency of energy usage</li><li>○ Checking population growth</li></ul>
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Since 2002, the Earth has started cooling instead of warming up further. Scientists think that it may be due to the rise in ozone concentration, weakening of the El Nino ocean effect or consumption of energy in melting of ice sheets and caps.

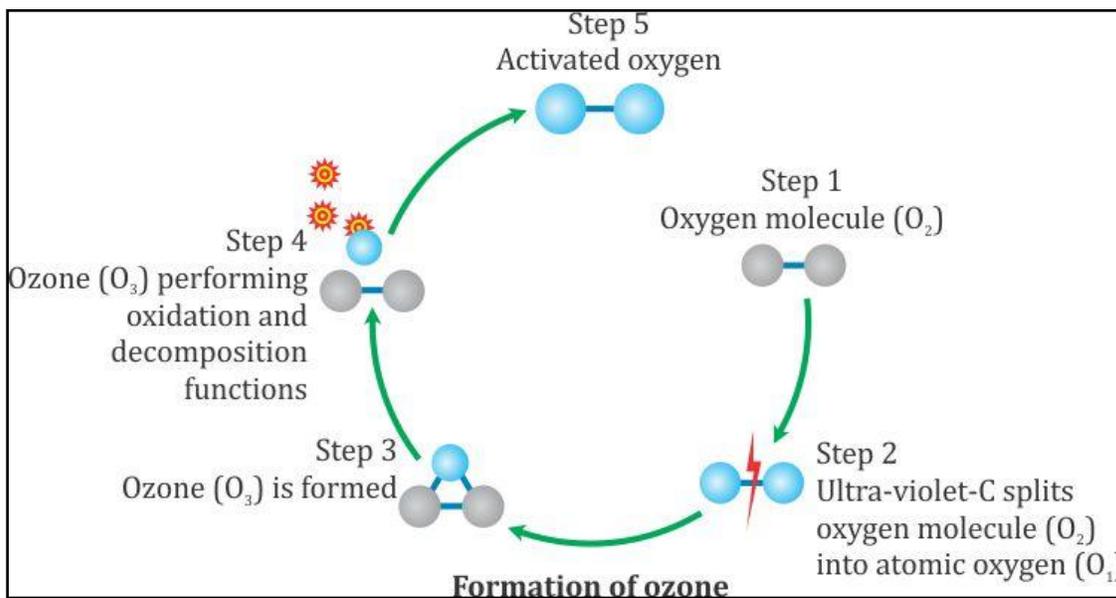
## Ozone Depletion

### What is Ozone Depletion?

- The ozone layer or the ozone shield called the ozonosphere is present in the stratosphere at an altitude of 23–25 km over the equator and at a slightly lower altitude of 11–16 km over the poles.
- Thickness of the ozone layer is measured in Dobson units (D.U.).
- In the stratosphere, ozone is being formed and photodissociated which dissipates the energy of ultraviolet (UV) radiations.



- Ozone is a molecule formed from three atoms of oxygen. It is a product of UV radiations acting on the oxygen molecule and splitting it into free oxygen atoms. These atoms combine with molecular oxygen to form ozone.



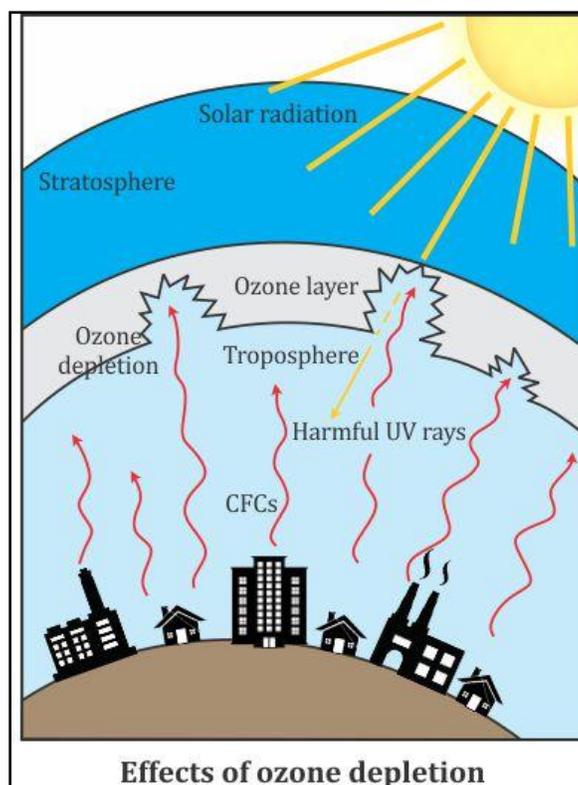
- The ozone layer functions as a shield against strong UV radiations and protects the Earth from these harmful radiations.
- The UV rays are highly damaging to organisms and can even cause skin cancer and other diseases in human beings.

## Causes of Ozone Depletion

- Methyl bromide
- Nitrogen oxides released from freezers, air conditioners, aerosol products and industrial solvents
- Compounds such as CFCs break down into chlorine atoms in the atmosphere. These chlorine atoms break down  $O_3$  into oxygen ( $O_2$ ) and nascent oxygen (O).
- The reduced amount of ozone cannot prevent the entry of UV rays.
- Depletion of the ozone layer widely in the stratosphere, particularly over the Antarctic region, resulted in the formation of a thinned ozone layer called the ozone hole.

## Effects of Ozone Depletion

- Incidence of skin cancer, cataract and poor immune response in humans.
- Affects crop yield and productivity in plants.
- UV radiation can cause the death of phytoplankton, young fish and larval forms.
- High-energy UV radiations break the chemical bonds of proteins and other biomolecules.
- UV radiations inhibit photosynthesis by affecting the photosynthetic machinery.
- Decreased photosynthetic activity will raise the  $CO_2$  concentration of the atmosphere resulting in global warming.
- Marine and terrestrial food chains get disturbed.
- UV-B damages DNA and can result in mutations.
- It causes ageing of skin, damage to skin cells and various types of skin cancers.
- In human eye, the cornea absorbs UV-B radiation. A high dose of UV-B causes inflammation of the cornea called snow blindness or cataract.



## International Initiatives for Mitigating Global Changes

- Under the support of United Nations Environment Programme (UNEP), various efforts have been taken to find a solution for ozone depletion and global warming.

<b>Montreal Protocol</b>	<ul style="list-style-type: none"> <li>○ It came into effect on 16<sup>th</sup> September 1987.</li> <li>○ 27 industrialised countries agreed to minimise the production of CFCs to half the level of 1986.</li> </ul>
<b>Helsinki Declaration</b>	<ul style="list-style-type: none"> <li>○ It came into effect in May 1989.</li> <li>○ The protocol was agreed by 82 nations at Helsinki who pledged to phase out CFCs by 2000.</li> </ul>
<b>Intergovernmental Panel on Climate Changes (IPCC)</b>	<ul style="list-style-type: none"> <li>○ It came into effect in 1988.</li> <li>○ It prepared a world climatic programme.</li> </ul>
<b>Convention on Climate Change (CCC)</b>	<ul style="list-style-type: none"> <li>○ It was held under the UN framework in 1991.</li> </ul>
<b>Earth Summit</b>	<ul style="list-style-type: none"> <li>○ It came into effect in 1992.</li> <li>○ It was held in Rio de Janeiro, Brazil, and adopted the recommendations of CCC for reducing greenhouse gases.</li> <li>○ The recommendations were signed by 154 nations.</li> </ul>
<b>Kyoto Protocol</b>	<ul style="list-style-type: none"> <li>○ It came into effect in December 1997.</li> <li>○ The International Conference held in Kyoto, Japan, obtained commitments from different countries for reducing overall greenhouse gas emissions at a level 5% below the 1990 level by 2008–2012.</li> </ul>
<b>Beijing Protocol</b>	<ul style="list-style-type: none"> <li>○ It came into effect in 1999.</li> <li>○ The protocol laid down steps to reduce the emission of CFCs and other ozone-depleting substances.</li> </ul>

## Improper Resource Utilisation and Maintenance

- Degradation of natural resources causes pollution.
- Improper utilisation and maintenance practices can also lead to degradation of natural resources.
- It is important to use the resources carefully and judiciously to conserve them for future generations.

### Soil Erosion and Desertification

- Soil formation is a long continuous process.
- It takes several hundreds of years for the development of fertile top soil.
- However, faulty utilisation practices can remove this layer within a few years.
- The vast fertile land can turn into an arid patch.
- The common causes of loss of fertile top cover of soil are deforestation, overgrazing, over-cultivation, leaving tilled soils without seedling and improper irrigation practices.
- Soil without a vegetation cover can be easily eroded by both wind and water. Soon, a sandy patch is formed.



Soil Erosion and Desertification

### Waterlogging and Soil Salinity

- Improper practices such as excessive irrigation, kutchra irrigation channels, presence of impermeable underground soil pans and poor drainage result in water logging of soil.
- A waterlogged soil has poor aeration capacity because of which the plant growth is stunted.
- Evaporation of water draws salt to the soil surface.
- A crust of salt is formed both over the surface and upper layers of the soil.
- Such soils are called saline soils and are unsuitable for the growth of crops.



## Deforestation

### What is Deforestation?

- Deforestation is the removal, decrease or deterioration of forest cover of an area.
- It has been practised on a large scale in India.
- In India, 1/3<sup>rd</sup> of the land was covered by forests in the late 1930s. In 1951, it was only 23%, while in 1980s, it was 19.4%. The percentage decreased to 20.64% in 2003.



**Deforestation**

### Causes of Deforestation

#### Jhum Cultivation

- It is slash and burn agriculture. It is known as *podu* in AP, *bewar* or *dahza* in MP and *dahi* in Odisha.



**Slash and burn agriculture**

- In this method, huge tracts of land are cleared every year through lopping, burning the remainder, mixing the ash with soil and sowing the cleared land with crop seeds.
- The land is used for 2–3 years without manuring. This results in nutrient depletion, reduced moisture retention and increased soil erosion.

**Hydroelectric Projects**

- Dams, reservoirs and hydroelectric projects submerge forest tracts, resulting in the death of plants and animals.



**Hydroelectric Power Generation**

**Forest Fires**

- Huge forest fires have been known to encroach upon areas up to 40,000 km<sup>3</sup> in Indonesia in 1983 and 1997.



**Forest fire**

**Human Establishments**

- Large tracts of forests have been cleared for feeding the overgrowing human population.
- More land is required for building more residential complexes and industrial townships.



**Deforestation for human settlements**

**Construction of Mountain and Forest Roads**

- Construction of roads and railways in hilly forested areas results in huge deforestation, landslides and soil erosion.
- This weakens the fragile mountain systems.
- The fragments of land pass into valleys and streams and block the flow of water bodies, damaging the slopes and causing soil erosion.



**Construction of Mountain Roads**

## Construction of Canals

- Sharda Sahayak Canal Irrigation Project was commissioned in eastern UP in 1974 to irrigate 16 lakh hectares of land.
- In 1987, Singh and Afroz found that seepage from the canal has damaged 13,677 houses, harmed 2200 cattle, killed about a million mature Sal trees and put about 1,42,000 hectares of land out of cultivation.



**Sharda Sahayak Canal Irrigation Project**

## Overgrazing

- The livestock graze naturally in forests trampling seedlings and causing compaction of soil.
- The compaction of soil reduces the water-storing capacity and increases the run off.



**Overgrazing**

## Requirement of Wood

- Trees have been cut down for industrial purposes, mostly for the timber and paper industry.



**Cutting of trees for timber**

## Quarrying and Mining

- Mining operations have been responsible for clearing of large tracts of forest lands.



**Cutting of trees for quarrying and mining**

## Effects of Deforestation

<b>Shrinking Firewood</b>	<ul style="list-style-type: none"><li>• In India, the availability of fuel wood is 58 million m<sup>3</sup>/yr against the requirement of 300 million m<sup>3</sup>/yr.</li></ul>
<b>Reduced Timber</b>	<ul style="list-style-type: none"><li>• There is decreased availability of timber and other forest products.</li></ul>
<b>Change in Climate</b>	<ul style="list-style-type: none"><li>• Deforestation results in reduced rainfall, increased droughts, hot summers and cold winters.</li></ul>
<b>Soil Erosion</b>	<ul style="list-style-type: none"><li>• Soil exposed to insolation dries up and gets eroded by wind and water.</li></ul>
<b>Flash Floods</b>	<ul style="list-style-type: none"><li>• In flash floods, the soil is unable to retain much rain water. There is little percolation to recharge the aquifers.</li></ul>
<b>Siltation</b>	<ul style="list-style-type: none"><li>• In siltation, rivulets bring eroded soil and deposit the same on the beds of reservoirs and rivers.</li></ul>
<b>Cyclones</b>	<ul style="list-style-type: none"><li>• Indiscriminate cutting of mangroves along the coastline resulted in cyclones in Odisha.</li></ul>
<b>Droughts</b>	<ul style="list-style-type: none"><li>• During dry seasons, there is little water in the rivers causing droughts.</li></ul>
<b>Loss of Biodiversity and Germplasm</b>	<ul style="list-style-type: none"><li>• Indiscriminate cutting of trees results in loss of biodiversity and destruction of valuable germplasm.</li></ul>
<b>Decrease in Rainfall</b>	<ul style="list-style-type: none"><li>• There is a decrease in the amount and periodicity of rainfall. It often leads to desertification in dry areas.</li></ul>
<b>Global Warming</b>	<ul style="list-style-type: none"><li>• Deforestation increases atmospheric CO<sub>2</sub> content by releasing carbon stored in organic matter and reduced primary productivity.</li></ul>
<b>Indigenous People</b>	<ul style="list-style-type: none"><li>• Deforestation results in uprooting and loss of livelihood of tribals residing in forests who depend on forest produce for their survival and culture.</li></ul>

## Measures to Conserve Forests

DID YOU  
KNOW



According to the National Forest Policy (1988), hills should have a forest cover of 67%, while plains should have a forest cover of 33%.

### Afforestation and Reforestation

- Afforestation is growing a forest cover over an area which was earlier devoid of trees.
- Reforestation is restoring a forest cover over an area where one existed earlier but was removed at some point of time in the past.
- Use of silviculture techniques with due consideration of biodiversity speeds up the forest formation process.
- Under the Van Mahotsava movement, 1950, Government and private agencies plant tree saplings during July and February every year.

FACT



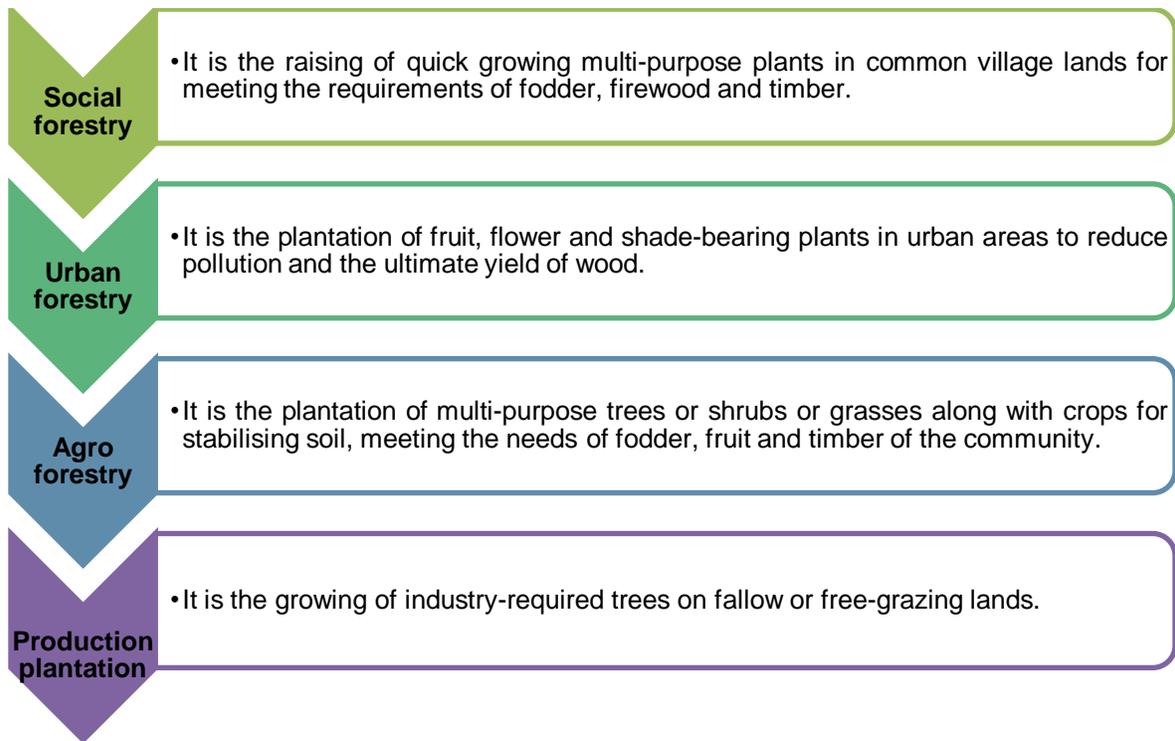
Silviculture is a programme started to replenish depleting forests by growing more trees.

### Protection or Conservation Forestry

- Degraded forests are regenerated through silviculture practices.
- The forests are allowed to regain before their exploitation.
- Certain forests included under sanctuaries and national parks are not allowed to be exploited.
- Well-stocked and mature forests are exploited scientifically.

## Production or Commercial Forestry

- Commercial forestry is the plantation of useful trees and shrubs for meeting commercial requirements without causing any undue demand on natural forests.
- It is of four types—social forestry, urban forestry, agroforestry and production plantation.

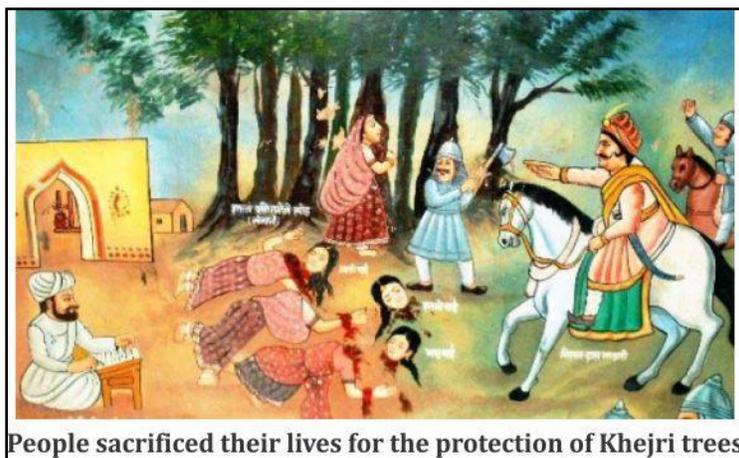


## People's Participation in Conservation of Forests

- Participation of people in the conservation of forests has been part of Indian history.

### Khejri Trees and the Bishnois

- Conservation of forests and wildlife has been a religious belief for the Bishnoi community in Rajasthan.

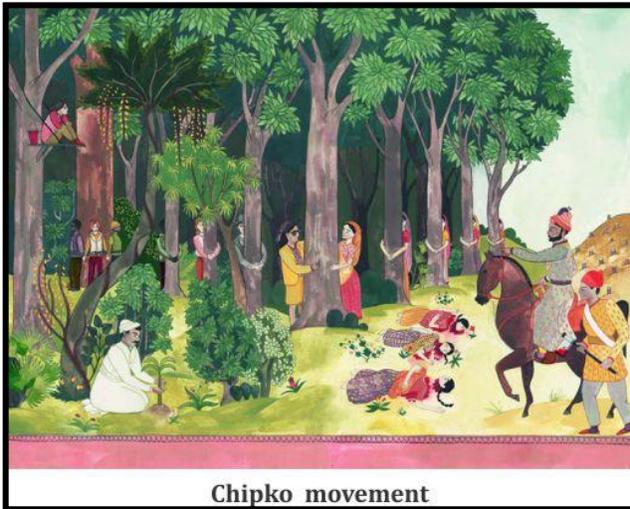


- In 1731, Amrita Devi Bishnoi led a group of 363 people who sacrificed their lives for the protection of Khejri trees in Khejarli village near Jodhpur in Rajasthan.

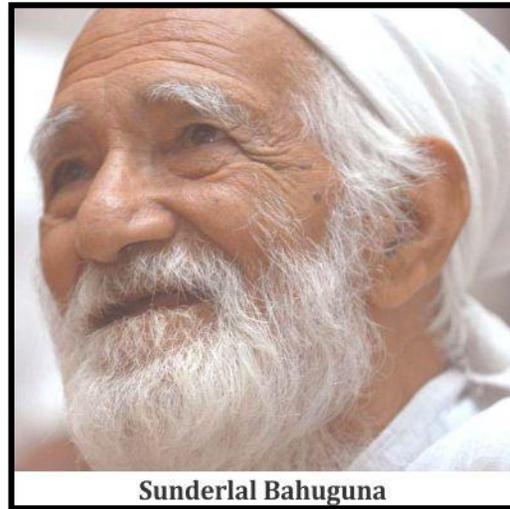
- The Government has recently instituted an 'Amrita Devi Bishnoi National Award for Wildlife Conservation' in the memory of Amrita Devi Bishnoi.

### The Chipko Movement

- The Chipko Andolan also called the 'Hug the trees movement' was organised to stop the destruction of forests. The movement began in 1970s in a remote village called Reni in Garhwal in the Himalayas.
- A logging contractor was given the permission to cut trees from the forest close to the village. One day, when the men folk were at work, the workers of the contractor entered the forest to cut trees. The women of the area rushed to the forest and hugged the trees, thereby preventing them from being felled. The contractor had no option but to withdraw.



Chipko movement



Sunderlal Bahuguna

- Cutting of trees would have affected not only the availability of natural resources but also the quality of soil and sources of water.
- The Chipko Movement spread quickly and the Government was forced to rethink their priorities with respect to the use of forest produce. Under the leadership of Sunderlal Bahuguna, the movement spread to the other parts as well.

### Joint Forest Management

- Under the guidelines issued in 1980s, village and tribal communities are involved in the development and protection of degraded forests on a share basis. It is called joint forest management (JFM).
- Currently, there are 84,632 JFM communities with 17.33 million hectare forest area. About 85.28 lakh families are involved in JFM all over the country.

