

regeneration. It is very important to protect and conserve our natural resources and use them in a judicious manner so that we don't exhaust them. The major natural resources:

1. Forest resource
2. Water resource
3. Mineral resource
4. Food resource
5. Energy resource
6. Land resource

3.1. WATER RESOURCES

Water is indispensable natural resources, on which all life depends. Water is needed for daily use by organisms, for irrigation, navigation, industrial use, electricity production and domestic use. Of the total water resource of the earth, 97.3% is salt water and the rest fresh water. About 97% of the earth's surface is covered by water and most of the animals and plants have 60-65% water in their body.

Of this about 77.2% is permanently frozen, 22.4% occurs as ground water and soil moisture, 0.35% is found in lakes and wetlands and 0.01% in rivers and streams. The total volume of ground water found in underground reservoir, called aquifers, is estimated to be 42.310^{10} m^3 . At present about 25% of the ground water is being used by man.

The water of even the healthiest rivers and lakes is not absolutely pure. All water (even if it is distilled) contains many naturally occurring substances – mainly bicarbonates, sulphates, sodium, chlorides, calcium, magnesium, and potassium. They reach the surface and groundwater from:

- soil, geologic formations and terrain in the catchment area (river basin);
- surrounding vegetation and wildlife;
- precipitation and runoff from adjacent land;
- biological, physical and chemical processes in the water;
- human activities in the region.

Water is purified in large part by the routine actions of living organisms. Energy from sunlight drives the process of photosynthesis in aquatic plants, which produces oxygen to break down some of the organic material such as plant and animal waste. This decomposition produces the carbon dioxide, nutrients and other substances needed by plants and animals living in the water. The purification cycle continues when these plants and animals die and the bacteria decompose them, providing new generations of organisms with nourishment.

DO YOU KNOW

India uses 90% of its water for agriculture, 7% for industry and 3% for domestic use.

Unfortunately, there are many toxic substances which are affected only slowly, or not at all, by this and other processes. These are called *persistent* and are of great environmental concern.

Water is characterized by certain unique features which make it a marvelous resource:

- It exists as a liquid over a wide range of temperature i.e. from 0° to 100°C . Water can exist on our planet in three physical states (i.e. state of matter) under them ambient conditions that normally occur. Water can be a liquid (water), a gas vapor (clouds), or a solid (ice).
- It has the highest specific heat (how much energy is needed to increase the temperature of each gram of substance to one degree) and a high "latent heat of fusion," which is the energy required to melt 1 gram of ice at 0°C . These properties make lakes slow to thaw and warm in the spring and slow to cool and freeze in the fall, thus providing exceptionally stable thermal environments for aquatic organisms.
- It has a high latent heat of vaporization (A change of state from liquid to vapor at constant temperature also requires the input of energy, called the latent heat of vaporization) hence it takes a huge amount of energy for getting vaporized. That's why it produces a cooling effect as it evaporates.
- Due to high surface tension and cohesion it can easily raise through great heights trunk even in the tallest of the trees.
- It has anomalous expansion behavior i.e. as it freezes, it expands instead of contracting and thus becomes lighter.
- It is an excellent solvent for several nutrients. Thus it can serve as a very good carrier of nutrients, including oxygen, which is essential for life. More substances dissolve in water than in any other liquid. For this reason, water is often called the "Universal Solvent." The reason for water's excellent dissolving capability relates to its polarity; water offers positive and negative charges to which other atoms of molecules can attach.
- The temperature/density relationship of water is also unique. Most liquids become denser (heavier) as they cool. Water also rapidly becomes denser as its temperature drops, but only to a certain point. Water reaches its maximum density at 39.9° degrees F (3.94° degrees C), and then it decreases slightly in density until it reaches 32° degrees F (0° degrees C), the freezing point. At this point, ice forms and its density decreases sharply. Ice, therefore, is much lighter than liquid water and thus forms at the surface of lakes rather than at the lake bottom. A second important consequence of the temperature/density relationship of water is the thermal stratification of lakes. Energy is required to mix fluids of differing densities, and the amount of energy

necessary is related to the difference in density. In the case of lakes, this energy is provided primarily by wind. Therefore, the changes in water density that accompany rapidly decreasing water temperatures in the metalimnion during summer stratification are of great importance. The metalimnetic density gradient provides a strong and effective barrier to lake mixing.

3.1.1. Use and Over Exploitation of Surface and Ground Water

Due to its unique properties water is of multiple uses for all living organisms. Water is absolutely essential for life. Most of the life processes take place in water contained in the body. Human beings depend on water for almost every developmental activity. Water is used for drinking, irrigation, and transportation, washing and waste disposal for industries and used as a coolant for thermal power plants. Water shapes the earth's surface and regulates ore climate.

Overuse of groundwater for drinking, irrigation and domestic purposes has resulted in rapid depletion of ground water in various regions leading to lowering of water table and drying of wells. Pollution of many of groundwater aquifers has made many of these wells unfit for consumption. Overexploitation of ground water lowers water tables, which may damage wetlands, cause ground subsidence, and induce salt-water intrusion in coastal aquifers.

Rivers and streams have long been used for discharging the waters. Most of the civilization have grown and furnished on the banks of rivers but unfortunately, growth in turn, has been responsible for pollution of the rivers.

Effect of ground water usage-

Subsidence: When groundwater withdrawal is more than its recharge rate, the sediments in the aquifer get compacted, a phenomenon known as *ground subsidence*. Ground subsidence at the surface can be regarded as ground movement which takes place due to the intensive abstraction of groundwater. It is attributed to the consolidation of sedimentary deposits in which the Groundwater is present, consolidation occurring as a result of increasing effective stress. The total overburden pressure in partially saturated or saturated deposits is borne by their granular structure and the pore water. It occurs where excessive pumping of groundwater removes ground support, particularly in areas of unconsolidated sediments and sedimentary rocks. Removal of water causes sediment compaction. The weight of buildings can also cause compaction and subsidence.

Lowering of water table: occurs where groundwater is withdrawn faster than it can be recharged. It can cause wells to dry up; for example, in some areas of the mid-West, 2-10x more water is being withdrawn from the High Plains aquifer than is being recharged. It is not advisable to do excessive mining as it would cause a sharp decline in future agricultural production, due to lowering of water table.

Water logging: Another problem associated with excessive irrigation on poorly drained soils is water logging. This occurs (as is common for salinization) in poorly drained soils where water can't penetrate deeply. For example, there may be an impermeable clay layer below the soil. It also occurs on areas that are poorly drained topographically. What happens is that the irrigation water (and/or seepage from canals) eventually raises the water table in the ground — the upper level of the groundwater — from beneath. Growers don't generally realize that water logging is happening until it is too late — tests for water in soil are apparently very expensive.

The raised water table results in the soils becoming waterlogged. When soils are water logged, air spaces in the soil are filled with water, and plant roots essentially suffocate — lack oxygen. Water logging also damages soil structure. Worldwide, about 10% of all irrigated land suffers from water logging.

Saltwater incursion: Involves contamination of freshwater aquifers with saltwater. Fresh water floats as a lens on denser salt water. If too much fresh water is removed, a cone of depression is created in the fresh water lens. Lowering the water table by 1 foot results in raising the level of salt water by 40 feet. This situation occurs primarily in island or coastal communities, but is also threatening the Salinas Valley in California. It can be counteracted by:

1. Reducing groundwater withdrawal.
2. Reinjecting treated wastewater into recharge wells.
3. Construction of recharge ponds.

Pollution: Sewage is the most common source of groundwater pollution. Landfills, underground storage tanks, and hazardous waste disposal sites are other sources of contamination. Surface sources of pollution can affect groundwater where the ground is very permeable or where conduits to the water table are present. Pollution spreads with the flow of groundwater. Cleanup of contaminated groundwater is extremely difficult and expensive. High-level nuclear waste disposal may threaten groundwater quality in the future.

3.1.2. Conflicts and Water

As water becomes increasingly scarce, national conflicts are expected to rise. Industry, agriculture, and citizens are in competition for the resource that is so desperately needed for further development. National tensions over the distribution of water can quickly escalate into discord between groups dependent on a shared resource.

Water tensions are brewing over shared rivers and basins in many countries around the world. Over 200 bodies of water are shared by two or more countries or areas. Strife over water is plaguing states to include the Middle

East, Eastern Europe, and South East Asia. Of particular concern for this case is the dispute between Tamil Nadu and Karnataka, two states in India, over access to the Cauvery River.

3.2. WATER CONSERVATION

Water is the most valuable resource on earth. It's the principal substance that separates our planet from all others and makes life possible. The availability of water impacts every part of our lives. While salt water is quite abundant on our planet, fresh water sources become more depleted every year as ever-greater demands are placed upon them.

That's why it's so important to know the water conservation facts. In addition to saving money on our utility bill, water conservation helps prevent water pollution in nearby lakes, rivers and local watersheds. When we know and fully understand our water conservation facts, we won't take water for granted. Careless use of our water resources is the surest way to bring about a future water crisis.

Over the years rising populations, growing industrialization, and expanding agriculture have pushed up the demand for water. Water conservation is the most cost-effective and environmentally sound way to reduce our 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 the 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.

Conserving water can extend the life of our septic system by reducing soil saturation, and reducing any pollution due to leaks. Overloading municipal sewer systems can also cause untreated sewage to flow to lakes and rivers. The smaller the amount of water flowing through these systems, the lower the likelihood of pollution. In some communities, costly sewage system

DO YOU KNOW

In the average home, the toilet accounts for 28% of water use. Outdoors, lawn and garden watering and car washing account for most of the water used.

DO YOU KNOW

Running a sprinkler for two hours can use up to 500 gallons. As much as 150 gallons of water can be saved when washing a car by turning the hose off between rinses.

DO YOU KNOW

Washing a sidewalk or driveway with a hose uses about 50 gallons of water every 5 minutes.

expansion has been avoided by communitywide household water conservation.

3.2.1. 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.

DO YOU KNOW

The state of Kerala has experienced periods of extreme water scarcity despite its rainfall being 2.5 times more than the national average.

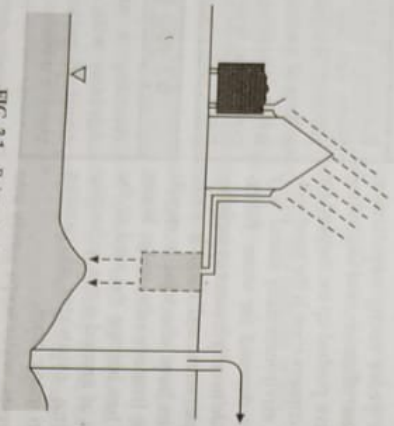


FIG. 3.1 Rain water harvesting

- Some of the benefits of rainwater harvesting are as follows:
- Increases water availability
 - Checks the declining water table
 - Improves the quality of groundwater through the dilution of fluoride, nitrate, and salinity
 - Prevents soil erosion and flooding especially in urban areas.

3.2.2. 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.

DO YOU KNOW

The human body is about 75% 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.

3.2.3. 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.

DO YOU KNOW

A person can survive about a month without food, but only 5 to 7 days without water.

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.

3.2.4. Water Conservation

The most important step in the direction of finding solutions to issues of water and environmental conservation is to change people's attitudes and habits. This includes each one of us. Water conservation comes naturally when everyone in the family is aware of its importance, and parents take the time to teach children some of the simple water-saving methods around the home which can make a big difference. We can follow some of the simple things that have been listed below and contribute to water conservation.

DO YOU KNOW

Each person needs to drink about 2 ½ quarts (80 ounces) of water every day.

Water conservation in the home

1. **Check for hidden water leaks:** Read the house water meter before and after a two-hour period when no water is being used. If the meter does not read exactly the same, there is a leak.
2. **Check your toilets for leaks:** Put a little food coloring in your toilet tank. If, without flushing, the color begins to appear in the bowl within 30 minutes, you have a leak that should be repaired immediately.
3. **Don't use the toilet as an ashtray or wastebasket:** Every time you flush a cigarette butt, facial tissue or other small bit of trash, five to seven gallons of water is wasted.
4. **Put plastic bottles or float booster in your toilet tank:** To cut down on water waste, put an inch or two of sand or pebbles inside each of two plastic bottles to weigh them down. Fill the bottles with water, screw the lids on, and put them in your toilet tank, safely away from the operating mechanisms or buy an inexpensive float booster. This may save ten or more gallons of water per day.
5. **Insulate your water pipes:** It's easy and inexpensive to insulate your water pipes with pre-slit foam pipe insulation. You'll get hot water faster plus avoid wasting water while it heats up.
6. **Install water-saving shower heads and low-flow faucet aerators:** Inexpensive water-saving shower heads or restrictors are easy for the

homeowner to install. Also, all household faucets should be fit with aerators.

7. **Take shorter showers:** One way to cut down on water use is to turn off the shower after soaping up, and then turn it back on to rinse. A four-minute shower uses approximately 20 to 40 gallons of water.
8. **Turn off the water after you wet your toothbrush:** There is no need to keep the water running while brushing your teeth. Just wet your brush and fill a glass for mouth rinsing.
9. **Rinse your razor in the sink:** Fill the sink with a few inches of warm water. This will rinse your razor just as well as running water, with far less waste of water.
10. **Check faucets and pipes for leaks:** A small drip from a worn faucet washer can waste 20 gallons of water per day. Larger leaks can waste hundreds of gallons.

DO YOU KNOW

Most people in North America use 50 to 70 gallons of water indoors each day and about the same amount outdoors, depending on the season. Indoors, 3/4 of all water is used in the bathroom.

11. **Use your dishwasher and clothes washer for only full loads:** Automatic dishwashers and clothes washers should be fully loaded for optimum water conservation. With clothes washers, avoid the permanent press cycle, which uses an added 20 liters (5 gallons) for the extra rinse. For partial loads, adjust water levels to match the size of the load. Replace old clothes washers.
12. **Minimize use of kitchen sink garbage disposal units:** In-sink 'garburators' require lots of water to operate properly, and also add considerably to the volume of solids in a septic tank which can lead to maintenance problems.

13. **When washing dishes by hand, don't leave the water running for rinsing:** If you have a double-basin, fill one with soapy water and one with rinse water. If you have a single-basin sink, gather washed dishes in a dish rack and rinse them with a spray device or a partial of hot water. If using a dishwasher, there is usually no need to pre-rinse the dishes.
14. **Don't let the faucet run while you clean vegetables:** Just rinse them in a stoppered sink or a pan of clean water.
15. **Keep a bottle of drinking water in the fridge:** Running tap water to cool it off for drinking water is wasteful.

Water conservation in the yard and garden

16. **Water your lawn only when it needs:** A good way to see if your lawn needs watering is to step on the grass. If it springs back up when you move, it doesn't need water. If it stays flat, the lawn is ready for watering.

17. **Deep-soak your lawn :** When watering the lawn, do it long enough for the moisture to soak down to the roots where it will do the most good. A light sprinkling can evaporate quickly and tends to encourage shallow root systems.
18. **Water during the early parts of the day; avoid watering when it's windy :** Early morning is generally better than dusk since it helps prevent the growth of fungus. Early watering, and late watering, also reduce water loss to evaporation. Watering early in the day is also the best defence against slugs and other garden pests. Try not to water when it's windy - wind can blow sprinklers off target and speed evaporation.
19. **Use efficient watering systems for shrubs, flower beds and lawns:** You can greatly reduce the amount of water used for shrubs, beds and lawns with strategic placement of soaker hoses, rain barrel water catchment systems and simple drip-irrigation systems. Avoid over-watering plants and shrubs, as this can actually diminish plant health and cause yellowing of the leaves.
20. **Plant drought-resistant shrubs and plants :** Many beautiful shrubs and plants thrive with far less watering than other species. Replace herbaceous perennial borders with native plants. Native plants will use less water and be more resistant to local plant diseases.
21. **Put a layer of mulch around trees and plants :** Mulch will slow evaporation of moisture while discouraging weed growth. Adding 2 - 4 inches of organic material such as compost or bark mulch will increase the ability of the soil to retain moisture.
22. **Don't water the gutter :** Position your sprinklers so water lands on the lawn or garden, not on paved areas.
23. **Don't run the hose while washing your car :** Clean the car using a pail of soapy water. Use the hose only for rinsing - this simple practice can save as much as 150 gallons when washing a car. Use a spray nozzle when rinsing for more efficient use of water.
24. **Use a broom, not a hose, to clean driveways and sidewalks**
25. **Check for leaks in pipes, hoses, faucets and couplings :** Leaks outside the house may not seem as bad since they're not as visible. But they can be just as wasteful as leaks indoors. Check frequently to keep them drip-free. Use hose washers at spigots and hose connections to eliminate leaks.

DO YOU KNOW

A dairy cow must drink four gallons of water to produce one gallon of milk.

These are water conservation facts like these and the small lifestyle changes they teach that can have a huge effect on our current and future water resources.

"The Water--Use It Wisely" program helps each of us realize that we all

eastern, central and southern India. Crippling skeletal fluorosis, which is associated with excessive fluoride exposure, can result from osteosclerosis, ligamentous and tendinous calcification and extreme bone deformity.

3.3.8. Ways to Remove Fluoride from Water

- **Reverse Osmosis Filtration**

This is used to purify several types of bottled water (not all), so some bottled waters are unfluoridated. Reverse osmosis systems are generally unaffordable for personal use.

- **Activated Alumina Defluoridation Filter**

These filters are used in locales where fluorosis is prevalent. They are relatively expensive (lowest price I saw was \$30/filter) and require frequent replacement, but do offer an option for home water filtration.

- **Distillation Filtration**

There are commercially available distillation filters that can be purchased to remove fluoride from water. On a related note: When looking at bottled water, keep in mind that 'distilled water' does not imply that a product is suitable for drinking water and other undesirable impurities may be present.

3.4. MINERAL RESOURCES

Minerals are naturally occurring inorganic, crystalline solid having a definite chemical composition and characteristic physical properties. There are thousands of minerals occurring in different parts of the world. However, most of the rocks, we see everyday are just composed of a few common minerals like quartz, feldspar, biotite, dolomite, calcite, laterite etc. these minerals, in turn, are composed of some elements like silicon, oxygen, iron, magnesium, calcium, aluminium etc. has been using minerals since the dawn of civilization.

3.4.1. Classification and Mineral Wealth of India

India has a thriving mining industry with mineral sector contributing about 3% of gross domestic product. The number of minerals mined in India is more than 80 and can be grouped into (i) fuel minerals like coal, petroleum, natural gas, lignite, (ii) metallic minerals like iron ore, chromium ore, bauxite etc, and (iii) non-metallic minerals like lime stone, dolomite, phosphorite, clay etc.

3.4.2. Use and exploitation

Minerals find use in a large number of ways in everyday use in domestic, agricultural, industrial and commercial sector and thus form a very important part of any nation's economy. The main uses of minerals are as follows:

- Development of industrial plants and machinery
- Generation of energy e.g. coal, lignite, uranium
- Construction, housing, settlements
- Defence equipments-weapons, armaments
- Transportation means
- Communication-telephone wires, cables, electronic devices
- Medicinal system-particularly in Ayurvedic system
- Formation of alloys for various purposes (e.g. phosphorite)
- Agriculture-as fertilizers, seed dressings and fungicides
- Jewellery- gold, silver, platinum, diamond

3.4.3. Conservation of Mineral Resources

As the mineral resources are limited in quantity and are being depleted very fast, the following steps are now being taken for the conservation of these resources:

- Minimizing waste and developing technologies to recover the resources from waste.
- Developing technologies to recycle metals.
- Research is being carried out to substitute some metals like gold, silver, mercury and platinum etc. by man-made products.
- Development of alloys which will reduce the demand of some pure metal, e.g. alloys of magnesium are replacing steel and reducing the demand of copper, lead and tin.
- Alternatives to fossil fuels need to be found.
- Mining areas need to be reclaimed.
- A data bank on the availability and expenditure of mineral resources should be maintained so that their use is regulated.

DO YOU KNOW

Surface mining is less hazardous than underground mining and metal mining is less hazardous than coal mining.

3.4.4. Environmental Effect of Mineral Extraction and Use

The mining of mineral resources usually have a considerable effect on land, air, water and biological resources. Following are the some major environmental effect of mining operations:

- Land degradation

- Surface and groundwater water pollution due to the release of harmful trace elements such as cobalt, cadmium, lead, by leaching.
- Adverse effect on the growth of vegetation
- Defacing of landscape
- Subsidence of land
- Loss of fauna and flora, finally resulting in deforestation
- Air pollution due to emission of harmful gases
- Adverse effects on biological environment directly or indirectly by mining
- Physical changes in the land, water, soil and air associated with mining
- Rehabilitation problem of local inhabitant especially tribal people.
- Occupational Health Hazard

3.4.5. Dereliction (Closing or Abandoning Mines)

Dereliction is a tendency to be negligent and uncaring. It results from the ruthless exploitation of natural resources without consideration for the future. In most of the cases, dereliction is the result of thoughtless and uncontrolled extraction of mineral resources. Dereliction arises because mining operators are not interested in the rehabilitation of local inhabitant especially tribal people because investment in rehabilitation programme will give them no financial return. Some of the adverse effects of dereliction are:

- Waste of valuable agricultural and industrial land
- Health and accidental hazards
- Old quarries may also be dangerous
- Permanent damage to landscape
- Wastes of human resources
- Large number of litigation

3.5. FOREST RESOURCES

About 420 million years ago, during the Silurian Period, ancient plants and arthropods began to occupy the land. Over the millions of years that followed, these land colonizers developed and adapted to their new habitat. The first forests were dominated by giant horsetails, club mosses, and ferns that stood up to 40 feet tall.

The landscape changed again during the Pleistocene Ice Ages—the surface of the planet that had been dominated by tropical forests for millions of years changed, and temperate forests spread in the Northern Hemisphere.

DO YOU KNOW

Forest is derived from latin word 'foris' meaning out of door'.