

*General Article:***Environmental Consequences of Deforestation****Rode Alka**Department of Economics, Shri Atal Bihari Vajpayee Govt. Arts and Commerce College, Indore, INDIA
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“A tree is beautiful, but what’s more, it has a right to life; like water, the sun and the stars, it is essential. Life on earth is inconceivable without trees. Forests create climate, climate influences peoples’ character and so on and so forth. There can be neither civilization nor happiness if forests crash down under the axe, if the climate is harsh and severe, if people are also harsh and severe. ... What a terrible future!”

~ Anton Pavlovich Chekov

Deforestation is the clearing of large parts of our forests for human needs. Much of Europe, Asia and North and South America were once heavily forested. For centuries, we have been cutting down these forests, but it is only in the past 50 years that we have been able to see the result clearing our forests is having on the planet as a whole. It is estimated that about half of all of the forests in the world have been cut down. Deforestation is worse in the tropics, where it is estimated that 100,000 square kilometers of forest are cleared every year. Scientists estimate that we will lose all of the tropical rain forests within 100 years if the rate of deforestation in certain areas continues. Forests are home to many plant and animal species. Some plants need the deep shade the forest canopy provides to grow. Tropical rain forests alone are home to more than half of the world’s plant and animal species. That’s not bad for a type of forest that makes up less than 10% of all forests in the world.

Forests also provide many helpful things for humans. It is hard to list all of the things we get out of the forest: Resins, incense, medicinal plants and wood for paper and furniture are just a few of the things the forests of the world provide for us. Some people use forests for food, whether through hunting or foraging for edible plants, berries and nuts. Tree and other plant roots help to keep the soil in place when it rains and reduce the chance of mudslides.

We are losing our forests for many reasons. Agriculture is the largest contributor to deforestation around the world. Huge sections of forest are cut down to make room for industrial cattle ranches and large plantations. Small farmers in some areas slash and burn forests near their homes to make room for livestock or to plant crops. When these small plots are unable to provide food for their animals because of overgrazing or the land becomes too depleted to grow crops, they burn down another section of forest and the cycle starts again.

Farmers are not the only cause of deforestation. Illegal logging operations move deep into forests and begin cutting down trees to supply paper mills. Miners push into forests to take advantage of fresh mineral deposits and the only way to

get to those deposits is to cut down the forests sitting on them. Many countries are discovering that building roads through their forests to help connect isolated communities also brings in people and companies that use the road to move further and further into the forest, causing more damage.

Forests are the lungs of our planet. All plants take in carbon dioxide and release oxygen, but trees are able to convert more carbon dioxide than a house plant. They are places where carbon dioxide is sequestered through photosynthesis. Tropical rain forests are very humid because of the water vapor they release along with the oxygen. When part of a rain forest is cut down, the humidity in the area drops, causing the remaining forest to dry. Scientists are starting to understand how cutting down the rainforest is affecting rainfall not just in the forest but thousands of miles away. Drying makes the ecosystem vulnerable to wildfires, which in turn destroy even more of the forest.

Depleting our forests is also adding to erosion. Erosion occurs when rock or soil is worn away, usually by water or air. Without plants to hold the soil in place, valuable nutrients are swept into rivers and streams and carried to the ocean. The removal of these nutrients from the life cycle of the forest causes additional stress on an already damaged ecosystem.

Many of the plants and animals found in forests are endemic, or only found in that particular forest and nowhere else on Earth. When we destroy their habitat, we drive these plants and animals to extinction. Every year, scientists find more species that we didn’t know existed in habitats that are critically endangered in large part due to deforestation. Some of these species may have medicinal properties that can be used to cure or treat diseases.

An undisturbed terrestrial ecosystem naturally develops into a sparse or dense forest. Factors like, humidity, temperature, rainfall and soil types etc. determine the nature and composition of the biotic community within a forest.

Those very factors of abiotic environment which influence and shape a forest are also in turn modified by the population of living organisms within the system. Deforestation involves removal of plant biomass which cripples the system. Various useful products such as firewood, timber, honey, fruits, nuts, resins and medicinal plants etc. are no longer available. A chain of events is set into motion the consequences of which can be summed up as follows:

1. Soil degradation and erosion

2. Changes in climatic conditions
3. Destruction of natural habitats.
4. Destruction of a valuable sink for environmental pollutants.

(1) Soil Degradation and Erosion: Plants check rapid movement of air and water. Flowing waters stay in the area for a longer duration during which time nutrients are re-absorbed and as water percolates down, ground water table is recharged. Plant cover keeps the ground surface humid. Trees with the help of deep root systems are able to draw water from sub-surface water table. Humidity prevents excessive water loss and rapid desiccation. Plants contribute organic matter which upon decomposition adds humus to the soil. Porosity, water-holding capacity and productivity of the soil improve. Organic matter binds the soil particles in soil crumbs which make it more stable against forces of erosion.

Deforestation leaves the ground surface bare. In humid tropics a large portion of available mineral nutrients is taken away when the biomass is removed. Herbaceous plants and grasses are exposed to the action of sun, wind and rapidly flowing waters. There is further loss of mineral nutrients. Grazing may remove much of the organic matter with which there is further loss of nutrients. Where remaining vegetation is burned to clear the land and agriculture attempted loss of nutrients is even more rapid. Already poor tropical soil is made poorer. All this further reduces the cover of small plants and grasses as well.

Adequate plant cover keeps the soil temperature lower. At all depths up to 70 cm a higher temperature is observed in soil devoid of plant cover. Higher temperatures speed up mineralization of organic matter. This reduces the stability of soil crumb structure and the soil becomes easily erodible. It also loses its capacity to hold water, recycle mineral nutrients, nitrogen-fixing capacity etc. and turns into a dead mass of silt, clay and sand. With plant cover gone the battering action of wind and rains loosen the top soil which is thus carried along with water or air currents and deposited elsewhere.

The top soil which is thus lost is irreplaceable. Nature takes about 1000 years to produce 2.5 cms of top soil. It has been estimated that prior to man's influence on earth's crust, oceans received about $9-10 \times 10^9$ tons of sediments annually. Today about 25×10^7 tons of precious top soil flows into oceans as silt and sediments every year. India loses about 5300 million tons of soil every year. Of this enormous amount nearly 2000 million tons get deposited in stream and river beds, about 480 million tons get lodged in dams and reservoirs and the rest is flushed into the sea (Gurmel Singh quoted by Venkataramani, 1991).

Most of the multipurpose reservoirs in India are silting up at a faster rate - silting being about 146-874% faster than what was assumed earlier. This has curtailed the life-span of our multipurpose, multimillion crore rupee reservoirs

drastically. The life of Ramganga reservoir in the Gangetic watershed has been curtailed to about one-fourth of its originally intended span of existence (Venkataramani, 1991).

Massive soil erosion aggravates flood situation in two ways. Firstly, the deposition of silt and sediments in river beds makes them shallow. Secondly, land devoid of forest cover loses its water holding capacity. About 10 million hectares of forested land can hold enough water to fill completely a reservoir as large as that of Bhakhra-Nangal dam. In absence of plant cover this water flows down in rapid torrents.

In streams and rivers it has to flow through shallow channels where it spills over its banks inundating low lying areas. Due to deforestation and extensive soil erosion in water sheds of almost all major rivers in India total area of land affected by floods has been rising steadily (Ehrich 1980).

(2) Changes in Climatic Conditions: Forests shape our natural environment and local climatic conditions. They maintain humidity, regulate temperatures, break wind velocities and influence precipitation. The extent up to which forests influence our natural environment is a controversial subject. However, it is almost certain that dense growth of green plants has a moderating influence on local climatic conditions and the global environment in a number of ways:

1. Maintenance of Humidity: Active transpiration by green plants keeps the environment humid. Roots of trees penetrate deep down to the sub-surface water table. They are able to draw water even when the surface is dry.

2. Regulation of Atmospheric Temperatures: Average air temperatures under tree cover have been found to be appreciably lower than those measured in open fields. The type of plants also influences the temperatures in a forest.

Evapo-transpiration exercises profound cooling effect-air cools down by $2-5^\circ\text{C}$ when it comes in contact with cool vegetation. A record of maximum temperature of Mussoorie (U.P.) bears ample testimony to the phenomenon. All around Mussoorie there were lush green forests earlier. Rapid deforestation has been taking place around the city since 1950 A.D. which was checked only by 1975 following demands of agitated inhabitants of the area.

The mean maximum temperature of the city rose by 6.5°C within a span of thirty years. A significant depression in the rising tree fan is observed from 1975 onwards as an extensive reforestation drive was undertaken to remix the situation.

3. Moderation of Wind Velocity: Forests check wind velocity by obstructing its passage physically. The velocity of wind through a forest is profoundly affected by the density of vegetation. Higher wind velocities accelerate

transpiration and evaporation which in turn speed up desiccation. Under drier conditions soil particles are loosened and transported by air currents resulting in a higher rate of soil erosion. High speed winds make man and animals uncomfortable, often uprooting weak structures and plants. The moderating effect of forests on wind velocity is, therefore, beneficial in many ways.

4. The Role of Forests in Enhancing Precipitation: The effect of forests on annual precipitation has been one of the most debated topics among scientists. Experts have come up with varying assessments starting from nominal rise to an enhancement of about 12% in plains and almost twice as much in hilly areas. While studying the forest-climate link it is important to realize that every shower is not due to forests. Rains depend on a number of factors such as location, topography sea-surface temperatures etc. Of these forests could be one of the factors which promote rainfall.

An interesting example of deforestation affecting rains is provided by rain fall data from Chhota Nagpur Plateau of Bihar which had a considerable area under forest cover in the beginning of 20th century. There were plenty of afternoon showers during summer months. Though there is no apparent reduction in monsoon rains over the plateau, these afternoon showers of summer months have declined.

This decline in pre-monsoon showers (April-May-June) is attributed to the extensive degeneration of forests in the area. Excessive summer heat caused the humid air under dense forest cover to be heated up during the earlier part of the day. It rose to considerable heights to cool down, condense into water droplets and by the end of the day fall back as pleasant showers. Such rains are known as Convective rains.

These pre-monsoon showers were a boon for tea-plantations which came at a crucial time, just when after a long spell of dry season water was badly needed. The number of rainy days excluding those of monsoon months, e.g., June, July and August, were 374 during the four-year period between 1870 A.D. to 1874 A.D. The number had gone down to 271 days during 1978-1982. The decline in the convective rains has caused the tea-gardens of Chhotanagpur plateau to disappear (Mehr-Homji, 1991).

However, it is not easy to correlate precisely the large variations in rainfall with deforestation as a number of factors act cumulatively to produce a rain. Monsoon rains and the rains of cyclonic origin caused by differential heating of land and sea surface are hardly affected by a forest cover. However, it can be said with some certainty that forests do influence convective rains or thunderstorms. The mechanism which is operative in forest-rains relationship can be examined as under:

(a) Evapo-transpiration: Evaporation and transpiration recycle back about 50-70% rains to the atmosphere. This is not possible by evaporation alone. The total surface area

from which evaporation can occur is enormous in forests due to the density of foliage. On bare land solar radiations heat up the soil and surrounding air making it drier.

(b) Albedo: The term albedo denotes the proportion of solar radiations reflected back into atmosphere to the total amount striking earth's surface. Lower albedo in regions under plant cover (about 15-25%) results in greater absorption of solar energy which sets into motion strong thermal up-currents. The moisture is taken high up into the atmosphere where it cools down and condenses into rain-drops. On bare soil albedo is higher (by about 30-35%) e.g., large amount of solar energy is reflected back into the atmosphere which heats up upper layers of air. This restricts upward movement of air bearing whatever moisture it happens to hold. The net result of which is reduction of rains of convective type.

(c) The effect of mechanical friction: Forests obstruct the path of air currents by raising the effective height of the land. While decreasing the velocity of air currents this obstruction redirects the air mass upwards, forcing it to rise. The moist air ascends and cools high up in the atmosphere, condenses and adds to the convective rains.

(d) Pollen grains and other plant debris: These act as effective nuclei on which water vapours condense. The aerosols of plant origin are lighter as compared to dust particles of the same size, which require a much lower temperature to act as a condensation loci for water vapours. Deforestation results in a sudden drop in the number of aerosols of plant origin in the atmosphere while those of dust particles rise as a consequence of soil erosion by wind. This has an adverse effect on convective rains.

(e) Horizontal precipitation: Plants growing on tropical mountains and coastal zones are capable of absorbing moisture from moist and humid air. This water is sufficient for the plant growth as well as for maintaining the surroundings humid and hospitable. No water can be harnessed if land is rendered devoid of plant cover.

5. Forest Cover and Global Warming: An enormously large quantity of Carbon is trapped in forests and forest soils of the world. Coniferous forests possess about 117.6 billion metric tons, forests and woodlands of temperate zone about 188.6 billion metric tons while the tropical seasonal and rain forests possess about 502.25 billion metric tons of carbon. Needless to say, the oxidation of this carbon shall yield a huge quantity of carbon dioxide which will be added to the atmosphere.

Apart from being the basic raw material for photosynthesis Carbon dioxide is an important green house gas. Rising concentrations of this gas in atmosphere could cause excess warming up of our planet just as a thicker blanket makes us too much warm and uncomfortable. A rise in global temperatures, however mild, could cause serious problems for the mankind.

About 81.50 billion metric tons of carbons are added into the atmosphere annually out of which about 3.5 billion metric tons are contributed by combustion of fossil fuels, organic matter, forest fires, deforestation and other human activities. A major part of this Carbon dioxide, almost 70 billion metric tons out of 81.5 billion metric tons are absorbed by green plants and is converted to organic matter. Of the remaining 11.5 billion metric tons, some CO₂ dissolves in rain water and is brought down to earth's surface while a continuous exchange of this gas occurs between water and air above at the air-water interface.

Deforestation substitutes lush green forests with agriculture, grass land or herbs and shrubs with low productivity and little biomass. Enormous quantities of carbon dioxide are set free while loss of plant cover reduces the overall photosynthetic efficiency of the system. Thus while the input of carbon dioxide to the atmosphere is increased its output decreases. Many scientists believe that deforestation has been contributing significant amounts of carbon dioxide to the global atmosphere and thereby to the greenhouse effect or global warming.

(3) Destruction of Natural Habitats and Reduction in Biodiversity: In forests the shaded area under trees provides protection, tolerable temperatures, adequate humidity etc. to other smaller plants, animals and microbes. The living organisms co-exist interact with one another and with plants, animals and microbes. The living organisms co-exist, interact with one another and with abiotic components maintain a state of dynamic equilibrium. It is these interactions which provide nutrition, water and shelter - a suitable habitat for the diverse flora and fauna to live and thrive in it.

Each species has developed through countless million years as a unique specimen in perfect harmony with its surrounding environment. No doubt the existence and well being of man is intimately linked with other life forms which provide the basic raw materials for his existence.

However, deforestation caused by man himself tends to disturb or eliminate completely the very habitats of millions of species. The bio-diversity is collapsing at an alarming rate. The greatest threat comes from the tropical regions where we are losing forests at an equally alarming rate of about 1.7 million sq. kms per year. The home of almost half of the living species on this planet is being destroyed and almost one species of mammal birds or plants is condemned to extinction per day.

(4) Destruction of an Important Sink for Pollutants of the Environment: Forest soils and vegetation have a large

capacity to absorb, transform and accumulate various pollutants of environment. Vegetation acts as an effective sink for a number of undesirable constituents of the environment. Deforestation not only destroys this sink but also reduces soil's capacity to eliminate pollutants. Removal of plant cover leaves the soil bare. Its organic matter content is quickly mineralized. Without organic matter microbes fail to survive and the soil is turned into a lifeless mass of sand silt and clay. In absence of microbial machinery the soil is unable to perform the biochemical activity involved in absorption, accumulation or transformation of pollutants.

As much as 1 -13 kg per hectare per year of Nitrogen, 6.1 kg per hectare per year of sulphates and about 20-40 kg per hectare per year of calcium and potassium may be provided to natural ecosystem through atmosphere in the shape of dry or wet deposition (Likens et al, 1977, Boremann and Likens 1979, Swank 1984).

No doubt many of the contaminants eliminated by green cover and the soil originate naturally from plants and the soil microorganisms. However, there is an efficient natural sink to eliminate them. The natural system is also capable of making adjustments for limited inputs of pollutants added by human activity. If we destroy this natural sink while introducing more and more pollution to the system, it is bound to fail with grave consequences for the human race.

In a moment the ashes are made, but a forest is a long time growing:

~ **Lucius Annaeus Seneca:** The best way to fight deforestation is through conservation. Try not to waste paper (remember, that paper was once a tree). Start recycling, not just paper but cans, glass bottles and plastics. Try to buy products made from recycled goods. Save electricity by not using lights during the day and remembering to turn off appliances like televisions when you're not using them. Instead of asking for a ride somewhere, walk or take public transportation. Finally, there are tree-planting programs like those of the Arbor Day Foundation that need volunteers to help plant trees not just in deforested areas but also in cities like yours.

References

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