

Man is the most highly evolved animal. Since its appearance on earth man and his associates has been dependent on nature. The development of new ideas enabled him to identify materials of nature and to put them in to different uses for his comfort and development. In this series water, air, sunlight, land, minerals, forest, coal, oil, metals etc. were available and were identified by man. As the development was in progress, he started to make use of these natural gifts. He converted most of the natural sources in to natural resources for his own interest. This was possible later, when development and research technology was developed to transform these natural sources or materials in to more valuable goods. Thus, natural resources can be defined as—**Things/materials of the nature, that can be put to some use by human beings for their growth, development, comfort and other necessities are called as “Natural Sources”.**

For example, air, water, soil, forests, animals, minerals, metals, energy and other substances are some examples of natural resources that are utilised by human beings. At present, total global production is nearly enough to match the human demand for energy, materials etc., if we judiciously distribute the resources available to us. But for future, the situation appears pretty grim.

The resources are not equally distributed throughout the world. We can realise the value of resource only when it is rather scarce. Over exploitation threatens most of our natural resources now.

The primitive man was a part of environment. His basic requirement were limited i.e. food and shelter. Food was collected from the surroundings while caves, bushes, trees were enough to provide shelter. Those days natural materials, fields and living beings only were considered useful. But exploitation, destruction, development of natural resources began right from the time when man learned to use fire, metal copper for arms, tools, pans, domestic animals and grow plants for food. Now the boundaries of environment is from polar ice to equitorial mountain tops and from deep down ocean to ionosphere of sky. Everything present in this environment is regarded as natural resource.

## **TYPES OF NATURAL RESOURCES**

All the natural resources can be divided into two categories—

- (i) Exhaustible natural resources
- (ii) Inexhaustible natural resources

**Exhaustible natural resources** are soils, forests, water, coal, petroleum, natural gas, minerals etc. These are consumed or exhausted through continuous use or misuse. Exhaustible natural resources can be further divided into two—

- (a) Renewable natural resources
- (b) Non-renewable natural resources



Resources that can be exhausted through continuous use

## RENEWABLE

Resources that can be renewed, like soils, groundwater, forests animals etc.

Resources that cannot be exhausted eq. Air and Sunlight.

## NON-RENEWABLE

Resources that can never be renewed, like fossil fuels such as petroleum, natural gas & coal, metals, limestone and other minerals.

Fig. 6.1. Natural Resources

**Inexhaustible natural resources** are those which can not be exhausted through continuous use or misuse e.g., air and sunlight etc.

### RENEWABLE RESOURCES

The natural resources which are consumed/exhausted/depleted through continuous use and can be recovered by very hard efforts taken up for long periods are called **Renewable Resources**, for e.g., soils, forests, groundwater etc. In other words we can say that all renewable resources are replenished through natural cycles or manually. For example oxygen in air is replenished through photosynthesis. Forest is maintained themselves and manually. Similarly fresh water is available through cycles & manually too.

Most of the removable resources are interdependent to each other. Forests maintained the environment/climate, plants need to check soil erosion & soil is needed for plants. Air and insects are needed for pollination. Wood, fibre, fodder, fruits, vegetables, milk etc. are developed directly or indirectly by recent photosynthetic activity. Thus the renewal of these resources will continue at as long as photosynthesis continues on this planet. These resources are the life support system which can fulfill all human needs. But its productivity/renewability is limited or depend upon availability of water, nutrients and environmental conditions.

The natural resources are useful to human society in one way or other. Hence we should ensure a continuous yield of useful plants, animals and materials by establishing a balanced cycle of harvest and renewal (Odum - 1971).

### NON-RENEWABLE RESOURCES

Non-renewable resources are not replenishable or we cannot get back our coal and petroleum reserves in our life time, if ones they are consumed/exhausted completely. Non-renewable resources are metals (iron, copper, zinc etc.), coal, oil deposits, minerals, stone, mineral salts (Phosphate, nitrates, carbonates etc.) etc.

Minerals are often called the '**STOCK**' resources, because their new materials can only be extracted from the earth's crust once. But even in the transformed state in which they are used, they are not lost to the planet and so are ideally available for reuse. Metals/minerals come from a very slow process of geochemical concentration, which took millions of years to form. Therefore, these deposits which occur today can disappear at some point of time in future. Coal, petroleum and natural gas are called as '**FOSSIL FUELS**' because they are formed from dead remains of plants and animals buried in the earth long long ago. They are called fuels



resources and controlled because it is the root of natural resources for their long term and used in as sustainable manner i.e. they should remain available.

## FOREST RESOURCES

India is one of the 12 mega diversity countries, commanding 7% of the world's biodiversity and supporting 16% of the major forest types, varying from alpine pastures in the Himalayas to temperate sub tropical, tropical forests and mangroves in the coastal areas. But nearly half of the country's area is degraded, affected by problems of soil degradation and erosion. Sixty percent forests are located in ecologically sensitive zones. These forests need to be managed in a way to ensure that they are ecologically protected and maintained, as well as sustained at the highest productivity level to meet the growing population's burgeoning demands for fuel, food, fodder, and timber.

### Country data

Total land area (thousand ha)	297,319
Total forest area 1995 (thousand ha)/% of total land area	65,005/21.9
Natural forest 1995 (thousand ha)	50,385
Total change in forest cover 1990-95 (thousand ha)/annual change (%)	36/0
Population total 1997 (million)/Annual rate of change 1995-2000 (%)	960.2/1.6
Rural population 1997 (%)	72.6
GNP per person 1995 in US\$	340

Source of data: FAO - State of the World's Forest 1999

India has a large and diverse forest resource. Its forest types vary from tropical rainforest in the north-east, to desert and thorn forests in Gujarat and Rajasthan; mangrove forest in West Bengal, Orissa and other coastal areas; and dry alpine forests in the western Himalaya. The most common forest types are tropical moist deciduous forests, tropical dry deciduous forests, and wet tropical evergreen forests.

According to the Forest Survey of 1997, the country has 76.5 million ha of forest. The degraded area was 26.13 million ha and there was another 5.72 million ha of scrub; thus, in total 31.85 million ha of forests were degraded or open.

The land use outside for habitations (rural and urban), industries and infrastructure, such as roads, rivers, canals, railway lines, under permanent snow, rocks, desert, or not available for other reasons amounted to 264 million ha. It consists of cultivated land of 142 million ha, forestland of 67 million ha, fallows of 24 million ha, pastures of 12 million ha, tree groves of 3 million ha, and cultural waste of 16 million ha. Thus, in order to achieve the national goal of one third of the country under forest/tree cover, an area of 29.7 million ha has to be brought under plantations.

It was reported that the country's achievement in raising forest plantations, in terms of area, has been impressive. Up to 1998, the total area of tree plantations was 28.38 million ha, of which about 17 million ha were planted before 1990's. The current annual rate of plantation is 1.2 million. The quality of these plantations varies considerably. It should be noted that forest plantations are a means to meet the increasing demand for industrial raw material or for direct



consumption, i.e. fuel wood, but not to justify deforestation or claim restoration of biodiversity and other environmental services.

There are other woodlands established in small blocks on non-forestry lands, which are not included in the forest survey because of limitations of interpretation of satellite data.

The performance of forest plantations, in terms of survival, growth and yield, has been poor caused by several factors, including inadequacies in site selection and site-species matching, poor planting stock, lack of proper maintenance and protection (from fire, grazing, pests and diseases), lack of timely tending/thinnings, delays in fund allocation, and inadequately trained staff. In this regard, some people are of the opinion that a master plan for tree plantations should be developed specifying categories, management regimes, utilisation and investment needs; and emphasis should be given to enhancing qualitative and quantitative productions.

Involvement of the private sector in plantation development has not been substantial and are not adequately supported by the government through relevant research, extension, technological packages, input delivery, market information or credit facilities. This sector is dominant in the area of harvesting and processing. It was noted that the needs and problems relating to this area are different from those producers of wood in rural areas.

According to the latest State of Forest Report, 1999, the total forest cover was 633.73 million ha or 19.39% of the geographical area, with dense forest accounting for 11%. The Report stated that the forest cover has increased by 4,000 km<sup>2</sup> since the last survey in 1997. Thus, the overall decline in the forest cover has been halted. In this regard, the Minister of Environment and Forests stated that a major constraint facing the afforestation programmes is funding, which requires Rs 66.95 billion per year (1US\$ approximately equal to Rs 43.5 in September 2000) in order to achieve one-third forest cover within the next 20 years. Rs 16 billion per year is available from both the central and state budget together to be allocated for afforestation. Involvement and investment from various NGOs, corporate, public and private sectors to fund this sector is being approached. In this connection, consultation with several donor agencies, including international and bilateral banks, for possible support have also been carried out. In this regard, WB and EU have provided substantial support to several forestry programmes in some states.

In regard to national parks, sanctuaries and other reserves, the country's achievement in terms of area is substantial. The Protected Areas (PA) cover about 14.8 million ha, or about 14% of the forest area, consisting of 80 national parks, 441 wildlife sanctuaries and 8 biosphere reserves. However, the condition of several PAs is poor because of fire, grazing and inadequate management. The Management plans of some PAs are not comprehensive. Some are below the minimum size required to be effective.

Non-wood forest products (NWFPs) have a great potential to support the socio-economic development of the country and also the principles of sustainable forest management. These products are essential to local communities. Some products have great potential for export. Some products have also provided employment and income earning.

## DEFORESTATION

The conversion of forested areas to non-forest is deforestation. Historically, this meant conversion to grassland or to its artificial counterpart, grainfields; however, the Industrial Revolution added urbanization and technological uses. Generally this removal or destruction of significant areas of forest cover has resulted in a degraded environment with reduced biodiversity. In developing countries, massive deforestation has accompanied mankind's progress since the Neolithic, and has shaped climate and geography.



Deforestation (whether deliberate or unintended) is the result of the removal of trees without sufficient reforestation. There are many causes, ranging from extremely slow forest degradation to sudden and catastrophic wildfires. Deforestation can be the result of the deliberate removal of forest cover for agriculture or urban development, or it can be an unintentional consequence of uncontrolled grazing (which can prevent the natural regeneration of young trees). The combined effect of grazing and fires can be a major cause of deforestation in dry areas. In addition to the direct effects brought about by forest removal, indirect effects caused by edge effects and habitat fragmentation can greatly magnify the effects of deforestation.

While tropical rainforest deforestation has attracted most attention, tropical dry forests are being lost at a substantially higher rate, primarily as an outcome of slash-and-burn techniques used by shifting cultivators.

### **Definition of Deforestation**

Deforestation is the loss or continual degradation of forest habitat due to either natural or human related causes. Agriculture, urban sprawl, unsustainable forestry practices, mining, and petroleum exploration all contribute to human caused deforestation. Natural deforestation can be linked to tsunamis, forest fires, volcanic eruptions, glaciation and desertification. The effects of human related deforestation can be mitigated through environmentally sustainable practices that reduce permanent destruction of forests or even act to preserve and rehabilitate disrupted forestland. (See Reforestation and Tree planting)

The term deforestation is often the source of disagreement between various interest groups. Conservation groups often use broad definition while groups seeking to maintain the status quo often use a narrow definition.

Deforestation defined broadly can include not only conversion to non-forest, but also degradation that reduces forest quality - the density and structure of the trees, the ecological services supplied, the biomass of plants and animals, the species diversity and the genetic diversity. Narrow definition of deforestation is: the removal of forest cover to an extent that allows for alternative land use. The United Nations Research Institute for Social Development (UNRISD) uses a broad definition of deforestation, while the Food and Agriculture Organization of the UN (FAO) uses a narrow definition.

Definitions can also be grouped as those which refer to changes in land cover and those which refer to changes in land use.

*Land cover* measurements often use a percent of cover to determine deforestation. This type of definition has the advantage in that large areas can be easily measured, for example from satellite photos. A forest cover removal of 90% may still be considered forest in some cases. Under this definition areas that may have few values of a natural forest such as plantations and even urban or suburban areas may be considered forest.

*Land use* definitions measure deforestation by a change in land use. This definition may consider areas to be forest that are not commonly considered as such. An area can be lacking trees but still considered a forest. It may be a land designated for afforestation or an area designated administratively as forest.

### **Use of the Term Deforestation**

The term deforestation has been used to refer to fuel wood cutting, commercial logging and the slash and burn technique, a component of some shifting cultivation agricultural systems. It is also used to describe forest clearing for annual crops, for grazing, and establishment of industrial forest plantations. The meaning of the term is ambiguous enough and so charged with emotion that the use of a more precise term might be better suited in specific cases. Related terms are



forest decline, forest fragmentation and forest degradation, loss of forest cover and land use conversion.

The term also has a traditional legal sense of the conversion of Royal forest land into purlieu or other non-forest land.

### **Causes of deforestation**

**Present causes:** While short-sighted, market-driven forestry practices are often one of the leading cause of forest degradation, the principal human-related causes of deforestation are agricultural and livestock grazing, urban sprawl mining and petroleum extraction. Causes include demand for farm land and fuel wood. Underlining causes include poverty, lack of reform. The causes of deforestation are complex and often differ in each forest and country. Government policies, such as ones in Brazil, make it a priority to resettle some of the country's numerous landless people. The largest cause as of 2006 is slash-and-burn activity in tropical forests. Slash-and-burn is a method sometimes used by shifting cultivators to create short term yields from marginal soils. When practiced repeatedly, or without intervening fallow periods, the nutrient poor soils may be exhausted or eroded to an unproductive state. Slash-and-burn techniques are used by native populations of over 200 million people worldwide.

**Prehistory:** Deforestation has been practiced by humans for thousands of years. Fire was first tool that allowed humans to modify the landscape. The first evidence of deforestation shows up in the Mesolithic. Fire was probably used to drive game into more accessible areas. With the advent of agriculture fire became the prime tool to clear land for crops. In Europe there is little solid evidence before 5000 BP. Mesolithic foragers used fire to create openings for red deer and wild boar. On Great Britain shade tolerant species like oak and ash are replaced in the pollen record by hazels, brambles, grasses and nettles. Removal of the forests led to decreased transpiration resulting in the formation of upland peat bogs. Widespread decrease in elm pollen across Europe between 6400–6300 BP and 5200–5000 BP, starting in southern Europe and gradually moving north to Great Britain, may represent and clearing by fire at the onset of Neolithic agriculture.

**Pre-industrial history:** The historic silting of ports along the southern coasts of Asia Minor (e.g. Clarus and the examples of Ephesus, Priene and Miletus, where harbors had to be abandoned because of the silt deposited by the Meander) and in coastal Syria during the last centuries BC, and the famous silting up of the harbor for Bruges, which moved port commerce to Antwerp, all follow periods of increased settlement growth (and apparently of deforestation) in the river basins of their hinterlands. In early medieval Riez in upper Provence, alluvial silt from two small rivers raised the riverbeds and widened the floodplain, which slowly buried the Roman settlement in alluvium and gradually moved new construction to higher ground; concurrently the headwater valleys above Riez were being opened to pasturage.

A typical progress trap is that cities are built in a woody area providing wood for some industry (e.g. shipbuilding, pottery) which starts consuming it so fast – and without proper replanting – that it becomes impossible to obtain it close enough to remain competitive, leading to the city's abandonment, as happened repeatedly in Ancient Asia Minor. Especially the combination of mining and metallurgy went along this self-destructive path.

Meanwhile most of the population remaining active in (or indirectly dependent on) the agricultural sector, the main pressure in most areas remained land clearing for crop and cattle farming; fortunately enough wild green was usually left standing (and partially used, e.g. to collect firewood, timber and fruits, or to graze pigs) for wildlife to remain viable, and the hunting privileges of the elite (nobility and higher clergy) often protected significant woodlands.



**Industrial Pressure :** The massive use of Charcoal on an industrial scale was a new acceleration of the onslaught on western forests.

## Environmental effects

**Atmospheric pollution:** Deforestation is often cited as one of the major causes of the enhanced greenhouse effect. Trees and other plants remove carbon (in the form of carbon dioxide) from the atmosphere during the process of photosynthesis. Both the decay and burning of wood releases much of this stored carbon back to the atmosphere. A.J. Yeomans asserts in Priority One (<http://www.yeomansplow.com.au/priority-one.htm>) that overnight a stable forest releases exactly the same quantity of carbon dioxide back into the atmosphere. Others state that mature forests are net sinks of CO<sub>2</sub> (see Carbon dioxide sink and Carbon cycle).

**Wildlife:** Some forests are rich in biological diversity. Deforestation can cause the destruction of the habitats that support this biological diversity - thus causing population shifts and extinctions.

### Hydrologic cycle and water resources

Trees, and plants in general, affect the hydrological cycle in a number of significant ways:

- their canopies intercept precipitation, some of which evaporates back to the atmosphere (canopy interception);
- their litter, stems and trunks slow down surface runoff;
- their roots create macropores - large conduits - in the soil that increase infiltration of water;
- they reduce soil moisture via transpiration;
- their litter and other organic residue change soil properties that affect the capacity of soil to store water.

As a result, the presence or absence of trees can change the quantity of water on the surface, in the soil or groundwater, or in the atmosphere. This in turn changes erosion rates and the availability of water for either ecosystem functions or human services.

The forest may have little impact on flooding in the case of large rainfall events, which overwhelm the storage capacity of forest soil if the soils are at or close to saturation.

### Soil erosion

Deforestation generally increases rates of soil erosion, by increasing the amount of runoff and reducing the protection of the soil from the tree litter. This can be an advantage in excessively leached tropical rain forest soils. Forestry operations themselves also increase erosion through the development of roads and the use of mechanized equipment.

China's Loess Plateau was cleared of forest millennia ago. Since then it has been eroding, creating dramatic incised valleys, and providing the sediment that gives the Yellow River its yellow color and that causes the flooding of the river in the lower reaches (hence the river's nickname 'China's sorrow').

Removal of trees does not always increase erosion rates. In certain regions of southwest US, shrubs and trees have been encroaching on grassland. The trees themselves enhance the loss of grass between tree canopies. The bare intercanopy areas become highly erodible. The US Forest Service, in Bandelier National Monument for example, is studying how to restore the former ecosystem, and reduce erosion, by removing the trees.



## **Landslides**

Tree roots bind soil together, and if the soil is sufficiently shallow they act to keep the soil in place by also binding with underlying bedrock. Tree removal on steep slopes with shallow soil thus increases the risk of landslides, which can threaten people living nearby.

## **Controlling deforestation**

**Farming:** New methods are being developed to farm more food crops on less farm land, such as high-yield hybrid crops, greenhouse, autonomous building gardens, and hydroponics. The reduced farm land is then dependent on massive chemical inputs to maintain necessary yields. In cyclic agriculture, cattle are grazed on farm land that is resting and rejuvenating. Cyclic agriculture actually increases the fertility of the soil. Selective over farming can also increase the nutrients by releasing such nutrients from the previously inert subsoil. The constant release of nutrients from the constant exposure of subsoil by slow and gentle erosion is a process that has been ongoing for billions of years.

**Forest management:** Efforts to stop or slow deforestation have been attempted for many centuries because it has long been known that deforestation can cause environmental damage sufficient in some cases to cause societies to collapse. In Tonga, paramount rulers developed policies designed to prevent conflicts between short-term gains from converting forest to farmland and long-term problems forest loss would cause, whilst during the seventeenth and eighteenth centuries in Tokugawa Japan the shoguns developed a highly sophisticated system of long-term planning to stop and even reverse deforestation of the preceding centuries through substituting timber by other products and more efficient use of land that had been farmed for many centuries. In sixteenth century Germany landowners also developed silviculture to deal with the problem of deforestation. However, these policies tend to be limited to environments with good rainfall, no dry season and very young soils (through volcanism or glaciation). This is because on older and less fertile soils trees grow too slowly for silviculture to be economic, whilst in areas with a strong dry season there is always a risk of forest fires destroying a tree crop before it matures.

**Afforestation:** Today, in China, where large scale destruction of forests has occurred, the government has required that every able-bodied citizen between the age of 11 and 60 plant three to five trees per year or do the equivalent amount of work in other forest services. The government claims that at least 1 billion trees have been planted in China every year since 1982. In western countries, increasing consumer demand for wood products that have been produced and harvested in a sustainable manner are causing forest landowners and forest industries to become increasingly accountable for their forest management and timber harvesting practices.

The Arbor Day Foundation's (<http://www.arborday.org/>) Rain Forest Rescue Program is a charity that helps to prevent deforestation. The charity uses donated money to buy up and preserve rainforest land before the lumber companies can buy it. The Arbor Day Foundation then protects the land from deforestation. This also locks in the way of life of the primitive tribes living on the forest land.