

ROLE OF FORESTS IN ENVIRONMENT

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Introduction

Nature is a complex phenomenon and it is difficult to understand its interaction and manifestation. It has created myriad forms. Land water and air have been supporting life-flora and fauna. Biodiversity can be defined as the condition where different species of plants and animals live together depending on each other in the same habitat. Biodiversity is very essential for maintaining the balance of nature or ecological balance. Plants make their own food whereas animals cannot and have to depend on plants for their food. When animals and plants die they are decomposed by bacteria. If we take an example of a simple food chain it is seen that plankton are consumed as food by the crustaceans which in turn are consumed by fish. These fish are consumed by man. Similarly rats feed on grains and in turn are consumed by snakes. The population of snakes is kept under check by eagles. Quite a few plants depend on insects for pollination while insects depend on plants for their nectar. Thus they are interdependent and if there is some break in the chain or one of the organisms is wiped out the other organisms in the chain either proliferate or die affecting the eco-system. If herbivore is withdrawn carnivore depletes. If carnivore is destroyed, herbivore proliferates and become a pest. While this is so, shocking revelations that nature's resources once considered limitless are found to be not that abundant and man

has started realising that the home in which he lived is being mismanaged and the nature's gifts are getting depleted. This is due to tampering with the intricate balance of nature either knowingly or unknowingly. Due to thirst for land and expansion of agriculture for feeding the growing human population, deep in-roads have been made into nature. In the process, forest areas are cleared and deforested. It is true that development of industry and agriculture are necessary for the progress of the nation but it should not be at the cost of other spheres of human activity upsetting the very balance of nature. Every item of creation has its role to play in this eco-system. But man has treated the earth as his colony and exploited the resources indiscriminately.

Importance of Water Management

Since water is a precious commodity, efficient management of available water resources is crucial. The total available water in the hydrosphere is estimated at about 1500 million km³. Ninety nine per cent of this total water is contained in oceans and icecaps as given in Table 1. Remaining one per cent is the actual available amount of fresh water which requires judicious use.

This tiny fraction of water present in the atmosphere in lakes, streams, soil and beneath is of great importance for economic, industrial and agricultural development.

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Table 1
Water storage in the hydrosphere

Storage	Volume ('000 km ³)
Average stream channels	1
Vapour and clouds in atmosphere	13
Soil water above water table	67
Saline lakes and inland seas	104
Fresh water lakes	125
Ground water	
(50% less than 800m below earth's surface)	8300
Icecaps and glaciers	29200
Oceans	1370000
Total	1407810

If this nature's gift of available water is mismanaged the very existence of the biosphere will be in jeopardy.

Now the major effort of our water management policy should be to tap the maximum of these resources available over our land mass. It may be desirable to assess the land use pattern of the country and then to assess the precipitation received over different land use areas.

Table 2
Land utilisation in India

Land use	Area (million ha)	Percentage of the total
Agricultural		
cultivated land	152.6	46.4
Forests	75.0	22.8
Other uncultivated land	42.3	12.9
Land under non-agricultural use	16.2	4.9
Barren and unculturable land	42.7	13.0
Total	328.8	100.0

It is seen that agriculture occupies the largest area that is 152.6 million ha and next is forest occupying 75 million ha in our country. The average annual precipitation received over our land is 400 million ha meters and the forest receives and processes 91.2 ha m of the rainfall.

Role of Forests in Water Management and Soil Conservation

Forests have been ruthlessly cut down for man's self aggrandisement. Felling trees in the river catchment is resulting in floods which have been ravaging our country. Both floods and droughts occur very regularly. In India 85% of the land is drought prone receiving less than 750 mm of annual rainfall. The impact of drought leads to shortage of fodder, drinking water, loss in agricultural production and a general decline in living standards. The damage due to floods can be reduced by reducing the run-off and soil erosion and by increasing percolation of water into soil. When top soil is washed away exposing the lower hard soil surface, the rain water does not percolate resulting in floods and water table going down. Drought is both man-made and environment induced. Man has played a key role in the creation of drought prone areas due to his over exploitation of natural resources like forests, degradation of grazing lands, excessive utilization of ground water, silting of tanks.

In the past luxuriant forests existed in Rajasthan. Our history tells us that armies of Alexander had taken shelter in these forests. But now devastation of forests has converted the land into desert and it is almost difficult to retrieve the conditions. In the *Mahabharata* the land around Mathura was considered as land of honey

and milk because of abundant tree growth, foods and fodder and bracing climate but now the conditions have completely changed and desert conditions are prevailing. It is estimated that desert is spreading at the rate of one km per annum and the sand particles are getting deposited in the fertile fields making them unproductive. It is generally thought that Himalayan ranges are thickly wooded and contain luxuriant growth of forests but man, in his greed to extend cultivation of potatoes and paddy even on steep hill slopes, has cut down the forests with the consequent result of heavy soil erosion and floods to the misery of the people living in the plains. This hill tops have become bald owing to removal of vegetation and hence have remained unproductive. Even the present Sahara desert once contained abundant forests. In fact Roman history tells us that Hannibal used to collect his war Elephants from these forests. This clearly shows that any step to upset the eco-system would adversely affect mankind itself. Shifting cultivation by tribals is resulting in enormous loss of forest wealth and creating ecological problems. Fortunately India has a variety of climatic and edaphic conditions. In our country we have rainfall zones of 750 to 1000 cm as in Eastern Himalayas and Western Ghats and very low rainfall areas as in Barmer and Jaisalmer in Rajasthan where the rainfall is about 18 to 25 cm. But most part of the country has moderate rainfall. We have very hot places as in Central and South India and also snow-clad mountains in the Himalayas. The edaphic conditions also vary. We have black cotton, sandy to sandy loam, lateritic soils etc. Naturally with such a diversity of climatic and edaphic conditions the flora and fauna in our country is very rich supporting a variety of forest species. It is seen that we have about 17,000 plant species in our country. We have Alpine

forests in the higher reaches of Western Himalayas, the evergreen forests in the Eastern Himalayas and Western Ghats. The deciduous forests exist in greater part of the country. Where the rainfall is low scrub type of forests exist. The forest area of India is 74.5 or 75 million ha as against 328.8 or say 329 million ha of land area which works out of 22.8% of the total land area. Of the total land area, 266 million ha is available for potential use. But in reality land has been subjected to varying degrees of degradation and a total of 42.7 million ha has been identified as uncultivable/waste land by National Wasteland Development Board. The reasons for degradation of land are water and wind erosion, salinity and alkalinity of soil, water logging, shifting cultivation and other defective methods of land use. 5-7 million hectares of cultivated land is destroyed every year due to one reason or the other all over the world.

The tropical forests were destroyed at an annual rate of 15.4 million ha between 1980 and 1990 according to a recent FAO survey. The causes of deforestation vary from region to region. Loss of vegetal cover has made land more susceptible to erosion. Wind and water erosion have left vast tracts of land barren. According to Dr. M.S. Swaminathan about 6000 million tonnes of top soil are washed or blown away annually in our country. This loss reflects on our overall productivity including that of food grains. If we evaluate this loss in terms of nutrients NPK loss it may amount to Rs. 12,000 millions annually. Out of this nearly 10% of this soil is being deposited in our multipurpose reservoirs thus reducing their storage capacity by 1-2% per year. About 29% of this eroded soil is being permanently lost into the sea. The loss of top soil represents a permanent depletion of the resource base. As per N.R.S.A. hardly about

14.1% of the total land area is really said to be under vegetative cover. With enormous bovine population of 450 million there is adverse impact on the fodder resources in the country. Due to lack of green agricultural fodder the cattle are driven to forests for grazing resulting in the depletion of vegetal cover in the forests, making the soils compact preventing vegetation from coming up. Over grazing in vegetal deficit areas leads to land degradation and desert like conditions which in turn reduce animal productivity and have adverse effect on people who live on cattle-rearing for their sustenance. National Forest Policy of India laid down in 1952 that 1/3 of the land area should be under forest but unfortunately this figure has never been achieved. On the contrary during the last four decades we have lost about 5 million ha of forest area for various purposes like agriculture, roads, industries, irrigation projects, canal system, transmission lines etc. If the forest falls below 10% of the land area particularly like in India which is a tropical country the whole eco-system is upset and the resultant conditions become irretrievable. Thus the forests are required for the very existence of mankind.

With enormous human population of over 900 million there is considerable pressure on the forest in our country for conversion of land for cultivation, industrial purpose and other developmental activities. The per capita forest in our country 0.109 ha as against world's average of 1.0 ha. Our country is classified as forest deficit zone.

The 'Bounty' from Forests

Direct benefits : Nature is bountiful and we derive a variety of benefits both direct and indirect. The forests yield timber, firewood, bamboo and various non-wood forest produce. The total growing-stock of the

country's forest is 1997 million m³. The annual increment of the forest is also very low which is hardly 1% of the growing-stock. The requirement of timber in our country is 35 million m³ and 202 million m³ of energy-wood. The projected demand of timber and fuel-wood in 2000 A.D. would increase to 64 million m³ and 225 million m³ of fuelwood. But considering the per capita requirement of 250 kg of wood, the requirement of forest produce is enormous which our forests can hardly meet. The timber is used for a variety of purposes constructional, furniture, plywood, agricultural implements, packing cases, match industry, saw milling, boat and ship building, railways, panelling, pencil and frame industry. Wood is used for producing energy for cooking purposes. Consumption of energy from firewood in rural area is 68.5% and in urban area it is 45.5% of the total energy consumed for domestic use. There is a large demand for energy source from forests. Thus wood is used virtually from cradle to coffin. Half of the fuelwood is used for industrial consumption viz. cellulose and paper, rayon, plywood, particle board industry etc. The forests also yield several other produce which are known as non-wood or minor forest products. Man used plants to cure ailments and to relieve pain, fruits, seeds, leaves to relieve hunger, essential oils, gums, resins, oleoresins, fatty oils, tanning materials, natural organic colouring materials, Katha and Kutch, oxalic acid, fibres and flosses, beverages, narcotics, fodder and forage plants, saponins, fish poisons, insecticides and raticides, green manure, beads, rubber plants, baskets and wicker-work, cane, beedi-leaf and miscellaneous including thatching and broom materials and animal products to meet other needs. Many of them are economically very important and also find place in export trade. Bamboo is used by a

considerable proportion of the people for making baskets etc. Forests provide employment to tens of thousands of people in various management and silvicultural operations, raising plantations, harvesting, collection, processing at site and factories, marketing etc. Beedi-leaf collection in certain parts of the country is a boon to the weaker sections in summer season when no other avocation is available besides earning considerable revenue to the Government. Quite a few products find place in external trade earning foreign exchange. These are only few among many of the products which are of great economic importance.

Indirect benefits: There are several indirect benefits derived from forests. They have great aesthetic value which can touch the tender chord of human soul and give pleasure. This is the reason why our Rishis and Munis sought the abode of forests for meditation and accomplishments, to know the glimpses of manifestations of the Creator in the serene and peaceful atmosphere of nature. Gautama Buddha meditated under the banyan tree which has become sacred in our country. Worshipping a tree in our country is not just superficial but has great philosophy behind it. Our forefathers understood the necessity of preserving the forest and tree growth. The forests have salutary and ameliorative effect on the environment. Rainfall is the primary source of water supply and any change in the ecological system either through deforestation or any other human activity has a direct bearing on the hydrological regime by making appreciable changes in net precipitation and in water infiltration rates of soils, resulting in higher run off, stream flow and soil loss. It has been experimentally found that peak rates of flood discharges from small watersheds could be reduced to as much as 60% by good

forest management. Forests prevent soil erosion and reduce silting of tanks, reservoirs and channels making available more water for irrigation. It has been estimated that the rainfall is more by about 13-17 cm in forest area than in the adjoining area. The tree growth continuously absorbs water from the soil and transpires. Consequently a cooler atmosphere is created over the canopy resulting in precipitation of clouds. Besides this phenomenon it is seen that in and around the forests the temperature is less by 5-7°C as compared to the open. Forests also sometime cause physical obstruction to more rainfall. India receives and processes about 400 million hectare meters of rainfall annually. Out of this a total of 115 million ha m goes as waste in the form of surface runoff. Most of the surface runoff occurs roughly in four months during summer while there is little flow in the rivers from March to May. Thus heavy floods are frequent at one part of the year while drought occurs during the other. Studies have shown that areas cleared of all the vegetation increase runoff by 40% (Moore, 1986). Humus and leaf litter besides enriching the soils by way of organic manure offer physical resistance to the run-off of water thereby the speed of running water is slowed down and water percolates into the soil. Humus acts as a sponge and retains moisture which is slowly released to the soil. Thus forests can reduce surface runoff and increase ground water storage for use during lean months. It has been estimated that out of 92 million ha m of rain received over India's forests, forest soils can absorb 49.02 million ha m of water and 26.22 million ha m goes as surface runoff. Because of humic acid produced from the leaf litter, humus and dead and decomposing root system, fine tilth of soil is formed. Forests return soil nutrient viz. nitrogen, phosphorous and potassium through litter

fall from different forest covers. Table 3 gives an idea of monetary benefit derived from litter fall from some of the important timber species of a typical type of forest i.e. deciduous forest which type represents the greater part of our country.

Ours being mainly a tropical country there is not much of humus content in the soil and this is the reason the farmyard manure etc., have to be added to our agricultural soils. The roots of trees when they get into cracks can exert pressure and break and disintegrate the rock to form productive soils. In a barren area devoid of tree growth the fine particles of soil on the ground get dislodged because of the velocity of rain drops and are drifted away. In areas of tree cover the soil erosion by water is prevented as the canopy offers physical obstruction and thereby the velocity of raindrops is reduced and the damage is minimised. The leaf litter humus and root system available in the soil also offer resistance to the runoff of water. As such the covering action of water on the soil is very much reduced and thus soil erosion is prevented. In Sal forests of Jhajra forest range in Dehra Dun District, a single gully initiated after clear felling and logging operation and subsequent fires had grown so big in size and it was 2900 m long and 70 active side gullies were recorded on the sides of the gully with colossal loss of top

soil. With forest cover more water percolates into the soil, which comes out in the form of springs elsewhere. The root system binds the soil together and prevents soil erosion and landslides in the hilly region. Therefore it is necessary to have wide and thick shelter-belt along the streams and river banks. When the velocity of rain water and surface runoff are reduced and the soil erosion is minimised, silting of tanks, reservoirs and channels is reduced and more water is infiltrated into soil. At Udagamandalam, maximum infiltration rate of 30 cm/hr was recorded under Shola (evergreen forests), as compared to grassland 8.7 cm/hr and 23.6 cm/hr under blue gum. This clearly shows that thick evergreen forest with thick under growth helps in minimising runoff and increasing infiltration of water into soil. Any land which is devoid to top fine soil cannot support any agricultural crop and forests preserve fertile soil. The forests also reduce wind velocity by offering physical resistance. It has been seen that in the cyclonic damage caused in the year 1977 in the coastal areas of Andhra Pradesh the loss was less in the lee-ward side of the tree growth. The forests or the shelter belts can prevent spreading of desert. In open areas in the desert the wind lifts and drifts away the sand particles to get them lodged in fertile lands making them unproductive and converting them into desert. Forests are best protectors of our most valuable

Table 3

Forest cover	Return of nutrients through litterfall in different forests (Rs./ha)			
	Nitrogen	Phosphorus	Potassium	Total
<i>Tectona grandis</i>	600.94	117.85	142.59	861.38
<i>Shorea robusta</i>	531.60	96.42	142.59	770.61
Deciduous forests	416.04	151.60	138.84	706.48

resource - the land, by conserving and protecting the soil bank and replenishing the soil with essential nutrients by decomposition and decay of its litter (dead leaves and twigs). Thus forests mean bread and bread means life.

Forests in Pollution Control

In our industrial areas waste and toxic gases are produced which may have deleterious effects on man. We inhale 16 kg of air daily. CO₂ content in atmosphere is about 300 ppm. But extensive use of fossil and fuels in industry is causing increase in CO₂ content and the adverse situation can be got over by having tree growth in the industrial zones since the plants absorb CO₂ by way of photo-synthesis and release life-giving oxygen O₂ to the atmosphere. Forests provide an environment by acting as carbon sinks and as a source of oxygen - the vital gas for existence of life on earth. The amount of carbon presently stored in the world's forests is equivalent to 700 billion tonnes which means that one ha of forest on global average contains between 100-200 tonnes of carbon. Afforested areas may fix an average of 5-10 tonnes of carbon per hectare per year.

In another study it is estimated that on a warm sunny day, one hectare of forest absorbs 220-280 kg of CO₂ and in turn produces 180-220 kg of oxygen. It is seen that 9.29 m² of leaf surface can produce 1 kg of O₂ in about 12 hours. In any industrial area which is devoid of tree growth, the atmospheric pollution may cause health hazards. Studies have revealed that if an air mass containing 150 ppm of ozone were to stand over a forest area for 8 hours, the vegetation would absorb 80% of it. It has been further reported that a 500 m wide green forest area surrounding factories will

reduce SO₂ concentration by 70% and Nitric oxide concentration by 67%.

Many gaseous effluents in the industrial areas get lodged on the trees and get shifted to the ground during the rain. Thus the vegetative growth screens and purifies the atmospheric air. Similarly the tree growth can also reduce the maddening effect of noise pollution in urban and industrial areas. As regards role of forests in noise abatement and attenuation of upto 10 DB (Decibels) is possible with the help of tree belts. A shelter belt of 30 metres can reduce sound pollution by about 20 to 30 decibels.

Mathur *et al.* (1986) have made an attempt to quantify the value of ecological benefits derived from different forest types over 50 years period in terms of lakhs of Rs/ha (Table 4).

Considering the importance and the need of forests for the very survival of man, the Govt. of India have taken stringent protective measures and introduced Forest Conservation Act 1982. With this, the powers of State Government to de-reserve forest areas have been taken away.

Forests and Wildlife

FAO estimates that about 400 tree species are endangered in whole or in significant parts of their gene pools. Forests are abode or habitat of fauna. Without proper habitat wildlife cannot exist. The loss of much of our wildlife and forest is a darker aspect of the so called progress or civilization. Several species have extinguished and shrinking habitat has endangered many more. In India over 90 vertebrate species and about 20 plant species are said to be on the verge of extinction. Our ancestors had

Table 4
Value of ecological benefits derived from different forest types for a 50 year period (Rs. in lakhs/ha)

Benefits	Tropical forest 450 t/ha	Sub-tropical deciduous 410 t/ha	Temperate forest 300 t/ha
Biomass			
Production of oxygen	22.50	20.50	15.00
Conversion of animal protein	1.80	1.64	1.20
Controlling of soil erosion and soil fertility	22.50	20.50	15.00
Recycling of water and controlling of humidity	27.00	24.60	18.00
Sheltering of birds, squirrels, insects and plants	22.50	20.50	15.00
Controlling of air pollution*	45.00	41.00	30.00
Absorption of carbon-di-oxide	-	-	-
Preservation of genetic diversity	5n	2n	n
Total benefits in 50 years	141.30	126.74	94.20
Average annual benefits per ha	2.82	2.53	1.88

* Applicable if air pollution exists in the area.

learned to live with wildlife in mutual respect. But man out of his ignorance rather arrogance has indiscriminately destroyed the faunal population. In our country a variety of animals is found. To name a few we have lion in Gir Lions in Gujarat, Rhinoceros in Assam, Tiger and Elephants in most parts of the country, Snow Leopard, Musk Deer and Brown Bear in the Himalayas. White Tiger which is said to be an albino was found in Rewa in Madhya Pradesh for the first time. We have several other carnivores and herbivores in our country. Our scriptures, mythology and folklore are full of references to wild life. In Rajasthan, Peacock is a protected bird and people sentimentally do not kill them. Our fore-fathers, saints, Munis and Rishis realised the philosophy of preserving wildlife

and always held them in high esteem. Ganesha is an embodiment of wisdom in our scriptures. Kurma (turtle), Matsya (fish), and Vamana have been the Vahanas (Chariots) of Lord Vishnu. The Snake or 'Naga' was abhorred and also worshipped. Deer was part and parcel of "Kanvashram" and Shakuntala played with it. It is known to all of us as to how our sages have showered love and affection on these dumb denizens of forests. In our great epic the *Ramayana*, Hanuman, Sugriva, Garuda along with their band of associates played a very important role and without their cooperation and association the story of the *Ramayana* would have been very different. Even Lord Rama realised their important role in day-to-day life of human beings. Emperor Ashoka realised the importance of

preserving wildlife and created "Abhayaranyas". Even in the *Jahangirnama*, the habits of wild animals particularly that of the Elephant as to what and how it eats and how it behaves in human society are described. This clearly shows that even the rulers and kings in the past appreciated the role of wildlife in their life. Pandit Jawaharlal Nehru has said that life would become dull and colourless if we do not have these magnificent birds and animals.

Wildlife has a very important role to play in our ecosystem. If the herbivore is destroyed in the name of sport, the carnivore migrates to human habitations for preying on cattle, causing loss of life etc. If carnivore is destroyed the population of herbivore increases which may migrate to fields and farm-lands causing damage to the agricultural crops. If birds are destroyed the insect population increases thereby causing difficulties to human beings. Birds always keep the population of insects under check. Birds and insects and even animals help in pollination of crops. Thus all men, wild animals, insects, birds are interdependent and are necessary for balancing eco-system and survival of man himself. Besides, wild life yields a variety of products like honey, wax, lac, tussar, bat guano, horns, ivory, musk etc. This clearly shows as to how much important the wildlife is in the life of human beings yet he has been resorting to indiscriminate killings of wildlife for his amusement and sport. With the advent of jeeps, powerful weapons and search lights the situation has worsened. The result is that several species have been wiped out and several are on the verge of extinction. It is unfortunate that man does not realise that as he has a right to live the other creatures of nature have also the right to exist. Our National animal, the

Tiger, which was estimated to be about 20,000 in the beginning of the century in our country had dwindled to a bare 2,600 in number in the year 1975. However thanks to the efforts of the Government, determination of the people in the last two decades, the number has steadily increased to over 5,000. Project Tiger was set-up in different States. Because of such measures the Tiger population has increased. But other animals are not as fortunate as Tiger. A few decades back the Great Indian Bustard was found in large numbers. This number dwindled to such a low ebb that at one stage it was considered to be extinct. Because of protection measures the population of the bird increased. Another endangered species that is the Crocodile has also staged a comeback as a result of active conservation measures. The bird Jerdon's Courser called 'Kalvikodi' in Telugu was reported extinct about 90 years back. Researchers from the Bombay Natural History Society in collaboration with forest officials of A.P. have been able to locate the bird near Siddavatam in Cuddapah District, establishing the fact that Andhra Pradesh is the only home of the bird in the world. The main object of creating sanctuaries is to give full protection to wildlife so that they live freely without fear, to create water-sources and raise fodder and forage in abundance where they are not available so that the lost faunal glory is brought back to society.

Conclusion

It can thus be seen as to how the quality of life is affected by any imbalance in nature or in our eco-system. Forests and environment are inseparable. They are interdependent. Without proper vegetative cover in the environment man's life is in jeopardy. Late Prime Minister Mrs. Indira

Gandhi had rightly said that conservation of flora and fauna is not a whim or luxury but it is essential for mankind's survival. With any faltered step a man takes, the whole edifice of civilization crumbles and falls. Forest is a major component of the whole ecosystem of environment and plays a vital role in its protection, conservation and development. Only remedy to set our edifice i.e. environment in proper condition is to bring back all our degraded forests to full stocking and afforest all wastelands, river catchments, steep hill slopes, industrial premises and barren sites. In

fact no vacant land without planting trees should be left. Every farm land should have shelter belts. Greening of all towns and cities should be taken up. Before taking up this massive afforestation programme, people living in and around forests should be properly educated about the value of tree growth in their life and protection and that conservation of tree growth is in their interest. In fact they should be involved in this massive programme. Therefore we cannot meddle with our forests and fauna as we like but it becomes our imperative duty to pass on this heritage to our posterity.

SUMMARY

Forest is a major component of the whole ecosystem. The only remedy to set our whole edifice i.e. environment right in a proper way is to bring back all our degraded forests to full stocking and afforest all waste lands.

पर्यावरण में वनों की भूमिका

टी० कृष्ण मूर्ति

सारांश

पर्यावरण को पूरी परिस्थिति संहति का वन एक मुख्य अंग है । अपनी समूची रचना अर्थात् पर्यावरण को ढंग पर लाने का एकमात्र उपाय है अपने सारे व्याहसित वनों को फिर से सघन बनाना सारी बंजर भूमियों का वनीकरण करना ।

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