Why the Conservation of Forest, Soil and Water is Necessary?

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Abstract: The planet earth has more than 1.7 million known species. Amongst these the human is the most creative, destructive and restless, who basically relies on nature and natural resources. In his blind quest for development, he is altering the balance of nature without realising its consequences. This paper after showing historical and practical importance of forests, soil and water discusses why the conservation of these precious resources is necessary? [Academia Arena, 2009;1(6):15-20]. (ISSN 1553-992X)

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"Only after the last tree has been cut down,
Only after the last river has been poisoned,
Only after the last fish has been caught,
Only then will you find,
That money cannot be eaten."

These words are thousands of years old but there essence is still as valid as it was then. We humans give more importance to the immediate gains and for which we have always threatened natural balance of our planet, forgetting how far reaching its adverse impacts can be. Conservation has been defined as "the management for the benefit of life including human kind of the biosphere, so that it may yield sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirations of the future generations." Need for conservation of natural resources has never been so urgent as it is now.

There are two kinds of resources: non-renewable (mineral wealth), of which there is a certain fixed amount in the world; and renewable resources (the forests, fresh water in the rivers, oxygen in the atmosphere and the biological mass), which come from the natural processes, taking place on earth and are balanced between annual increase and annual consumption. The renewable natural resources are being consumed at a higher rate than their renewal, because of which the possibility of their further utilization is also shrinking.

Human beings have always disturbed the "natural equilibrium" and exerted pressure on the biosphere in three forms: (1) changing the structure of the earth's surface (ploughing the steppes, cutting down forests, land improvement, creating man made lakes and seas, and influencing the surface water system in other ways); (2) changing the composition of the biosphere which means in effect changing the balance and circulation of constituent substances, through extraction of minerals, creation of spoil banks, discharge of various substances into the atmosphere and into water bodies, and through changes in moisture circulation; and (3) changing the energy balance (including the heat balance) of individual areas, and our planet as a whole.

Forests has contributed generously to the food supply of primitive peoples and pioneer communities, as a breeding place and home of wild animals from which fur clothing would have been started to be derived. Throughout the centuries wood has served the human need for shelter. The wood fuel has been in use for over 500,000 years. It was probably the rolling section of a fallen tree that elicited the idea of the wheel and floating wood might have given birth to a boat. By wood the man could make a bow, musical instruments, handles of the tools, baskets, twig brooms, furniture and several household articles. On the other hand the domestic animals have roamed the forest throughout the ages. Almost invariably, the water used for irrigation comes from a forest managed watershed. Building up a rich organic capital in the surface soil is due to forest, which at many places has become unproductive because of soil erosion and can still be reclaimed by planting forests on it. Forests were used as barriers against enemies in ancient times, which were frequently fortified by ditches and other artificial barriers and occasionally used as hiding places in case of need. Trees and forest have from very ancient times featured prominently in spiritual and religious life. The spiritual yearnings of people throughout the ages have led them to seek the beauty and solitude of forests, and these sanctuaries still yield deep satisfaction.

Because the forest yields certain things that humans need and can sell or barter, it has always been vulnerable to quick exploitation, resulting in its destruction. And because it has been in the way of farms, cities, highways, and other space requirements, it has been drastically removed in many countries. Fire, insects, disease pests, and storms take their yearly toll, and yet defence of the forests seems expensive and unnecessary to many. Humans have used their scientific knowledge and their ability to organize and destroy the forest by overuse. Whereas, the services of forests are invaluable for retarding of too rapid runoff, which carries away precious topsoil, and decreases the volume and destructiveness of floods, controlling to some extent the drying and soil-eroding power of high winds, and covering the scars of fire, erosion, soil exhaustion and other similarly unsightly forms of poor land use.

Table 1: Production of timber and fuel wood in India

Forest Product	Quantity	Source
Timber	12 million m^3	Forest
	31 million m^3	Farm forestry and other woodland
Fuelwood	101 million tones	Forest
	98 million tones	Farm forestry and other woodland

Data source: Thomas and Patrick. (2004).

Lush green tropical rain forests, with their tall tree canopies and thick undergrowth, cover only 7% of the earth's surface, but they are home to nearly half of its entire species. Now they are being cut and burned at the rate of a hundred acres a minute to provide logs for export and in some cases living and farming space for expanding populations. Pressure on the forests is tremendous in the form of timber, fuel wood, fodder and NTFP's extraction. For example: the total demand of timber in India has been estimated at 64 million cu. m in 1996 that increased to 73 and 82 million cu.m in 2001 and 2006 respectively. Out of 64 million cu.m demand of timber, nearly 31 million cu.m comes from farm forestry and other woodlands and 12 million cu.m from the forests (Thomas and Patrick, 2004). The balance 21 million cu.m is removed from plantations and from natural forests (Table 1). On the other hand, out of 445 million cattle in the country, nearly 270 million graze in forest areas. It is generally agreed that nearly 30% of the fodder requirement of the country comes from the forest areas. Therefore there is removal to the extent of 145 million tons of dry fodder and 178 million tons of green fodder (Figure 1) annually from the forest areas of the country (IIFM, 2007).

Figure 1. Tree loping in higher temperate forests of Himalaya.

Clearing the rain forests destroys ancient ecosystems and the millions of rare, beautiful and useful species of plants and animals that live within them. Clearing the forest allows poor farm workers to move in and plant crops on the land, but only for a year or two, until sparse nutrients in the soil are used up. Without forest cover to shade and replenish the soil, the complex ecosystem of the rain forest gets destroyed. The destruction of trees produces great quantities of carbon dioxide from the material of the forests and releases it into the atmosphere, adding to the global warming. It allows huge amounts of the world's fresh water to run off, carrying the forest topsoil away. Normally it takes an average of 500 years for nature to build up 1 inch of topsoil. To grow crops agriculturally, 6 inches of topsoil are required. Therefore, approximately 3,000 years are needed to build up a reasonable agricultural soil. Reports during the 1970's indicated that large-scale agricultural techniques in the United States were depleting the soil about 8 times faster than they were being created naturally. In 1994, the United States Department of Agriculture reported that approximately 12,000 pounds of soil were being lost per acre per year from wind and water erosion of U.S. land farmed with large-scale techniques (N.R.I, 1994). Worldwide soil erosion rates are highest in Asia, Africa, and South America, averaging approximately 13 metric tons to 17.5 metric tons per acre per year (Oldeman *et al.*, 1990). In India, out of total geographical area of 328.73 million hectares, 147 million hectares are degraded, while 57 million hectares are affected by soil erosion (Mohan *et al.*, 2007). Table 2 represents the soil loss in different land resource regions and major land use systems in India, whereas table 3 shows causes of soil degradation across the globe.

Table 2: Annual soil loss estimates in different regions of India

Land Resource Region	Area ('000 km^2)	Soil loss (t/km^2)	Major landuse
North Himalayan forest region	131.70	287	Forest
Punjab- Haryana alluvial plains	101.25	330	Agriculture
Upper Gangetic alluvial plains	200.00	1,440-3,320	Agriculture and wasteland
Lower Gangetic alluvial plains	145.50	287-940	Agriculture
North- Eastern forest region	161.00	2,780-4,095	Agriculture/ Shifting cultivation
Gujarat alluvial plain region (include ravines)	62.75	240-3,320	Agriculture
Red soil region	68.80	240-360	Agriculture
Black soil region	67.34	2,370-11,250	Agriculture
Lateritic soils	61.00	3,930	Agriculture

Data source: Mohan *et al.* (2007).

Table 3: Causes of soil degradation (% of degrading land)

Area	Deforestation	Fuelwood	Overgrazing	Agriculture	Industrialisation
Europe	38	-	23	29	9
Africa	14	13	49	24	-
North America	4	-	30	66	-
Central America	22	18	15	45	-
South America	41	5	28	26	-
Asia	40	6	26	27	-
Oceania	12	-	80	8	-
World	30	7	35	28	1

Data Source: ISRIC. (1990).

Generally the forest belts are planted to conserve the moisture in the soil and to retain the moisture in the fields. Forests are also planted over larger area by the governments to strengthen and improve the topsoil and to cater the needs of the industries. The presence of forests and vegetative cover on the hill areas safeguard the rich topsoil by protecting it from the damages due to rainfall. This conserves the rainwater that falls during the rainy season with the help of roots of the trees. It stores the water and releases it slowly over the period during the dry and summer seasons. It provides a regular flow into streams and rivers, and increases the storage of water below the surface of the ground. Therefore, it helps to provide a perennial source of water for surface as well as sub-surface irrigation. On the other hand forest transpires large quantities of water in the atmosphere and regulates rainfall in the neighbouring areas. Thus the forest facilitates regular visit of rainfall in the area. Heavy soil erosion in uncovered areas aggravates the siltation problem in the plains, where the river current is no longer as strong as it used to be in hilly regions (Figure 2). Hence most of the hill areas should be kept under forest by planting suitable tree species. The trees should be planted in the catchments areas for absorbing the excess rainwater in the rainy season, which should release water during dry season. By this the floods in the rainy season and drought in the dry season can be controlled. The tree species planted along the boundaries of agricultural field bunds can give remarkable benefits by replenishing the ground water which they had absorbed during the monsoon seasons. This shows that trees recharge the sub-soil water more efficiently, thereby mitigating the rate of transpiration vis-a-vis seasonal crops. They also help in more production of food crops. Right now only a small fraction of the world's river flow is used in artificial irrigation.

Loss of water by evaporation from the soil surface is considerably less in a forest than in open fields, but relative humidity is generally slightly higher. Total moisture lost by transpiration is often much greater from forest than from open-field vegetation. The transpiration is in fact the basis for the belief that forests may increase precipitation, especially rainfall. There are tremendous amounts of water lost to the atmosphere through forest transpiration. It is believed that forest transpire more water than is evaporated from an equivalent area of open water. From this we know that forests contribute heavily to atmospheric moisture. On the other hand most scientists feel that cooling effect above forests may increase rainfall by 2% or 3% over that of non-forested areas.

Figure 2. Soil erosion on slopes of Himalayan temperate forest.

The destruction of trees allows huge amounts of the world's fresh water to run off, carrying the forest topsoil away. A forest soil will absorb water up to 50% of its own dry weight. If rain falls faster than the soil can absorb it, the water runs off as surface water. An unprotected exposed soil has poor infiltration, and most rain water flows off the surface, resulting in erosion and floods. Not all surface run off is serious, since its contribution to stream flow is not usually in the nature of a flood. It finds its way into streams and lakes where some is lost to evaporation, or used by stream-side vegetation, or may be used for domestic water system or irrigation. The remainder may serve the purposes by hydraulic power, recreation, and many other uses before eventually reaching to ocean, where it completes the hydrological cycle.

Crown of trees reduce the mechanical beating power of rainfall on the soil, while roots reinforce the soil and, along with forest litter, keep it absorptive and make it less vulnerable to erosion. When water strikes bare soil, it becomes muddy, the amount of muddiness depending on the character and condition of the soil. Muddy water tends to clog soil openings and the absorptive rate rapidly decreases, as a result of which the water moves over the surface. The steeper the slope the faster will be the flow and the greater will be the water's carrying and grinding power. Rivers, lakes and reservoirs are silted in this way. The farmers should therefore prepare the soil through tillage, strip-cropping and terracing for reduction of erosion in such areas.

Water covers more than 70% of the earth's surface. Life on earth began in water billions of years ago. We depend on water and use it in many different ways. Water cycles from rain to stream, from streams to running rivers and from rivers to seas. Sea water, warmed by the sun heat, rises to the atmosphere as water vapour, then forms clouds in the cooler air and falls to the earth again as rain. The cycle through which water moves from the ocean to the atmosphere, to land and back to ocean is called as the hydrological cycle. Air masses laying over the ocean collect large amounts of water through evaporation. As these air masses or clouds containing water vapour move over land, they are often forced to rise, and on cooling they precipitate moisture in the form of rain, snow, hail or dew.

As the water falls, some is lost by evaporation. Much of the water is intercepted by the leaves of trees and other vegetation and it, too, is lost by evaporation. The water that runs off the leaves to the ground wets the surface and infiltrates the soil. Approximately 50% of most soils are made up of air spaces of different sizes and water entering the smaller pores is held there against the pull of gravity. A considerable amount of this water is taken up by tree roots; some is used for growth but most is transpired by the tree and goes in to the air as water vapour. A large amount of water may be held in storage in a forest soil. The thicker and more decomposed the litter and humus layers, the more the soil will hold. In this way forest soils act as a reservoir. Excess water percolates deeper and deeper and joins the ground water. The ground water may move laterally to feed in to streams and lakes, or it may lie under the surface of the ground to be used as water pumped from wells. The upper level of ground water is known as water table, which fluctuates with precipitation and surface use. Infiltration is the process whereby rain water seeps into the soil; the rate at which this happens is referred to as infiltration capacity, and is related to texture of the rock and soil, slope of the ground, and vegetation cover. Agriculture practice also affects the infiltration capacity of soils. Overgrazing by cattle tends to trample down the top soil, making it compact and reducing its porosity and permeability. Vegetation is also a factor affecting infiltration capacity and it has been a common practice to plant forests around water reservoirs in order to slow down the run off rate and to promote infiltration.

Water in rivers and lakes amounts to less than 1% by volume of the world's water budget, but its importance to life and human geography is enormous. Indeed, it has been estimated that the U.S.A. spends 10% of its national wealth on structures designed to change the hydrological cycle on that continent. This expenditure is directed towards projects like collection, diversion and storage of about 25% of the available surface water, as well as distributing and recycling it. But as we realize that the world is running short of readily available fresh water, we see a world-wide shift in policies from one of project orientation to one of water resource management. The latter involves many spheres of interest including navigation, irrigation, energy, fishing, wildlife, recreation, water supply, flood protection and pollution.

In Britain, an average of approximately 100 cm of water falls as rain and snow each year, yet only 40% appears to run off the ground via streams. The balance either infiltrates in to the ground or is evaporated or used by plants, animals or man. The relative importance of the various factors in the hydrological cycle is dependent upon climate, relief, vegetation and geology. In Britain, it is estimated that 50% of the rainfall is lost through evaporation and transpiration, whereas in North America this loss is about 75% and in Australia it is even higher. The variations are due to climate and difference in other factors.

The fresh water comes from two sources; lakes and rivers on the surface of the land, and water that soaks downward through soil and spongy rock and collects in underground aquifers can be tapped by wells. Draining wetlands and covering the land with roads and homes and cities forces rainwater to overflow storm drains and to carry pollutants washed from the streets in to streams and rivers. When we destroy wetlands, we also destroy breeding grounds for birds and fish. We lose the wetlands' capacity to purify water; to store heavy flows of storm water might flood the land; and in dry times, to release stored water in to streams and wells. In United States, nearly 500,000 acres of surface wetlands, most of which are freshwater wetlands are lost each year in this way.

Everything we dump on the land can eventually end up in water: medical waste; salts for dicing roads; toxic chemicals from factories; fertilizers; pesticides and animal waste from agriculture; oil grease and gasoline; lead and radioactive waste etc. Some of the waste, like paints and paint thinners, bug sprays, motor oil and household cleaners, may sink in to the ground and end up polluting drinking water. People not only pollute the earth's water resources but they also manage them badly. In some places, engineers dam or channel the natural flow of rivers in order to irrigate farm land, but this diversion often takes water away from the places where it is needed. Damming a river may keep it from flooding downstream, but the dam creates an artificial lake that buries usable land and disrupts the natural flow of streams and the life cycles of many stream animals.

In fact there is not endless supply of water. Rain does not fall continuously. To support constantly growing populations, we need more freshwater than we get from the skies. But every time a factory uses water to produce goods, every time one person flushes a toilet, the supply of freshwater in a stream or reservoir is lowered and our precious supply of fresh ground water is reduced. Significantly, the purification systems now in use throughout the world are largely inadequate.

There is artificial form of precipitation known as induced precipitation, which has come under scientific scrutiny all over the world. The crystallization of super cooled clouds through stimulating agents like dry ice or some iodides leads to rain precipitation. However, using this method we can expect to draw only 50% to 70% of the moisture contained in the clouds, while the clouds formed in the natural way yield about 10 to 20 times as much moisture as they can contained at the moment of precipitation. This can be explained by the fact that for a certain time, the clouds act as a kind of moisture generator, transforming the vapour in the air into liquid or crystalline moisture, which then precipitates upon the earth. In many parts of the earth, people are using up ground water faster than it can be replenished. In some places, water is so scarce that only a very few crops can be grown. It is difficult for people who live in those places to survive. They are desperate for water. Just having enough fresh water to drink would seem like blessing. Wasting it thoughtlessly would almost seem a crime.

There are ways that we can preserve the usable amounts of water we have. We can make laws to protect it, like the Clean Water Act in the United States or the regulations passed by the United Nations to protect the earth's oceans. But laws must be enforced to be effective. Right now, industries around the world are breaking water pollution laws. UNEP report (2001) on the protected forest areas in the world by continent (Table 4) shows that only 6.1% of the geographic area of the world and 3.1% of the geographic area in Asia and Europe is set aside mainly for protection of biological diversity: against norm of 10% set by IUCN. It is crucial for citizens to learn about the laws and to pressure companies to comply and politicians to enforce them. Like Article 48A of Constitution of India; 'State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country'. Further, one of the 10 fundamental duties of every citizen under article 51A of the constitution of India is 'to protect and improve the natural environment including forests, lakes, river and wildlife and to have compassion for living creatures'.

Table 4: Protection status of the World Closed Forests by Continents. (Area: Million ha)

Continents	Total Land Area	Total Protected Area	Total Protected Area (%)	Area Under Closed Forests	Protected Closed Forests	Protected Closed Forests (%)
Africa	2997	191	6.4	277	26	9.5
Australia and Pacific	1065	74	6.7	179	28	15.5
Europe and Asia	5163	171	3.3	1089	42	3.8
North & Central America	2408	185	7.7	699	52	7.4
South America	1773	198	11.1	628	123	19.5
World	13405	818	6.1	2872	270	9.4

Data Source: UNEP. (2001).

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