

## Soil Degradation In India:Problems And Potential Solutions

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### ABSTRACT

*More than half population of India relies directly or indirectly on agriculture for their survival. With increasing population the pressure on land is increasing day by day. This increasing pressure resulted in the over exploitation of soil as resource, which leads to its degradation. Soil degradation refers to the reduction in the producing capacity of land by natural and human factors. Naturally it occurs by soil erosion by wind or water and human factors includes improper use or poor management, usually for agricultural, industrial or urban purposes. Soil degradation in India is estimated to be happening on 147 million hectares (Mha) of land, including 94 Mha from water erosion, 16 Mha from acidification, 14 Mha from flooding, 9 Mha from wind erosion, 6 Mha from salinity, and 7 Mha from a grouping of factors. Soil degradation is emerging as a serious environmental as well as agricultural problem. It is affecting agricultural productivity, which is a big problem because even now 90 percent of the food production comes from the soil. Soil degradation seriously undermines livelihood opportunities and leads to poverty, migration and food insecurity. This paper tried to highlight the problem of soil degradation in India with special reference to Haryana. It also suggests some techniques and strategies to combat with soil degradation.*

**Keywords:** Degradation; soil degradation; livelihood; poverty; migration; food insecurity.

### Introduction :

In India, maximum population is depend on agriculture for their survival. The pressure on land is increasing day by day as well as the population is increasing. Because of this increasing pressure,

the soil is exploited which is called soil degradation. Soil degradation has become a serious problem in both rainfed and irrigated areas of India. Soil degradation in India is estimated to be occurring on 147 million hectares(Mha) of land, including 94 Mha from water erosion, 16 Mha from acidification, 14 Mha from flooding, 9 Mha from wind erosion, 6 Mha from salinity, and 7 Mha from a combination of factors. This is extremely serious because India supports 18% of the world's human population and 15% of the world's livestock population, but has only 2.4% of the world's land area. Despite its low proportional land area, India ranks second worldwide in farm output. Agriculture, forestry, and fisheries account for 17% of the gross domestic product and employs about 50% of the total workforce of the country. Causes of soil degradation are both natural and human-induced. Natural causes include earthquakes, tsunamis, droughts, avalanches, landslides, volcanic eruptions, floods, tornadoes, and wildfires. Human-induced soil degradation results from land clearing and deforestation, inappropriate agricultural practices, improper management of industrial effluents and wastes, over-grazing, careless management of forests, surface mining, urban sprawl, and commercial/industrial development. Inappropriate agricultural practices include excessive tillage and use of heavy machinery, excessive and unbalanced use of inorganic fertilizers, poor irrigation and water management techniques, pesticide overuse, inadequate crop residue and/or organic carbon inputs, and poor crop cycle planning. Some underlying social causes of soil degradation in India are land shortage, decline in per capita land availability, economic pressure on land, land tenancy, poverty, and population increase. In this review of land degradation in India, I summarize the main causes of soil degradation in India and potential solutions to improve soil health using a variety of conservation agricultural approaches.

### **Causes of Soil Degradation:**

**The main reasons for unproductiveness or degradation of soils are as follows:**

1. Nutrient disorder
2. Water-logging
3. Salinity
4. Erosion

5. Biological degradation

6. Other causes

**Nutrient disorder:**

Most of the Indian soils are deficient in nutrients and organic matter. Organic matter is rapidly decomposed and leached or eroded by heavy rains. In addition to these causes, intensive cultivation using high-yielding short-duration and fertilizer-responsive cultivars of crops has further accelerated the loss of plant nutrients which is much greater than what is supplemented through fertilizers.

According to an estimate of 1992, every year 20.2 million tonnes of NPK is removed by growing crops. The data published by National Bureau of Soil Survey and Land Use Planning (Sehgal and Abrol, 1994) show that about 3.7 million ha land suffers from nutrient loss or depletion of organic matter.

The problem is more severe in the cultivated areas of the subtropical belt. Out of 20.2 million tonnes NPK removed by the plants, only 2.66 million tonnes comes from fertilizers and 3 million tonnes from organic sources. If the loss of nutrients due to soil erosion is included, the loss of nutrients from top soil is 43 million tonnes.

**Water-logging:**

Soils become water-logged when the water balance of an area is disturbed because of excess recharge. Important sources of water are heavy rains, overland water flow towards basin, seepage from canals and distribution system and tidal flooding. Natural basins without outlet for water, low permeability of subsurface horizons, internal drainage, low intake rate of surface soils and obstructions to natural flow of rain water etc. are conditions cause water logging.

In highly productive areas, canal irrigation is responsible for a rapid rise in water table. Expansion of canal irrigation is also directly concerned with widespread water-logging and salinity problems in arid and semiarid areas. Disturbances in the hydrologic cycle due to

inefficient use of surface irrigation water, poor land development, seepage and poor drainage have resulted in higher water tables.

Most of the canal areas in arid and semiarid regions are rich in soluble salts. In irrigation these salts are dissolved in soil water and rise to the surface through capillary action. When the water dries up, the salts are left on the upper surface as a crust or layer. According to National Commission on Agriculture (1976), about 6 million ha area is under water-logged condition. Data of World Bank Survey (1995) reveal that India loses 1.2 to 6 million tonnes of food grains production every year due to water-logging of soil. The water-logging and salinity cause a loss of Rs. 12 billion to 27 billion annually.

#### **Salinity (Saline and alkali soils):**

Salinity directly affects the productivity by making the soil unsuitable for crop growth. Indirectly it lowers productivity through its adverse effects on the availability of nutrients. The adverse effect of alkalinity on availability of nutrients is due to deflocculating effect of sodium ions. An area of about 21.7 million hectares of soil is rendered unproductive due to salinity and water-logging.

The saline degradation is due to natural causes and poor irrigation practices which disturb the water cycle in areas. Most of the crops in India are affected due to salinity.

#### **Erosion:**

Soil erosion is the major cause of soil degradation. In the soil erosion, uppermost fertile layer of soil which contains essential nutrients is lost. Thus soil becomes deficient in essential minerals and this results in productivity loss. Deforestation or destruction of forests accompanied by reduced frequency of rainfall leads to soil erosion and causes damage to agriculture property. Deforestation causes fast degradation when the soil is steep sloppy or easily erodible. Destruction of natural vegetation cover is a major factor responsible for erosion of soils by water and wind.

According to Global Assessment of Soil Degradation (GLASOD), deforestation is the main cause of soil erosion by wind in about 98% of the area. Overgrazing, cutting of timber trees,

collection of fuel wood, shifting cultivation and encroachment of forest areas are some of the important factors responsible for the loss of vegetation cover on the soil which ultimately causes soil erosion. The latest data provided by Sehgal and Abrol (1994) show that the total degraded land in India is 187.8 million ha, of which 162.4 million ha is degraded due to soil erosion alone

### **Biological degradation:**

The factors which affect soil micro flora and fauna also reduce the biological or microbial activity of soil adversely. These factors reduce the yield. It is well known that mono cropping (growing the same crop on the same land year after year) often leads to increasing attack of pests and diseases. The fatal nematodes threaten potato cultivation in the Nilgiris and, if not controlled they may pose threat to potato cultivation in that area. Excess use of pesticide reduces microbial activity and biomass.

Applications of some pesticide chemicals (e.g., amitrole, atrazine, bromacil, picloram, etc.) inhibit nitrification. The nodulation and growth of some leguminous crops and nitrogen fixation are inhibited by different pesticides. Disposal of oil shales, heavy metal contamination of soil and spillage of crude oils adversely affect soil micro flora which ultimately affect soil productivity and cause soil degradation.

### **Other Causes of Soil Degradation:**

#### **Extension of cultivation to marginal land:**

Due to tremendous population increase the use of land is increasing day by day. Marginal lands though sustainable for farming are less fertile and more prone to degradation. Examples of marginal lands are steep sloppy lands, shallow or sandy soils and the lands in dry and semi-dry areas.

#### **Improper crop rotation:**

Due to shortage of land, increase of population and economic pressure, the farmers have adopted intensive cropping patterns of commercial crops in place of more balanced cereal-legume rotations. During last two decades the area under food crops decreased and that under non-food

crops increased. Intensive cultivation leads to removal of large quantities of nutrients from the soil which results to in loss of soil fertility.

**Fertilizer misuse:**

Soil fertility is reduced due to prolonged intensive cultivation. The farmers maintain productivity of soil by applying chemical fertilizers but make less use of organic manures. Although the yield can be maintained by using fertilizers that provide deficient minerals yet their use often results in deficiencies of other nutrients.

**Overgrazing:**

In India pasture land area is decreasing day by day due to expansion of agricultural land. Recent satellite data show that the area under pasture land is severely degraded. This poor condition of pasture lands is due to excessive grazing. The unchecked and indiscriminate grazing on forest land also leads to degradation of forest soils. Overgrazing directly leads to disappearance of vegetation which is one of the important causes of wind and water erosion in dry lands.

**Mining:**

Mining disturbs the physical, chemical and biological features of the soil. The impact of mining on soil depends on the physical, chemical properties of the waste generated. The soil profile is changed; the top soil is turned deep inside the dumps. The erodible material is almost devoid of organic matter and lacks in mineral plant nutrients. According to an estimate, about 0.8 million ha soil is degraded due to mining activity.

**Table 1.1 Sources of Soil Degradation in India**

<b>Sources of Soil Degradation</b>	<b>Percentage of Total Degraded Area</b>
Water Erosion	63.83
Wind Erosion	6.47
Water Logging	9.74
Salinity/Alkalinity	4.02
Soil Acidity	10.9
Complex Problem	5.04

Total Degraded Area	100
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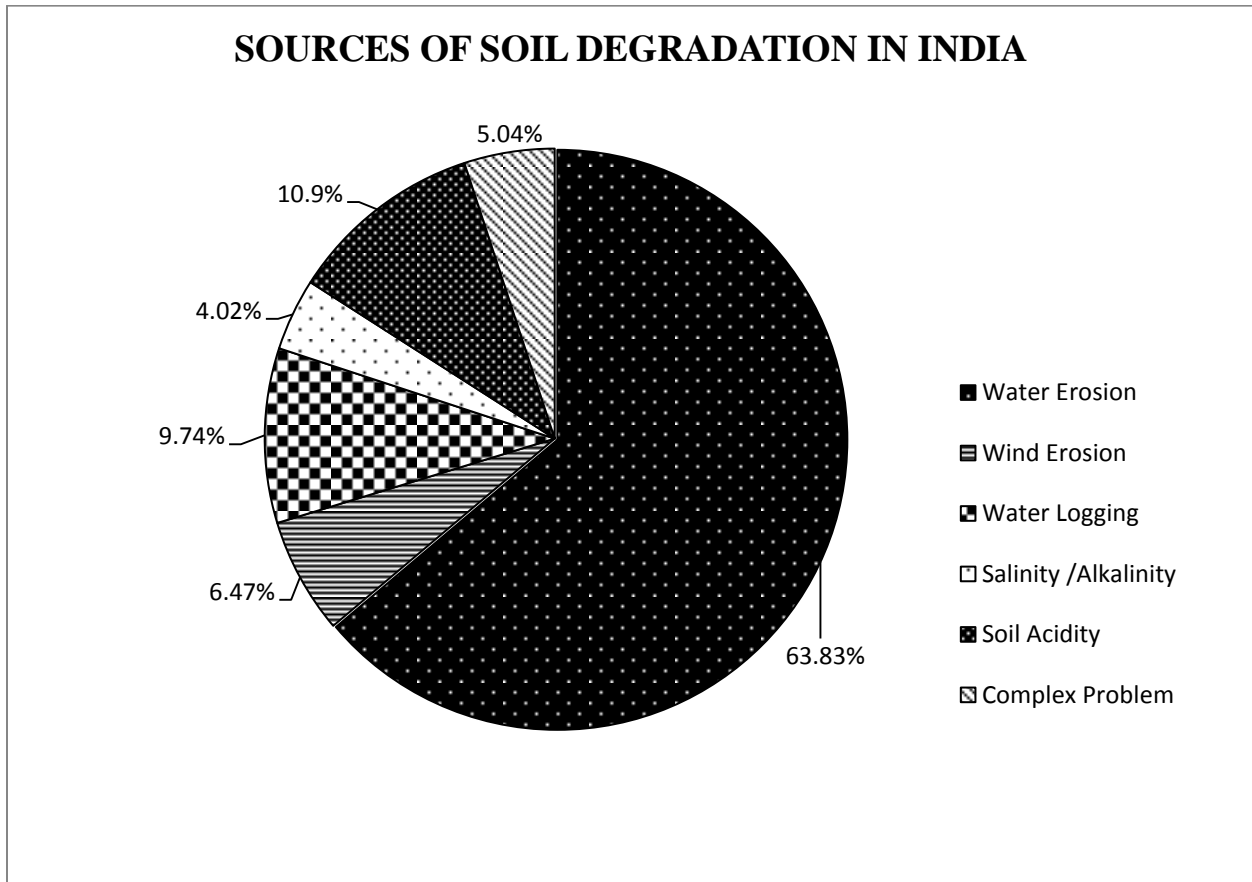


Figure 1.1

This figure 1.1 shows that in India, maximum area is degraded by water erosion which is 63.83% followed by soil acidity which is 10.90% and minimum area is degraded by salinity/alkalinity which is 4.02%. Similarly, complex problem is 5.04%, wind erosion is 6.47% and water logging is 9.74% of total degraded area in India.

State	Water Erosion	Wind Erosion	Water Logging	Salinity/ Alkalinity	Soil Acidity	Complex Problem	Total Degraded Area	%of Degraded Area to TGA*
Andhra Pradesh	11.5	0	1.9	0.5	0.9	0.2	15.0	54.5
Goa	0.1	0	0.1	0	0	0	0.2	43.9
Karnataka	5.8	0	0.9	0.1	0.1	0.7	7.6	39.8
Kerala	0.1	0	2.1	0	0.1	0.3	2.6	67.1
Tamilnadu	4.9	0	0.1	0.1	0.1	0.1	5.3	41.0
Manipur	0.1	0	0	0	1.1	0.7	1.9	42.6
Mizorum	0.1	0	0	0	1.1	0.7	1.9	89.2
Meghalaya	0.1	0	0	0	1.0	0	1.2	53.9
Assam	0.7	0	0	0	0.6	0.9	2.2	28.2
Arunachal Pradesh	2.4	0	0.2	0	2.0	0	0	53.8
Nagaland	0.4	0	0	0	0.1	0.5	1.0	60.0
Sikkim	0.2	0	0	0	0.1	0	0.2	33.0
Tripura	0.1	0	0.2	0	0.2	0.1	0.6	59.9
Himachal Pradesh	2.8	0	1.3	0	0.2	0	4.2	75.0
Jammu & Kashmir	5.5	0.1	0.2	0	0	0	7.0	31.6
Uttar Pradesh+Uttrakhand	11.4	0.2	2.4	1.4	0	0	15.3	52.0
Delhi	0.1	0	0	0	0	0	0.1	55.4
Haryana	0.3	0.5	0.1	0.3	0	0.2	1.5	33.2
Punjab	0.4	0.3	0.3	0.3	0	0	1.3	25.4
Bihar+Jharkhand	3.0	0	2.0	0.2	1.0	0	6.3	36.1
West Bengal	1.2	0	0.7	0.2	0.6	0.1	2.8	31.0
Union Territories	0.2	0	0	0	0	0	0.2	24.8
Gujarat	5.2	0.4	0.5	0.3	0	1.7	8.1	41.5
Rajsthan	3.2	6.7	0	1.4	0	0.1	11.4	33.2
Madhya Pradesh+ Chhattisgarh	17.9	0	0.4	0	7.0	1.1	26.2	59.1
Maharashtra	11.2	0	0	1.1	0.6	0.3	13.1	42.4
Orissa	5.0	0	0.7	0	0.3	0.1	6.1	39.3
<b>Total (Mha)</b>	<b>93.7</b>	<b>9.5</b>	<b>14.3</b>	<b>5.9</b>	<b>16.0</b>	<b>7.4</b>	<b>146.8</b>	<b>-</b>



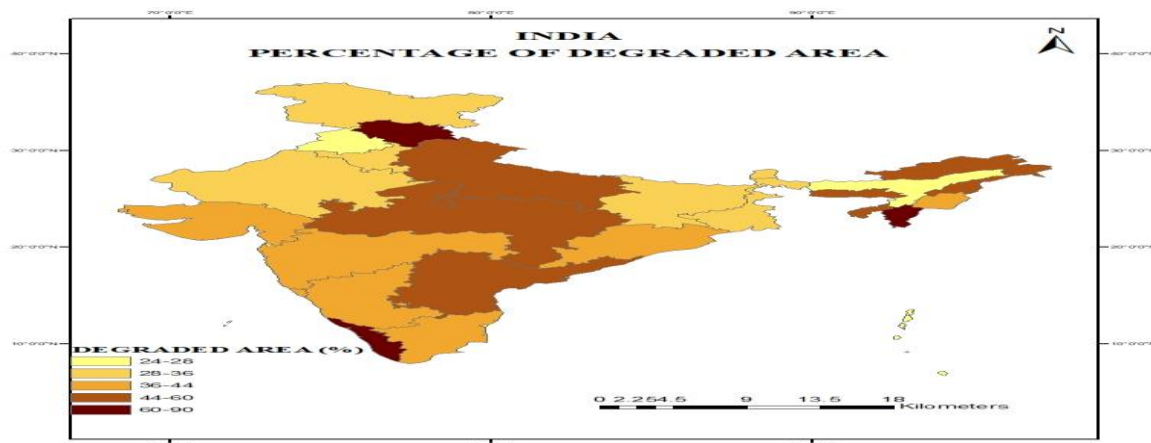
**Table:1.2 State-Wise Extent of various kinds of land degradation in India(Mha).**

**Source: NBSS & LUP (National Bureau of soil survey and land use planning) TGA\* - Total Ground Area**

The table 1.2 shows that maximum area is degraded in Mizorum (89.2%) followed by Himachal Pradesh (75.0%) and Kerala (67.1%). But there is difference between the sources of degradation among these states like ; In Mizorum, soil acidity is more effective than other sources ; In Himachal Pradesh, water erosion is more effective and in Kerala, water logging is more effective than other kind of degradation. On the other hand, in Union Territories, there is low level of degradation which is 24.8% followed by Punjab (25.4%) and Assam (28.2%).

**Table 1.3 Soil Degradation in Different States in Percentage**

Level of Degradation	Degradation in %	States
Very Low	24-28	Assam, Punjab
Low	28-36	Sikkim, Jammu & Kashmir, Haryana, Bihar, West Bengal, Rajsthan
Midium	36-44	Goa, Karnataka, Tamilnadu, Manipur, Gujarat, Maharashtra, Orrissa
High	44-60	Andhra Pradesh, Meghalaya, Arunachal Pradesh, Nagaland, Tripura, Uttar Pradesh, Delhi, Madhya Pradesh
Very High	60-90	Kerala, Mizorum, Himachal Pradesh



### Impact of Soil Degradation:

The following are the impacts of soil degradation:

1. Degradation leads to reduction in crop yield in the affected lands and a possible decline in cropping intensity.
2. In extreme cases, soil becomes unfit for cultivation.
3. Silting of drainage, canals, rivers and reservoirs results in increased floods and droughts.
4. In some cases farmers use more fertilizer inputs to compensate reduced soil productivity while in other cases, they use excess fertilizers.
5. The rate of siltation in many water reservoirs are significantly high. According to Central Water Commission (1991), nearly 11 per cent of the total capacity of water reservoirs has been silted.
6. Soil degradation has several adverse impacts on the environment. It affects global climate through alterations in water cycle and energy balances and disruptions of carbon, nitrogen and sulphur cycles.

The estimated annual loss of different crops due to soil degradation ranges from Rs. 89 billion to 232 billion which represent a loss of 11 to 26 per cent yield (Table 27.6).

### **How to Prevent Soil Erosion:**

**Plant grass and shrubs.** Bare soil is easily swept away by wind and water, the two main causes of erosion. Plant roots hold the soil together, while their leaves block rain and stop it breaking the soil apart. Turf, ornamental grass, and low, spreading shrubs work best since they cover the soil completely.

**Add mulch or rocks.** This will weigh down the soil and protect the seeds and young plants underneath from getting washed away. It also slows the absorption of water to reduce runoff. Grass clippings or bark chips work especially well.

**Use mulch matting to hold vegetation on slopes:** Simply lay the mat over your seeds or young plants. On steep slopes, dig a small trench at the top of the hill first. Lay the top of the mat in the

trench, fill it up with soil, then fold the mat back over the top. This helps water run over the top of the mat, where the mat will slow it down, instead of traveling underneath it.

**Put down fiber logs:** Another option for erosion control on steep slopes is a series of rolled up logs or "wattles" made from fibrous material (like straw). Water running down the slope will slow down when it hits the logs, soaking into the soil instead of carrying mud downhill. Put the logs down across the slope, 10 to 25 feet (3–8m) apart. Hold them in place with wooden stakes or sturdy, living plants.

**Build retaining walls:** Badly eroded slopes will continue to collapse downhill until they are stabilized. A retaining wall at the base of the slope will block the soil and slow down the collapse. This gives grass or other plants time to grow and help the soil hold together.

**Improve drainage:** All buildings should have gutters or pipes that can drain water effectively out of your garden and into water collection systems. Without adequate drainage, heavy rain could wash away a whole layer of topsoil.

**Reduce watering if possible:** Over-watering your garden can speed up erosion by washing away soil. Use less water if you can, or install a drip irrigation system. Since a drip system only delivers small amounts of water at a time, there is no water flooding across the surface to carry topsoil.

**Avoid soil compaction.** When people, animals, or machines travel over soil, they press it down, compacting the soil into a dense layer. Since there is less space between dirt particles in compacted soil, water has a hard time draining through, and carries soil on the surface downhill instead. Walk on paving stones or cleared paths instead of trampling the soil, especially when it is wet. Adding compost or manure can also help by attracting earthworms, which break the soil into looser clumps.

## Preventing Farmland Erosion:

**Keep soil covered year-round:** Bare soil is far more vulnerable to erosion than soil with ground cover. Aim for at least 30% ground cover on all grazing land, ideally 40% or more.

**Plant trees to prevent landslides:** Tree roots are powerful tools when soil is too eroded or steep to plant. Plant native trees on steep slopes and riverbanks to reduce soil loss.[1]

**Reduce tillage:** Deep, frequent tillage creates a layer of compact soil vulnerable to water erosion, topped by loose soil easily removed by wind. Consider a zero-tillage approach using a coultter or other deep planting device.

**Protect weak crops with strip cropping:** Crops with weak roots or that need to be sparsely planted are more vulnerable to erosion. Plant these in strips, alternating with strips of an erosion-resistant crop such as dense grass or legumes.

**Practice wet season spelling:** Grazing land cannot remain healthy and erosion-resistant if cattle are allowed to graze year-round. For best results, close off a paddock for the entire wet season to allow grasses to reestablish themselves.

**Control downhill runoff with flumes:** Runoff is concentrated into a narrower area as it travels across lands. The points where the concentrated runoff reaches a slope are particularly vulnerable to erosion. You can build a paved flume, or lined channel, to lead the water to a safe drainage system. Build these at gully heads as well.

**Turn a hillside into terraces:** The steepest slopes are almost impossible to farm on. Turn the hill into terraces instead by building retaining walls running across the slope. In between the walls, grade the soil level to create a flat area resistant to erosion.

## References:

1. National Bureau of Soil Survey & Land Use Planning (NBSS&LUP). *Soil Map (1:1 Million*

*Scale*); NBSS&LUP: Nagpur, India, 2004.

2. NCA. *Report of the National Commission on Agriculture. National Commission of Agriculture*; Government of India: New Delhi, India, 1976; pp. 427–472.

3. Vohra, B.B. *A Policy for Land and Water*; Department of Environment, Government of India: New Delhi, India, 1980; Volume 18, pp. 64–70.

4. National Bureau of Soil Survey and Land Use Planning (NBSS&LUP). *Annual Report 2005, Nagpur*; NBSS&LUP: Nagpur, India, 2005.

5. Singh, G.; Ram, B.; Narain, P.; Bhushan, L.S.; Abrol, I.P. Soil erosion rates in India. *Ind. J. Soil Conserv.* **1992**, *47*, 97–99.