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Land Degradation and Its Restoration

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Land degradation

Land is an essential resource to humankind, like air and water.The term "land degradation" refers to the decline in biological or economic output and intricacy of rainfed farmland, irrigated cropland, range, pasture, forest, or woodlands as a consequence of abiotic factors, anthropogenic uses of the land, or both. Alternatively, land degradation is the deterioration of the quality of the land or the decrease in its output and is defined as the loss of real or prospective productivity or usefulness as a result of natural or anthropogenic causes.It is a worldwide issue that impacts everyone due to food insecurity, rising food costs, climate change, environmental threats, and the decline of biodiversity and ecological functions.

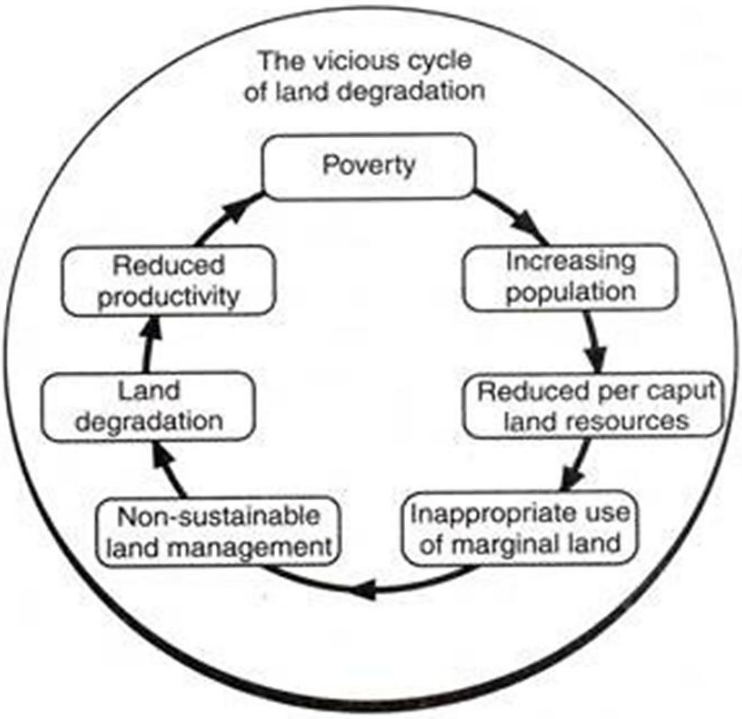

Figure 1 – The vicious cycle of Land degradation

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Multiple factors, including severe weather events, especially drought, contribute to its occurrence. It is also brought on by human actions that deteriorate or pollute soil quality and land usefulness.In the context of productivity, land degradation results from a mismatch between land quality and land use. (Beinroth *et al.*, 1994).Mechanisms that initiate land degradation include:

- Physical processes
- Chemical processes
- Biological processes

Physical processes are a decline in soil structure leading to crusting, compaction, erosion, desertification, anaerobism, environmental pollution, and unsustainable use of natural resources. However, chemical processes include acidification, leaching, salinization, decrease in cation retention capacity, and fertility depletion.

Current scenario of land degradation

One of the most urgent environmental issues facing the planet is land degradation, which will only get worse if immediate corrective action is not taken. Approximately, 25% of the planet's territory has been degraded. Land deterioration is one of the main causes of climate change because it releases nitrous gas and carbon from the earth into the atmosphere. Scientists recently issued a warning that poor agricultural practises were primarily to blame for the annual loss of 24 billion tonnes of rich soil. Currently some 6–7 million hectares are lost annually through soil erosion, desertification affects about one-sixth of the world's population and one-quarter of the world's land, and salinization affects some 20 million hectares of irrigated landBy 2050, 95% of the Earth's land regions risk degradation if this pattern persists.

Table 1 – Scenario of land degradation in India (Source – Forest Survey of India)

Types of land degradation	Area (in million hectares)
Water eroded	111.26
Wind eroded	38.74
Water logged	6
Alkali soils	2.50
Saline soil	2.50

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Ravine and gullies	3.97
Shifting cultivation	4.36
Riverine	2.73
Total problem area	175.06
Total geographical area	347.12

Table 2 –Category-wise percentage of degraded land in India (Source www.pmfias.com)

Category	Percentage
Gullied and/or ravenous land	3.22
Upland with or without scrub	30.40
Water-logged and marshy land	2.58
Land affected by salinity/alkalinity/coastal/inland	3.22
Shifting cultivation area	5.50
Under-utilized degraded notified forest land	22.02
Degraded pastures/grazing land	4.07
Degraded land under plantation crops	0.90
Sands/inland/coastal	7.84
Mining industrial wastelands	0.20
Barren rocky/stony waste/sheet rocky area	0.12
Steep slopping area	1.20
Snow covered and/or glacial area	8.73

Procedure for assessment of land degradation (SOURCE-FAO. 1976.

A Framework for Land Evaluation. FAO Soil Bulletin No. 32)

- Comprehensive land type mapping, land cover and vegetation index study
- Land characteristics data base construction based on land type mapping units.
- Land information system (LIS) construction: maps are digitized within ARC/INFO,ILWIS or other environment
- Set up an applied Land Information System: Land Type Units, integrated with land cover and vegetation index, are compared with land degradation classification systems.
- Reinterpretation of Land Type Map into Land Degradation Map: Extraction, Integration and Conversion of the Spatial (polygon etc.) data e.g. for the Land Degradation Map Reproduction.
- Conversion and Reconstruction of Statistic data.

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- As the map and land inventory are produced, then sustainable land use planning can be carried on.

Types of land degradation

Land degradation have been grouped into six classes:

1. Water Erosion

Water erosion includes sheet and rill erosion as well as gully erosion, which are both types of soil erosion caused by water. It also takes into account the increase of landslides brought on by human activity, such as when foliage is cleared away or roads are built.

2.Wind Erosion

The natural process of transportation and deposition of sand and soil by the action of wind is known as wind erosion. It is a common phenomenon occurring mostly in dry, sandy soils or anywhere the soil is loose, dry, and finely granulated.

3. Soil fertility decline

Soil fertility decline is used as a short term to refer to deterioration in soil physical, chemical and biological properties. Although a primary impact of erosion is a decline in fertility, the word is used here to refer to effects of processes other than erosion.The main processes involved are:

- Reduced soil organic matter is accompanied by decreased soil biological activity.
- Deterioration of the physical characteristics of the soil (structure, porosity, and water-holding ability), brought on by a decrease in organic matter.
- Adverse changes in soil nutrient resources, such as decreased availability of the main nutrients (nitrogen, phosphate, and potassium), the onset of micronutrient deficiencies, and the formation of nutrient imbalances
- Accumulation of toxins, mainly acidity due to improper fertiliser use.

4. Water logging

The reduction in land yield caused by an increase in groundwater near the soil top is known as water logging. The severe adaptation, known as ponding, in which the water level raises above the surface, is also covered under this heading. Salinization and water logging are related, both being caused by improper irrigation management.

5. Salinization

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Salinization is the term used to describe all forms of land degradation brought on by a rise in salt content. Thus, it includes both salinization in the literal sense, which is the accumulation of free salts, and alkalization, which is the rise of sodium dominance over other elements in the exchange complex. These are primarily the result of improper irrigation scheme design and administration, which makes them human-induced processes. Saline intrusion occurs when groundwater is overdrawn and sea water seeps into coastal soils.

6. Lowering of the Water table

Land degradation that lowers the water table is evidently caused by groundwater being pumped for agriculture through tubewells at a rate that exceeds the capacity for natural replenishment. This happens where the groundwater is non-saline (sweet). Pumping for urban and industrial use is a further cause.

Land Restoration

The process of ecologically restoring a location to a natural landscape and habitat that is secure for people, animals, and plant groups is known as land restoration.The most important aspect of land restoration is turning marginal land or previously degraded soils back into productive resources so that the producing area can grow without encroaching on natural environments (Smith et al., 2013).

Restoration Technology

1. **Improvement in soil organic carbon pool**
   - Crop yields can be increased by 20–70 kg ha^{-1} for wheat, 10–50 kg ha^{-1} for rice, and 30–300 kg ha^{-1} for maize with every 1 Mg ha^{-1} increase in soil organic carbon pool in the root zone.
   - Adoption of recommended management practices on agricultural lands and degraded soils would enhance soil quality including the available water holding capacity, cation exchange capacity, soil aggregation, and susceptibility to crusting and erosion. Increase in soil organic carbon pool by 1 Mg ha^{-1} y^{-1} can increase food grain production by 32 million Mg y^{-1} in developing countries.
2. **Peatland restoration**
   - Organic or peaty soils accumulate large quantities of carbon due to anaerobic decomposition of the organic matter. Anaerobic decomposition, or decomposition under absence of oxygen, occurs due to the flooded conditions of peatlands.

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- When converted to agricultural lands the soils are drained, which removes the anaerobic conditions as it introduces oxygen into the soil.
- This process favours aerobic decomposition (decomposition with oxygen) which results in high CO_2 and N_2O fluxes (IPCC, 2007).

Methods for restoration

- Land treatments
- Desalinization
- Soil remediation
- Use of organic farming techniques
- Afforestation/ Plantation

Conclusion

More than 6-7 million hectares of land are degraded annually and it is risingper year due to poor management and ever-increasing demand and increasing population which should be controlled with proper restoration technology and creating awareness towards land use planning.Small areas of soil can be restored using conventional techniques. However, large effected degraded land are hard to restore and are much more expensive.So, it is better to take care of soil and land before it gets late to recover.

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