

# Problem Soils

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Land degradation is temporary or permanent degeneration of productivity of land due to physical, chemical or biological factors. India shares 16% of the world population, while its land is only 2% of the total geographical area of the world. Naturally, the pressure on the land is often beyond its carrying capacity. Therefore, the productive lands, especially the farmlands in India are in the constant process of various degrees of degradation and are fast turning into wastelands. At present, approximately 68.35 million hectare area of the land is lying as wastelands in India. Out of these lands, approximately 50% lands are such non-forest lands, which can be made fertile again if treated properly.

**In news:** Desertification and Land Degradation in India

**Placing it in syllabus:** Environment

## **Dimensions**

- Land degradation in India
- Types of degradation
- Stages of soil erosion
- Affected areas
- Reclaiming problem soils
- Integrated Wasteland Development Program
- Integrated Watershed Management Program

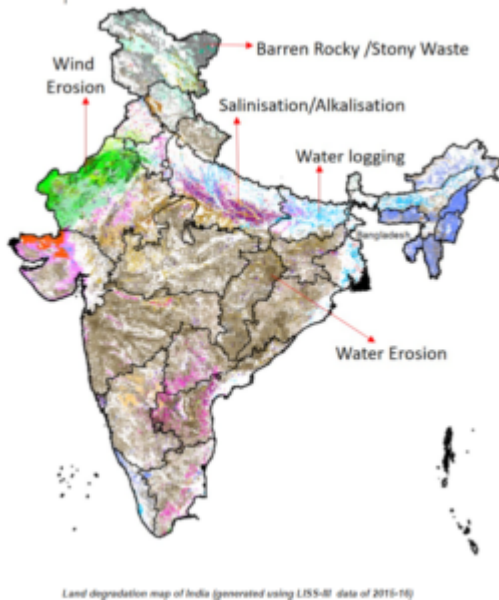
## **Content:**

### **Land Degradation in India:**

- Degraded land includes eroded lands, saline / alkaline lands, water logged lands and mined lands.
- The total land area of India is 329 million hectares of which about 178 million hectares (54%) is converted into wastelands for one or other reasons. This also includes

about 40 million hectares of degraded forest.

- The total cultivable land of the country is about 144 million hectares of which 56% (80.6 million hectares) is degraded due to faulty agricultural practices and the dense forest cover has been reduced to 11% (36.2 million hectares) of the total geographical area.
- Watershed areas, river corridors, and rangelands have been extensively disturbed. The situation is frequently so bad that even cessation of abuse may no longer lead to self-restoration of biological diversity, stability, and productivity of the ecosystems.
- Nearly one-third of the area in India faces the threat of land degradation.
- At the behest of the Ministry of Environment, Forest and Climate Change, ISRO's Space Applications Centre, Ahmedabad along with partner institutes took up the task of inventorying and monitoring land degradation and desertification in India using Indian Remote Sensing Satellites (IRS) data.
- The analysis reveals that 96.40 million hectares (mha) area or 29.32% of the Total Geographic Area (TGA) in India is undergoing a process of land degradation during 2011-13, which is an increase of 1.87 mha area or 0.57% of TGA since 2003-05.
- Approximately 6.35% of land in Uttar Pradesh is undergoing desertification/degradation.



## Types of Land Degradation

### **Water erosion:**

- It covers all forms of soil erosion by water, including sheet and rill erosion and gullyng.
- Human activities such as vegetation clearance, road construction, etc. intensify this process..

### **Wind erosion:**

- It refers to loss of soil by wind, occurring primarily in dry regions.
- Wind erosion is a natural process where the soil is moved, carried, and transported by the force of the wind from one place to another.
- In order to be transported, the threshold velocity of the wind is needed. However, this depends on the size, weight, and wetness of the soil particles.

### **Waterlogging:**

- Waterlogging is the rise of the water table into the root zone of the soil profile, such that plant growth is adversely affected by deficiency of oxygen.
- It lowers land productivity through the rise in groundwater close to the soil surface.

- Also included under this heading is the severe form, termed ponding, where the water table rises above the surface.
- Waterlogging is linked with salinization, both being brought about by incorrect irrigation management.

### **Salinization**

- Salinization refers to all types of soil degradation brought about by the increase of salts in the soil.
- It thus covers both salinization in its strict sense, the buildup of free salts; and sodification (also called alkalization) the development of dominance of the exchange complex by sodium.
- As human-induced processes, these occur mainly through incorrect planning and management of irrigation schemes.
- Soil salinization/alkalization is a serious phenomenon widely distributed in various bioclimatic zones of the world.
- However, in arid and semiarid areas, dry climate is characterized by scarce rainfall and high evaporation, which commonly accelerates the process of salt accumulation on land surface.
- In particular, inappropriate irrigation methods, such as low water use efficiency and infiltration of canal or irrigation system, result in the rise of groundwater table, as well as the secondary salinization of arable land on a large scale.
- Soil salinization/alkalinization may cause crop failure or even abandoned cultivation due to the loss of land productivity.
- Saline intrusion, the incursion of sea water into coastal soils arising from over-abstraction of groundwater.

### **Soil Acidification:**

- It is a reduction in the pH of soil
- When the soil becomes too acidic, it loses its productivity.
- It can be caused by soil amendments, acid rain, nitrogen emissions in the air, and other factors.

### ***Soil fertility decline:***

It is the deterioration in soil physical, chemical and biological properties. Whilst decline in fertility is indeed a major effect of erosion, the term is used here of cover effects of processes other than erosion.

The main processes involved are:

- lowering of soil organic matter, with associated decline in soil biological activity;
- degradation of soil physical properties (structure, aeration, water holding capacity), as brought about by reduced organic matter;
- adverse changes in soil nutrient resources, including reduction in availability of the major nutrients (nitrogen, phosphorus, potassium), onset of micronutrient deficiencies, and development of nutrient imbalances.
- buildup of toxicities, primarily acidification through incorrect fertilizer use.

## **Stages of soil erosion**

### ***Rain Drop or Splash Erosion:***

The erosion due to the impact of falling raindrops on soil surface leading to the destruction of the crumb structure is known as the raindrop or splash erosion.

### ***Sheet Erosion:***

It is the uniform removal of soil in thin layers from the land surface caused by the wind. Land areas with loose, shallow

topsoil overlies compact soil are most prone to sheet erosion

### ***Rill Erosion:***

Rill erosion is a form of water erosion in which the erosion takes place through numerous narrow and more or not so straight channels called streamlets, or head cuts. Rill is the most common form of erosion, which you can also observe during heavy rain.

### ***Gully Erosion:***

Gully erosion occurs due to the runoff of surface water causing the removal of soil with drainage lines. Gullies, when started once, will move by headward erosion or even by slumping of side walls unless and until proper steps are taken in order to stabilize the disturbance.

### ***Stream Bank Erosion:***

Bank erosion is nothing but washing up away from banks of a stream or a river. It is different from the erosion of the bed of a watercourse, which is referred to as scouring. This type of erosion is also termed as Stream Bank Erosion.

### **Affected areas:**

- In India, about 25% of the land area is suffering from the problem of water erosion.
- Soil erosion by water in the form of rill and sheet erosion is a serious problem in the red and lateritic soils of South and Eastern India where about 40 tonnes per hectares of topsoil is lost annually.
- Out of 70 million hectares of the black soils of Central India about 6.7 million hectares are already unproductive due to the development of gullies.
- Over 4.4 million hectares of land is degraded due to shifting cultivation practiced largely by tribals in North-eastern India.

- Ravines are a system of gullies or gorges worn out by torrents of water running more or less parallel to each other and draining into a major river or its tributaries after a short distance with development of deep and wide gorges.
- In fact, ravine lands are a manifestation of an extreme form of water erosion occupying approximately 3.67 million hectares of land chiefly distributed in Uttar Pradesh, Madhya Pradesh, Rajasthan, and Gujarat.
- It has been estimated that the production potential of ravine areas in Uttar Pradesh, Madhya Pradesh and Rajasthan alone would amount to 3 million tonnes of food grains annually besides fruit, fodder, and wood.
- On a conservative estimate, the country is losing a total output worth about Rs.157 crores a year by failure to reclaim and develop the ravine lands.
- Furthermore, these ravine lands have been creating the problem of law and order maintenance in states of Uttar Pradesh and Madhya Pradesh as the notorious dacoits take refuge in these eroded lands and conduct their unlawful activities.
- Wind erosion is chiefly the problem of arid and semi-arid regions of the country where the soil is sandy with scanty vegetation or even without vegetative cover.
- In India about 50 million hectares of land area is affected by wind erosion most of which belong to Rajasthan and Gujarat. Overgrazing is the main cause of soil erosion in these areas.
- It is estimated that a program for the control of wind erosion covering 50 million hectares would cost about 3,000 crores of rupees.
- Approximately 140 million hectares of land area of the country is affected from water and soil erosion as a result of which the top fertile layer of the soil is lost annually at the rate of 6,000 million tonnes per year containing more than Rs.1,000 crores worth of nutrients.

- The number of macronutrients like nitrogen, phosphorus, and potassium (N, P & K) lost during this process is about 5.53 million tonnes.
- The alkali soils are largely predominant in the Indo-Gangetic plains encompassing States of Punjab, Haryana, Uttar Pradesh & Bihar and partly in states like, Chhattisgarh, Rajasthan, Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh and Tamil Nadu.
- The saline soils are found mainly in the States of Gujarat, Bihar, Haryana, Rajasthan, Maharashtra, Odisha, Andhra Pradesh, Kerala, Tamil Nadu, Uttar Pradesh and West Bengal. Isolated patches of problem soils are also found in other States.
- The problem of acid soils exists in most of the States except Gujarat, Punjab, Rajasthan and Uttar Pradesh.
- With the advent of canal irrigation, the area under problem soils is increasing day by day, due to which large fertile cultivated lands are losing production potential across the country.

## **Reclaiming problem soils**

- Depending upon soil type, slope and soil capability, it is proposed to implement two models ie Crop Based Farming System (CBFS) and Agroforestry Based Farming System (ABFS) for reclamation of problem (alkali / saline) soils
- For Alkali Soils: application of soil amendments (Gypsum/Pyrite) at the average rate of 5 tonnes per ha. and it's mixing with soil when temperature is around 40 degree centigrade
- For reclaiming saline soils: construction of surface/sub-surface drainage as per need of the area for lowering the ground water level & also for flashing salt accumulated upper soil layer crop root zone
- For reclaiming acidic soils: application of soil



amendment (lime), at the rate of 2 to 4 quintals per ha. in furrows depending on extent of acidity along with growing crops suiting to such soils to enhance productivity

## **General Methods of reclaiming problem soils include:**

- Field bunding, land shaping, construction of field channels/water harvesting structures
- Green manuring & its mulching into soil for increasing organic carbon in the soil
- Growing of suitable crops (Pigeon pea, Soya bean, Groundnut, Lentil, Gram, Pea, Cotton, Maize, Sorghum, Wheat, Linseed and Mustard etc.) /horticultural/agro-forestry species including fuel & fodder plantation depending upon soil capabilities and slope conditions

## **Integrated Wasteland Development Program:**

Major programme implemented for improving the productivity of waste & degraded lands keeping in view the poverty, backwardness, gender & equity is Integrated Wasteland Development Programme.

IWDP is being implemented by the National Wasteland Development Board of the Ministry Of Rural Development (now Ministry of Rural Areas and Employment).

The strategy includes development of wastelands mainly in non-forest areas aimed at:

- checking land degradation , putting such wastelands of the country to sustainable use
- increasing bio-mass availability especially that of fuelwood , fodder , fruits, fiber & small timber.

IWDP also works for revitalizing & reviving village level institutions & enlisting people's participation. It is

people's own programme which aims at giving them actual decision making powers in terms of project implementation & fund disbursement.

### **Integrated Watershed Management Program (IWMP):**

- IWMP was launched in 2009-10 with the objective of bringing various programmes such as the Integrated Wastelands Development Programme (IWDP), Desert Development Programme (DDP) and Drought Prone Areas Programme (DDAP), under one common integrated programme.
- The Integrated Watershed Management Programme (IWMP) aims at prevention of soil erosion, regeneration of vegetative cover, introduction of rainwater harvesting and recharging of ground water table.
- The IWMP seeks to bring together all government agencies under one common programme to address all these problems and improve the quality of life and health of these people through enhanced livelihood opportunities.
- Cluster approach is adopted in selecting and preparing the project, with the average size of the IWMP implementation being 5,000 hectares, which comprises a cluster of micro-watersheds.
- The programme also involves extensive use of technology using remote sensing data, IT and GIS for project planning, implementation, monitoring and evaluation.

**Mould your thought:** Enumerate different types of land degradation and comment on their extent in India. Suggest solutions to overcome these problems.

#### ***Approach to the answer:***

- Introduction
- Define land degradation
- Mention the types of land degradation briefly
- Discuss the extent of the problem in India
- Discuss different conservation measures / Govt programs

- Conclusion