drishti

Distance Learning Programme

UPPCS Mains

Indian Geography

drishti

INDIAN GEOGRAPHY

641, First Floor, Dr. Mukherjee Nagar, New Delhi-110009
Contact No.: 011-47532596, 8448485520
Web : www.drishtiias.com
E-mail : dlpsupport@groupdrishti.com

CONTENTS

- **Nutrients:** Peaty soils are black and acidic in nature and formed in anaerobic conditions. They lack in potash and phosphate. Large quantity of dead organic matter accumulates in these areas, and this gives a rich humus and organic content to the soil. Organic matter in these soils may go even up to 40-50 per cent.
- The soil is mostly useless for agriculture, but at some places rice is grown.

Soil of Uttar Pradesh

The soils are natural, dynamic, heterogeneous, non-renewable resource, which support plant and animal life. It is the most precious basic resource for the very existence of mankind since they cater the basic needs of mankind by producing food, fibre and timber. For sustainable utilization of soil resource, it is imperative to know the nature, characteristics and extent of distribution of different soils, their qualities, productive potentials and suitability for optimum land uses.

The state of U.P. is endowed with diverse climate, relief, parent material, vegetation which influences the genesis of the soils. Soil formation is a very slow but ceaseless process. The climate acting over parent material for a never ending large period of time is the most important factor responsible for the successive changes in soil development.

The soils of Uttar Pradesh can be discussed under the following heads:

Soils of Gangetic Plain

The Gangetic Plain lies between Himalayas in the north and highlands plateaus and scarplands in the south, occupying nearly 20.7 m ha which is 70.53 percent of the Total Geographical Area (TGA) of the state. The soils are developed from alluvium deposited by the two major rivers of the state, i.e., The Ganga, The Yamuna and their tributaries.

The general slope of the Gangetic plain is from north-west to southeast, and the finer fraction increases from western to eastern parts of the state due to gravimetric assorting of soil particles. The region is quite rich in ground water resources, both free and confined. The flora consists of a variety of deciduous trees, shrub and grasses.

The soils are very deep, highly productive and intensively cultivated for wheat, rice, sugarcane, etc. However, problems of salinity, flooding, light texture etc., are also confronted in this region. The major constraints of the piedmonts are the low moisture holding capacity and root zone limitations. Presence of boulders in the substratum leads to an acute scarcity of moisture for normal crop growth, whereas in the Tarai belt problem of wetness, overflows and at places erosion are observed.

- **Soils of Piedmont Plains:** It constitutes nearly 0.72 million hectares which is 2.44 percent of the TGA of the state. The soils are deep, well drained, neutral to slightly alkaline, coarse-loamy/fine-loamy (calcareous/non-calcareous).
- **Soils of Tarai:** It covers an area of 0.49 million hectares which is 1.68 percent of the TGA of the state. The soils are dominantly very deep, well drained, slightly alkaline, coarse-loamy/fine-loamy. These soils are rich in organic matter, plant nutrients and have fairly good water holding capacity.
- **Soils of Old Alluvial Plain:** It occupies an area of 11.2 million hectares which is 38.09 percent of the TGA of the state. The soils show maximum profile development which can be attributed to the age (late Pleistocene) and topography. The dominant soils are deep, well drained coarse-loamy/fine-loamy/fine silty (calcareous/non-calcareous). They are the most potent and intensively cultivated soil of the state.

- **Soils of Alluvial Plain with Occasional Sand Dunes:** It covers an area of 0.40 million hectares which is 1.34 percent of the TGA of the state. The soils derived from alluvium are at places modified by the aeolian activity prevailing in the area. The dominant soils are deep, well drained coarse-loamy/fine-loamy Typic Haplustepts interspersed with Typic Ustipsamments.. Other major soils are coarse-loamy and coarse-loamy over sandy, Fluventic Haplustepts. These soils are slightly alkaline in reaction with low fertility and Available Water Capacity (AWC). The other constraints of these soils are slight wind erosion and light texture. Sand dunes at many places have either been reclaimed or stabilized.
- **Soils of Recent Alluvial Plain:** It covers an area of 5.02 million hectares which is 17.06 percent of the TGA of the state. It lies in between old alluvial plain and active flood plain. The soil profile has little development. This plain at present is to some extent free from flood activity. The major soils are deep, well drained, coarse-loamy/fine-loamy/fine-silty, (calcareous/non-calcareous), Typic/Fluventic Haplustepts associated with deep imperfectly drained to poorly drained coarse-loamy/fine-loamy/fine silty, (calcareous/non-calcareous), Aquic Haplustepts/and Typic/Aeric Haplaquepts.
- **Soils of Active Flood Plain:** It covers an area of 1.85 million hectares which is 6.29 percent of the TGA of the state. It lies along the present and old courses of the main rivers and rivulets and formed as a result of meandering action of these rivers and rivulets. When these rivulets overflow, sediments variable in texture spread all along their courses. The development of soil is restricted to A-C horizons due to the high intensity of flooding. The soils are deep, well drained, coarse-loamy/fine-loamy/sandy over coarse-loamy, (calcareous/non-calcareous), stratified, Typic Ustifluvents in association with Typic/Aquic Ustipsamments. Other soils are deep, imperfect to poorly drained, coarse-loamy/fine-loamy, (calcareous/non-calcareous) stratified, Aquic Ustifluvents and Typic Fluvaquents. A soil-physiographic relationship in Ganga-Ghaghara river Doab is depicted through a cross section.
- **Soils of Ravinous Plain:** It occupies an area of 1.01 million hectares which is 3.48 percent of the TGA of the state. This plain is confined along the Yamuna, Chambal, Sengar, Betwa and Kuwari rivers in the districts of Agra, Etawah, Kanpur and Fatehpur etc. Major soils of this plain or deep, excessively drained coarse-loamy/fine-loamy, (calcareous/non-calcareous), Typic Haplustepts. They are severe to very severely eroded and prone to droughtiness. At many places these ravines are the abode of so many unsocial elements. The ravine control and reclamation of this area is one of the major problems of the state.

Soils of Southern Highlands, Plateaus and Scarplands

It lies just south of Ganga trough occupying the entire southern zone of the state covering Jalaun, Jhansi, Lalitpur, Hamirpur, Mahoba, Banda, Chitrakoot, Sonebhadra, and parts of Kaushambi, Allahabad, Mirzapur, and Chandauli districts of the state. It covers around 3.69 million hectares, constituting 12.34 percent of the TGA of the state. The climate of the region is subtropical with mean annual rainfall ranging from 750 to 1000 mm. Summers are very hot while winters are cold. Forests of the region are poorly stocked and overgrazed, thus characterised by retarded regeneration. Dhak, Semal, Salai, loahal, Khair, and haldu are the common trees. Scurbs and grasses represent the secondary growth throughout the region. The length of growing period (LGP) varies from 120-180 days. Wheat, sorghum, bajra, gram and arhar are important crops of this region. The mixed sowing of seeds still used as a device to ensure the crops from total failure.

Major constraints of this region are:

- Shallow soil depth
- Gravelliness
- Moderate to severe erosion
- Stoniness
- Runoff
- Water stress

The physiography is divided into four sub-physiographic units. The soils are described under different subheads in the following sections.

- **Soils of Eastern Rajasthan Upland:** This is alluvial plain formed by Chambal river and its tributaries underlain by igneous and sedimentary rocks, dotted with low monando rocks. Agroclimatic condition of the region is by and large similar to those as experienced in the Aravalli plain. Major soils are deep, well drained, coarse-loamy/fine -loamy, (calcareous/non-calcareous), Typic Haplustepts with slight to moderate erosion. However the soils along the river channels are excessively drained, Typic Ustipsamments. These soils are neutral to alkaline in reaction with low to medium annual water content.
- **Soils of Bundelkhand Upland:** It lies in the southwestern part of the state just south of Yamuna river. It comprises the districts of Jalaun, Jhansi, Lalitpur, Hamirpur, Mahoba, Banda and Chitrakoot. The soils of Bundelkhand region have developed from Vindhyan rocks abounding in gneiss and granites with highly ferruginous beds and often soft limestone. The landscape comprises of two diverse geology. It consists mainly of sandstone, quartzite, limestone, dolomite and granite-gneiss on one hand while a vast area is formed from the alluvium brought down by Chambal and its tributaries. The generalised soil-scape relationship is presented in and are dealt in the following subsections.
  - **Soils of Sandstone Landscape:** It occupies an area. The hills and escarpments are occupied with rock outcrops in association with shallow to moderately shallow, somewhat excessively drained, loamy-skeletal, Lithic/Typic Ustorthents. They are moderate to severely eroded, slightly stony, neutral to slightly alkaline with low AWC. The undulating plateaus are covered with moderately shallow somewhat excessively drained, fine-loamy/loamy-skeletal, Typic Haplustepts/Ustorthents with severe erosion and slight to moderate stoniness. The intervening basin on the other hand are occupied with deep moderately well drained, fine, (montmorillonitic), Vertic Haplustepts and Entic Haplusterts. The other soils mapped are moderately shallow to deep well to moderately well drained fine-loamy, (calcareous/non-calcareous), Typic Haplustepts. These soils are slight to moderately eroded, neutral to slightly alkaline with medium AWC.
  - **Soils of Granite-Gneissic Landscape:** The subdued and residual hills are dominantly occupied by rock outcrops in association with moderately shallow to shallow, excessively drained, neutral, loamy-skeletal, Typic/Lithic Ustorthents with severe erosion and slight stoniness. The uplands/plateau are occupied with moderately shallow to deep, well drained, fine-loamy/loamy-skeletal, Typic Haplustepts in association with deep, well drained, fine, (montmorillonitic), Vertic Haplustepts and shallow to moderately shallow, well to somewhat excessively drained, loamy-skeletal, Lithic/Typic Ustorthents. They are slight to moderately eroded, neutral to slightly alkaline with medium AWC. On the other hand moderately shallow to moderately deep, somewhat excessively drained. loamy-skeletal, Typic Ustorthents/Haplustepts are identified on the pediments. They are neutral, severely eroded with moderate to strong stoniness and low AWC. In contrast, the valleys are occupied with deep,

moderately well drained, fine to fine-loamy, (calcareous/non-calcareous) slight to moderately eroded soils. They are classified as Typic/Vertic Haplustepts. They are slightly alkaline, with medium to high AWC.

- **Soils of Bundelkhand Alluvial Plain:** The soils found on residual isolated hillocks are shallow, excessively drained, loamy-skeletal/coarse-loamy, Lithic Ustorthents. They are neutral, severely eroded with moderate stoniness and low AWC. The very gentle to gently sloping uplands consists of deep, well to moderately well drained, fine-loamy, (calcareous/non-calcareous), Typic Haplustepts in association with deep, moderately well drained, (calcareous/non-calcareous), Vertic Baplustepts and Typic Entic Haplusterts. They are slight to moderately eroded, slight to moderately alkaline with medium to high AWC. A significant portion of this tract is under ravines. The soils of the ravines are dominantly deep, well drained to moderately well drained, coarse-loamy/fine-loamy, (calcareous/non-calcareous), Typic Haplustepts. They are slight to moderately alkaline, moderate to severely eroded droughty with low to medium AWC.

- **Soils of Vindhyan Ranges and Scarplands:** It lies in the southeastern part of the state just south of Yamuna and Ganga rivers. It comprises the parts of the districts of Chitrakoot, Kaushambi, Allahabad, Mirzapur, Chandauli, and Sonebhadra. The soils are developed on Vindhyan rocks comprising of sandstone, shales, mixed conglomerates and to some extent the limestones. The rainfall and the nature of the soils provide an environment suitable for a variety of vegetation ranging from grasses and thorny to deciduous trees like teak, sal, haldu, tendu, khair, and salon etc. Paddy, wheat, gram, jowar, and arhar are the important crops of this region.
  - **Soils of Hilly Terrain:** It occupies an area. The hilly terrain soil consists of shallow, excessively drained, loamy-skeletal to fine-loamy, Lithic Ustorthents. They are neutral to slightly acidic, moderate to severely eroded with low AWC. At places, they are associated with rock outcrops. Lithic Ustorthents and rock outcrops respectively occupy 65 and 35 percent area.
  - **Soils of Residual Hills and Intervening Valleys:** The soils are shallow well to somewhat excessively drained, coarse-loamy/loamy-skeletal, (calcareous/non-calcareous), Lithic Ustorthents, occurring in association with rock outcrops. These soils are slightly alkaline, moderate to severely eroded, slight to moderately stony with low AWC. Nearly 60 percent of the area is covered by Lithic Ustorthents and the rest is under rock outcrops.
  - **Soils of Plateau:** The soils on moderate slopes consists of moderately shallow, somewhat excessively drained, sandy-skeletal/coarse-loamy. Typic Ustorthents associated with moderately deep, somewhat excessively drained, fine-loamy, Typic Haplustepts. They are neutral to slightly alkaline, moderate to very severely eroded with low AWC. The nearly level to very gently sloping plateaus develops deep, well to moderately well drained, fine-loamy, Typic Haplustepts in association with fine, Vertic Haplusterts. At places deep, well drained, fine-loamy, Typic Paleaustalfs/ Haplustaifs have also been encountered. These soils are slightly alkaline, slight to moderately eroded with medium to high AWC.
- **Soils of Eastern Plateau:** It lies south of river Son, covering a part of the district Sonebhadra. The soils developed on granite-gneissic landscape are deep, well drained, fine –loamy, Arenic Haplustalfs associated with moderately shallow, excessively drained, loamy-skeletal, Typic Ustorthents. They are neutral to slightly alkaline, moderate to

severely eroded with low AWC. The soils on the hills and narrow valleys (Dharwar system) dominantly consist of rock outcrops in association with moderately shallow, somewhat excessively drained, loamy-skeletal, Typic Ustorthents. They are neutral, severely eroded with low AWC, whereas the soils on undulating uplands are deep, well drained, fine, Typic Haplustalfs occurring in association with fine-loamy, Typic Haplustaifs. At places, moderately shallow to deep, well drained, loamy/fine-loamy, lithic/Typic Ustorthents have also been encountered. They are neutral to slightly alkaline, moderate to severely eroded with low AWC.

Soil Degradation

Soil degradation refers to decline in the soil's productivity through adverse changes in nutrient status, soil organic matter, structural attributes, and concentrations of electrolytes and toxic chemicals. Soil degradation is a process, which lowers the current and/or future capacity of the soil to produce goods or services.

Soil degradation includes decline in soil fertility, adverse changes in alkalinity, acidity or salinity, extreme flooding, use of toxic soil pollutants, erosion, and deterioration of the soil's structural condition. These elements contribute to a significant amount of soil quality depreciation annually. Excessive soil degradation thus gives rise to immediate and long-term impacts.

Factors Responsible for Soil Degradation

- **Physical Factor:** The factors contributing to soil degradation distinguished by the manners in which they change the natural composition and the structure of the soil. Rainfall, surface runoff, floods, wind erosion, tillage, and mass movements result in the loss of fertile top soil thereby declining soil quality.
- **Biological Factors:** These factors include the human and plant activities that tend to reduce the quality of soil. Some bacteria and fungus overgrowth in an area and has the capacity to highly impact the microbial activity of the soil through bio-chemical reactions, which reduces crop yield and the suitability of soil productivity capacity.
- **Chemical Factors:** Reduction of soil nutrients because of alkalinity or acidity or water logging are categorized under the chemical components of soil degradation. In the broadest sense, it comprises alterations in the soil's chemical property that determine nutrient availability. It is mainly caused by salt buildup and leaching of nutrients which reduces the quality of soil by creating undesirable changes in the essential soil chemical ingredients.

Causes of Soil Degradation

The causes of degradation due to direct/indirect human interventions are:

- **Deforestation and Removal of Natural Vegetation:** Deforestation exposes soil minerals by removing trees and crop cover, which support the availability of humus and litter layers on the surface of the soil. Vegetation cover binds soil together, and when it is removed, it considerably affects the capabilities of the soil such as aeration, water holding capacity, and biological activity.

  Urbanization has major implications on the soil degradation process. It denudes the soil's vegetation cover, compacts soil during construction, and alters the drainage

pattern. It covers the soil with an impermeable layer of concrete that amplifies the amount of surface runoff which results in more erosion of the top soil. Again, most of the runoff and sediments from urban areas are extremely polluted with oil, fuel, and other chemicals. Increased runoff from urban areas also causes a huge disturbance to adjacent watersheds by changing the rate and volume of water and impoverishing them with chemically polluted sediment deposits.

- **Overgrazing:** Overgrazing destroys surface crop cover and breaks down soil particles, increasing the rates of soil erosion. As a result, soil quality and agricultural productivity are greatly affected.
- **Agriculture-related Activities:** Certain agricultural practices that are environmentally unsustainable are the single biggest contributor to the worldwide increase in soil quality decline. The tillage on agricultural lands is one of the main factors since it breaks up soil into finer particles, which increase erosion rates. Apart from this, mechanization of agriculture gives room for deep plowing, reduction of plant cover, and the formation of the hardpan exuberated decline in soil quality. Other improper cultivation activities such as farming on steep slope and mono-cropping, row-cropping and surface irrigation wear away the natural composition of the soil and its fertility, and prevent soil from regenerating.

  Most agricultural practices involving the use of fertilizers and pesticides often entail misuse or excessive application, thereby contributing to the killing of soil beneficial bacteria and other micro-organisms that help in soil formation. The complex forms of the fertilizer's chemicals are also responsible for denaturing essential soil minerals, giving rise to nutrient losses from the soil. Therefore, the misuse or excessive use of fertilizers increases the rate of soil degradation by destroying the soil's biological activity and builds up of toxicities through incorrect fertilizer use.
- **Industrial and Mining Activities:** Industrial activities release toxic effluents and material wastes into the atmosphere, land, rivers, and ground water that eventually pollute the soil and as such, it impacts on soil quality. Mining destroys crop cover and releases a myriad of toxic chemicals such as mercury into the soil, thereby poisoning it and rendering it unproductive for any other purpose. Altogether, industrial and mining activities degrade the soil's physical, chemical and biological properties.
- **Inappropriate Soil Management:** Unsuited to the location like tilling along the slope, lack of crop cover during heavy rainfall, etc. is responsible for accelerated soil erosion with consequent loss of land productivity. According to an estimate, more than 85 M ha of TGA is subjected to water and wind erosion. Because of different processes like slaking and dispersion, mechanisms of soil structural collapse and degradation vary climatically and from one soil type to another. Soil erosion by water is one of the most serious degradation in the Indian context.

  Soil degradation, therefore through the loss of topsoil is one of the major factors of low and unstable crop yields in rain-fed semiarid to sub-humid subtropics of India. Loss of productivity is further governed by types of soils. For instance, moderate water erosion in alluvium derived deep soils showed significantly less reduction in the soil productivity as compared to deep red and black soils.

Soil Erosion

The removal of the upper veneer of soil, which leads to the loss of fertility of the soil is referred as soil erosion. There is a natural balance between the rate at which the soil is

replenished and the rate at which it is being eroded. Any disturbance in this balance leads to a greater rate of removal of the soil cover. Soil erosion is essentially a problem created by man and also faced by man himself.

Extent of Soil Erosion in India

According to estimates, around one-fourth of the total area of India is affected by wind and water erosion; half of this area has undergone serious erosion.

- **Wind erosion** is a serious issue in arid and semi-arid areas of the country. Rajasthan and adjoining areas of Punjab, Haryana, Gujarat and Western Uttar Pradesh suffers from severe wind erosion. These areas receive scanty rainfall and are also devoid of vegetation cover.
- **Water erosion** is active in humid areas with plenty of rainfall. As per ICAR, the loss due to water erosion is in the tune of 53.34 million hectares annually. Ravines are widespread in the Chambal basin and are also found in Tamil Nadu and West Bengal.
- The flood plains of the Ganga and its tributaries suffer from soil erosion in Uttar Pradesh and Bihar especially. Gully erosion is intensively active in the Shiwalik range.
- The practice of shifting cultivation has caused immense soil erosion in tribal regions of Assam, Meghalaya, Nagaland, Tripura and Mizoram. Tribal areas of Madhya Pradesh, Chhattisgarh and Odisha are also affected.
- **Coastal erosion** is found all along the coastal areas of Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh and Odisha. This erosion is more pronounced in the season of monsoon and also during storms and cyclones.

Salinization and Alkalization

The expansion of irrigation has been one of the key strategies in achieving self-sufficiency in food production. The net irrigated area in India has increased from about 22 M ha in 1950 to about more than 51 M ha at present. In most of the expansion, the area is increased under canal irrigation that leads to rise in groundwater table resulting in the soil deterioration through accumulation of salts. However, with reclamation efforts, the area of 7 M ha soils suffering from salinization or alkalinization has decreased to 6 M ha. These soils contain excessive amount of either soluble salts or exchangeable sodium or both affecting crop yields and crop production.

The alkali soils in general are characterized by high soil pH (up to 10.8), high exchangeable sodium per cent (ESP) up to 90, low organic carbon, poor infiltration and poor fertility status. These soils are dominated by sodium carbonate and sodium bicarbonate salts. On the other hand, the saline soils have a higher electrical conductivity (> 4dS m-1), low ESP (< 15) and low pH (< 8.5). The dominant salts in saline soils include chlorides and sulphates of Na, Ca and Mg.

25% of the groundwater resources in the country are saline and brackish. Certain states like Rajasthan and Haryana are endowed with 84 and 62% of poor quality groundwater, respectively. Continued use of such waters for irrigation of agricultural crops is bound to increase the problem of salinity and sodicity in India.

Acidity

The largest areas covered by acid soils in India belong to laterites and various latosolic soils e. g. Ferruginous red soils, mixed red and black, or red and yellow soils. It is reported that about 6.98 M ha area is affected by acid soils; which is cultivated areas of rice-wheat cropping system in the Indo–Gangetic Plains.

Assessment of Degraded and Wastelands of India

It is estimated that out of 329 M ha total geographical area (TGA) of India, the area under agriculture is 179.9 M ha (60.47% of TGA) and 120.4 M ha area is degraded through one or more degradation types, which in turn, is affecting the country's productive resource base. It has been estimated that a total of more than 5000 tonnes of topsoil is being eroded every year. Of about 1600 m tonnes, representing 30% of the total eroded area, is permanently getting lost to the sea.

National Remote Sensing Centre (NRSC) prepared the wasteland Atlas of India highlighting the different forms of wastelands, their nature and extent. The earliest assessment of the area affected by the land degradation made by the National Commission on Agriculture was 148 M ha, followed by 175 M ha by the Ministry of Agriculture (Soil and Water Conservation Division).

The National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) projected an area of 187 M ha as degraded lands in 1994, and revised it to 147 M ha in 2004. The National Wasteland Development Board estimated an area of 123 M ha under wastelands.

Effects of Soil Degradation

Land Degradation

One of the main causes of soil quality decline is land degradation and is considered to be responsible for 84% of the ever diminishing acreage. Huge acres of land are lost year after year, due to soil erosion, contamination and pollution. About 40% of the world's agricultural land has severely diminished in quality because of erosion and the use of chemical fertilizers, which prevent land from regenerating.

Increased Flooding

Soil degradation takes away the soil's natural capability of holding water and thus it contributes to more and more cases of flooding.

Pollution and Clogging of Waterways

Most of the soil eroded from the land together with the chemical fertilizers and pesticides utilized in agricultural fields is discharged into waterways and streams. With time, the sedimentation process can clog waterways, resulting in water scarcity. The agricultural fertilizers and pesticides also damage marine and freshwater ecosystems and limits the domestic uses of the water for the populations that depend on them for survival.

Drought and Aridity

The contributing factors to soil quality decline such as overgrazing, poor tillage methods, and deforestation are among the leading causes of desertification characterized by droughts and arid conditions. In the same context, soil degradation may also bring about loss of biodiversity. Drought and aridity are problems highly influenced and amplified by soil degradation.

Solutions to Soil Degradation

Reducing Deforestation

Avoiding deforestation completely is an uphill task. However, deforestation can be cut down and this can create an impressive way of reshaping and restoring forests and