



India: Soil Types, Problems & Conservation

Dr. Supriya

Assistant Professor (Guest)

Department of Geography

Patna University, Patna



Alluvial Soil



Laterite Soil



Red Soil



Black Soil

CONTENTS



- **Introduction**
- **Classification of Soils**
- **Major Soil Groups of India**
 - 1. Alluvial Soils
 - 2. Black Soils
 - 3. Red Soil
 - 4. Laterite soil:
 - 5. Desert soil:
 - 6. Mountain soil
 - 7. Alkaline and Saline Soils
 - 8. Peaty Soils
- **Problems of Indian soils**
- **Effect of soil erosion**
- **Soil Conservation**
- **Methods of Soil Conservation**
- **Model questions**
- **References**

Introduction



- Soil is the uppermost part of the Earth's crust. It is formed due to the weathering of rock under the influence of climate, vegetation, relief and parent rock.
- India is a country of vast dimensions with varied conditions of geology, relief, climate and vegetation. Therefore, India has a large variety of soil groups, distinctly different from one another. Different criteria have been applied to classify Indian soils:-geology, relief, fertility, chemical composition and physical structure, etc. The formation of the soil in a particular climate is so perfect that each climate type and its own soil
- Soil ingredients: Soil being an important natural resources has many factors affecting its formation and they are:
 - a) **The parent rocks or material** whose break down gives regolith.
 - b) **Topography** particularly the slope aspects i.e., whether it is steep, gentle or undulating as this will determine whether the soil is going to be thick or thin, whether prone to erosion etc
 - c) **Climate** being one of the most important factor acts through moisture, temperature and wind conditions
 - d) The type of **vegetation** found in the particular region has over-whelming responsibility for the coloration and the structure of the soil.

Classification of soil



- Any classification based on any one of the aforesaid criteria has its own inherent drawback. Even the most competent pedologist would find it difficult to present an accurate, complete, comprehensive and generalised account of the Indian soils.
- During the 'British rule in India, a vast body of fascinating accounts had emerged in district gazetteers and official reports. These accounts were generally directed towards the assessment of differential soil fertility and land revenue collection, but did not attempt classification of soil types in the country.
- In 1957, The National Atlas Organisation (Kolkata) published a soil map of India in which Indian soils were classified into 6 major groups and 11 broad types.
- Geologically, Indian soils can broadly be divided into two main types: (a) Soils of peninsular India and (b) Soils of extra-peninsular India.
- The soils of Peninsular India are those which have been formed by the decomposition of rocks in situ, i.e. directly from the underlying rocks. They are transported and redeposited to a limited extent and are known as sedentary soils.
- On the other hand, the soils of the Extra-Peninsula are formed due to the depositional work of rivers and wind. They are mainly found in the river valleys and deltas. They are very deep and constitute some of the most fertile tracts of the country. They are often referred to as transported or azonal soils.



Classification of soil....

➡ The Irrigation Atlas of India (1972) and Spate's India, Pakistan and Ceylon (1976) utilised the 7th approximation soil classification developed by the U.S. Department of Agriculture (USDA).

➡ The 7th approximation defines soil classes strictly in terms of their morphology and composition as produced by a set of natural and human forces. The classification is determined by quantifiable criteria. Inceptisols, Vertisols, Alfisols, Oxisols, Histosols, Ultisols, Podisols, mollisols, Entisols, Aridisols And Spodosols.

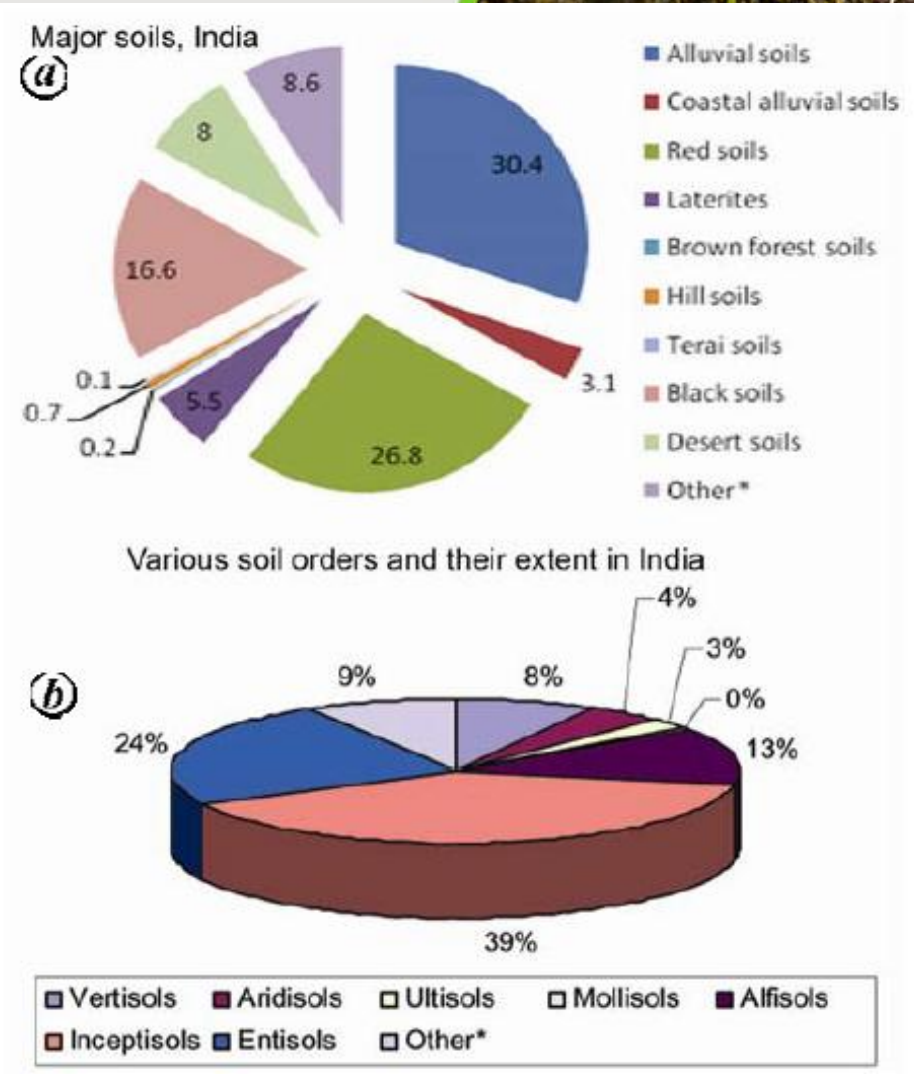
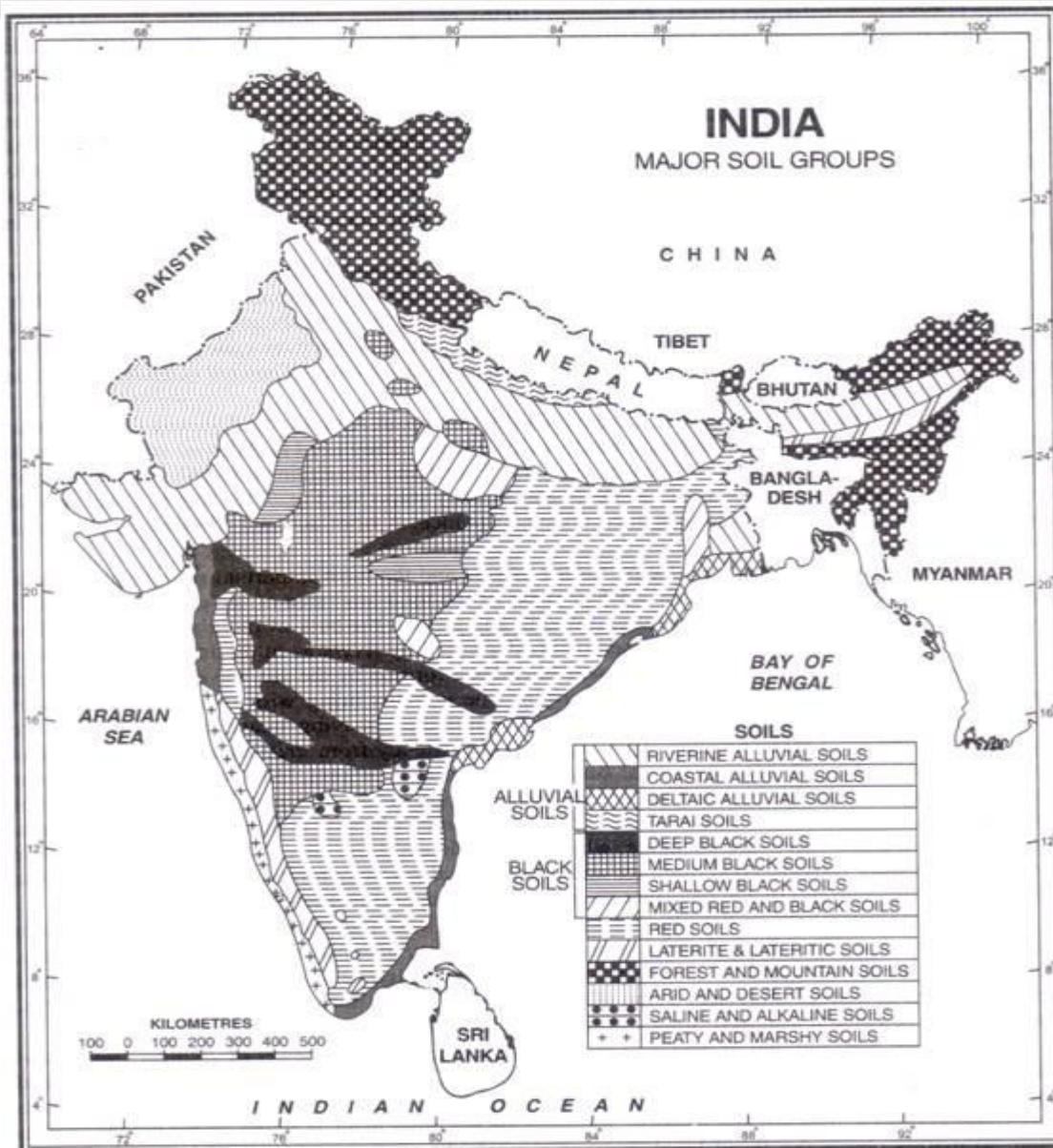


Figure 1. a, Major soils of India (values in per cent); b, Various soil orders and their extent in India.

Major Soil Groups of India



➤ The Indian Council of Agricultural Research (ICAR) set up an All India Soil Survey Committee in 1963 which divided the Indian soils into eight major groups. Later on ICAR divided India into the following Groups:

- (1) Alluvial soils,
- (2) Black soils,
- (3) Red soils,
- (4) Laterite and Lateritic soils,
- (5) Forest and Mountain soils,
- (6) Arid and Desert soils,
- (7) Saline and Alkaline soils and
- (8) Peaty and Marshy soils

➤ This is a very logical classification of Indian soils and has gained wide acceptance.

1. Alluvial Soils

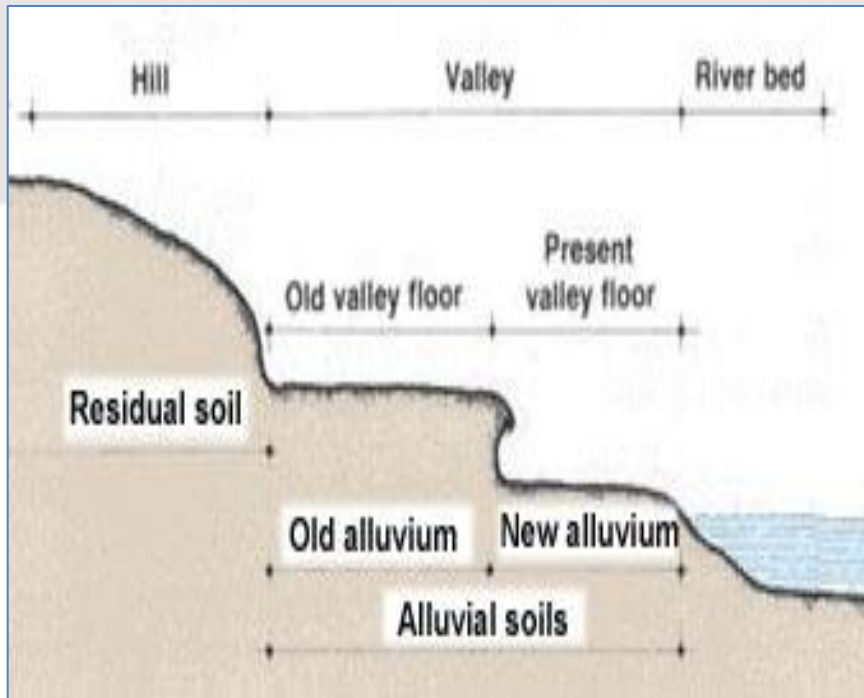


- ▶ Alluvial soils are by far the largest and the most important soil group of India. Covering about 15 lakh sq km or about 45.6 per cent of the total land area of the country. These soils contribute the largest share of our agricultural wealth and support the bulk of India's population.
- ▶ Being one of the most important and fertile soils of India they support growth of wide variety of crops such as Rice, wheat, sugarcane, cotton, jute, potato and vegetables, but they are deficient in nitrogen, phosphorous and Humus.
- ▶ Alluvium are finer particles of rock materials carried in suspension and later deposited by the river in its bed and bank. The soils which is composed of alluvium is called alluvial soil.
- ▶ Most of the alluvial soils are derived from the sediments deposited by rivers as in the Indo-Gangetic plain although some alluvial soils in the coastal areas have been formed by the sea waves. Thus the parent material of these soils is all of transported origin.
- ▶ The flood plains of Satluj-Ganga and Bhrahmaputra from Punjab to Assam, the valleys and plains of river Narmada, Tapti, Mahanadi, Godhavari, Krishna and Cauvery covering about 23.40% of the total soil cover in India.

Occurrence & Types of Alluvial Soil



- The widest occurrence of the alluvial soils is in the Great Indo-Gangetic Plain starting from Punjab in the west to West Bengal and Assam in the east.
- They also occur in deltas of the Mahanadi, the Godavari, the Krishna and the Cauvery, where they are called ***Deltaic alluvium***.
- Along the coast they are known as ***Coastal alluvium***. Some alluvial soils are found in the Narmada and Tapi valleys. Northern parts of Gujarat also have some cover of alluvial soils.
- Geologically, the alluvium of the Great plain of India is divided into newer or younger ***Khadar*** and older ***bhangar*** soils.
- ***The Khadar*** soils are found in the *low areas* of valley bottom which are flooded almost every year. They are ***pale brown, sandy clays and loams***, ***more dry*** and ***leached, less calcareous*** and ***carbonaceous*** i.e. They are **less kankary**.
- ***The Bhangar***, on the other hand, is found on the higher reaches about 30 metres above the flood level. It is of a **more clayey** composition, generally ***dark coloured***. A few metres below the surface of the bhangar are beds of ***lime nodules*** known as ***kankar***



➡ Along the *Shiwalik foothills*, there are *alluvial fans* having *coarse*, often *pebbly soils*. This zone is called *bhabar*. To the south of the bhabar is a long narrow strip of *swampy lowland* with *silty soils*. It covers an area of 56,600 sq km and is called *tarai*.

➡ The *tarai soils* are rich in *nitrogen* and *organic matter* but are deficient in phosphate. These soils are generally covered by tall grasses and forests but are suitable for a number of crops such as wheat, rice, sugarcane, jute and soyabean under reclaimed conditions.

2. Black Soils



- The **Black soil** are so called because of their black colouration and derived from the Basalt rock under semi-arid conditions. It is also known as '**Regur**' (from the Telugu word Reguda) or black cotton soil as it is best suited for cotton cultivation.
- In India black soil are largely found over **Deccan trap** region of the states of Maharashtra, Madhya Pradesh, parts of Andhra Pradesh, Northern part of Karnataka, Gujarat, parts of Tamil Nadu and Rajasthan.
- Several theories have been put forward regarding the origin of this group of soils but most pedologists believe that these soils have been formed due to the solidification of lava spread over large areas during volcanic activity in the Deccan Plateau, in Triassic Period.
- Most of the black soils are derived from two types of parental rocks, the Deccan and the Rajmahal trap, and ferruginous gneisses and schists occurring in Tamil Nadu. The former are sufficiently deep while the later are generally shallow.
- Krebs holds that the regur is essentially a mature soil which has been produced by relief and climate, rather than by a particular type of rock. According to him, this soil occurs where the annual rainfall is between 50 to 80 cm and the number of rainy days range from 30 to 50. The occurrence of this soil in the west deccan where the rainfall is about 100 cm and the number of rainy days more than 50, is considered by him to be an exception.

2. Black Soils.....



- ▶ In some parts of Gujarat and Tamil Nadu, the origin of black cotton soils is ascribed to old lagoons in which the rivers deposited the materials brought down from the interior of Peninsula covered with lava.
- ▶ Geographically, black soils are spread over 5.46 lakh sq km (i.e. 16.6 per cent of the total geographical area of the country) encompassed between 15°N to 25°N latitudes and 72°E to 82°E longitudes. This is the region of high temperature and low rainfall. It is, therefore, a soil group of the dry and hot regions of the Peninsula. These soils are mainly found in Maharashtra, Madhya Pradesh, parts of Karnataka, Andhra Pradesh, Gujarat and Tamil Nadu.
- ▶ The black colour of these soils has been attributed by some scientists to the presence of a small proportion of titaniferous magnetite or even to iron and black constituents of the parent rock. The black colour of this soil may even be derived from crystalline schists and basic gneisses such as in Tamil Nadu and parts of Andhra Pradesh. Various tints of the black colour such as deep black, medium black, shallow black or even a mixture of red and black may be found in this group of soils.
- ▶ The black soil is very retentive of moisture. It swells greatly and becomes sticky when wet in rainy season. Under such conditions, it is almost impossible to work on such soil because the plough gets stuck in the mud.
- ▶ However, in the hot dry season, the moisture evaporates, the soil shrinks and is seamed with broad and deep cracks, often 10 to 15 cm wide and upto a metre deep. This permits oxygenation of the soil to sufficient depths and the soil has extraordinary fertility.

2. Black Soils.....



- Remarkably “self-ploughed” by loosened particles fallen from the ground into the cracks, the soil “swallows” itself and retains soil moisture. This soil has been used for growing a variety of crops for centuries without adding fertilizers and manures, or even fallowing with little or no evidence of exhaustion.
- A typical black soil is highly argillaceous with a large clay factor, 62 per cent or more, without gravel or coarse sand. It also contains 10 per cent of alumina, 9-10 per cent of iron oxide and 6-8 percent of lime and magnesium carbonates. Potash is variable (less than 0.5 per cent) and phosphates, nitrogen and humus are low. The structure is cloddy but occasionally friable.
- In all regur soils in general, and in those derived from ferromagnesian schists in particular, there is a layer rich in kankar nodules formed by segregation of calcium carbonate at lower depths. As a general rule, black soils of uplands are of low fertility but they are darker, deeper and richer in the valleys.
- Because of their high fertility and retentivity of moisture, the black soils are widely used for producing several important crops. Some of the major crops grown on the black soils are cotton, wheat, jowar, linseed, Virginia tobacco, castor, sunflower and millets. Rice and sugarcane are equally important where irrigation facilities are available. Large varieties of vegetables and fruits are also successfully grown on the black soils.

3. Red Soil



- ➡ These are generally reddish to brownish in color obtained from weathering of granites, gneisses, and crystalline rocks and grade from poor, thin and light colored soils on the uplands to that of fertile deep dark color soils of plains and valley.
- ➡ Red soils in India occupying 29.08% of the total soil cover of India extending extensively over parts of Tamil Nadu, Southern Karnataka, South-East Maharashtra, parts of Madhya Pradesh, Goa, Kerala, Orissa, Bihar, West Bengal, Uttar Pradesh, Eastern Parts of Rajasthan, Assam, Manipur, Tripura, Meghalaya and Nagaland.
- ➡ These soils are ideal for cultivation of Ragi, Ground-nuts, millets, Tobacco and potato. They are rich in Iron, containing small amount of Humus as they about retain moisture and are slightly acidic with poor quantity of phosphorous, nitrogen and organic contents. Though they can be used for variety of crop cultivation provided the fields are having good irrigation facilities.
- ➡ Red to yellow in color due to coatings of ferric oxides on the soil particles. Texture of these soils is highly variable from loam to clayey loam texture. They are poor in nitrogen, phosphorous and humus there by soil depth varies from shallow to very deep in nature.

4. Laterite soil



- ▶ Laterite is a formation that is only found in tropical countries like India with alternative wet and dry climatic conditions. The heavy rainfall conditions and high temperature makes the soil rich in oxides of Iron and Aluminum depleting in completely from Silica. The remnants of such oxides are known as laterites which are characterized by compact to vesicular structure occupying 4.30% of India's soil cover.
- ▶ They are mainly found on the summits of Western Ghats and Eastern Ghats along with Vindhyas and Satpura's found in States of Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Assam and Tamil Nadu.
- ▶ Since they are very poor in calcium and magnesium and are well drained and porous. They are useful for both rice cultivation as well as plantation crops like cashew, rubber, tea and coffee.
- ▶ They are acidic in elevated areas and poor in retaining moisture but essentially heavy loam to clayey on the plains.

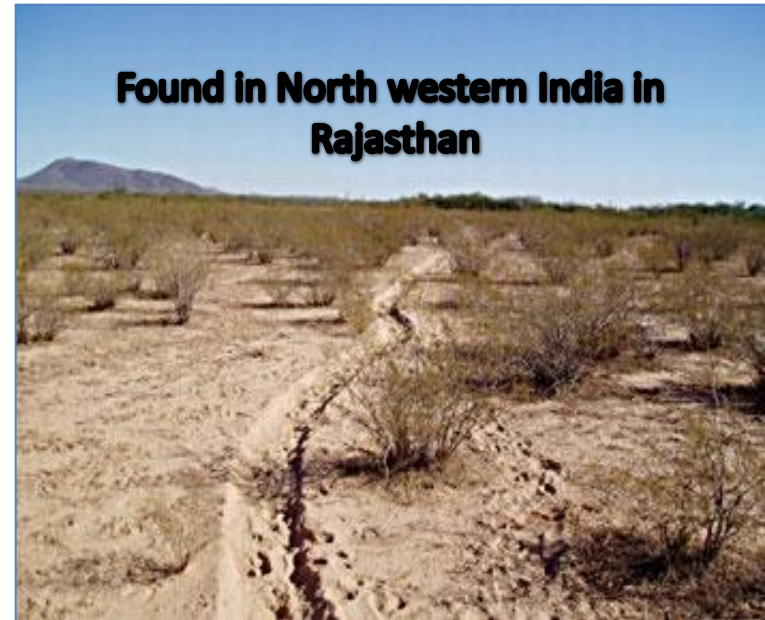
5. Desert soil



➡ The *arid* and the *desert* soil are found in semi-arid and arid conditional regions of India, namely the western Rajasthan, the Southern Haryana, and South-West Punjab. These are areas lying between Indus river and the Aravali-hill covering an area of about **29 million Hectares** i.e., **1.42 lakh Sq Km**.

➡ These soils contain soluble salts whose concentration is just below the toxic level as they are poor in nitrogen, Humus, and quite rich in phosphates and nitrates, thereby not suitable for many crops except for few that grow with the help of irrigation.

➡ They are found sandy to loamy, pale brown to yellowish brown in color. Structure less to sub-angular blocky in structure, poor in nutrient and water holding capacity therefore moisture is deficient making the pH of the soil, vary from 7.2 -9.2 under generally high in salt content but not in toxic amounts.



Found in North western India in Rajasthan

6. Mountain soil



- ▶ Soils which are found all along the slopes of mountains and hills are termed as mountain soils.
- ▶ They are found from decomposition of organic matter from the forest. The characteristics of these soils differ from region to region depending on climates, vegetation and topography which contribute to the development of soil profile.
- ▶ They are dark brown in color with clayey silt to loamy texture and slightly acidic to moderate acidic in nature as they are rich in humus.
- ▶ Being the most fertile soil they are useful for the growth of plantation crops such as tea, coffee, spices and tropical fruits.
- ▶ In India they are largely seen in Jammu & Kashmir, Himachal Pradesh, Manipur, Western Ghats in Karnataka, Kerala and Tamil Nadu covering a total area of 2.85 lakh Sq Km.

7. Alkaline and Saline Soils



- ▶ These soils are seen in Saline, arid and Semi-arid parts of Rajasthan, Punjab, Uttar Pradesh, Haryana, Gujarat and Maharashtra.
- ▶ These soils are infertile, and uncultivable generally grading in texture from sandy to loamy sand with deficiency in nitrogen and highly pervious there by having low water retain capacity.
- ▶ They are estimated to occupy 7 million hectares in India of which 50% is in Indo-Gangetic alluvial plain 30% among black cotton soils and the rest 20% in arid and coastal regions of India.
- ▶ Saline and alkaline soils: Moderate to strongly acidic in nature with high organic matter but deficient in phosphorous.

8. Peaty Soils



➡ These types of soils occur in hot humid conditions as a result of large amount of organic matter getting accumulated, essentially they are black, heavy and highly acidic with large amount of soluble salts. These types of soils are mainly found in Orissa, the Sunderbans in West Bengal, parts of Bihar, Uttar Pradesh and Kottayam, Alleppey, districts of Kerala.

➡ They are dark almost black in color with abundant organic matter. Fine in texture with moderate accumulation of ferrous and aluminum sulphates resulting in pH below 3.5 or 4 there by strongly acidic. This is due to decomposition of organic matter under anaerobic conditions.

Problems of Indian soils



Table: Types of Degraded Land

Categories of Degraded land	Area in million hectare
Gullied lands	2.05
Land with/ Without scrub	19.40
Water logged and marshy lands	1.66
Land affected with salinity & alkalinity	2.05
Shifting cultivation area	3.51
Under utilised/ degraded forest	14.06
Degraded pastures and grazing lands	2.60
Degraded land under plantation crops	0.58
Sand (Inland/coastal)	5.00
Mining/ Industrial wasteland	0.12
Barren rock / strong waste sheet rock area	6.42
Steep sloping area	0.77
Snow covered glaciated area	5.58
Total degraded land	63.84

➡ **Degradation** of the soil is the most problematic problem of the India soil. Here, degradation refers to variety of factors which leads to loss in the quality of the soil which includes **lateritisation, alkalization and Salinization** of the soil along with **soil erosion** i.e., loss of top soil.

➡ The process of Soil degradation is the result of **natural forces** and **human activities**.

➡ The **torrential rains, flowing rivers, glaciers, wind** etc are the natural agents for soil erosion leading to the soil becoming useless for cultivation.

➡ Their main causes of soil erosion are **deforestation, over-grazing, shifting cultivation, faulty methods of cultivation, rivers and removal of top soil for industrial purposes**.

Effect of soil erosion



- ▶ According to one estimate about 180 Million hectare (60 % of total area of the country) is adversely affected through the soil erosion
- ▶ The adverse effect of soil erosion in India agriculture where in 45.7 million hectares of land is facing this effect.
- ▶ This renders vast area of cultivable land useless as their fertility is reduced due to erosion by rivers causing rapid run-off change in the course of rivers and floods, with rapid decrease in quantity of ground water percolation.
- ▶ They problem of soil erosion is common on the steeper slopes with heavy rainfall in states such as Assam, Meghalaya, Manipur, Tripura, Mizoram and the Western Ghats .
- ▶ It also occurs in parts of Maharashtra, Madhya Pradesh, Karnataka , Tamil Nadu, and Andhra Pradesh.
- ▶ The government of India has taken measures to prevent soil erosion via setting a central soil conservation board to study and solve the problems.

Soil Conservation



➡ The protection of soil from erosion and deterioration along with its management is called soil conservation.

➡ All such measures can be divided into 2 types:

- 1) Biological measure and
- 2) Mechanical measures

1) Biological measures: *Contour farming, mulching, dense growing crops, strip cropping, afforestation and reforestation* along with *control grazing* are some of the biological measures.

➡ **Contour farming** involves practice of forming across the slopes in the hills reducing surface run-off thus conserving soil and moisture thus increasing crop-yield. **Mulching** on the other hand is spreading of materials like straw leaves, paddy husk, grass, over the soil surface to prevent erosion and evaporation.

➡ **Dense growing crops** involves method of providing cover for cultivated crops by growing legumes.

➡ **Strip cropping** is cultivation of crop in alternate strips which is very effective in controlling run-off and thus erosion.

➡ **Afforestation** and **reforestation** is a method of planting a new forest in areas where previously trees did not exist or where destroyed. Both help in checking soil erosion all along the hill slopes in and around the water bodies and base lands.

➡ **Control grazing** is a method by where in proper control on excessive grazing is maintained to prevent soil erosion.

Soil Conservation



2) Mechanical Measures: It includes *basin listing*, *sub-soil contour bunding*, *channel trenching*, *bench terracing* and *gully control*.

➡ **Basin listing** consist of making small interrupted basins along contours which helps in collecting and retaining rain water.

➡ **Sub soil** is another method in which hard impermeable sub soil is broken in order to allow more rain water thus improving the physical condition of the soil.

➡ **Contour bunding** consists of building narrow embankments at regular intervals across the slopes to prevent rapid flow of water.

➡ **Channel trenching** is a method in which series of deep pits are dug across the slopes at suitable distances. Bench terracing involves a series of platforms which run across the contour thus retaining water and controlling soil erosion.

➡ **Gully control** on the other hand is a method use to prevent erosion by using gully plugs such as boulders, sand bags, and plant hedges as materials to control soil erosion.

Soil management:

➡ The method of improving soil fertility and productive capacity of the soil termed as soil management.

➡ There are several measures such as judicious use of manure and fertilizers, rotation of crops, cultivation of leguminous crops for certain periods of time.

➡ However the more essential step for soil management involves educating and motivating farmers regarding the importance, suitability of soil for a particular crops and its conservation

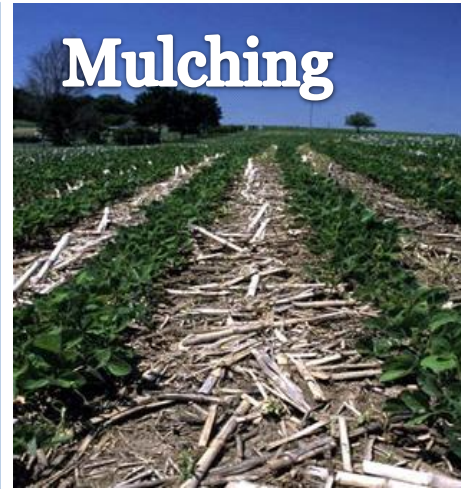
Methods of Soil Conservation



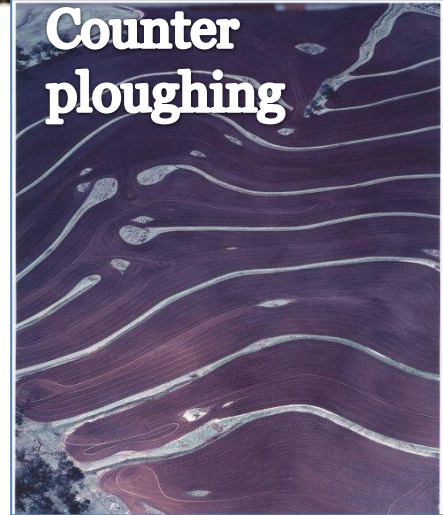
Strip cropping



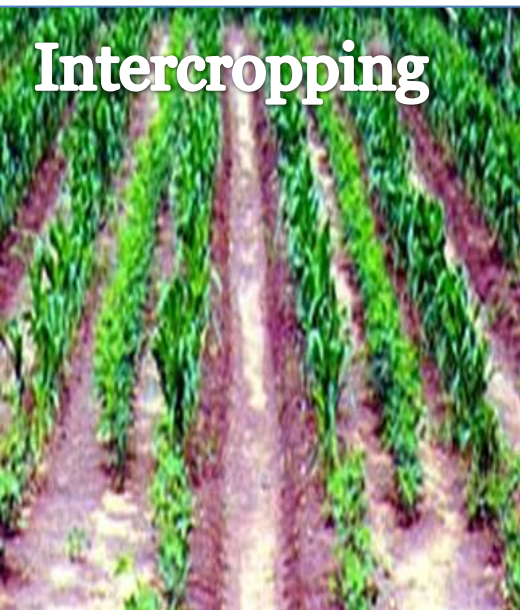
Terrace farming



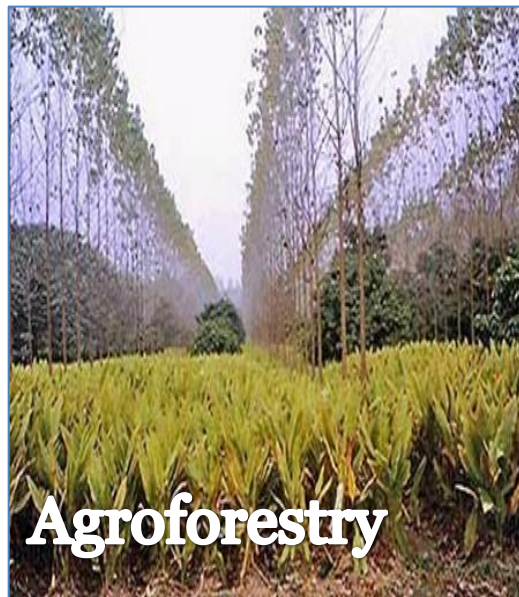
Mulching



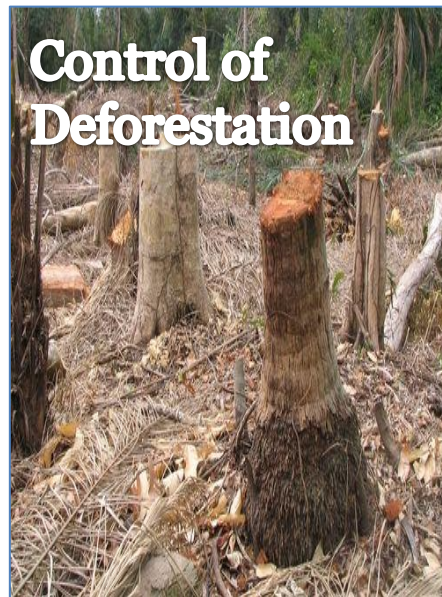
Counter ploughing



Intercropping



Agroforestry



Control of Deforestation



Afforestation

Model questions



- Q1. Examine the classifications of soil in India & discuss major soil groups of India. (long type)
- Q2. What is soil degradation? Discuss the causes and impact of soil degradation and soil conservation methods in India?
- Q3. Represent the Major Soil Groups on the given Map of India:
- Q4. Write short notes on them:
- Black Cotton soil
 - Soil Degradation & Soil Erosion in India
 - Methods of soil conservation
 - Multi cropping & Intercropping
 - Aforestation & Deforestations
 - Strip cropping & Counter Ploughing



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Contact me:

Mob: 9006640841

Emai:supriyavatsa52256@gmail.com

Webpage: <http://bhuvankosh.com>