

Soils of India: Classification and Characteristics and improvement using natural farming techniques in areas with compacted soils

Ashish Kumar Nagar

Department of Extension Education, Sourabh agriculture College Kheda

Corresponding Author: nagarashish09@gmail.com

The soils of India are diverse and have led to a rich mosaic of agricultural practices, with different crops and cropping systems suited to specific soil and climatic conditions. Soil management and conservation practices are crucial for sustaining agricultural productivity and food security in the country. Currently, in India, the most prevalent soil type is alluvial soil, covering a large portion of the northern plains and river valleys, considered highly fertile and rich in humus, potash, and organic matter; however, a significant portion of Indian soil is also facing degradation issues like salinity, erosion, and nutrient depletion, with "laterite" soil in high rainfall areas being particularly infertile due to leaching of nutrients; other major soil types include black soil (regur) in the Deccan Plateau, red soil in low rainfall regions, and desert soil in arid areas.

Key points about Indian soil conditions

- **Dominant soil:** Alluvial soil, found widely in the northern plains and river valleys, considered very fertile due to its high content of humus, potash, and organic matter.
- **Black soil (Regur):** Primarily found in the Deccan Plateau, known for its high moisture retention capacity and suitable for crops like cotton, sugarcane, and wheat.
- **Red soil:** Present in low rainfall areas, characterized by its red colour due to iron oxide, often deficient in nutrients like lime, phosphate, and nitrogen.
- **Laterite soil:** Found in regions with high rainfall and temperature, prone to nutrient leaching, leaving the soil infertile and rich in iron.
- **Saline and Alkaline soil:** Occurs in areas like the Rann of Kutch and western Uttar Pradesh, often due to improper agricultural practices.
- **Soil degradation issues:** A significant portion of Indian soil is affected by erosion, salinity, and nutrient depletion, impacting agricultural productivity.

soil nutrients conditions at present in India

Currently, Indian soils are largely deficient in essential nutrients, particularly nitrogen, phosphorus, and potassium, with widespread micronutrient deficiencies in elements like zinc, boron, iron, and sulfur, affecting a significant portion of the country's agricultural land; most soil samples show a lack of organic carbon, indicating a generally poor soil health across India. More than 50 million soil samples from across India were tested during 2015-16 to 2018-19 in the government-approved laboratories to understand the state of the country's soils. The State of Biofertilizers and Organic Fertilizers in India flagged poor status of soil health and increasing consumption of chemical fertilizers in India. About 85 per cent of the samples were found to be deficient in organic carbon; 97 per cent samples were deficient in available nitrogen; 83 per cent were deficient in phosphorus; and 71 per cent in potassium, showed the State of Biofertilizers and Organic Fertilizers in India. Soils were deficient in micronutrients as well: About 47 per cent, 39 per cent, 37 per cent and 36 per cent soil samples were deficient in boron, zinc, iron and sulphur respectively. Organic carbon deficiency is widespread across the country. At least half of the soil samples in 24 states and Union territories were deficient in organic carbon. Of them, seven states have more than 90 per cent deficient samples. Haryana's soils are the most deficient in organic carbon, followed by those of Punjab, Uttar Pradesh, Rajasthan, Tamil Nadu, Mizoram and Andaman and Nicobar Islands, in that order.



Soil health and nutrient management: The way forward

As farm yields reduce, and cost of inputs keep rising, farmers are realizing the importance of improved soil health and nutrient management on their fields.

Balanced and integrated use of fertilizers and micronutrients: All essential nutrients need to be applied in optimum quantities and in planned methods that are dependent on soil, crop, and climatic conditions. Timing and a judicious mix of nutrients will meet crop demands and will prevent excesses. Over-fertilizing of crops increases pest issues. Excess of nitrogen levels in plants can decrease resistance to pests, and result in crop damage.

Reduction in inversion tilling: Excess tilling is detrimental to soil health. Tilling tends to decompose organic matter, and disturb the soil aggregates, leading to reduction in soil health, increase in erosion, and reduced productivity. Tilling would only be required in order to increase organic input via residual crops or manure. Reduction in tillage may appear to be cumbersome and dependent on the individual field's status; however, the benefits to the farmer are significant in the long run.

Reduction in synthetic pesticides/insecticides and promoting beneficial organisms: Indiscriminate use of synthetic pesticides and insecticides has adversely affected the environment and agricultural production. Harmful chemicals have found their way into the food chain and water table. Pesticide residue pollutes soil, groundwater and surface water, and affects livestock, crops, and humans. Use of agro-chemicals has been particularly rampant in commercial farming, as the damage to standing crops from pests is a continuing problem. Relying on pest-resilient plant varieties, crop rotation, biodegradable pesticides, and environment-friendly pesticides is the way forward. Newer concepts such as farm scaping could control the problem of pests through beneficial organisms and lead to a reduction in use of synthetic pesticides.

Preserving soil moisture: Water shortages due to shrinkage in groundwater availability is a major issue affecting soil health especially in monsoon dependent arid regions of north India. Crops are starved or stressed for water due to low rainfall, high

temperatures, and inconsistent or poor irrigation. Methods or systems that promote moisture guard against droughts and have a cyclical effect on soil health and fertility. Techniques such as strip tillage, no tillage, mulching, cover cropping, contouring, etc., have been shown to increase moisture retention in soil.

PM-PRANAM

Approved by the Cabinet Committee on Economic Affairs (CCEA) on June 28, 2023, the draft guidelines for the Scheme were provided to us by Department of Fertilisers on December 17, 2024 in response to an RTI application filed on December 9, 2024. Objectives of the scheme are (i). encouraging balanced and sustainable chemical fertiliser use, (ii). promoting uptake of alternate fertilisers (such as Fermented Organic Manure (FOM), liquid FOM, Phosphate Rich Organic Manure (PROM) and urea gold), (iii). advancing natural and organic farming practices and (iv). furthering natural resources conservation technologies.

The scheme aims to achieve these by incentivising States/Union Territories achieving reduction in chemical fertiliser consumption by rewarding them with a grant based on savings in fertiliser subsidy. As NK Lenka, Principal Scientist, Indian Institute of Soil Science opines, "PM-PRANAM is a well-thought program of the government with vision for positive impact on soil health and environment conservation." Fifty per cent of fertiliser subsidy saved by a State/UT through reduced fertiliser consumption, as compared to previous three years' average consumption would be provided to them as a grant of the total grant calculated, 95 per cent would be allocated to the state with the remaining five per cent being used by the Centre (through DoF) for monitoring, capacity building and research. At the state level, 65 per cent of the total grant allocated can be utilised for capital expenditure projects and the remaining 30 per cent for awareness activities focusing on significance of soil health, sustainable farming methods and balanced use of fertilisers. The subsidy savings would be calculated based on the data entered into the Integrated Fertiliser Management System (iFMS) portal coupled with the subsidy rates determined by the DoF for that particular assessment year.
