

Soil of Orissa and Its Management

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The State of Orissa covering geographical area of 15.57 million ha. lies in the tropical belt in the eastern regions of India between 17° 47'-22° 33' N latitude and 81° 31'-87° 30' E longitudes. The climate is characterized by high temperature and medium rainfall. The average annual rainfall of the State is 1500mm and the mean annual temperature is 26.2°C. The mean summer and winter temperatures are 30.3°C and 21.3°C respectively.

The physiographic classifications of the State are (1) The Northern Plateau, (2) Central Table land, (3) Eastern Ghat, and (4) Coastal plain. Integrating the effect of land-form, topography, climate, soil and crop adaptability, the state has been divided into ten (10) agro-climatic zones. The soils of Orissa have been divided into 8 broad soil groups. Taxonomically these 8 broad groups of soil come under 4 orders, 10 suborders and 18 great groups.

Each soil group is associated with specific characters and problems posing constraints for higher agriculture production. These characters have been identified and special attentions are made to increase the productivity. The characters of each soil along with their management practices are discussed below.

1. Red Soil (Haplustalfs, Rhodustalfs, Ustorthents)

Red soil covers about 7.14m. ha of lands and being the highest coverage of all soil groups of the state, extend to the districts of Koraput, Rayagada, Nawrangpur, Malkanagiri, Keonjhar, Ganjam, Kalahandi, Nuapada, Bolangir, Dhenkanal and Mayurbhanj. Presence of excess amounts of oxides of iron imparts red colours to the soil. The soils of the former four districts are heavier in texture and the rest of the districts have light textured soil. The soils have angular or sub angular blocky structure. The clay fraction of these soils is dominated by kaolinites and illites.

The soils are strongly to moderately acidic with low to medium organic matter status and poor water retentive capacity. These soils are deficient in nitrogen and phosphorus. Micronutrients like boron and molybdenum are highly deficient in these soils. These soils have low cation exchange capacity with high phosphate and sulphur absorption property and deficient in calcium and magnesium. Water soluble phosphates get fixed and become non available to crop plants. Applications of in-soluble phosphates two weeks before sowing seeds or mixed application of insoluble rock phosphates and single super phosphate at equal proportion (1:1) makes the best utilization of phosphate. Soil acidity is

corrected by application of lime. Application of 1 to 2 t/ha of papermill sludge corrects soil acidity. Winter vegetables and groundnut crops need application of 10 to 15 kg. borax/ha. Seed treatment with sodium molybdate at 10g/25 kg seeds corrects molybdenum deficiency in pulses and groundnut crops. Application of phosphogypsum at 200 kg/ha meets the sulphur demand of oil seed crops. Crops like rice, finger millet, minor millets, niger, potato, brinjal and fruit trees such as mango, jack fruit, guava, papaya and sapota are grown successfully in these soils.

2. Mixed red and Yellow Soil :- (Haplustalfs, Paleustalfs, Ustochrepts).

These soils occupy 5.5m ha of lands being the second highest in area. These soils occur in the district of Sambalpur, Bargarh, Deogarh, and Sundargarh. Mixed red and yellow soils occur as a catenary associations in undulating and rolling terrains which differ in depth, texture, and colour. The soils are moderately shallow in depth and coarse-textured. The upland soils are more shallower and lighter in texture than the low land soils. Presence of ferruginous concretions and fluctuation of water table imparts the mixed red and yellow colour to the soil. The upland soils are moderately acidic whereas, low land soils are slightly acidic. The low land soils are formed mainly by colluvial deposits.

The upland soils are low in nitrogen and phosphorous whereas, the low land soils are medium in phosphate and high in potassium. Upland light textured soils are deficient in boron and lowland soils with rice-rice cropping system under Hirakud command area are deficient in zinc. Soil acidity can be corrected through liming.

The upland soils are suitable for crops like rice, finger millet sugarcane, potato, brinjal, tomato and pointed guard. The low and soils are suitable for paddy following pulse as pyra crops.

Fruit trees like mango, guava and banana grow well in these soils.

3. Black Soil : (Chromusterts, Us-torthents)

There are no regular occurrence of black soils in the state. These soils occur sporadically in the districts of Puri, Ganjam, Malkangiri, Kalahandi, Nuapada, Bolangir, Sonepur, Boudh, Sambalpur, Bargarh and Angul covering an area of 0.96 m. ha. of lands. The black colour of the soil is due to presence of titaniferous magnetite, humins, bitumins etc. These soils are formed due to weathering of basic rocks in the low lying areas.

These soils are heavier in texture having clay content more than 30 percent. Clay minerals are dominated with smectites for which deep cracks are observed during summer. The effective soil depth extends to more than 90 cm. The soils swell on wetting holding maximum amount of moisture. Permeability of these soils is slow which result in severe surface soil erosion.

The soil pH is neutral to alkaline having free calcium carbonate nodules in the profile. The soil is rich in calcium but deficient in phosphorus, potassium, zinc and boron. Upland rice suffers from iron deficiency. Groundnut, mustard and safflower are found to respond to application of sulphur. Ammonia volatilization is higher in paddy fields.

Soil moisture stress conditions set early under drought. Either at low or high moisture conditions the soil could not be ploughed. Management of these soils is difficult. Tillage operations should be completed at right moisture consistency. Green manuring and application of bulky organic manures help in increasing water infiltration rates. Recycling of rice straw improves the aggregability of these soils. The soil is suitable for growing rice, jowar, bajra, maize, Bengal gram, safflower, mustard and cotton.

4. Laterite Soil : (Haplustalfs, Plinthustalfs, Ochraqualfs)

Lateritic soils occupy 0.70m. ha of lands in the districts of Puri, Khurda, Nayagarh, Cuttack, Dhenkanal, Keonjhar, Mayurbhanja and Sambalpur. Lateritic soils are characterised by compact vesicular structure and rich in hydrated oxides of iron and aluminium with small amounts of manganese, titanium and quartz. Degraded laterites are honey combed structure and found in the districts of Khurda and Cuttack. These soils are loamy sand to sandy loam in the surface having hard clay pan in the subsoil, crusting is its problem in upland laterite. Presence of higher amount of exchangeable aluminium and manganese results in slightly acidic to strongly acidic soil with pH ranging between 4.5 to 5.8.

These soils are poorly fertile with low organic matter. Available nitrogen and phosphate are low and potash is medium. Nitrogen is lost due to leaching and phosphate becomes unavailable due to fixation by Fe and Al oxides. Cation exchange capacity of the soil is low and it is low in percentage base saturation. Sulphur is absorbed as pyrites or zine sulphide.

Medium and low land soils adjacent to uplands suffer from iron toxicity due to literal movement of soluble iron from upper ridges. Crops can be raised better in these soils through proper soil management such as, liming, application of organic manure, growing green manure crops and applying balanced fertilizer with application of paper mill sludge (1 to 2 t/ha). Groundnut and pulses could be grown successfully in these acidic soil. Potato and other vegetables can grow well without liming. Application of mixture of water soluble and insoluble phosphatic fertilizers increases the crop yield. Soil application of boron and seed treatment with molybdenum improve legume yields. Rice, finger millet, miner

millets and sesamum can grow well with proper fertilizer application. Fruit trees like mango, jack fruit, banana, guava, and sapota grow well in this soil.

4. deltaic alluvial : Soils (Haplaquepts, Fluvaquepts, Ustochrepts)

Those soils cover 0.67m. ha of lands and occur in the deltaic regions of the rivers such as Mahanadi, Brahmani, Baitarani, Subarnarekha and Rushikulya in the districts of Balasore, Bhadrak, Jajpur, Kendrapara, Jagatsinghpur, Cuttack, Puri, Gajapati and Ganjam. Textural class of the soil varies from coarse sand to clay and is mostly dependent on geomorphology of the flood plain and the type of alluvial material carried by river water. The structure may be granular or platy. The latter structured soil is difficult to handle. Alluvial soils of clayey texture crack upon drying and becomes sticky when wet. The plough-share is loaded with heavy clay and becomes difficult to work. Water holding capacity of this type of soil is high. Once water-logged, the clay soil takes more time to become ploughable. Drainage is difficult due to slow permeability.

Deltaic alluvial soils are generally fertile but fertility decreases if the soil is not recharged regularly by flood. pH is acidic to neutral. The coarse textured soils are deficient with N, P, K and S.

Deltaic alluvial soils are suitable for rice in kharif and for groundnut, mustard, sesamum, potato and vegetables in Rabi. With residual soil moisture, groundnut, greengram and black gram are grown very successfully.

5. Coastal Saline and Alluvial Soil : (Halaquepts, Halaquepts)

Alluvial soils with high total soluble salts (EC-4ds/m) are included in this group. These soils

occur along the coastal belt of the state in a narrow strip extending 5-25 km inward. The salinity occurs due to littoral deposits of estuarial intrusion of brackish tidal water from sea through creeks. Nearly 0.254m ha. of saline soils are distributed in the districts of Balasore, Bhadrak Jagatsinghpur, Kendrapara, Puri, Khurda and Ganjam. Saline soils are rich in soluble salts of chloride and sulphate in conjunction with sodium and magnesium. Soils of lacustrine sediments of lake Chilika also get affected by salts due to flooding of brackish lake water in the districts of Puri, Khurda and Ganjam. During monsoon a build-up of subsoil salinity occurs due to high ground water table under low lying situation.

These soils are mostly clay to clay loam in texture and columnar in structure. The pH of these soils varies between 6.0 to 8.0 with a conductivity of 10-40 dS/m in the summer. The exchangeable sodium percentage varies between 18 to 27. The soils are rich in nitrogen, potassium and low to medium in phosphorus. The saline soils are sufficient in sulphate, boron, molybdenum and chloride. Failure of crops normally occurs due to (i) plasmolysis of germinating seeds and roots (ii) death of young seedlings, (iii) reduced uptake of K, Ca and Mg due to presence of excess Na, (iv) toxicity due to B and (v) hydrogen sulphide injury.

However, during rainy seasons the salinity hazards are low due to dilution and flushing of soluble salts by heavy rains. Rice is the main kharif crop with usual and well distributed rainfall. Although kharif rice does not suffer very much from salinity, very often early drought and cyclonic sea water inundation cause hazards to rice. Salt tolerant high yielding rice varieties like Lunisharee, SR-26B and Mohan out yield the local saline resistant varieties like Sola, Pateni and Cuttack Chandi. Salt tolerant rabi crops such as safflower,

mustard, barley, linseed, chilli, sugarbeet, tomato, spinach and some cucurbits grow well in these soils. Cotton is a successful crop in saline soil if managed properly.

Coastal saline soils with high exchangeable sodium but acidic in reaction could be reclaimed by application of lime which replaces some of the exchangeable Na^+ or H^+ by Ca^{++} . Use of organic manures, recycling of straw and incorporating green manure crops reduce the salinity and alkalinity and improve soil structure.

Cropping on sides of alternate ridges of irrigated furrows with the intermediate furrow left as fallow and frequent light irrigation are some of the cultural practices that save crops from salinity. Preventive measures such as construction of salt embankments, provision of suitable drainage system, flush out the soluble salts, construction of sluices across the creeks, raising shelter belts over and near saline belts check salinity hazards to a great extent.

6. Brown Forest Soil : (Haplustalfs, Ustochrepts, Rhodustalfs)

These soils being associated with forest areas are distributed in the districts of Phulbani, Kandhamal, Rayagada and parts of Ganjam and Nayagarh and cover about 0.17 m.ha. These are brown to gray brown in colour, light texture and acidic in reaction. Organic matter and nitrogen content of the soils are medium to high. Phosphorus and potash content are medium. The contents of most of the micronutrient are high barring molybdenum. Under slopy terrain soil erosion occurs making lands barren. Shifting cultivation is regular practice causing land degradation.

Land shapping and checking 'podu cultivation' would improve the soil and land

management. With proper moisture conservation, soil are most suitable for growing ginger, turmeric and tapioca. Maize, wheat and mustard grow well in this soil. In the marginal lands niger comes up successfully with use of nitrogen fertilizer. Horticultural crops like jackfruit, mango, guava and citrus are the established fruit crops in these soils. Social forestry plantations are taken up successfully in the degraded soils.

7. Mixed red and black soil (Association of Alfisols, Vertisols and Vertic Intergrades)

These soils occur as association of both red and black soil together in which black soil occurs in patches within the predominant red soil. The red and black soils are so intermixed that red soils are found in upper ridges whereas, black soils occur in lower ridges. The soil occupies about 0.16 m.ha of lands in the western districts of Sambalpur, Bargarh, Sonepur and Bolangir.

The soils are light to medium textured having neutral pH. Black soils are rich in calcium and red soils are dominant with iron-giving catenary formation to the soil. The soils are deep with medium fertility status. The lowland soils growing rice are deficient in zinc. Rice, sugarcane maize, ragi, groundnut, sesamum and all types of vegetable crops are cultivated successfully with adequate fertilizer application.

Soils of Orissa influenced by climate, topography and parent material are the most heterogeneous for which the average productivity of many crops is low. Identification of specific soil problems and their efficient management would accelerate the crop productivity.

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Hon'ble Chief Minister Shri Naveen Patnaik watching the MIP Project from the Tower at Deras on 11.10.2005.