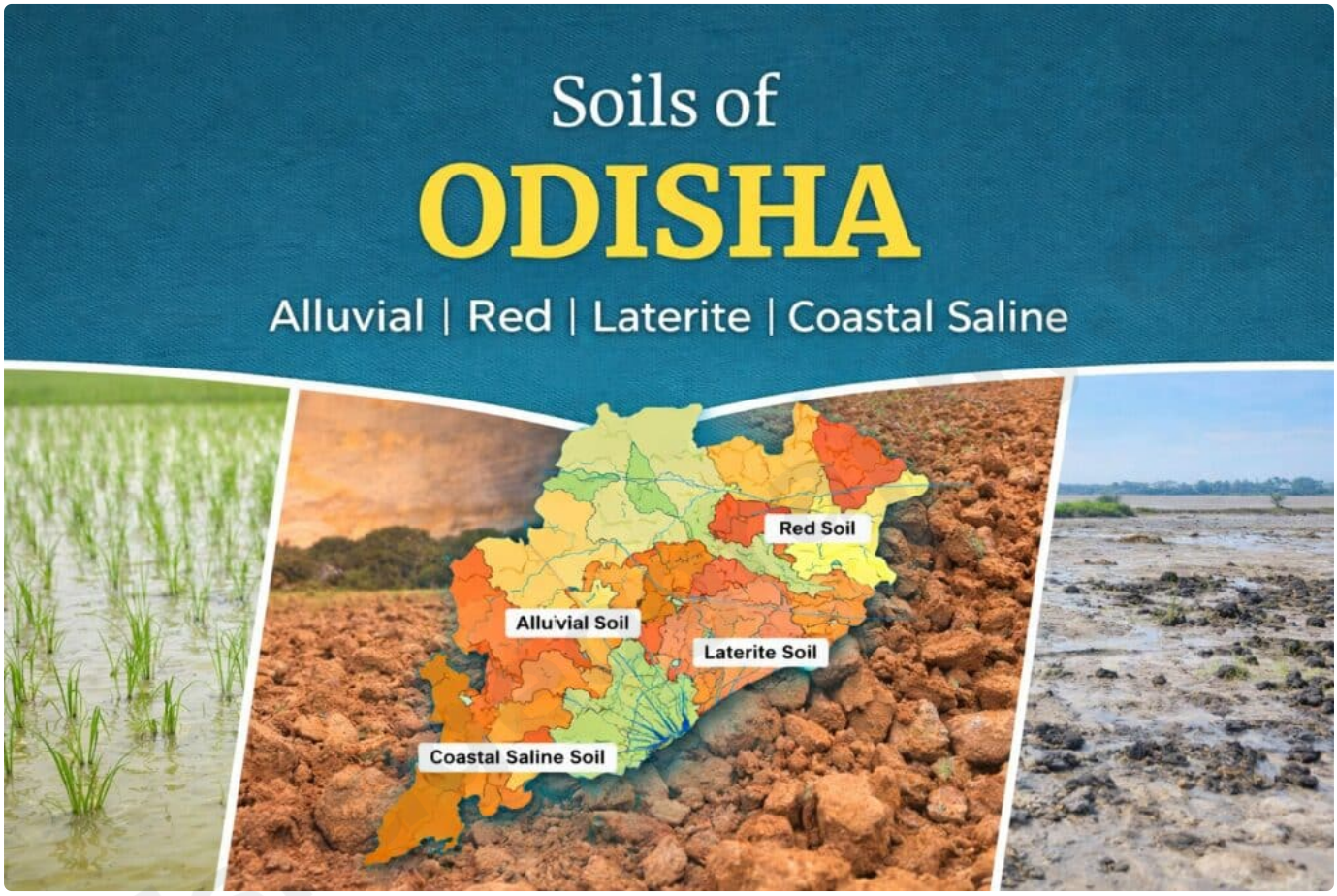
Soils of Odisha

By **Brajabandhu Mahanta** • April 1, 2026 • Updated October 7, 2026 • 9 min read



Odisha's soils are grouped into **eight major soil groups**. Red soils and mixed red-and-yellow soils together cover about 12.6 million hectares, more than four-fifths of the state, and black, laterite, alluvial, saline, forest and mixed red-black soils make up the rest. Taxonomically, these soils belong to four orders (Alfisols, Inceptisols, Entisols and Vertisols), ten suborders and eighteen great groups (Odisha Geography: Soils of Odisha).

The single most important fact about Odisha's soils is that they are **acidic**. About 70% of the state's area has acid soils, and in one large sampling study more than 80% of samples were acidic (ICRISAT, Status of Odisha's Soils). Most are also low in organic matter, nitrogen and

phosphorus, and many lack micronutrients such as boron and zinc. This explains why crop yields in Odisha are often lower than in states with similar rainfall.

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Factors of soil formation

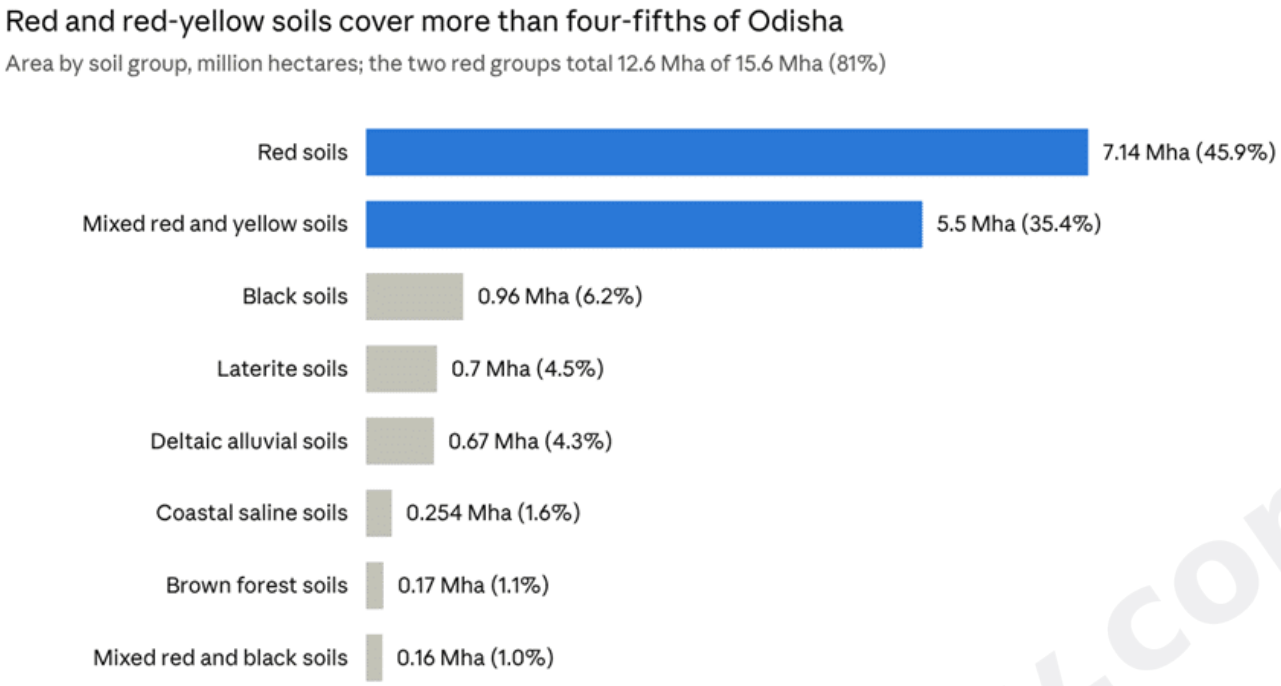
Factor	Effect on Odisha’s soils
Parent rock	Granites, gneisses and khondalites of the Precambrian shield give red and lateritic soils; basic rocks give black soils in patches; river sediments give alluvium on the coast
Climate	High rainfall and warm temperatures cause intense weathering and leaching of bases, making soils acidic and forming laterite
Relief	Uplands have thin, coarse, eroded soils; valleys and lowlands have deeper, finer soils; this “catena” pattern is typical of the plateaus
Vegetation	Forests add organic matter, giving the brown forest soils of the hills
Time and the sea	Young deltaic soils on the coast; salt-affected soils where tides and storm surges reach inland
Human use	Shifting cultivation, deforestation, mining and continuous cropping degrade soils

This article covers how Odisha’s soils are classified, each major soil group, their chemical status, problem soils, the link between soils and crops, and soil conservation.

Classification of soils

Major soil groups

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The eight groups together account for almost the whole state area of about 15.6 million hectares. Red soils dominate the Eastern Ghats, the southern and western plateaus and much of the north. Mixed red-and-yellow soils cover the central tableland. The remaining groups occupy smaller but agriculturally important pockets: alluvium in the deltas, black soils in the west, and saline soils along the coast.

Taxonomic classification (USDA Soil Taxonomy)

Soil order	Meaning	Where in Odisha
Alfisols	Leached, clay-enriched subsoil, moderate base status	Most red, red-yellow and lateritic upland soils of the plateaus and hills
Inceptisols	Young, weakly developed soils	River valleys, gently sloping uplands, much of the coastal plain
Entisols	Very young soils with little profile development	Recent alluvium, sandy coastal soils and steep, eroded hill slopes

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Vertisols	Clayey soils that swell when wet and crack when dry	Black soil patches in Bolangir, Kalahandi, Nuapada, Sambalpur, Bargarh and parts of Ganjam and Malkangiri

The National Bureau of Soil Survey and Land Use Planning (NBSS&LUP) maps these orders in detail. In broad terms, Alfisols and Inceptisols cover most of the state.

Major soil groups

Soil group	Main districts	Properties	Main crops
Red soils (about 7.1 Mha)	Koraput, Rayagada, Nabarangpur, Malkangiri, Keonjhar, Mayurbhanj, Ganjam, Kalahandi, Nuapada, Bolangir, Dhenkanal	Red from iron oxides; coarse in the south-west, finer elsewhere; strongly to moderately acidic; low water-holding capacity; low in N and P; boron and molybdenum deficient; fix phosphate	Rice, ragi and minor millets, niger, potato, brinjal; mango, jackfruit, guava
Mixed red and yellow soils (about 5.5 Mha)	Sambalpur, Bargarh, Deogarh, Sundargarh, Angul, Jharsuguda	Occur in catenas on rolling land; shallow, gritty uplands and deeper lowlands; yellow tint from hydrated iron and a fluctuating water table; moderately acidic uplands; zinc deficiency in rice–rice lowlands of the Hirakud command	Rice, ragi, sugarcane, vegetables; pulses and oilseeds in lowlands
Black soils (about 0.96 Mha)	Bolangir, Kalahandi, Nuapada, Subarnapur, Boudh, Sambalpur, Bargarh, Angul, Malkangiri, and patches in Ganjam and Puri	Clay over 30%; swelling (smectite) clays that crack deeply in summer; neutral to alkaline with lime nodules; rich in calcium but low in P, zinc and boron; hard to till	Cotton, rice, jowar, maize, Bengal gram, mustard, safflower

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Laterite soils (about 0.70 Mha)	Khordha, Puri, Nayagarh, Cuttack, Dhenkanal, Keonjhar, Mayurbhanj, Sambalpur	Iron- and aluminium-rich, vesicular, often with a hard subsurface layer; pH about 4.5–5.8; low fertility, phosphate fixation, nitrogen leaching	Rice, ragi, cashew, groundnut and pulses with liming; mango, jackfruit
Deltaic alluvial soils (about 0.67 Mha)	Balasore, Bhadrak, Jajpur, Kendrapara, Jagatsinghpur, Cuttack, Puri, Ganjam	Sand to clay depending on landform; renewed by floods; acidic to neutral; clayey soils waterlog and crack; generally the most productive soils	Rice in kharif; pulses, oilseeds, potato, vegetables, jute and sugarcane in rabi
Coastal saline soils (about 0.25 Mha)	Balasore, Bhadrak, Kendrapara, Jagatsinghpur, Puri, Khordha (Chilika), Ganjam	In a 5–25 km coastal strip; high soluble salts (EC above 4 dS/m, reaching 10–40 in summer); pH about 6–8; salinity from tidal creeks and storm surges	Salt-tolerant rice (Lunishree and others) in kharif; coconut, chilli, cotton, sunflower, barley with management
Brown forest soils (about 0.17 Mha)	Kandhamal, Rayagada, Gajapati, hilly Ganjam and Nayagarh	Brown to grey-brown; light texture; acidic; rich in organic matter and nitrogen; erosion-prone on slopes and under shifting cultivation	Turmeric, ginger, tapioca, maize; jackfruit, citrus; agroforestry
Mixed red and black soils (about 0.16 Mha)	Sambalpur, Bargarh, Subarnapur, Bolangir	Red soils on ridges and black soils in hollows; light to medium texture; near-neutral pH; zinc deficiency in lowland rice	Rice, sugarcane, maize, ragi, groundnut, sesame, vegetables

Source for areas and properties: Odisha Geography: Soils of Odisha, based on OUAT and Agriculture Department descriptions.

Other notable soils

- **Sandy coastal soils** on beach ridges and dunes in Puri, Ganjam and Balasore: very low fertility and water-holding capacity; suited to casuarina, cashew and coconut.

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- **Peaty and acid sulphate soils** in a few low-lying, waterlogged coastal pockets, such as parts of the Bhitarkanika–Dhamra and Chilika margins.

Soil chemistry and fertility

Acidity

Acidity is the defining problem of Odisha's soils. Heavy rainfall over thousands of years has washed calcium, magnesium and potassium out of the soil, leaving it acidic. About 70% of the state's geographical area has acid soils, and in a study of more than 40,000 samples, over 80% were acidic (ICRISAT).

In acid soils:

- **Aluminium and iron** become soluble and toxic to roots, and they lock up (fix) phosphorus;
- **calcium, magnesium and molybdenum** run short;
- useful soil microbes, including the bacteria that fix nitrogen for pulses, are less active.

The standard remedy is **liming**: applying lime, dolomite, or industrial by-products such as paper-mill sludge and basic slag in the furrows, often at a few quintals per hectare rather than the full lime requirement.

Nutrient status

Nutrient	General status in Odisha
Organic carbon	Low to medium; lowest in eroded uplands and continuously cropped fields
Nitrogen (N)	Mostly low; easily leached in light soils
Phosphorus (P)	Low to medium; much of it fixed by iron and aluminium in acid soils
Potassium (K)	Medium in most soils; low in light-textured sandy and lateritic soils
Sulphur (S)	Deficient in many upland soils, especially for oilseeds

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Boron (B)	Widely deficient in red and lateritic soils; affects vegetables, groundnut and pulses
Zinc (Zn)	Deficient in intensively cropped lowland rice soils, such as the Hirakud command
Molybdenum (Mo)	Deficient in strongly acid soils; affects pulses and groundnut
Iron and manganese	Usually sufficient or in excess in acid soils

Under the national **Soil Health Card** scheme, the state's soil-testing laboratories, OUAT and the Krishi Vigyan Kendras test farmers' soils and recommend fertilisers, lime and micronutrients field by field.

Problem soils and land degradation

About 5.4 million hectares of Odisha, roughly a third of the state, is affected by land degradation, with water erosion the leading cause on more than 3 million hectares (SwitchON Foundation report).

Problem	Where	Causes and effects
Soil erosion	Hill slopes of the Eastern Ghats, northern plateau, western uplands; ravines along rivers such as the Mahanadi, Tel and Brahmani	Heavy rain on sloping, bare land; shifting cultivation (podu), deforestation, overgrazing; topsoil and nutrients lost, reservoirs silt up
Acid soils	About 70% of the state, mainly uplands	Leaching by high rainfall; aluminium toxicity, phosphorus fixation, low yields of pulses and oilseeds
Coastal salinity	5–25 km coastal strip, Chilika margins	Tidal creeks and storm surges (worse after cyclones), poor drainage; crops fail, especially in the dry season
Waterlogging	Low-lying deltaic areas, canal commands, back swamps	Flat land, poor drainage, canal seepage; delayed sowing, reduced rabi cropping

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Laterisation and hardpans	Laterite uplands of Khordha, Puri, Cuttack, Dhenkanal	Hard layers limit roots and water movement; crusting on the surface
Mining and industrial degradation	Keonjhar, Sundargarh, Angul–Talcher, Jajpur (Sukinda), Koraput	Overburden dumps, fly ash, heavy metals such as chromium near chromite mines; loss of farmland
Nutrient mining	Intensively cropped commands such as Hirakud	Continuous rice without balanced fertilisation; zinc and sulphur deficiency

Soils, land types and crops

Land situation

Odisha’s farmers classify land by its position in the landscape, which closely matches soil depth and moisture:

Land type	Soils	Typical use
Upland (high land)	Shallow, coarse, acidic red and lateritic soils; drain quickly	Short-duration rice, millets, pulses, oilseeds, vegetables; very drought-prone
Medium land	Deeper, medium-textured soils	Medium-duration rice, followed by pulses or oilseeds on residual moisture
Low land	Deep, fine, often waterlogged clay soils	Long-duration rice; floods in heavy-rain years

Soils by agro-climatic zone

Agro-climatic zone	Dominant soils
North Western Plateau	Red and yellow, red and black
North Central Plateau	Red, lateritic
North Eastern Coastal Plain	Deltaic alluvium, coastal saline, laterite
East and South Eastern Coastal Plain	Deltaic alluvium, laterite, coastal saline and sandy
North Eastern Ghat	Brown forest, red, lateritic

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Eastern Ghat Highland	Red, mixed red-black, brown forest
South Eastern Ghat	Red, black, lateritic
Western Undulating Zone	Black, mixed red-black, red
Western Central Table Land	Red and yellow, mixed red-black
Mid Central Table Land	Laterite, red, alluvium

These zone–soil links underpin the crop plans described in the *Agriculture in Odisha* article.

Soil conservation and management

Managing problem soils

- **Acid soils:** liming (lime, dolomite, paper-mill sludge, basic slag), applying rock phosphate together with soluble phosphates, boron (borax) for vegetables and groundnut, molybdenum seed treatment for pulses, and growing acid-tolerant crops.
- **Saline soils:** saline embankments and sluices across tidal creeks, field drainage, salt-tolerant rice varieties, gypsum and organic manure, and raised-bed and ridge planting.
- **Black soils:** tillage at the right moisture, green manuring, and organic matter to improve infiltration.
- **Waterlogged soils:** surface drains, raised beds, and deep-water or flood-tolerant rice varieties such as Swarna-Sub1.

Conservation measures

- **Watershed development:** contour bunds, trenches, check dams and farm ponds under programmes such as the Watershed Development Component of the PMKSY.
- **Treating shifting cultivation:** land shaping, terracing and agroforestry for tribal farmers in the Eastern Ghats.
- **Afforestation and grassland development** on degraded uplands and mined land.
- **Coastal shelterbelts and mangroves** to protect soils from storm surges and salinity.

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- **Integrated nutrient management:** organic manure, green manure, crop residue recycling, bio-fertilisers and balanced fertilisers based on soil tests.
- **Reclamation of mined land** using District Mineral Foundation funds, with topsoil replacement and revegetation.

Institutions and schemes

- **Soil Health Card** scheme and soil-testing laboratories, including mobile labs.
- **Odisha University of Agriculture and Technology (OUAT)**, Bhubaneswar: soil research and recommendations.
- **Directorate of Soil Conservation and Watershed Development**, Odisha.
- **NBSS&LUP Regional Centre, Kolkata**: soil surveys and maps for Odisha.
- **ICAR–Indian Institute of Water Management and NRRI, Cuttack**: research on waterlogged, saline and rice soils.

Conclusion

Odisha’s soils reflect its ancient rocks, heavy rainfall and varied relief. Red and red-yellow soils dominate the uplands, fertile alluvium lines the deltas, and black, laterite, saline and forest soils fill distinct niches. Their common weakness is acidity and low fertility, made worse by erosion, salinity and degradation. With liming, balanced nutrition, watershed conservation and careful management of the coast and mined lands, these soils can support far higher and more sustainable yields.

Quick facts for exam aspirants

- Major soil groups: 8. Taxonomy: 4 orders (Alfisols, Inceptisols, Entisols, Vertisols), 10 suborders, 18 great groups.
- Most extensive soil: red soil (about 7.1 million ha); second: mixed red and yellow (about 5.5 million ha).

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- Red and red-yellow soils together: about 81% of the area.
- Black soils: about 0.96 million ha, mainly western Odisha (Bolangir, Kalahandi, Nuapada).
- Laterite soils: about 0.70 million ha (Khordha, Puri, Cuttack, Dhenkanal).
- Deltaic alluvial soils: about 0.67 million ha; the most productive.
- Coastal saline soils: about 0.25 million ha in a 5–25 km coastal strip.
- About 70% of Odisha’s area has acid soils; liming is the main remedy.
- Common deficiencies: nitrogen, phosphorus, sulphur, boron, zinc, molybdenum.
- Salt-tolerant rice for coastal soils: Lunishree.
- Land degradation: about 5.4 million ha, mainly from water erosion.

Sources

- Odisha Geography: Soils of Odisha
- ICRISAT: Status of Odisha’s Soils, Management of Acidic Soils
- SwitchON Foundation: Land Degradation, Desertification and Drought in Odisha

Source: https://odishageography.com/soils-of-odisha/

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