Application of Geo-informatics in Agriculture

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Kerala Agriculture

Features

- **Kerala with a geographic area of 38864 km^2 is only 1.3 percent of the total area of the country.**
- **land mass shows altitudinal variations from 5m below sea level in the west to soaring heights 0f 2695 m above msl in the east.**
- **Wide diversity in climate and physiographic conditions**
- **Permits the cultivation of a wide variety of crops ranging from plantation crops and cash crops cool season vegetables and fruits.**
- **The average size of holding in Kerala is 0.27 ha as against the national average of 1.6 ha.**

Topography

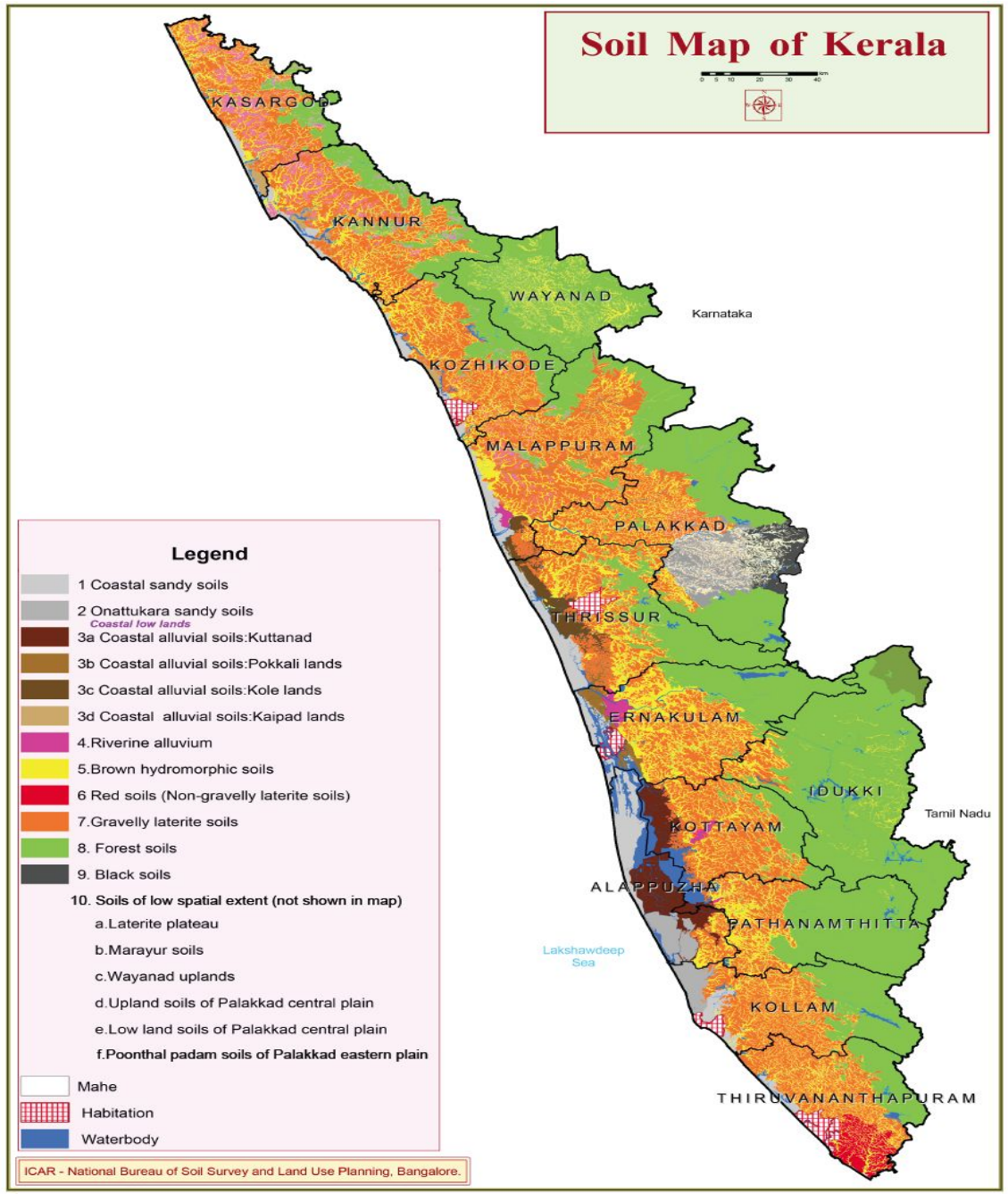
- Has three natural divisions of low land, mid land and high land forming parallel belts across the length of the state.
- Low land with stretches of sand and numerous back waters lies on western fringe of the state along the seashore ,ideally suited for coconut and rice
- Mid land region with hills and valleys presents an undulating tract of laterite soil cut across by numerous rivers.
- Noted for a large variety of agricultural products like rice, coconut, pepper, cashew, ginger, tapioca and rubber.
- High land consists mainly of mountains covered by dense forests bordering the Western Ghats. Important plantation Crops like cardamom, coffee, pepper and rubber are grown in this region.

Climate

- Humid tropical belt with two distinct monsoons , North East (June To September) and the South West (October to December) with average annual rainfall of 3000 mm
- The mean annual temperature ranging from 27.5 ^{0} C to 29.5 ^{0} C in the coastal areas and midlands and temperature of 15 ^{0} C or lower in the high hills of Idukki and Wayanad.

Geology

- Geologically, Kerala is occupied by four major rock formations
- Crystalline rocks of Precambrian age
- Sedimentary rocks of Tertiary,
- Laterite capping the crystalline and sedimentary rocks
- Recent and sub recent sediments forming the low lying areas and river valleys.

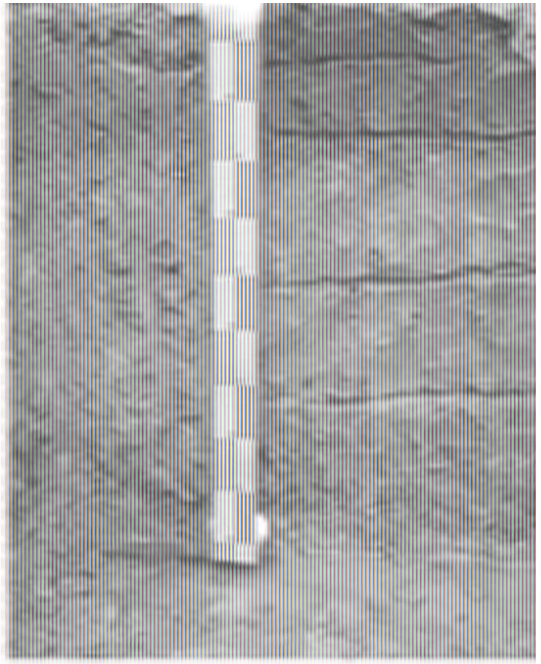


- The major soil groups of Kerala
- 1. Coastal sandy soils (Coastal plains)
- 2. Onattukara sandy soils (Onattukara plains)
- 3. Coastal Alluvium (Potential Acid Sulphate)
- 3a. Kuttanad soils
- 3b. Pokkali soils
- 3c. Kole soils
- 3d. Kaippad soils
- 4. Riverine alluvial soils (River banks)
- 5. Brown hydromorphic soils (Valleys of
- midlands, foothills and highlands)
- 6. Red non Gravelly laterite soils (Southern midlands and highland plateaus of (Western Ghats)
- 7. Gravelly laterite soils (South, Central and Northern midlands and foothills)
- 8. Forest soils (Western Ghats and Escarpments)
- 9. Black soils (Palakkad eastern plain)
- 10. Special group (soils of limited spatial extent)
- a. Laterite plateau
- b. Marayoor soils (Lowhills and rolling lands)
- c. Wayanad upland soils
- d. Upland soils of Palakkad central plains
- e. Low land soils of Palakkad central plain
- f. Poonthal padams (Lowlands of Palakkad
- eastern plains)

Coastal Sandy Soils

Features

- Occur as a narrow strip along the coast line from southern to northern end of the state
- Very deep, well drained,sands on very gently sloping subdued coastal sand dunes
- Color is yellowish brown to brown or gray ,strongly acid
- Cation exchange capacity low, poor water and plant nutrient retention capacity
- Deficient in bases calcium, magnesium, potassium organic matter

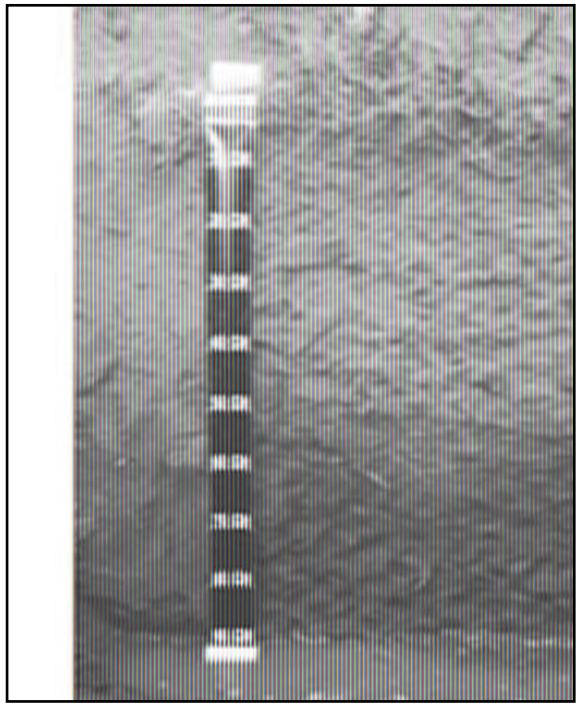


Low land coastal sands-
Thiruvananthapuram l

Onattukara Sandy Soils

Features

- Occur in the level sandy plain of extending inward, from the coast line into the midlands in Kollam and Alappuzha called as the Onattukara Region
- Grayish, sandy soils , very Deep,well drained, with shallow water table, located in low landscape regions
- Strongly acid, single grain StructurLow cation exchange capacity deficient in basic cations, grey color due to organic matter, distinguishes these soils from the coastal sands



Kuttanad Region

- A vast stretch of land area below sea level, bounded on the west by a narrow strip of coastal sands, south by Onattukara sandy plain, east by laterite uplands and north by Pokkali lands
- Sea water ingress into these lands regulated by bunds and barrages

Comprises of lakes,rivers which drain to the Vembanad lake

- Soils of the Kuttanad have been formed from mixed alluvial and marine sediments
- Poorly drained.high organic matter, strongly acid, clay texture

Soils identified are :

Kayal,Karappadam,Kari

Kuttanad

Kayal soils

- These soils have high levels of organic matter often reaching more than 20 per cent
- Sulphur bearing minerals within 50 cm from the surface.
- They are black in colour,poorly drained, heavy textured are extremely acid.
- Draining of the potential acid-sulphate soils results in ultra acid conditions and formation of acid sulphate soils.

Karappadam soils

- Ocur along the inland water ways and rivers.
- Soils are deep, poorly drained with clay loam surface texture and silty clay subsoils.
- Very strongly acid to extremely acid in the subsoil layers due to the presence of decaying organic debris

Kuttanad

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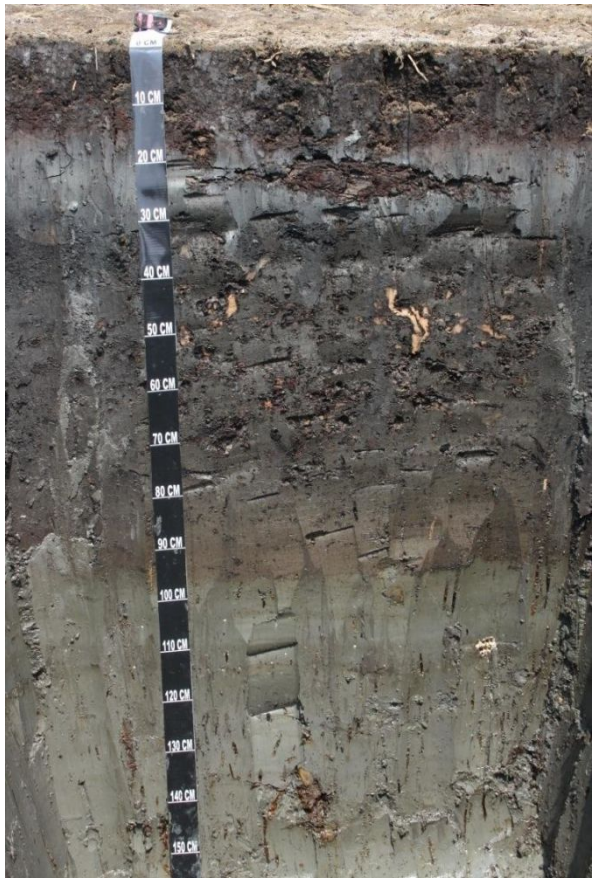
Soil profile



Pokkali Soils

Features

- **Distributed in coastal parts of northern Alappuzha, Ernakulam and south Thrissur**
- **Lands lie below sea level and do not have any protection from sea water ingress and hence mostly inundated with saline water**
- **Soils developed from mixed marine and river alluvium ,are deep, poorly drained, acid-saline clay**
- **Soils contain very high levels of organic matter, CEC and content of basic cations Soils have sulphur bearing minerals which on exposure to air cause extreme acidity**

Soil profile

Kole Soils

Features

- **Kole lands of coastal Thrissur andMalappuram are lands bekow sea level, protected from sea water ingress by bunds and barrages**
- **Soils developed from mixed marine and river alluvium, deep, poorly drained, strongly acid clay,rich in organic matter, CEC and bases**
- **Soils contain sulphur bearing minerals at various depths and hence are potential acid sulphates**

Soil profile

Kaipad soils

Features

- Hydromorphic soils occurring in coastal lowlands of north Kerala
- Developed from marine sediments with sulphur bearing minerals at various depths
- No protection from sea water ingress and hence acid saline
- Organic matter rich soils are very strongly acid,high CEC and fairly rich in bases
- A rice–fish sequence is often practiced

Soil profile

Wet land

Altered

Alluvium- Soils of River Banks

Features

- **Distributed on the banks of rivers in gently sloping lands especially in their lower reaches**
- **Well drained, moderately slow permeability moderately good cultivable lands ,medium fertility**
- **Wide variation in their physico-chemical properties and arrangement of layers depends on the nature,deposirion of alluvium**
- **Very deep (> 150cm), acidic, non gravelly with textures varying from sandy loam to clay loam with dominance of silt fraction.**

River Alluvium from Ernakulam

Brown Hydromorphic soils

Features

- Occurin the low lands of laterite terrain in midlands and foothills
- Distributed in almost all the agro-ecological units, with largest extent in midlands
- Formed on the alluvial and colluvial deposits and therefore inherit most properties of the upland laterite soils
- Periodic waterlogging of reveal redoximorhic features like mottles and gleyed horizons in the soi profiles
- Very deep soils, grayish brown or gray in colour, gravel free, strongly acid and clay texture
- Dissolution of iron in toxic levels seriously impair crop growth
- Water table at 1 to 1.5 m from surface

Soil profile

Red Soil

Features

- Distributed in Neyyattainkara Taluk and South of Trivandrum
- Occur as association of laterite soils,devoid of gravel and plinthite the root limiting layer
- Slightly acid to neutral ,poor in bases and nitrogen
- Low activity clay with low CEC and base saturation

Soil Profile

Gravelly laterite Soils of Northern Kerala

Features

- Covers midland laterites of northern Kerala, from Malappuram to Kasaragod,
- Developed under longer dry period,higher gravel content and harder plinthite compared to the southern Laterites
- Laterite duricrusts are a common feature of the northern laterite terrain
- Loss of vegetation and accelerated erosion exposes the plinthite which irreversiblyhardens to duricrusts (iron stone)
- Plinthite and high gravel content limits the volume of fine earth
- Low activity clay, acid soils have low base status and are deficient in plant nutrients
- Long dry period , low water holding capacity low effective soil volume are constrains for crop productivity

Soil profile

Soils of Foot Hills

Features

- Soils on the foothills of Western Ghats are formed t
- hrough the process of laterisation Deep, well drained, organic matter rich contain very little gravel, initial stages of laterisation
- Absence of dry spell due to forest or/plantation canopy impedes laterisation
- Surface soils are rich in organiccarbon, have moderate CEC and basic cations as compared to subsoils

Soil Profile

Forest Soils

Features

- **Steeply sloping forested lands of Western Ghats,deep, well drained, dark gray to reddish brown, clay, strongly acid soils, dominantsoil forming process is laterization**
- **The modifying effect of the vegetation on the temperature, movement of water and other factors are not conducive to laterization**

Soil Profile

Black Cotton Soil

Features

- Swell-shrink black soils, found in the Eastern parts of Chittur taluk (Palakkad district)
- Found in association with red loam soils, on nearly level lower landscape and red soils on undulating upper landscape
- Black cotton soils, are deep to very deep, dark grayish clay
- During dry period deep, wide cracks extending down to 50 cm or more is quite frequent
- Soils with alkaline reaction exhibit high CEC and are fully base saturated
- Calcium carbonate nodules or powdery lime is often observed in lower soil layers

Soil Profile

Remote Sensing and GIS – Areas identified

- Area, extent and distribution of various crops
- Management of water resources
- Identification of pest attacks and diseases
- Yield assessment studies
- Land suitability assessment for agriculture
- Disaster management
- Precision agriculture

Management of water resources

- Identification and mapping of surface water Infrared satellite images – Identification of surface water bodies
- Calculation of reservoir capacity,
- Identifying seasonal fluctuations of water levels
- Identification of tank water levels and irrigation command areas
- Irrigated lands assessment and inventory
- Calculation of water requirement of crops and subsequent water budgeting for command areas
- Assessment of water availability in rivers and reservoirs for optimal management to meet irrigation needs
- Determine volume of water stored and change in the level with time

Identification of problem and degraded areas

- Delineation of water logged /saline areas
- Identification of aquatic vegetation associated with water logging
- Eutrophication and pollution monitoring
- Soil erosion prone areas
- Watershed management

Identification of pest attacks and diseases

- Based on -
- Changes in pigmentation
- Chlorophyll content
- Leaf orientation and vegetative characteristics

Land suitability assessment for agriculture

- Land suitability for a given crop is based on Soil characteristics,
- Existing land use, Climatic factors such as rainfall and temperature
- Topography
- Availability of transportation facilities and agricultural labour
- Availability of water sources for irrigation

Disaster Forecasting and Management

Prone /Vulnerable areas and extent

- Floods
- Droughts
- Cyclones
- Forest fires
- Land slides

Precision agriculture or Precision farming

Is an information and technology-based agricultural management system to identify, analyze, and manage site-soil spatial and temporal variability within fields for optimum profitability, sustainability, and protection of the environment

HIGH-TECH TOOLS FOR SITE-SPECIFIC CROP NUTRIENT MANAGEMENT

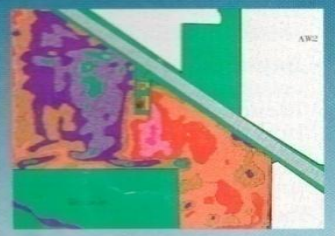
Grid sampling guided by GPS gives more accurate soil test data.

Variable rate fertilizer application can improve efficiency.

Photo Credit: Dealer PROGRESS Magazine

Variable rate seeding, variety changes and starter can adjust for soil properties and productivity.

Crop scouting with new technology improves field records.



On-the-go yield monitors can quickly track variability in the field.

PAST YEARS' YIELDS

SOIL TEST (K)

SOIL TEST (P)

SOIL MAP

Definition

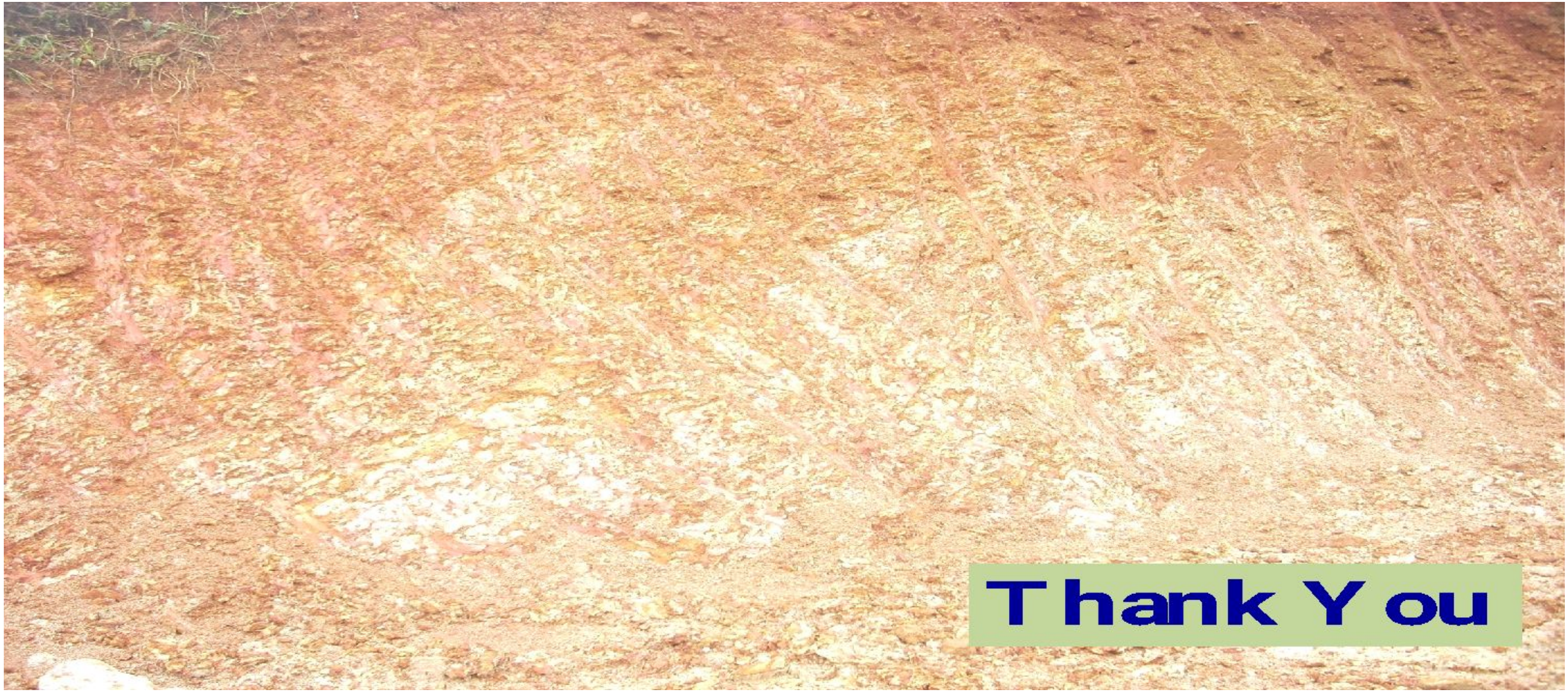
- Watershed may be defined as a Natural hydrologic entity that cover a specific expanse of land surface from which the rainfall and runoff flows to a defined drainage channel, stream or river at any particular point
-

Classification of watershed

		Mean size (+50% sq.km.)
1	Water resources region	5,00,000
2	River Basin	50,000
3	River sub basin	5,000
4	Watershed	500
5	Sub watershed	50
6	Mini watershed	5
7	Micro watershed	Below – 2.5
8	Nano watershed	a few hectares of land

- Source : MOA (1990) Watershed Atlas of India

A Laterite Quarry with cut Bricks


Thank You