Soils of Kerala- Formation and characteristics

Dr. V. K. Venugopal
Former Professor & Head
Department of Soil Science and Agricultural Chemistry College of Agriculture, Vellayani
Consultant, Digital University Kerala

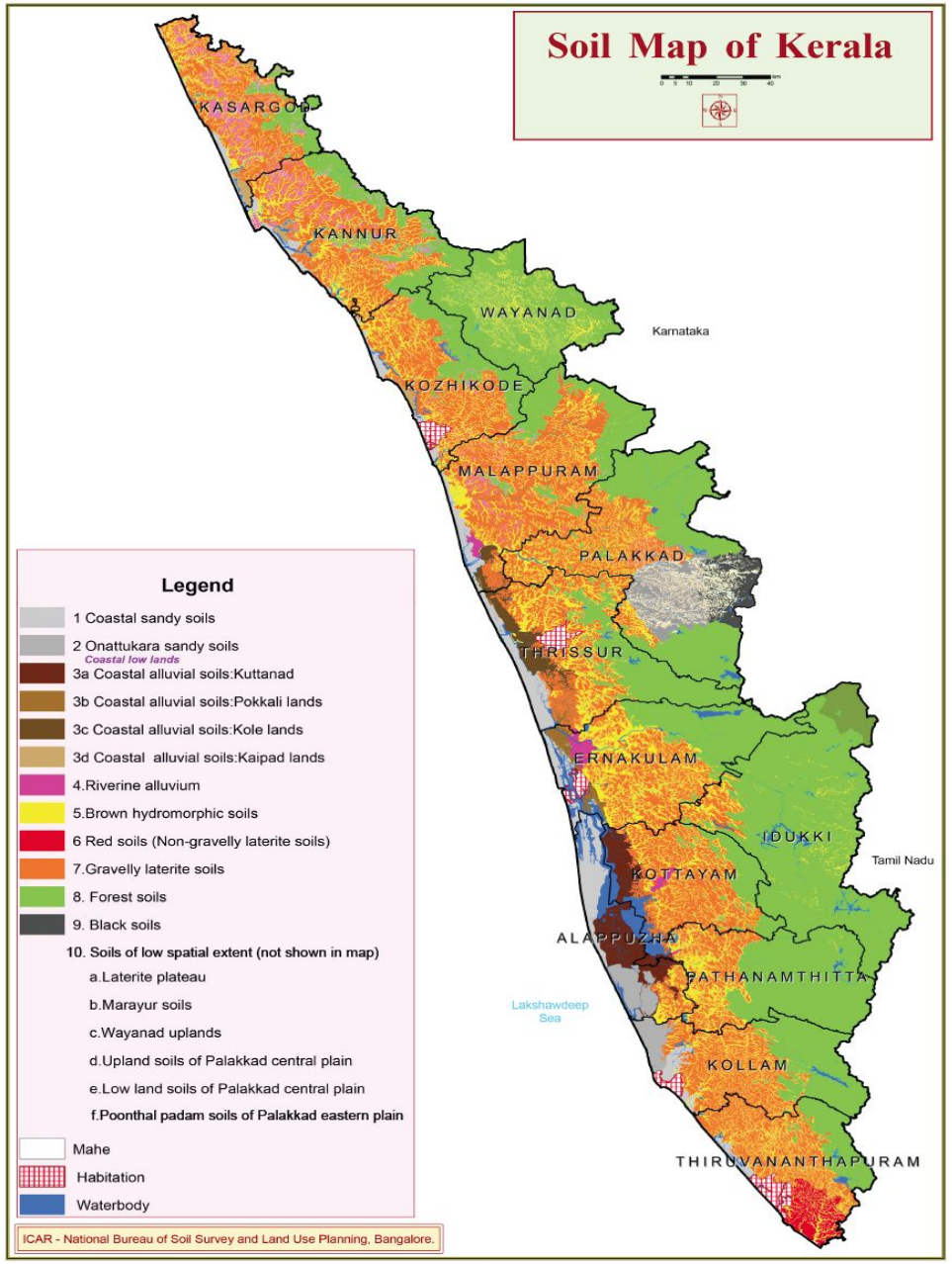
CDIPD
CENTRE FOR DIGITAL INNOVATION AND PRODUCT DEVELOPMENT

CENTRE FOR DIGITAL INNOVATION AND PRODUCT DEVELOPMENT
(A centre of excellence established by Digital University Kerala)
www.cdipd.duk.ac.in

DIGITAL UNIVERSITY KERALA
Curating a responsible digital world

General Features

- Kerala falls in the humid tropical belt with high rainfall and temperature conditions conducive to intense weathering processes
- It is the *type locality* of laterite first observed in Angadipuram in Malappuram
- Over 90 % of geographic area is covered by highly weathered laterite soils
- In general, soils are inherently acidic, kaolinitic, gravelly with low CEC and poor in bases and plant nutrients, low water holding capacity and high P fixation



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

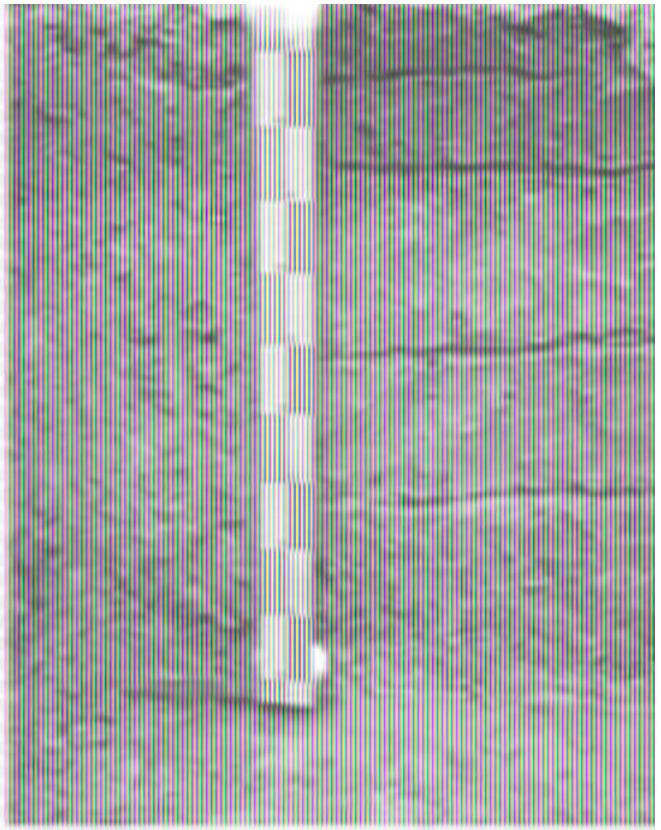
Features

- **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 nutrient retention capacity**
- **Deficient in bases calcium, magnesium,**

Potassium,Organic matter

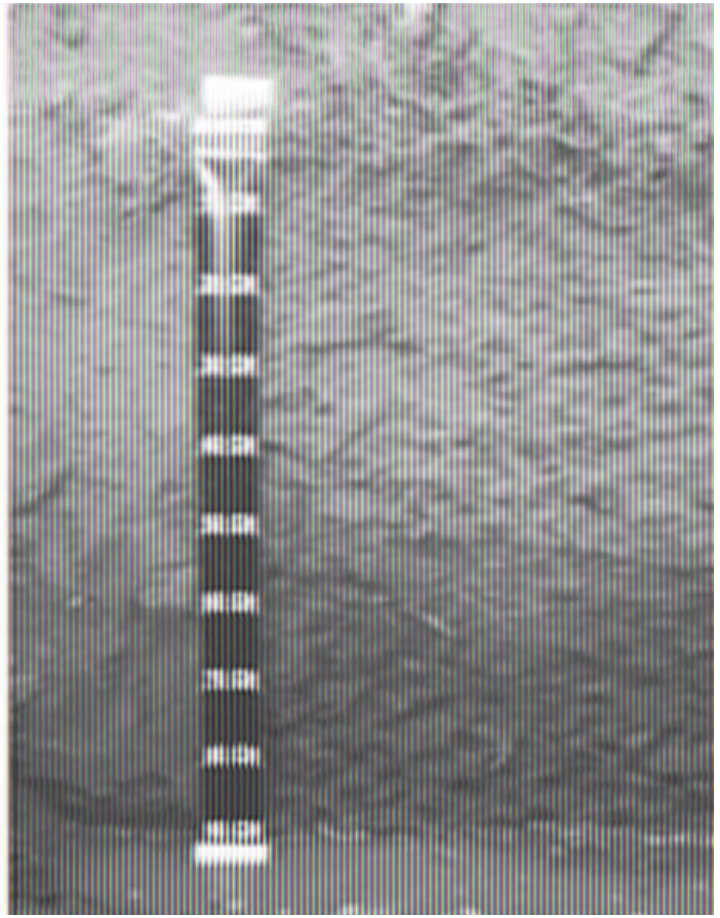


Low land coastal sands-
Thiruvananthapuram

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 are very deep,well drained, with shallow water table located in low landscape regions
- Strongly acid with single grain Structure
- Low CEC , 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 developed from mixed alluvial and marine sediments, poorly drained.high organic matter, strongly acid, clay texture**

Soils identified are :

Kayal, Karappadam, Kari

Kayal

- Deep, poorly drained, strongly acid, clay soils with very high organic matter Contain sulphur bearing sediments at shallow depths and are potential acid sulphates
- CEC and exchangeable bases are fairly high

Karappadam

- Occur on the fringes of Kuttanad close to the laterite uplands
- Soils are poorly drained, deep, acidic clay, organic carbon levels much lower than the Kayal soils and sulphur bearing minerals occur at deeper layers
- CEC and exchangeable bases are fairly high

Kayal Soil profile

Kari 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

- Occur 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

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 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 and Malappuram are lands below 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 northKerala**
- **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

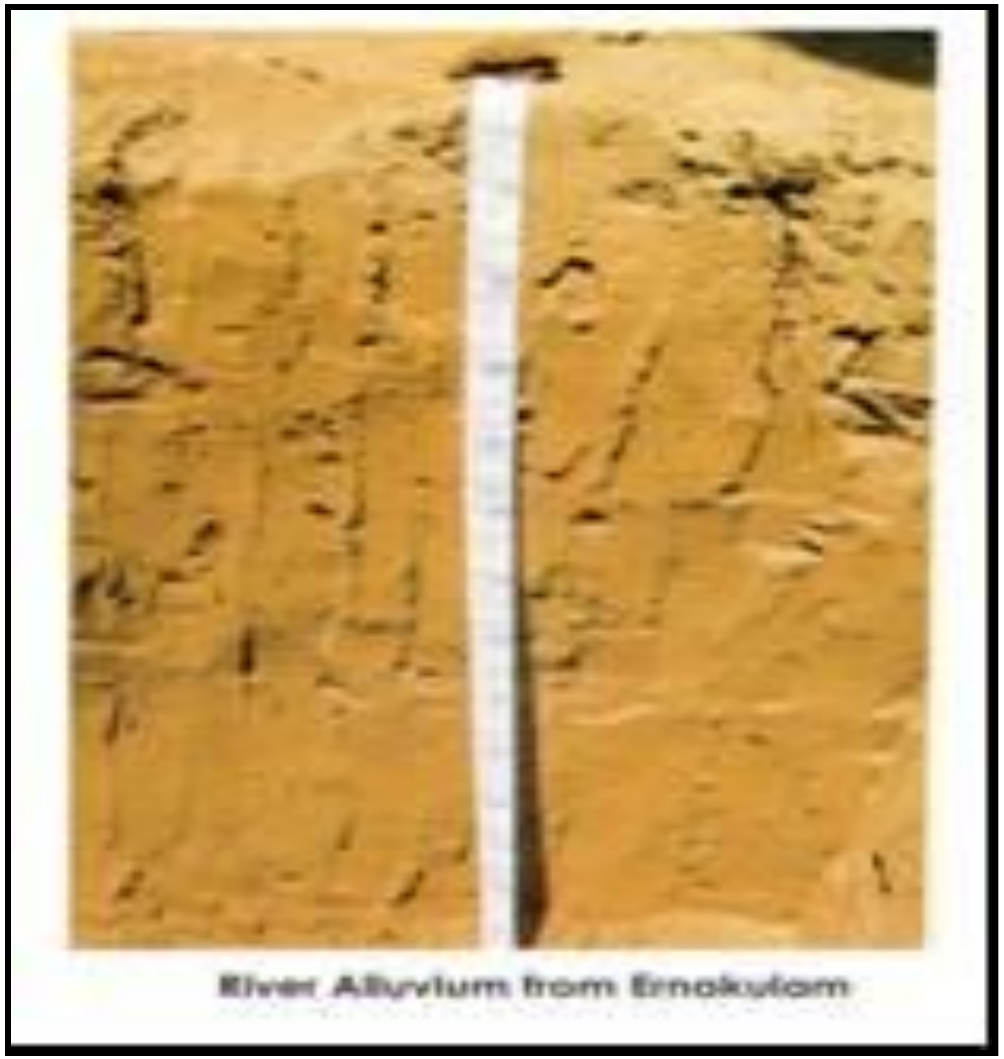
Wet land

Altered

Riverine 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 the**
- **arrangement of layers depends on the nature of the 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

- **Occurring 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 mottlesand gleyed horizons in the soi profiles**
- **Very deep soils, grayish brown orgray 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**

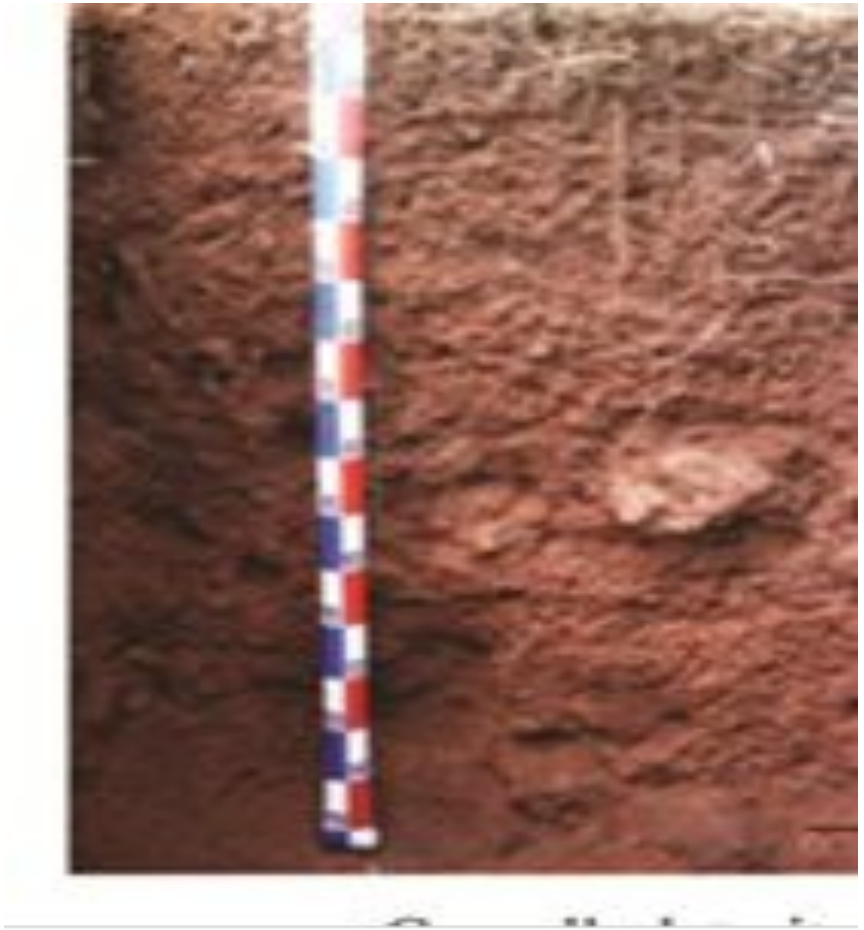
Soil Profile

Gravelly laterite soils – Central Kerala

Features

- Covers the midland laterite terrain from north of Thiruvanantapuram to the end of Thrissur and West of Palakkad
- Deep, well drained, gravelly soils, often underlain by plinthite at various depths
- The soft plinthite, used as bricks and hardens on exposure to air and drying
- Plinthite layer is root limiting and the gravel reduces effective volume of fine earth
- Strongly acid low activity clay soils have low CEC and base saturation

Soil profile

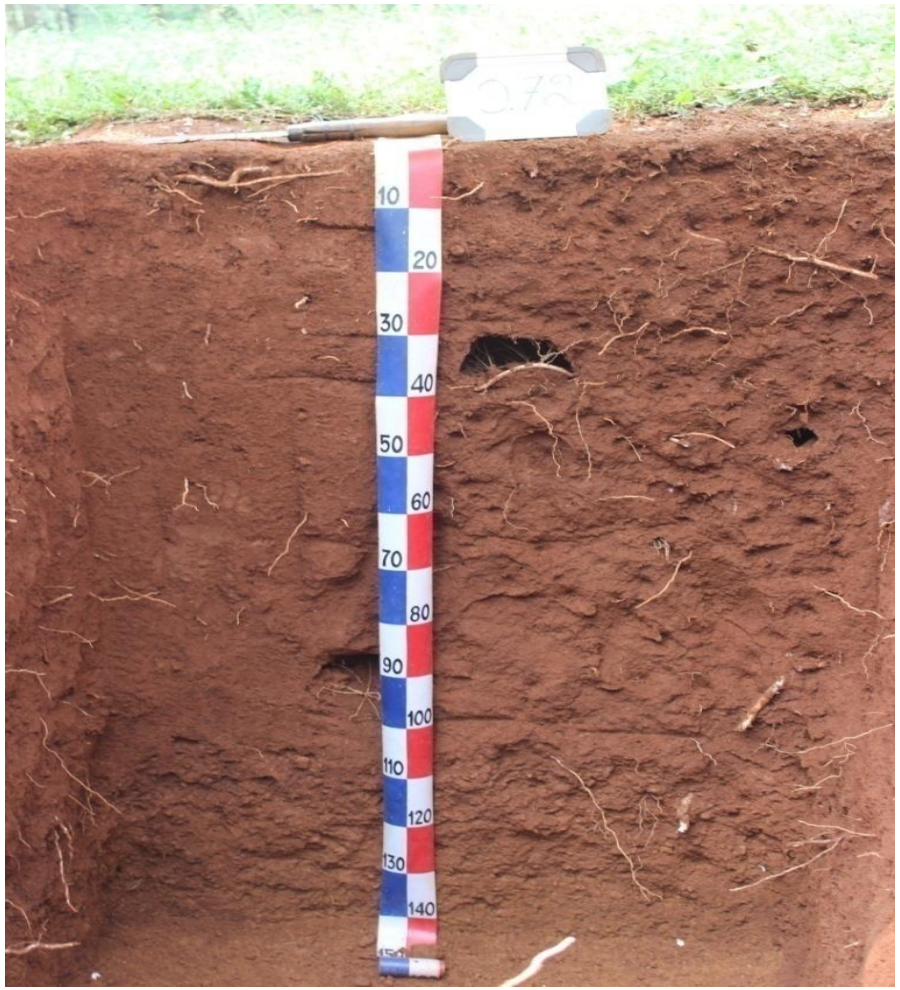


Gravelly laterite Soils of Northern Kerala

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 plinthite which irreversibly hardens 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 through 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 organic carbon and have moderate CEC and basic cations as compared to subsoils**

Soil Profile

Forest Soils

Features

- **Steeply sloping forested Lands of Western Ghats have deep, well drained,dark gray to reddish brown, clay, strongly acid soils,**
- **Basic soil 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 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 highCEC and are fully base saturated
- Calcium carbonate nodules or powdery lime often observed in lower soil layers

Soil Profile

***Poonthalpadam* soils**

- **Slushy soils found in eastern parts of Palakkad in parts of Alathur and Chittur taluks as isolated patches in lower landscape positions**
- **Completely slushy, almost year round, characteristic similar to the surrounding non-slushy soils Slushiness caused by seepage of water from the rocks underlying the soil mass**
- **Geographic association of tanks constructed to impound and store water for irrigation is evident in many locations of occurrence of these soils**
- **Complete and continuous drainage of soils through very deep channels can alleviate slushiness**
- **Major disadvantage with the otherwise very fertile soil is the very poor load bearing capacity which prevents use of any machinery /even bullock drawn plough for cultivation of crops**
- **Rice is the only crop raised on these lands**

Marayoor Soils

- Developed in low rainfall areas in Marayoor, Vattavada and Kanthalloor panchayats in Idukki district
- Moderately deep to deep soils are near neutral in reaction, high in organic matter and well supplied with basic cations
- Soils exhibit moderate CEC, compared to laterite soils
- Similar soils occur in the low rainfall regions of Attappadi, in Palakkad district
- Fertility of soils is high with high organic matter, basic cations and presence of weatherable minerals.

Red loam neutral soils

- Deep red loam ,clay or gravelly soils found in the easyern part of Chitoor taluk and Attapady Hills in Palakad district
- Developed in moist dry ,subhumid climate with low rainfall on granite gneiss parent material
- Soils with near neutral reaction, moderate CEC and high base saturation
- Soils are very productive when adequate moisture is available

Reference

Kerala State Planning Board (2017). Soil Health Management for Sustainable Crop Production in Kerala. Kerala State Planning Board, Thiruvananthapuram, P 1- 426


Thank You