LATERITE SOILS OF KERALA, PEDOGENIC PROCESSES AND FORMATION

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Occurrence and Distribution

- Red and laterite associated soils of Kerala cover 70-75 per cent of the total geographical area of the state.
- Considered, the backbone of the states agriculture.
- Laterite soils respond well to management practices
- Distributed in the midland and mid upland regions as a narrow belt from Thiruvananthapuram in the south to Kasargod in the north
- Kerala has a unique place in the field of pedology.
- Buchanan (1807) first reported the presence of a ferruginous, vesicular material occurring within the soils from Angadipuram, located in Malappuram district.

- The material irreversibly hardens on exposure to air and widely used for construction purposes.
- Thickness of the laterite capping, ranges from a few meters to as much as 50 meters in some places
- The word laterite was coined from the latin word ‘later’ meaning brick.
- Scientific studies on the laterite soils of Kerala began with the field study of soil profiles of Angadipuram by Thomas (1955).
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Factors of soil formation- Kerala

Climate

- Enjoys a humid tropical climate with an average annual rainfall of 3000 mm.
- Rainfall is received during the south west (June to September) and north east (October to December) with 60 per cent of the rainfall in the former.
- Mean annual air temperature ranges from 20.7°C in the high ranges to 29.8°C .
- Soil temperature regime is isohyperthermic throughout the state.
- Mean annual soil temperature at 50 cm depth is 22°C or more and the difference between the mean summer and mean winter temperature is less than 5°C

Parent material

- Rocks of the state are crystalline mostly of igneous and metamorphic origin
- Mostly siliceous and include charnockite, khondalite , granite, granite gneiss and basic dykes.
- The yellow and reddish clayey laterites are of common occurrence in the mid and mid upland region of Kerala
- They are distributed from low flat topped ridges and hills covering the crystalline rocks and Tertiary sediments between the foot hills of Western Ghats and Lakshadweep Sea.

Vegetation

- The natural vegetation comprises of the following groups
- Tropical wet evergreen and Semievergreen (50%).
- Tropical moist deciduous (33%),
- Tropical dry deciduous (2%) Grass lands (2%)
- Forest plantations (12%).

Physiography

- Major physiographic features are high hills, valleys and plains
- Considerable geologic processes of erosion, deposition and uplift have been responsible for the present configuration of the landscape.

Pedogenic processes

- The intense weathering, characteristics and other environmental factors are conducive to the laterisation process
- The high temperature, heavy precipitation, diverse vegetation and relief characteristics acting over long period of time have been responsible for the wide heterogeneity in the soils of the state.
- Both the primary/residua or insitul/high level/and secondary/laterite varieties identified in laterite literature do occur in Kerala.
- Intense desilication, followed by accumulation of sesquioxides are the key processes.
- Various permutation and combinations of the factors of formation have contributed to wide variation in morphology and other characteristics observed among the red and laterite soils of the state.
- The entire state is prone to the laterisation process and 70-75 per cent of the geographic area of the state is covered by these soils.

Laterisation process

- Schmidt Lorenz (1978) outlined the processes involved in laterites formation in Kerala.
- The acidic igneous rocks undergo primary ferralitization/laterisation with leaching out of silica and bases leading to yellowish saprolite.
- The upper horizons undergo pedoplasmation -the transformation of weathered rock (saprolite) to soil B-horizons.with a finer texture and higher specific surface
- The lower horizons undergo plinthization.- process leads to formation of yellowish red solum, consisting of mostly kaolinite, ferric hydroxide and quartz.
- Mottled lower layers, called as plinthite, with red yellow mottles is as a result of plinthization.
- Weathering of kaolinite proceeds further to form reddish-red solum and the process is called . plinthrodification
- Dominant minerals are goethite (FeO (OH)), limonite,(hydrated ferric oxide ($FeO(OH)\cdot nH_2O$)).and gibbsite ($Al(OH)_3$.

Catenary soils

- Jenny (1941) has coined the term catena/toposequence to describe an association of soils along a slope transect.
- Kerala landscape is dominated by undulating hills and valleys have been responsible for the genesis of an association of soils extending from the crest of hills to valleys.
- Venugopal (1980) has elucidated the various macro and micro pedogenic processes responsible for the formation of four diverse group of soils in the catena, extending from the crest of the hills to the valley. The 4 groups of soils identified are
- Crest soils with the typical insitu laterites , distinct horizon differentiation, abundance of gravel, well developed structural aggregates resting on a bed of soft laterite, rich in iron and aluminum oxides and kaolin.

- Soils of the side slope the second member are the deep red soils of the catena and occupies the upper mid slope lying in close proximity to the crest. Soils are deep, red hues, gravel free with ill defined horizons.
- The third member of the catena include soils of the toe slope just above the valley. Soils are deep with poor drainage, formed from down slope movement of materials from the side slope,. Soils show subsurface mottled horizons indicative of poor drainage.
- Soils the fourth member include soils of the valley formed from colluvial sediments and are deep,ill drained with subsurface mottled horizons

Plinthite and Petroplinthite formation

- The lower horizons undergo plinthization.- process leads to formation of yellowish red solum, consisting of mostly kaolinite, ferric hydroxide and quartz.
- Mottled lower layers, with red yellow mottles called as plinthite is soft under the soil column but hardens irreversibly on exposure to air
- The intensive cultivation in the mid land region and faulty agro techniques of slope cultivation especially tapioca, has depleted the surface soils exhaustively of organic matter and plant nutrients.
- The removal of the soil column exposes the laterite bed to air and prolonged dry conditions which promote dehydration and crystallisation of the iron hydroxides, resulting in formation of iron stone/petroplinthite (Alexander and Cady 1962).

- This process is irreversible and makes such areas unsuitable for any cultivation.
- Extensive areas of petroplinthite (degaraded laterites) formation are the characteristics of the laterite landscape in Calicut, Malappuram, Kannur and Malappuram districts of Kerala.
- These areas have been designated as waste lands, not suited for farming and is a grim reminder of the long term repercussions of mismanagement of these plinthic soils (KSLUB, 1989).

References

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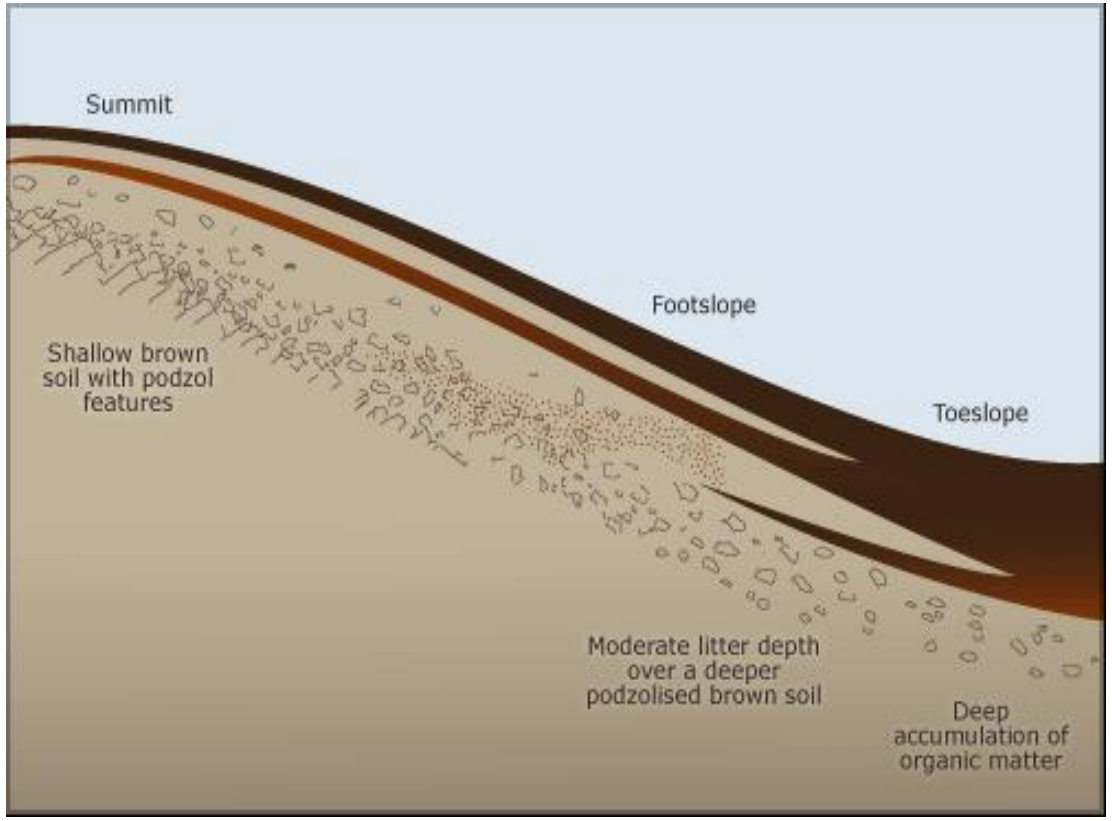
- A monument giving details of the Laterite formation over a pedestal made of laterite

- The GSI has erected a monument at Angadippuram where the laterite formations were first identified, as one of the 26 monuments declared as National Geological Monuments, on the occasion of the "International Conference on Laterization" held in 1979.[6]

A latertite section showing the top soil with the subsoil laterite hard pan which is quarried as bricks

Quarried laterite bricks which is soft beneath the soil and hardens on exposure to air



Catenary sequence of soils at different slope positions

Laterite hill slope in Varkala showing soils of side slope and toe slope

Iron stone formation-pertoplinthite

Root zone limitation


Thank You