

Clay and other minerals in the formation, management and ecosystem services of Indian tropical soils

To sustain the productivity of tropical soils is difficult because comprehensive knowledge on their pedogenetic processes and the nuances of mineralogical make up remained incomplete for a long time. Therefore, a need of a book was felt amidst the myth on the formation and clay mineralogical make up of tropical soils, in general and those in the Indian subcontinent in particular. Many such soils did experience the climate change from humid to semi-arid environments in the Holocene period and also during the Plio-Pleistocene transition period, and thus, their polygenetic history adds further challenges to soil/ earth science researchers. In India, students of pedology and pedo-geomorphology generally come across extreme difficulty in relating to examples applying the principles of soil science from textbooks devoted almost exclusively to soils of temperate climate of the west. Therefore, the format of the book is arranged for a process-oriented treatise as a reference for pedologists, allied earth scientists and soil science students and young land resource managers. The book based on review of the published literature on shrink-swell soils, red ferruginous soils and soils of the Indo-Gangetic Plain, showcases the unique role of clay and other minerals in refining some basic concepts of pedogenic processes of major Indian soil types that would help in their proper management and also highlighting their ecosystem services. The research undertaken over the last several decades on important soil/paleosols types and the sediments, demonstrates that the pedogenic clay minerals of intermediate weathering stages and pedogenic carbonates can be very useful paleoclimatic indicators. Climatic change towards aridity is a bane because this has caused soil degradation in terms of depletion of organic carbon, pedogenic formation of CaCO_3 with concomitant development of sodicity. Also, the role of palygorskite clay mineral as indicator of natural soil degradation is understood. Research efforts on Indian soils explain the cause-effect relationship of the degradation, and provide enough insights as to how the remedial measures are to be invented including the role of pedogenic CaCO_3 , geogenic Ca-zeolites and gypsum as soil modifiers in making degraded soils resilient and also enabling them to be ecosystem service providers in agricultural land uses. Book chapters help to improve the basic understanding on the role of interstratified clay minerals, kaolin, in particular and the short-range order minerals in organic carbon sequestration and also updates why the formation of Oxisols from Ultisols is an improbable genetic pathway in tropical environment of India and elsewhere. This information strongly suggests the need in modification of the mineralogy class of highly weathered red ferruginous soils, and dispels the long-standing myths on the formation of tropical soils and their low fertility by putting in context their characteristics and capacity to be productive. From the few examples cited in book, it is evident that unless the mineralogical description is accurate enough for the purpose intended, it would not be prudent to look for their inherent roles in pedogenetic processes, carbon sequestration, soil sodicity development and climate change research. With the use of qualitatively superior mineralogical database including that of nano-clays, a new knowledge is now developed that would explain discreetly many unresolved issues of pedology and edaphology, especially its significant role in enabling the soils as an efficient ecosystem service provider to perform as sustainable medium for plant growth.