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To Study on Soil Nutrient and Physico-Chemical Analysis of Soil in Bar-Phatakhera-Raipur Section of Pali District, Rajasthan, India.

KEYWORDS Soil enriching, soil nutrient, rock material, Delhi Supergroup, Pali district, Rajasthan.

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ABSTRACT *The main constituents of soils are minerals and organic matter, which are produced by breaking up the rock particles. The soil enriching with organic matter from aerial and subterranean parts and are influenced by biological activities. The role of the vegetation is relatively less in arid zones because of the scanty sparse canopy cover and the poor development of aerial parts but the root systems often exhibit exceptional development and have the greatest influence of the cracking of the rocks influencing soils formation processes. The parent rocks had definite relation with the soil nutrient and material which supports the vegetations. But in western Rajasthan the studies of relation between parent rock material and soil and further correlation of these aspects with different types of vegetations e.g. herbs, shrubs and trees supported by the soil is quite deficient. The present paper, therefore, highlights by the fact that the vegetations including herbs, shrubs and trees and most importantly the herbaceous vegetation vary from soil to soil depending upon minerals present in the soil and these minerals are derived from the parent rock materials. The present investigation may bridge this gap in the Aravalli hill ranges occurs in semi arid region. Therefore, the objective of this paper are i) to study the type of soils formed under the influence of parent rocks found in and around the Bar region of Delhi Supergroup; and ii) to investigate nutrient availability and different characters in soil for finding out its relation with the different type of vegetations it supports. River sands, gravels, cobbles, pebbles, and boulders are the main and chief sources of soil.*

The unique desert and semi-desert locations of Rajasthan having difficult geoenvironment and particular kind of cultural and economic aspects makes it a distinct and characteristic state. Rajasthan is a predominantly mountainous as well as desert state and is home to many endemic, endangered and threatened species, which affects the socio-economic condition of the existing natives of the state. Great diversity in climate and wide variety of topography has further distinguished Rajasthan from other states. The lifestyle of the people is purely rooted in the traditional values. Rajasthan is also well known for its rich culture, lifestyle and natural resources.

The roads and highways along the road sides and river valley slopes innumerable rock cutting and open cast mining generated granules and debris, occurring in the form of soil and fine clay. Heavy vehicles etc generation micro-seismic waves which add to the instability of the soil particles which are already unstable due to road cutting. Devastating results occurred during rainy season, water flows on the surface and simultaneously penetrated inside the fractures, pores, cavities and fissures. These structures are formed with partial dissolution and erosion of rocks. Agriculture is common land use of the area, mostly of single crop nature in Dipawas and in Lawacha villages. Double crop areas are found in patches especially in Phatakhera and Kalab Kalan villages. There are two major categories present as wasteland i.e. "Land with scrub" and "Land without scrub". Whatever reserve forest area left over is confined around Kalab Kalan village i.e. Bagri Kalaliya Reserved Forrest. It is huge reserved forest but a very limited investigated area is under the forest cover in the region. These are subsidiary trophic i.e. full of nutrition type of dry tropical forest that are widely scattered over hillocks and ridges, Beena and Singh (2015). To prevent erosional processes plantation has been done on Kalab Kalan hills by the Department of forest, Government of Rajasthan, India.

Geology of the area
The rocks of Bar-Phatakhera- Raipur area of Pali district are included under three main tectonic divisions of Delhi Supergroup from southwest to northeast viz. Banded Gneiss Complex (BGC of Heron, 1953), Barotia Formation (Alwar Group) and Sendra Formation (Ajabgarh). All the three tectonic divisions are well displaced in the study area. The BGC is made up of Precambrian basement in the southwestern side and the lower most tectonic unit of the area. It is separated from the overlying rock of the Barotia Formation with an unconformity (Gangopadhyay, P.K. and Lahiri, A. 1983).

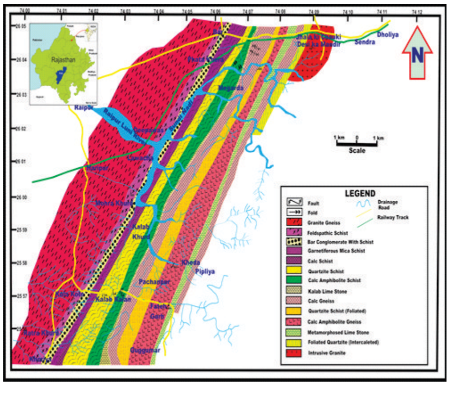

Fig. GEOLOGICAL MAP OF BAR-PHATAKHERA-RAIPUR SECTION OF PALI DISTRICT (RAJ)

Mineral Content of Soil
Gupta (1958) studied on the desert sands of Rajasthan and found a varying amount of easily weatherable minerals, such as, hornblende, feldspars, kyanite and mica, which seemed to be Aeolian in origin. The clay minerals in the soil of Rajasthan contain illite (mica, smectite, vermiculite, kaolinite and chlorite). In this, first four are dominated in sandy soils, whereas grey loam soil contains attapulgite as the additional mineral (Table 1).

While working in Yamuna alluvial plain, Haryana Shanwal et al. (1989) found mica is the predominant in soil followed by kaolinite, chlorite, vermiculite and smectite in a decreasing order. They considered that the presence of fibrous mineral was due to aeolian material from Rajasthan and not as alluvial

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deposit of Yamuna River. Kasser et al. (1979) studied sands of red soils and found quartz as the dominant whereas light pink colour feldspars occurs as a accessory mineral, and opaque pyrobols and epidots in large amounts; zircon, rutile, tourmaline and staurolites were observed in moderate amounts.

Soil Nutrients

The parent rock mineralogy and the nutrients available in soils are in strong relationship. High magnesium availability in soils is related with the alteration products of the ultramafic rocks. Potassium content of the soils exhibits no relation with the geology of the area. Micronutrients iron and manganese, shows strong dependence to the bulk chemistry and mineralogy of the parent rock material. According to the study of Moraetis et al. (2006) the parent rock bulk chemistry and mineralogy affects the Mg^{2+} availability in the soils. An oversupply of Mg^{2+} in soil solution appeared in areas underlain by ultramafic parent rock. Potassium availability did not exhibit any correlation with the bulk chemical analysis and the mineralogy of soil. In contrast, it showed good correlation with the particle size distribution and specifically with soil clay content. The input and output of magnesium and potassium was strongly related with the availability of these elements in vegetation. Also, the availability of important micronutrients such amanganese and iron followed the bulk chemical analysis and the mineralogy of the soil zinc and copper showed no correlation with the chemistry and mineralogy of the different types of soils.

Nutrient concentrations in plants are usually correlated with nutrient availability in the soil. Nutrients concentrations are predicted to be higher in understorey than open-grassland plants. Garcia-Moya and McKell (1970) found that shrubs helped maintaining the pool of soil nutrients in desert ecosystem by creating islands of accumulation of organic matter. Tiedmann and Klemmedson (1973) studied soil profiles under the canopy zone soil of Mesquite tree (*Prosopis juliflora* (Swartz) DC.), and compared it with the soil from adjacent openings at three depths near Tuscon, Ariz. Bulk density was lower in soil under Mesquite but increased with depth in that location. Organic matter, total nitrogen, total sulphur and total soluble salts were up to three times greater in the surface 0-4.5 cm of mesquite soil than in open soil but declined with increasing depths to the level approximately the same as in the open soil. Total potassium was higher under mesquite but increased with depth. Total phosphorus and hydrogen ion concentration were the same as in soil from open areas. Results suggested that mesquite trees function to improve soil condition under their canopies by redistribution of nutrients from areas beyond the canopy to areas beneath the canopy. Bernhard-Reversat (1982) observed good correlation between total carbon and nitrogen in soil under *Acacia Senegal* and *Balanites aegyptiaca* tree canopies and tree girth. Soil nutrients changed with time of woody plant occupancy of a patch. In Africa and Australia, nutrient accumulation in patches of the landscape is generally looked on favourably, since it raises the nutrient content at least some of the grass above the threshold for digestion by ruminants (Scholes, 1990). Soil nutrients concentrations tend to diminish with increasing soil depth but there is increased evidence of a large reserve of nitrate-nitrogen at depth in groundwater in arid zone. Edumunds et al. (1992) found NO_3-N concentrations as high as 2.8 g L^{-1} in interstitial waters of unsaturated sediments in Sudan.

Average value of soil available PO_4-P, NH_4-N and NO_3-N were 15.27 mg kg^{-1}, 3.09 mg kg^{-1} and 2.18 mg kg^{-1}, respectively across the sampling sites and soil layers (Table 6). Irrespective of soil layers, available PO_4-P ranged from 10.59 mg kg^{-1} at Kalab Kalan I to 18.78 mg kg^{-1}, whereas available NH_4-N ranged from 2.12 to 2.03 mgkg^{-1} at Bar I and 5.09 mg kg^{-1} at Bar II. Available NO_3-N ranged from 1.6 mg kg^{-1} at Bar I to 3.06 mg kg^{-1} at Raira Khurd I. While averaging sites for soil layers, all these soil nutrients showed their higher concentrations in top soil layer as compared to the deeper soil layers and showed a decreasing trend towards deeper soil layers. However, at Dipawas I the PO_4-P availability was relatively greater in deeper soil layers as compared to the top soil layer.

Table 1: Clay mineralogy of soils of Rajasthan

Name of soil	Clay minerals (in order of dominance)
Dune Soil	Illite (Mica), Smectite, Vermiculite, Kaolinite
Sandy plain soil	Illite (Mica), Smectite, Vermiculite, Kaolinite
Grey brown loams	Illite (Mica), Smectite, Vermiculite, Kaolinite, Attapulgite, Kaolinite (in traces)
Grey Brown loams	Illite (Mica), Smectite, Vermiculite, Kaolinite, Attapulgite,
Borwn soil	Smectite, Illite (Mica), Vermiculite, Chlorite, Kaolinite
Younger alluvial plain soil	Illite (Mica), Vermiculite, Chlorite and Kaolinite
Medium black soil	Smectite, Illite, Kaolinite

(Source: Dhir and Singh, 1985)

Table 3: Soil nutrients at the site selected for the vegetation study around Bar area of Pali District.

Sampling site	Soil depth (cm)	Soil nutrients (mg kg^{-1})		
		PO_4 – P	NH_4 – N	NO_3 – N
Bar I	0-15	17.80	2.12	1.11
	15-80	19.76	2.03	0.98
Bar II	0-30	8.93	5.28	1.98
	30-75	12.60	5.14	1.62
	75-100	17.35	4.88	1.09
Dipawas I	0-10	11.05	4.31	3.35
	10-30	8.93	3.89	1.91
	30-80	15.76	3.24	2.01
Dipawas II	0-25	20.44	4.81	2.48
	25-80	10.60	4.11	1.87
	80-100	13.19	3.60	1.95
	100-110	11.32	3.40	1.85
Kalab Khurd I	0-10	19.44	4.94	3.94
	10 -50	11.93	4.38	1.53
	50-70	8.59	2.54	2.43
Kalab Khurd II	0-10	13.8	3.63	1.43
	10-180	12.3	2.99	1.31
Kalab Kalan I	0-60	10.59	3.43	2.29
Kalab Kalan II	0-20	21.15	4.51	3.28
	20-40	13.56	3.01	2.05
	40-70	14.91	1.84	0.68
Kalab Kalan III	0-30	18.17	2.31	3.09
	30-60	19.10	2.72	2.85
	60-90	14.26	2.12	1.85
	90-180	12.36	2.16	1.98
Raira Khurd I	0-10	17.03	5.04	4.04
	10-50	16.60	4.04	2.08
Raira Khurd II	0-10	17.07	3.86	2.51
	10-100	16.24	3.44	1.64
	100-140	13.26	2.40	1.28

CONCLUSION

The natives and relating to the indigenous inhabitants of the Bar, Phatakhera and Raipur area of Pali district faces adverse challenges of climatic conditions along with some specific aspects related to market on rock types and soils which are used as a building material and different mineral deposits. Granite, dolomite, limestone, quartzitic schist and Bar conglomerate mica schist that may be utilized for making tiles, slabs and pillars, which are in demand in rural and urban areas. In addition soil, sand, concrete, cobble, pebble and boulders are already being utilized for masonry works and giving a good revenue.

Garnet, emerald and beryl are favorite semi precious stones for the local residents. Almandine garnets are available as valuable

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deposits in pegmatite veins which are very well exposed in the investigated area. Fertilizer plants and refractory units may be established on the basis of dolomite and kyanite mineralization. Limestone may be used in cement plants and calcium carbide manufacturing units which are well exposed in Fatehgarh and Kanuja villages.

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