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RESEARCH ARTICLE

SOIL CHARACTERISTICS AND NUTRIENTS AVAILABILITY AROUND LAWACHA-MOHRA KHURD SECTION OF PALI DISTRICT, RAJASTHAN, INDIA

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ABSTRACT

Chemical weathering breaks up the physically disintegrated rock fragments and organic matter. The process of chemical weathering in arid regions is not fast because of water deficiency. The present study was undertaken on soil contamination in Lawacha-Mohra Khurd section of Pali district, Rajasthan. The aim of the study was investigate the pollution of soil, which is a source of danger to the human and animal kingdom. The polluted soil also damages the nutrient availability along with quality of soil is also diminishing. Various inorganic soil samples were collected from different locations. In laboratory these samples of soil were analyzed to measure various chemical parameters by standard methods such as pH, electrical conductivity and % of organic carbon (OC) were determined. During the course of the study periods, fluctuation in the various parameters was observed due to unequal distribution of different minerals constituents present in the soil. These constituents in soil are produced by breaking up the rock particles and enriching with organic matter from aerial and subterranean parts, also influenced by biological activities. The role of the root systems often very important because it exhibit exceptional development and have the greatest influence of the fracturing in the rock formations producing soils rather than vegetation. Therefore, the objective of this paper is to study the different characteristics of soils around Lawacha-Mohra Khurd region of Delhi Super group and to investigate nutrient availability in different types of soil for finding out its relation with the different type of vegetation it supports.

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INTRODUCTION

A retail store is the last component in the distribution channel. It is a repeated discussion once again in unambiguous terms that we depend on minerals and their productions innumerable times in our daily needs and there seems no possibility of controlling our necessities for them. 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. Anomalous wastage of mineral resources has drawn the attention of environmentalists, geologists and biologists for a long time because they concerned with improving the quality of the environment.

Geology of the area

The rocks of south western side of area include granitic gneisses which are intruded by posts-tectonic dikes, sills, and pegmatites veins. Igneous intrusive activity, especially acidic, is widespread in Lawacha and Haripur and its immediate vicinity. The faint impressions of granitization are also present in the form of veins and boudins, however, not as well marked rock formations. These veins indicate the presence of intrusive activity in the region, as also noticed by Naha *et al.* (1984), these veins bear tourmaline, garnet, beryl etc. The study area included 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 Roy *et al.* (1985). It is separated from the overlying rock of the Barotia Formation with an unconformity (Gangopadhyay and Lahiri, 1983). The Barotia Formation consists of Bar conglomerate horizon, Calc amphibolite schist, Quartzitic schist and Calc-schist with intercalated Quartzite schist. Bar conglomerate horizon is further divided into Quartzofeldspathic schist, Bar conglomerate schist, Garnetiferous mica schist, Staurolite schist and Kyanite schist. The overlying Sendra Formation constitutes the northeastern part of the study area. Dolomite (equivalent to Nandana crystalline limestone of Heron, 1953)

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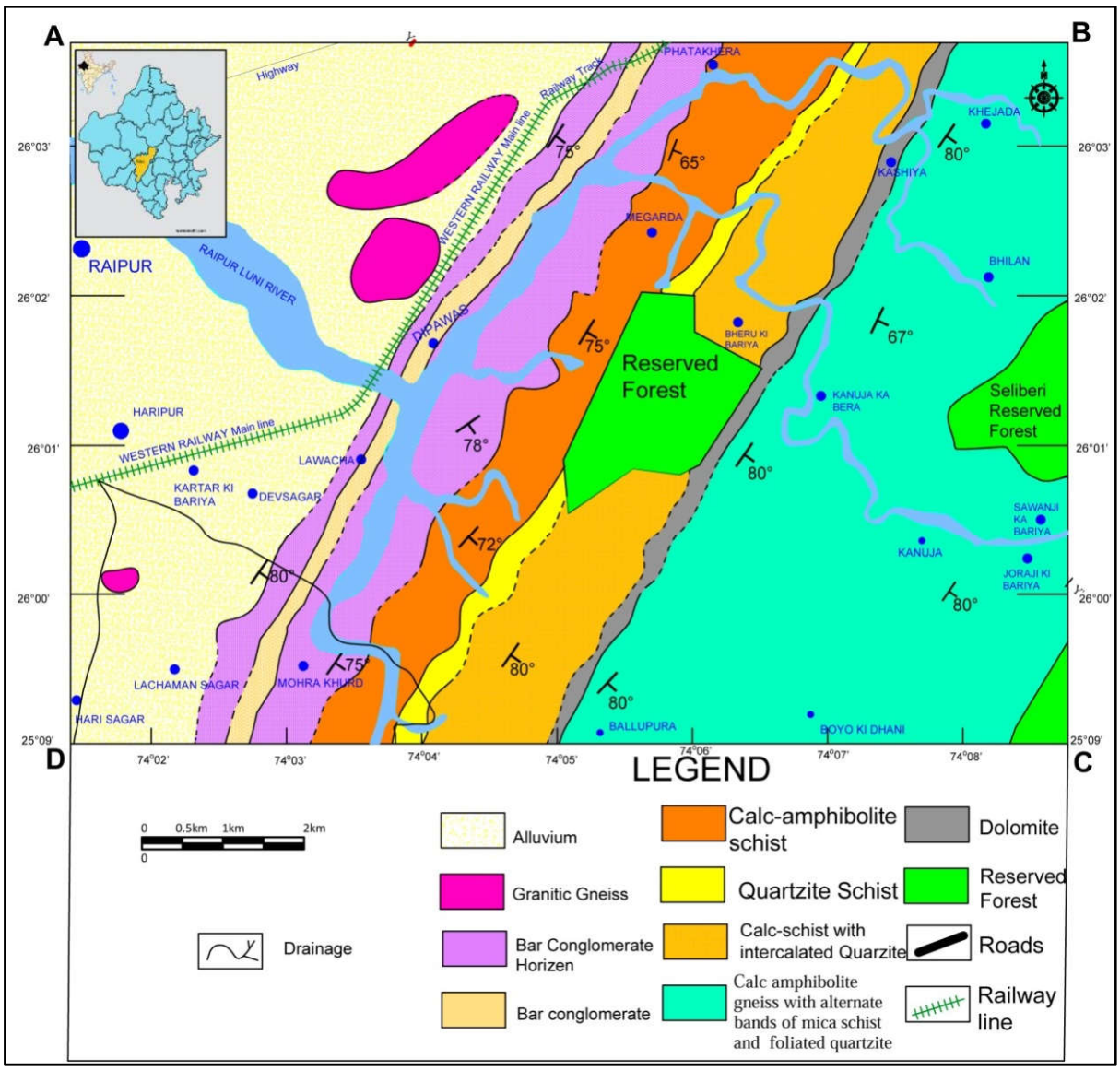

Fig. 1. Geological map of Lawacha-Mohra Khurd section of Pali District (Raj)

eparates the Sendra Formation from the underlying Barotia Formation conformably. The Sendra Formation is constituted of mostly gneisses with alternate bands of mica schist and foliated quartzite Beena *et al.,* (2015).

Mineral Content of Soil

Soil samples were collected in well cleaned polythene bags and after then wrapped in a cotton bag and write down the details of the samples on the cotton bag with help of water proof marker pen. In laboratory these samples were analyzed to measure various chemical parameters by standard methods. The biological and chemical activities are the main sources for enriching the soil. In desert sands of Rajasthan varying amount of weathered minerals are easily found, such as, hornblende, feldspars, kyanite and micas, which seemed to be aeolian in origin and are dominated in sandy soils. The common clay minerals in the soil contain illite which contains mica, smectite, vermiculite, kaolinite and chlorite Gupta (1958). There is a strong relationship present in between parent rock mineralogy and nutrients available in soils. 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 mineralogy affects the Mg^{2+} availability in the soils. An oversupply of Mg^{2+} along with iron, calcium, sodium and aluminum present in soil solution appeared in areas underlain by amphibolite schist and amphibolite gneiss. Less quantity of 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 magnesium and iron etc. was strongly related with the availability of these elements in vegetation.

The availability of important micronutrients such manganese and calcium also followed the bulk chemical analysis and the mineralogy of the soil. 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.

Table 1. Soil nutrients at the site selected around study area of Pali District

Sampling site	Soil depth	Soil nutrients (mg kg^{-1})		
	(cm)	$PO_4 - P$	$NH_4 - N$	$NO_3 - N$
Lawacha 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
Lawacha 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
Mohra Khurd I	0-60	10.59	3.43	2.29
Mohra Khurd 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
Mohra Khurd 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

Table 2. Soil characteristics and Physico-chemical properties of Lawacha and Mohra Khurd area of Pali District

Sampling site	Depth (cm)	Gravel content (%)	Soil content (%)			Texture	pH	EC	OC
			Sand	Silt	Clay			(dSm^{-1})	(%)
Lawacha I	10-30	58.50	34.55	2.42	2.42	Sand	7.55	0.12	0.52
Lawacha II	00-30	59.54	35.24	2.40	2.82	Sand	7.26	0.07	0.75
Mohra Khurd I	00-60	43.12	44.93	6.85	5.13	Loamy sand	7.50	0.11	0.22
Mohra Khurd II	10-100	52.00	32.50	5.12	4.60	Loamy sand	7.38	0.14	1.15
Mohra Khurd III	25-45	76.75	52.50	6.20	6.00	Sand	7.05	0.06	0.44

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 and 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 14.1769 mg kg^{-1}, 3.3355 mg kg^{-1} and 2.2286 mg kg^{-1}, respectively across the sampling sites and soil layers (Table 1). Irrespective of soil layers, available PO_4-P ranged from 10.59 mg kg^{-1} at Mohra Khurd I to 18.78 mg kg^{-}. The 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. At Lawacha I the PO_4-P and NH_4-N availabilities was relatively greater in different soil layers as compared to the soil layers at Lawacha II. However, at Lawacha I the NO_3-N availability was relatively greater in different soil layers as compared to the soil layers at Lawacha II (Table 2). Arid land spread over on the western side of Aravalli is almost flat encountering heaps of sand as soil. Inorganic minerals and organic matter of different chemical compositions are the main constituents of soils. The process of soil formation by breaking up the rock particles and enriching the soil with organic matter from aerial and subterranean parts are influenced by different geological and biological activities Ashok et al (2013). The naturally occurring different soils have played a dominant role as possible mineral resources in the future. The soil of the investigated area is of sandy and loam type with medium grained texture. The parent rocks had definite relations with the soil materials/nutrient and the vegetation it supports. But the studies on relation between parent rock material and soil and further correlation of these aspects with vegetation supported by the soil is lacking in western Rajasthan. This study therefore highlights by the fact that the vegetations vary from soil to soil depending upon minerals present in the soil and these minerals are derived from the parent rock materials.

Conclusion

Land, vegetation, minerals and drinking water are the basic natural resources for existence, survival and progress of the human society. Any country that wants to grow its economy and improve living standards must secure robust and vigorous supply mineral resources. Increasing population, urbanization and industrialization are exerting relentless pressure on the supply of mineral resources and drinking water as well as energy all over the world. Our future generations along with indiscriminate mining of large amount of ores, rocks, minerals, placer deposits and soil for domestic, commercial and industrial purposes create unfortunate results for coming races and developed a sence of insecurity worldwide. The human, industrial activities, quarrying and mining etc, which emit

several toxic chemicals such as nitrogen oxide, sulfur dioxide, carbon dioxide, carbon monoxide, volatile organic compounds etc, pollute the atmosphere in which we all live. Sometimes a small number of naturally occurring minerals give off invisible radiation as they gradually decay into a more stable form. Now the time has come to prevent the natural resources and control the unnecessary utilization on modern comforts and luxuries for the sake of economic development of our country. The main purpose of this paper is to protect the vulnerability of the human society all over the world and also developed the other options concerning management of the water and mineral resources, otherwise future generations give penalties for no reason. The present paper, therefore, highlights by the fact that the vegetations vary from soil to soil depending upon minerals present in the soil and these minerals are derived from the parent rock materials.

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