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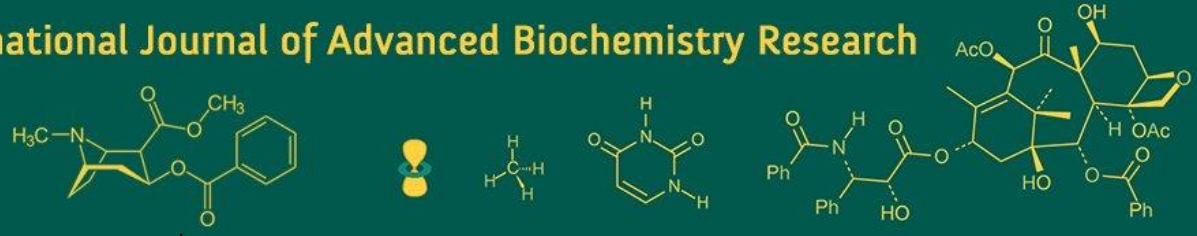

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Bhupendra Singh
Department of Silviculture and Agroforestry, College of Horticulture and Forestry, Agriculture University Kota, Kota, Jhalawar, Rajasthan, India

SBS Pandey
Department of Silviculture and Agroforestry, College of Horticulture and Forestry, Agriculture University Kota, Kota, Jhalawar, Rajasthan, India

Aditya Kumar Jayant
Department of Silviculture and Agroforestry, College of Horticulture and Forestry, Agriculture University Kota, Kota, Jhalawar, Rajasthan, India

Corresponding Author:
Bhupendra Singh
Department of Silviculture and Agroforestry, College of Horticulture and Forestry, Agriculture University Kota, Kota, Jhalawar, Rajasthan, India

Physico-chemical analysis of forest soil of Baran forest division-Rajasthan

Bhupendra Singh, SBS Pandey and Aditya Kumar Jayant

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Abstract
For proper environmental supervision and resource consumption, research on the nature and characteristics of soil in forest ecosystems is essential. The physico-chemical characteristics of soils in various forest microsites of the Baran forest division are of interest in the current scientific research, which is a review. The findings show that all of the Baran forest division's chosen sites have medium or high mineral contents. The pH ranged from 6.89 to 7.05, and the highest amount of organic carbon, 3.27 percent, was found at Site-IV. At a depth of 0 to 30 cm, Site-V had the highest value of available nitrogen (405.20 kg/ha), and Site-II had the lowest value of available nitrogen (355.20 kg/ha).

Keywords: Ecosystems, microsite, forest, soil properties, natural resources

Introduction
Forests are considered a complex ecosystem because they are primarily composed of trees, shrubs, and climbers, have a closed canopy of plants, and are the natural repository for a wide range of life forms such as plants, animals, birds, insects, reptiles, and microorganisms (Singh *et al.*, 2018) [14].

One of the most vital natural resources is soil, which makes up the top layer of the earth's crust and serves as the basis for all life on the planet. A thin layer of the earth's crust is referred to as soil and serves as a natural medium for plant growth. Soil has different morphological, physical, chemical, and biological characteristics than its parent substance. The components of soil, whose ratios vary and together form a system for plant growth, are mineral matter, organic matter, water, and air. The most significant non-renewable resource for people's food and means of subsistence in rural or tribal areas is soil. Maintaining and enhancing soil quality is of utmost importance in a developing nation like India where the majority of the population still relies on agriculture and forests. Plant growth is directly correlated with healthy soil functions. Physical and chemical properties make up soil characteristics, and the distribution and ratio of these properties typically determine how a soil behaves. The use of a soil is specifically determined by the ratio and percentage of its chemical and physical properties (Subba and Chakraborty, 2015) [15].

Topography, climate and study area
The Sehariya tribe is one of the tribes in the Baran district. Sehariya Basti is the name given to about 283 villages in the Kishanganj, Shahbad, Atru, and Mangrol Tehsils, where Sehariyas make up about 90% of the population. A study estimates that there are 80,000 Sehariya. It is situated at a height of 265 meters above mean sea level. In this district, the rivers Kalisindh, Parwati, Andheri, Banganga, and Parwan flow from south to north. Maximum and minimum temperatures are respectively 48.6 °C and 10.6 °C. 873.80 mm of rainfall is typical. Rainfall is typically concentrated from July to September and follows a monsoon pattern. In the months of April, May, and June, just before the monsoon season, there are drought-like conditions. (*Anon*, 2015) [1, 2].

The Baran Forest Division in Rajasthan served as the site of the current study. The Baran district is located in Rajasthan State between 72°12' and 76°26' E longitude and 24°25' to 25°25' N latitude. The state of Madhya Pradesh borders the Baran District to the northeast. South Jhalawar and North West Kota District. The district has a total area of 6992 square kilometres, of which 6909.82 square kilometres are rural and 82.18 square kilometres are urban.

A total of 2239.31 square kilometres, or 32.20 percent of the district's geographic area, are currently covered by forest. In terms of the amount of forest cover, the district ranks second. The Baran forest division is reportedly represented in group 4 - dry tropical forest - by Champion and Seth in 1962 (*Anon*, 2015) [1, 2].

Table 1: General characteristics of the study sites

Site No.	Site name	Character	GPS readings		Soil texture class
			Starting	Ending	
	Around Naka	Plane	25^0 12' 13.06"N 77^0 07' 51.21"E	25^0 12' 22.20"N 77^0 07' 46.57"E	Sandy loam
II	Bansthooni	Rocky	25^0 04' 47.60"N 76^0 42' 27.74"E	25^0 04' 51.92"N 76^0 42' 38.79"E	Clay
III	Butea Valley	Slope	25^0 14' 30.54"N 77^0 09' 31.00"E	25^0 14'28.45"N 77^0 09' 27.89"E	Sandy
IV	Kunda Kho	Highly slope	25^0 13' 18.45"N 77^0 07' 48.27"E	25^0 13' 21.68"N 77^0 07' 50.09"E	Clay
V	Shahbad Upland	Upland	25^0 14'24.71"N 77^0 09' 31.72"E	25^0 14' 27.87"N 77^0 09' 33.05"E	Sandy loam
VI	Toll Left	Undulate	25^0 12' 56.30"N 77^0 08' 20.01"E	25^0 12' 58.62"N 77^0 08' 18.90"E	Sandy loam
VII	Toll Right	Plane	25^0 12' 24.62"N 77^0 08' 25.31"E	25^0 12' 51.58"N 77^0 08' 30.60"E	Clay

Materials and Methods

Representative soil samples were combined, and they were then dried out in the air, to measure the physico-chemical characteristics of the soil in the Baran forest division. To prevent metallic contamination, the sample was ground using a wooden mortar and pestle and put through a 2 mm plastic sieve. From each sample, 100 g of soil was taken, and 300 ml of distilled water was added to make 1:3 soil water suspensions. After a thorough shake, the suspension was left overnight. The remedy underwent filtering. Additional evaluation of soil filtrate was conducted in the soil science lab at the College of Horticulture and Forestry, Jhalawar. Major physico-chemical soil quality parameters such as moisture (%), texture class, bulk density (g/cc), pH, electrical conductivity (dS/m), organic carbon (%), and available N, P, and K (Kg/ha) were examined in the collected soil samples.

Table 2: Show Parameters and Method/Instrument used for determination

Parameters	Method/Instrument used for determination
pH	pH meter
EC (dS/m)	Digital conductivity meter
Bulk density (g/cc)	Wax coating method
Moisture (%)	Gravimetric method (Jackson, 1973) [4]
Texture class	Hydrometer
Organic carbon (%)	Colorimeter (Walkley and Black's, 1954) [18]
N (Kg/ha)	Alkaline potassium permanganate method (Subbiah and Asija, 1956) [16]
P (Kg/ha)	Spectrophotometer
K (Kg/ha)	Flame photometer (Meston, 1956) [9]

Table 3: Soil properties in different sites of Baran Forest division

Sites	pH	Sand (%)	Silt (%)	Clay (%)	Texture class	Moisture (%)
Site-I	7.05	50.87	17.44	31.69	Sandy loam	5.45
Site-II	6.94	61.30	12.02	26.68	Clay	4.93
Site-III	7.00	74.44	6.05	19.52	Sandy	7.41
Site-IV	6.98	68.78	11.62	19.60	Clay	7.79
Site-V	6.89	72.01	10.69	17.29	Sandy loam	2.50
Site-VI	7.01	76.71	8.82	14.46	Sandy loam	5.80
Site-VII	6.96	62.44	10.09	27.46	Clay	7.20
CD at 5%	NS	11.23	4.07	9.57		1.29

Table 4: Soil properties in different sites of Baran Forest division

Sites	E.C. (DS/m)	B.D (g/cc)	Organic carbon (%)	Available Nitrogen (kg/ha)	Available phosphorus (kg/ha)	Available potassium (kg/ha)
Site-I	0.27	0.97	2.79	373.20	54.20	418.40
Site-II	0.30	0.97	0.37	355.20	47.20	426.40
Site-III	0.38	1.04	3.11	391.40	52.80	508.20
Site-IV	0.19	1.06	3.27	376.40	38.40	482.60
Site-V	0.26	1.00	2.36	405.20	46.60	384.60
Site-VI	0.21	0.99	2.71	385.20	47.20	456.00
Site-VII	0.21	0.98	1.37	374.40	43.40	470.80
CD at 5%	0.05	NS	0.48	NS	NS	47.51

Results and Discussion

The maximum value of soil pH *i.e.* 7.05 was recorded under Site-I at the depth of 0-30 cm and minimum pH *i.e.* 6.89 was observed under the Site-V. The significantly higher per cent of moisture content in soil was noted under the Site-IV *i.e.* 7.79 percent and minimum moisture percent was recorded under the Site-V *i.e.* 2.50 percent. The higher percentage of sand was recorded under the Site-VI *i.e.* 76.71 percent and minimum sand percent was observed in Site-I with 66.65 percent. The significantly higher percent of silt

content in soil was recorded under the Site-I *i.e.* 17.44 percent and minimum was in Site-III *i.e.* 6.05 percent. The higher per cent of clay content in soil was recorded under the Site-I *i.e.* 31.69 percent and minimum clay percent observed in the Site-VI *i.e.* 14.46 per cent (Table 3). The maximum value of bulk density was recorded under the Site IV *i.e.* 1.06 g/cc at the depth of 0-30 cm and minimum bulk density *i.e.*0.97 g/cc was recorded under the Site-I and II. The higher rate of soil EC *i.e.*0.38 DS/m was recorded under Site-V at the depth of 0-30 cm and minimum EC *i.e.*0.19 DS/m was observed under Site-IV. The significantly higher value of organic carbon was recorded under the Site-IV *i.e.* 3.27 percent which was at par with Site-III and Site-I and minimum value of organic carbon was recorded under Site-II *i.e.* 0.37 percent. The maximum value of available nitrogen was recorded under the Site-V *i.e.* 405.20 kg/ha and minimum available nitrogen *i.e.* 355.20 kg/ha was observed under Site-II. The maximum value of available phosphorus was recorded under the Site-I *i.e.* 54.20 kg/ha and minimum available phosphorus *i.e.* 38.40 kg/ha was recorded under the Site-IV. The higher value of available potassium content was recorded under the Site-III *i.e.* 508.20 kg/ha and minimum available potassium *i.e.* 384.60 kg/ha was recorded under the Site-V (Table-4).

The range of bulk density in Baran forest area is from 0.97 g/cc to 1.06 g/cc. The minimum bulk density found in Site-I and Site-II and maximum bulk density found in Site-IV. It may possibly be due to high clay contented in these protected forest areas. The range of per cent sand content was from 50.87 to 76.71 percent, range of percent silt content from 6.05 percent to 17.44 percent and percent clay content was from 14.46 to 31.69 percent. The results of present findings are supported by Sathya and Kumar, 2017; Sarkar *et al*, 2017 [19]. Moisture content was ranged from 2.50 to 7.79 percent. Site-IV retained higher moisture content while minimum moisture content was retained by Site-V. While the pH range from 6.89 to 7.05. It means the pH range from slightly acidic to slightly alkaline pH. Slightly acidic pH was found in Site-V, Site-IV, Site-II and Site-VII while neutral pH was found in Site-III and Site-VI and slightly alkaline pH was found in Site-I. The results of the present conclusion are in consonance with those reported by Verma *et al.*, 2015; Kumar *et al.*, 2012 [17, 5]. Regarding soil E.C. of different forest communities, Site-III having highest E.C. *i.e.* 0.38 dS/m, whereas, other forest communities show lesser E.C. The percent organic carbon ranged from 0.37 percent to 3.27 percent. The higher soil organic carbon percent found in Site-IV forest area *i.e.* 3.27 percent followed by Site-III *i.e.* 3.11 percent. The higher organic carbon in Site-IV may be due to dense canopies of forest trees, resulting in superior litter inputs that enrich soil organic carbon, as evidenced by the results (high density and thick humus layer of soil). The lower soil organic carbon in Site-II is a good quality indicator of tree spacing, which allows for low leaf litter inputs to the forest soil. Nitrogen levels ranged from 355.20 kg/h to 405.20 kg/ha in various major forest communities, while phosphorus levels ranged from 38.40 kg/ha to 54.20 kg/ha and potassium levels ranged from 384.60 kg/ha to 508.20 kg/ha. Phosphorus and potassium levels in Pine and Oak forests were equivalent to those reported by Kumar *et al.* (2004) [8], ranging from 9.3 to 18.2 kg/ha for phosphorus. Kumar *et al.* (2006) [7] examined soil in a variety of ways and discovered that soil organic carbon ranged from 0.47% to 0.68%, potassium ranged from 141.87 to 172.48 kg/ha, and phosphorus ranged from 9.67 to 10.67 kg/ha. SOC, nitrogen, phosphorus, and potassium content were higher than in other studies in the Garhwal Himalayan, possibly due to the highest nutrient eminence of forests as our research area occurred within a protected forest area with little pollution and very little anthropogenic disturbance. The evaluation of available nitrogen was medium to high, where phosphorus and potassium are highest, and the results agree with Kumar *et al.*, 2011; Saralch (1994), Bhola (1995), and Nayak (1996) [6, 11, 3, 10] have also investigated the degree of difference in forest soil properties caused by differences in the nutrient cycle. In all of the forest sites, there was a gradual but steady decline in the accessibility of percent soil organic carbon, nitrogen, and phosphorus toward the poorer soil layer. It could be due to insufficient aeration, microbial activity, and C: N in the subsurface soil layer. Another cause could be photo-cycling of different nutrients, i.e. deep tap root structure extracting components from the lower layer and laying them down.

Conclusion

According to the parameters measured, natural (protected) forest land systems have superior soil profiles. On the basis of findings in this study, forest soil properties can predict the dynamic nature of soil processes as well as the impact of various management practices on those processes. The physico-chemical properties of forest soil are soil superiority determinants that can play an important and vital role in the appraisal and enhancement of sustainable management of any forest area and have the capability of influencing forest efficiency (productivity). The consequence of this present study indicates that soil quality of forest is in a superior state indicating vigorous forest ecosystem. On the basis of data findings of this study, it is likely that the forest soil of the studied areas is extremely fertile and sustainable because the ecosystem of the forest is currently managed in a sustainable manner; however, numerous sampling and monitoring of these parameters is recommended because soil is dynamic and practices can change over time. Recognizing confined actors as key forest stakeholders and promoting their enclosure in forest supervision should be ensured in order to improve local livelihoods and rural development without jeopardizing forest maintenance goals and soil superiority.

Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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