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Zeba Perween

Research Scholars, Plantation,
Research and Evaluation,
Department of Forest
Environment & Climate Change
Government of Jharkhand,
Jharkhand, India

Pradeep Kumar Thakur

Research Scholars, Plantation,
Research and Evaluation,
Department of Forest
Environment & Climate Change
Government of Jharkhand,
Jharkhand, India

Nikita Kumari

Research Scholars, Plantation,
Research and Evaluation,
Department of Forest
Environment & Climate Change
Government of Jharkhand,
Jharkhand, India

Rashmi Khusboo Minz

Research Scholars, Plantation,
Research and Evaluation,
Department of Forest
Environment & Climate Change
Government of Jharkhand,
Jharkhand, India

Rachna Sunanda Kachhap

Research Scholars, Plantation,
Research and Evaluation,
Department of Forest
Environment & Climate Change
Government of Jharkhand,
Jharkhand, India

Kamlesh Pandey

Conservator of Forest,
Plantation, Research and
Evaluation, Department of
Forest Environment & Climate
Change Government of
Jharkhand, India

Corresponding Author:

Zeba Perween

Research Scholars, Plantation,
Research and Evaluation,
Department of Forest
Environment & Climate Change
Government of Jharkhand,
Jharkhand, India

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**Soil nutrients and fertility status of forest in
Latehar and Hazaribagh District of Jharkhand**

**Zeba Perween, Pradeep Kumar Thakur, Nikita Kumari, Rashmi Khusboo
Minz, Rachna Sunanda Kachhap and Kamlesh Pandey**

Abstract

Soil nutrients and fertility status of Northern Dry Mixed Deciduous (NDMD) Forest in Kutku range of Latehar district (site1) and Dry Peninsular Sal (DPS) Forest in Barkagaon range of Hazaribagh district (site2) of Jharkhand was compared. Soil samples were collected and analyzed for pH, organic carbon, available macronutrients (N, P, K) & micronutrients (Zn, Fe, Mn, Cu). Based on fertility rating for both the sites, pH of soils of both types were slightly acidic, SOC of NDMD was moderate to high while that of DPS forest it was low. Nitrogen and phosphorus content was low to medium and potassium was low in NDMD type but medium in DPS type. Iron was found high in both the forest types, zinc content was medium to high in NDMD forest and medium in DPS forest soil.

Keywords: Macronutrient, micronutrient, fertility status, nutrient index

Introduction

Forest eco-systems comprise flora, fauna and forest soils which have very complex but important interactive relationship. Soil becomes one of the important medium of regulating forest ecosystem processes of nutrient uptake, decomposition, water availability etc., which is essential for plant community. Forest and forest soils interact in a manner which creates and helps in maintaining the environment conditions including microclimate needed for agricultural productivity. Fertility status of the soils is primarily and importantly dependent upon both the macro and micronutrient reserve of that soil. The fertility status of soils can be evaluated using nutrient index methods and fertility indicators. For continuum of these positive effects for sustainability, forest and forest soils have to be properly managed. Keeping this in view, the present study is therefore aimed at evaluating the fertility status of forest soil.

Material and Methods

Study Area

Latehar district is one of the twenty-four districts of Jharkhand state. This district is part of Palamu division. It is surrounded by Ranchi, Lohardaga, Gumla, Palamau and Chatra district apart from Chhattisgarh state. It has an average elevation of 327 m (1,073 ft). The higher areas in south receive annual rainfall upto 1400 mm. but northern part of the district remains in rain shadow and receive less than 1200 mm rainfall. The district has one subdivision and seven development blocks viz. Barwadih, Manika, Balumath, Chandwa, Latehar, Garu and Mahuatn. Out of total geographical area of 4211-2508 km², forest area covers nearly 2010.2245 km² the tribal economy revolves around using forest products, by products and minor products. Kendu leaves, Bamboo and its manufactured products,

Mahua fruits, leaves, lac etc. play a role in the economic activity of the people.

Hazaribagh district comprising majority area of plateau and bounded by district Koderma in the north, Giridih and Bokaro in the east, Ranchi in south and Chatra in the west. Total geographical area of the district is 5049 sq. km area. The

district has two subdivisions and fourteen development blocks. The general slope of the district is from north-west to south east. The district receives annual rainfall of 1350 mm and more than 80 percent rainfall. Alfisols is the dominant soils covering 71.9% of TGA followed by Entisols (18.1%) and Inceptisols (7.8%).

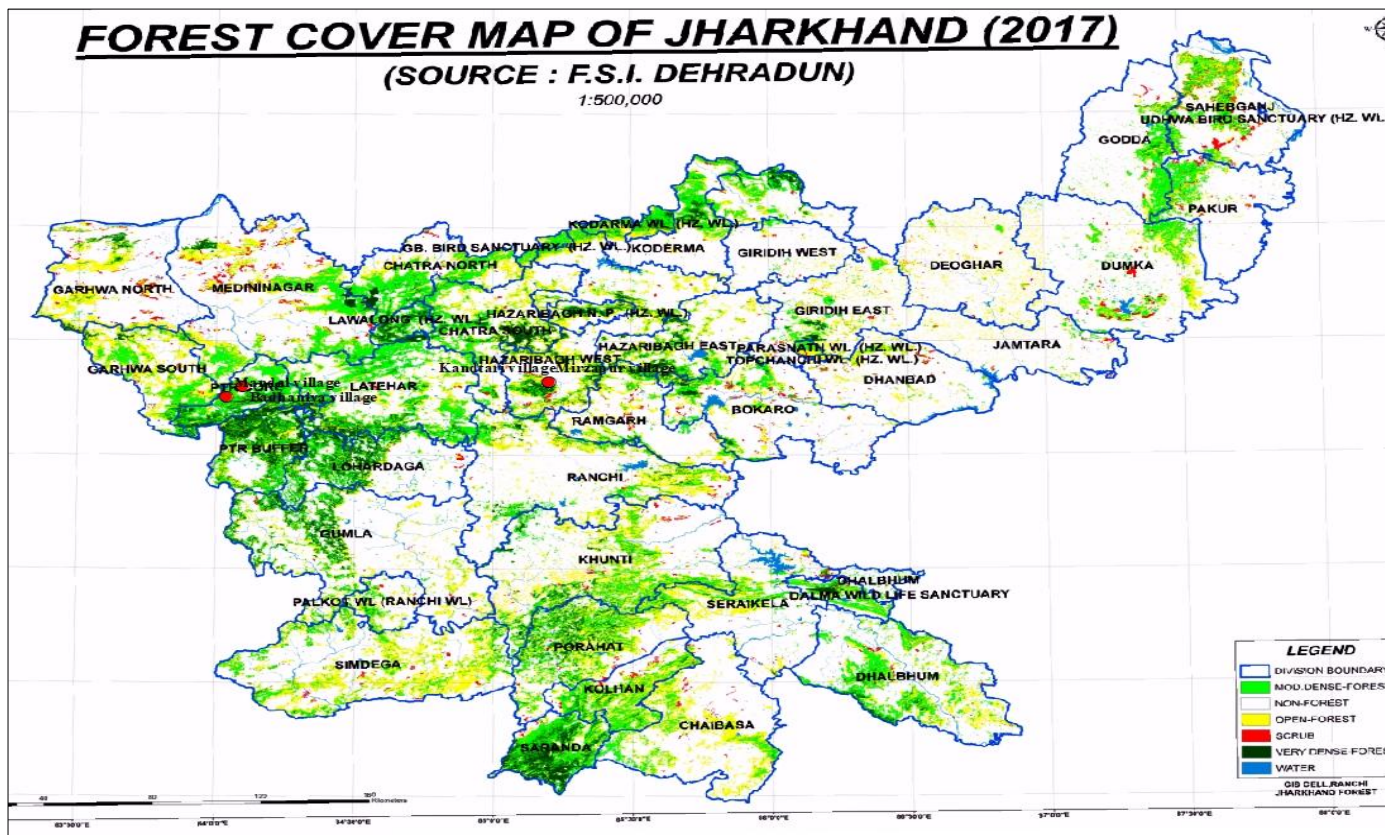


Fig 1: Location of the sampling sites in Latehar and Hazaribagh District of Jharkhand

Soil sampling and analysis

Randomly three samples were collected from forests of two villages Barhania (23°80'09.97''N / 84°09'09.13''E) and Mandal (23°74'37.33''N / 86°07'71.92''E) in Latehar (site 1), Kandtari (23°81'86.75''N / 85°19'85.54''E) and Mirzapur 23°82'01.06''N / 85°22'89.15''E in Hazaribagh (site 2), from up to a depth of 45cm–60cm with the help of hand auger. The sample locations (latitude and longitude) were recorded with

the help of a hand held GPS device. Samples were analyzed in IEM laboratory, Pundag, Ranchi, Jharkhand using standard analytical methods.

To evaluate the fertility status of forest soil, the soil quality parameters were analyzed that affect nutrient availability and calculated on the basis of specific rating chart (Table 1) modified from Brajendra *et al.*, (2014) [1].

Table 1: Rating chart for Soil Test Values and their Nutrient Indices

Soil properties	Unit	Range		
pH	pH	<6.0 (Acidic)	6.1-8.0 (Neutral)	>8.0 (Alkaline)
Organic carbon	%	<0.5 (Low)	0.50-0.75	>0.75 (High)
Available nitrogen	Kg/ha	<280 (Low)	280-560	>560 (High)
Available phosphorous	Kg/ha	<10 (Low)	10-25	>25 (High)
Available potassium	Kg/ha	<110 (Low)	110-280	>280 (High)
Zinc	mg/kg	<0.5 (Low)	0.5-5.0	5.0-20.0 (High)
Manganese	mg/kg	<10 (Low)	10-50	50-100 (High)
Iron	mg/kg	<15 (Low)	15-50	50-100 (High)
Copper	mg/kg	<0.2 (Low)	0.2-0.6	>0.6 (High)

Table 2: Nutrient Index with Range and Remarks

Nutrient Index	Range	Fertility Level
I	Below 1.67	Low
II	1.67-2.33	Medium
III	Above 2.33	High

Based on the soil test values for different nutrients, soils were classified into three categories viz low, medium and high nutrient status. Using these fertility classes as proposed by Ramamoorthy and Bajaj (1969) [2] (Table 2), Nutrient Index was calculated using the following equation:

$$\text{Nutrient Index (NI)} = \text{NL} * 1 + \text{NM} * 2 + \text{NH} * 3 / \text{NT}$$

where, NL, NM and NH are number of samples falling in low, medium and high classes of nutrient status, respectively and NT is total number of samples analyzed for a given area. Descriptive statistics in the form of mean and standard deviation (SD) were determined.

Results and discussion

The analytical results of parameters analyzed in the samples from the study areas are presented in Table 3. Soil pH or soil reaction is an indication of the acidity or alkalinity of soil. The solubility of most nutrients varies in response to pH. The study revealed that the pH values of soils of both forest types (NDMD-6.20±0.08, DPS-6.11±0.35) were found slightly acidic. The ideal pH of forest soil is acidic due to organic

matter and minerals that break down in soil overtime. Forest soil organic carbon mostly derives from decaying above and belowground plant tissues and root exudates. The study revealed (Table 3) that the organic carbon content of soils in NDMD forest has 0.81±0.19 & DPS has 0.31±0.07. Nitrogen is commonly limiting nutrient for plant growth and its availability is important to soil fertility. The available nitrogen content found low to moderate in the forest soil of both site. The level of phosphorus in soils of the study area varies from low to moderate value. Potassium is important to plants as it participates in the activation of large number of enzymes which are involved in physiological processes of plants. The potassium was found low in NDMD forest soil while medium in DPS forest soil. Iron content was high in both the forest types.

Table 3: Summary of the Statistics for Soil Nutrients in Study Area

Variable	NDMD Forest			DPS Forest		
	Range	Mean	SD	Range	Mean	SD
pH	6.09-6.30	6.20	0.08	5.40-6.23	6.11	0.35
Organic carbon (%)	0.66-1.20	0.81	0.19	0.19-0.30	0.31	0.07
Available Nitrogen (kg/ha)	219.52-564.48	313.60	131.56	125.44-344.96	224.25	82.50
Available Phosphorous (kg/ha)	10.30-14.90	12.85	1.60	1.60-13.50	5.81	4.40
Available Potassium (kg/ha)	25.10-39.10	30.21	4.86	124.80-197.80	156.86	32.52
Iron	123.63-356.2	221.60	99.54	66.22-133.42	112.45	23.92
Manganese	78.65-155.30	117.92	40.46	30.56-76.11	57.31	15.44
Zinc	1.10-4.00	2.58	1.10	1.25-3.22	2.37	0.71
Copper	1.44-5.22	3.54	1.66	1.33-4.63	3.14	1.10

NDMD: Northern Dry Mixed Deciduous, DPS- Dry Peninsular Sal

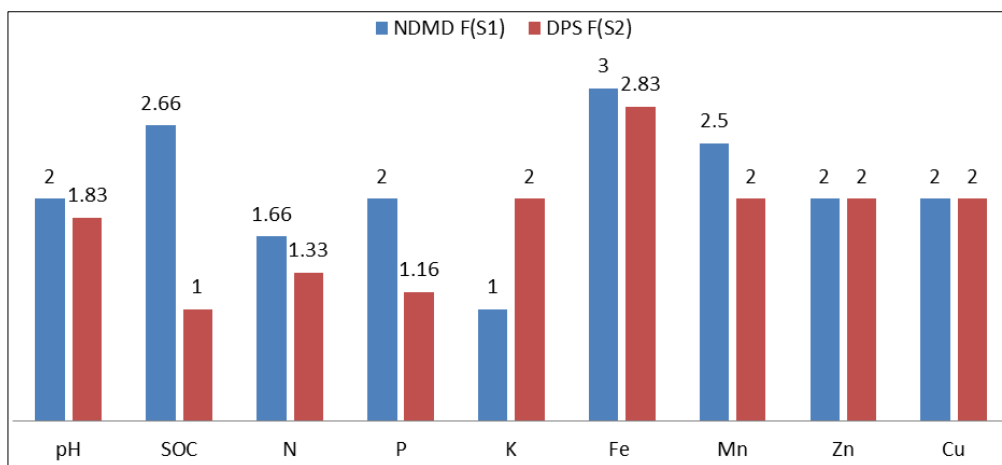


Fig 2: Soil Nutrient Index based on pH, SOC, NPK & micronutrients level for study area. (F- Forest, S1-Latehar, S2-Hazaribagh)

Table 4: Nutrient index of the study area

Variables	NDMD Forest						DPS Forest					
	Low	Moderate	High	NI Values	NI	FS	Low	Moderate	High	NI Values	NI	FS
pH	0	6	0	2	II	Medium	1	5	0	1.83	II	Medium
Organic carbon	0	2	4	2.66	III	High	6	0	0	1	I	Low
Available Nitrogen	3	2	1	1.66	I	Low	4	2	0	1.33	I	Low
Available Phosphorous	0	6	0	2	II	Medium	5	1	0	1.16	I	Low
Available Potassium	6	0	0	1	I	Low	0	6	0	2	II	Medium
Iron	0	0	6	3	III	High	0	1	5	2.83	III	High
Zinc	0	3	3	2.5	III	High	0	6	0	2	II	Medium
Manganese	0	6	0	2	II	Medium	0	6	0	2	II	Medium
Copper	0	6	0	2	II	Medium	0	6	0	2	II	Medium

NI- Nutrient Index, FS- Fertility Status

Conclusion

According to the soil fertility tests based on the calculated nutrient index of pH, SOC, available macronutrients (N,P,K)

and micronutrients, the soil of Northern Dry Mixed Deciduous Forest of Kutku Range, Latehar show high fertility status in SOC, Fe & Zn content and low in N and K content.

Whereas Dry Peninsular Sal forest soil of Barkagaon range, Hazaribagh show high fertility status in Fe content and low in SOC, N & P content.

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