International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; SP6: 495-499

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(Special Issue -6)
3rd National Conference
On
PROMOTING & REINVIGORATING AGRI-HORTI, TECHNOLOGICAL INNOVATIONS [PRAGATI-2019]
(14-15 December, 2019)

Status of Soil Nutrients and Fertility of Forest and Nearby Agricultural Land in Bokaro District of Jharkhand

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Abstract
Soil nutrients and fertility status was studied in three locations viz., forest, nearby agricultural land and control land in Bokaro, Jharkhand. Soil samples were collected from two villages- Bermo (site 1) and Pipradih (site 2) and samples were analyzed for pH, organic carbon, available macronutrients (N, P, K). Based on fertility rating for both the sites, pH of soils of forest and nearby agricultural land was slightly acidic to neutral. Soil organic carbon was significantly high. Nitrogen and phosphorus content is low to medium and potassium is medium. Soil of forest and of nearby agricultural in both the villages was found to be more fertile as compared to control land based on the calculated Nutrient Index.

Keywords: Macronutrient, Micronutrient, Fertility status, Nutrient Index

1. Introduction
Soil fertility is an aspect of the soil-plant relationship. Fertility status of the soils is primarily and importantly dependent upon both the macro and micronutrient reserve of that soil. Continued removal of nutrients by crops, with little or no replacement will increase the nutrient stress in plants and ultimately lowers the productivity. The fertility status of soils can be evaluated using nutrient index methods and fertility indicators. Forest contributes in sustainable agricultural production through the maintenance and restoration of soil fertility and soil improvement most important by organic matter maintenance, nutrient recycling and maintenance of biodiversity. Keeping this in view, the present investigation is therefore aimed at evaluating the fertility status of forest, agricultural land nearest to forest and control agricultural land of two villages of Bokaro district of Jharkhand.

2. Materials and Methods
Study Area
Bokaro district is lies in the eastern portion of Jharkhand state. It is bounded by the district of Giridih in the north, West Bengal in the south, Dhanbad in the east and Hazaribag in the west. It has an area of 2861 sq. km area. The district comprises two subdivision (Chas and Bermo) and eight development blocks viz. Chas, Bermo, Gomia, Chandankyari, Jaridih, Kasmar, Peterwar and Nawadih. The river Damodar passes through the center of the district. Other important rivers in the districts are Jamunia and Chandrapura. The general slope is from North West to south east. The average rainfall is 1570 mm. The district has climatic condition slightly different because of less elevation and less forest cover. The vegetation of the area has been considerably affected by mining and industrial activity. However scattered vegetation of

Sal, Mahua, Gamhar, Semal are observed at some places. Three soil orders namely entisols, inceptisols and alfisols were observed in Bokaro district. Alfisols were the dominant soils covering 62.0 percent of TGA followed by Inceptisols (21.4%) and Entisols (12.7%).

For the study soil samples were collected from two villages of Bokaro district namely Bermo (site 1) and Pipradih (site 2) lies in Bermo range with GPS coordinates 23˚74'37.33"N / 86˚07'71.92"E and 23˚65'43.91"N / 85˚92'25.37"E respectively. Each study site was further divided into three locations- Forest (Dry Deciduous Scrub type), nearby agricultural at 200m, 400m, 600m from forest and control agricultural land far from the forest.

Soil sampling and analysis

Randomly three samples were collected from each locations-forest (from up to a depth of 45cm – 60cm), nearby agricultural land and control agricultural land (from a depth of 0-15, 15-30cm) with the help of hand auger. The sample locations (latitude and longitude) were recorded with the help of a hand held GPS device. The samples were analyzed in IEM laboratory, Pundag, Ranchi, Jharkhand using standard analytical methods.

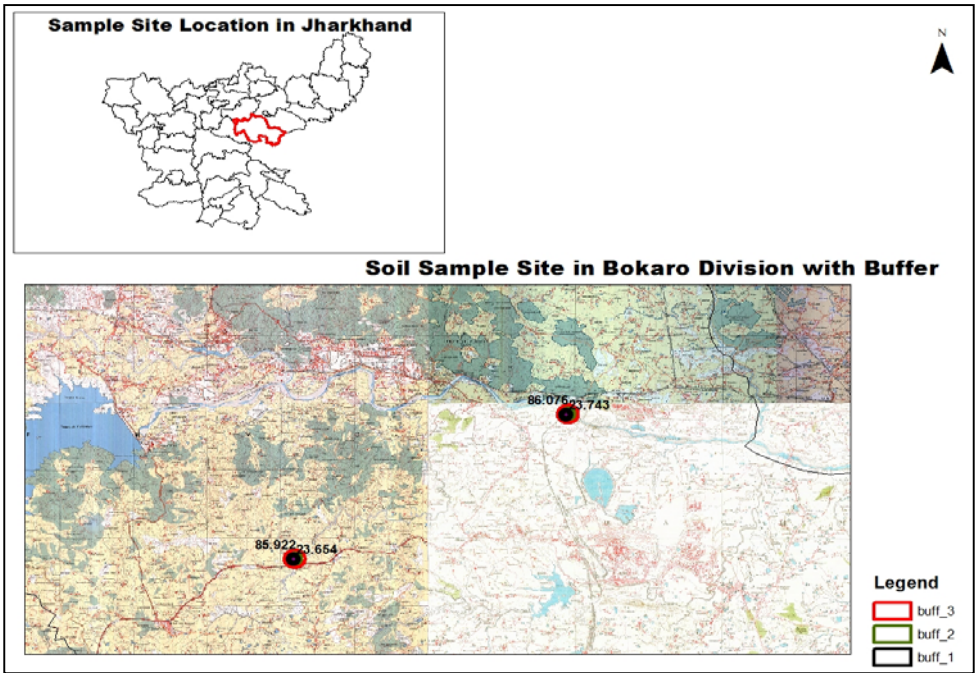


Fig 1: Location of the Sampling Sites in Bermo and Pipradih village, Bermo Range, Bokaro

3. Results and Discussion

To evaluate the fertility status of soils in the study area, the soil quality parameters were analyzed (Brajendra *et al.*, 2014) [1] that affect nutrient availability and presented in Table 1). 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 Ramamoorty and Bajaj (1969) [2] (Table 2), Nutrient Index was calculated using the following equation: Nutrient Index (NI) = NL*1 + NM*2 + NH*3/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.

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

Soil Property	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)

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

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 forest, nearby agricultural field and of control plot of the study area (Bermo and Pipradih village) found neutral. The ideal soil pH for plant growth is close to neutral. It has been determined that most plant nutrients are optimally available to plants within this pH range. On this note, it is observed that soils of study site Bokaro show potential for high nutrient availability. Organic matter has a vital role in agricultural soil, it supplies nutrient, improve water infiltration, feed soil micro flora and fauna. The study revealed that the organic carbon content of soils in the study area is significantly high. Nitrogen is commonly limiting nutrient for plant growth and its availability is important to soil fertility. The available nitrogen content found to be moderate in the study area. Phosphorus has been called the "Master key to agriculture" because low crop production is attributed mainly to the

deficiency of phosphorus. Phosphorus is essential for root growth and early ripening of the crop. The level of phosphorus in soils of the study area varies from low to moderate value. The study revealed that the phosphorus content of the study area is found to be moderate. 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 content of potassium in soils of study area is moderate but in forest soil of Pipradih was high.

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

Variable	Site	Bermo		Pipradih	
		Range	Mean± SD	Range	Mean± SD
pH	Forest	6.81-6.95	6.86±0.07	6.72-6.78	6.75±0.03
	Ag land 200m	6.69-6.75	6.71±0.03	5.63-6.95	6.133±0.71
	Ag land 400m	5.83-5.90	5.87±0.03	6.71- 6.73	6.72±0.01
	Ag land 600m	5.86-6.70	6.41±0.48	6.72-6.73	13.44±0.005
	Ag land control	6.55-6.84	6.70±0.14	6.74-6.84	6.78±0.05
Organic carbon (%)	Forest	0.55-0.88	0.74±0.17	0.76-0.89	0.81±0.07
	Ag land 200m	0.86-0.92	0.89±0.03	0.68-0.86	0.77±0.09
	Ag land 400m	0.72-0.87	0.78±0.07	0.82-1.03	0.91±0.10
	Ag land 600m	0.69-0.74	0.71±0.02	0.92-1.17	1.03±0.12
	Ag land control	0.75-0.91	0.823±0.08	1.79-1.82	1.85±0.07
Available Nitrogen (kg/ha)	Forest	260.32-277.29	270.70±9.09	288.13-470.4	365.91±94.02
	Ag land 200m	308.45-360.55	339.93±27.6	205.56-276.25	245.73±36.32
	Ag land 400m	266.54-439.04	328.61±95.8	302.67-401.76	361.67±52.18
	Ag land 600m	275.26 -324.56	292.82±27.5	307.688-439.04	357.37±71.27
	Ag land control	298.32-410.32	347.42±57.2	350.88-482.24	426.11±67.73
Available Phosphorous (kg/ha)	Forest	6.30-7.20	6.76±0.4	4.9-6.2	5.43±0.68
	Ag land 200m	6.50-11.20	9.16±2.4	3.3-5.6	4.56±1.16
	Ag land 400m	5.90-14.50	10.96±4.5	3.9-9.6	6.03±3.10
	Ag land 600m	1.7-5.40	5.45±3.7	7.5-11.2	9.8±2.00
	Ag land control	6.5-12.00	9.7±2.8	5.4-13.9	11±4.85
Available Potassium (kg/ha)	Forest	159.5-175.56	166.77±8.1	186.95-295.2	255.9±59.9
	Ag land 200m	214.5-223.5	218.86±4.5	121.3-185.6	147.76±33.62
	Ag land 400m	122.6-188.6	146.69±36.4	185.6-	216.03±1.40
	Ag land 600m	125.8-233.5	193.2±58.7	215.6- 223.1	224.4±9.51
	Ag land control	221.3- 233.3	228±6.10	217.6-220.6	218.8±1.58

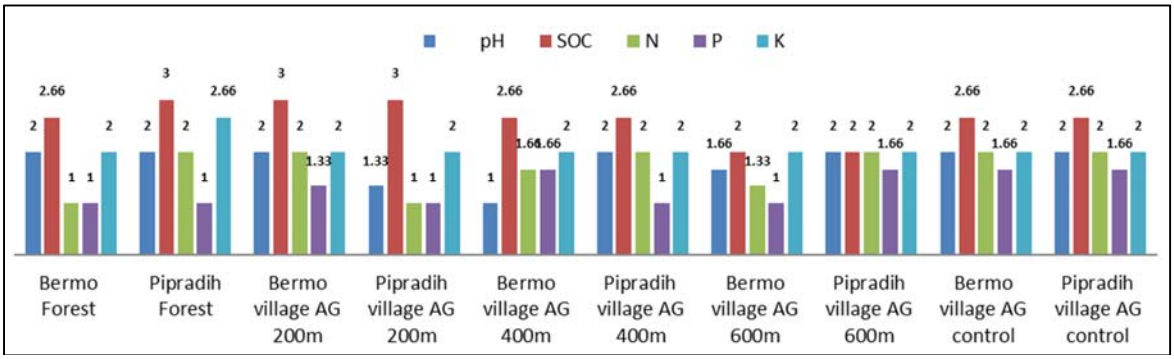
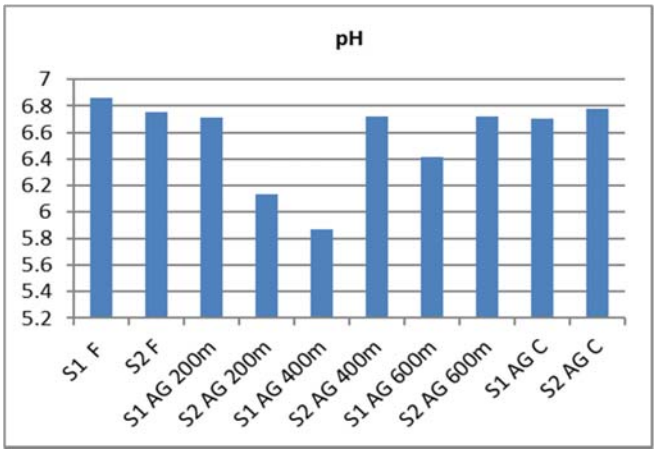


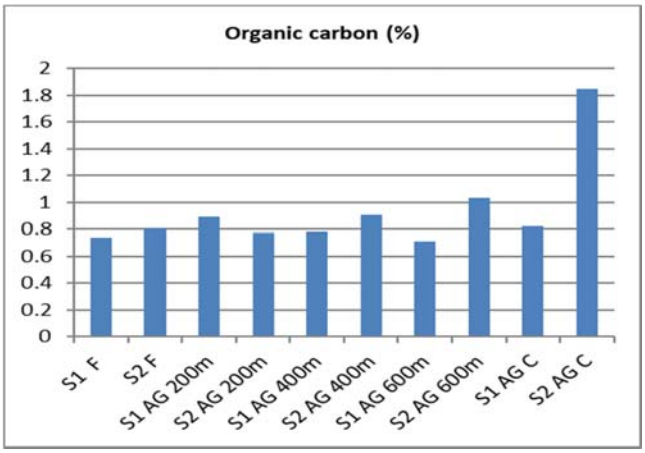
Fig 2: Soil Nutrient Index based on pH, SOC & NPK levels for various locations in study area.

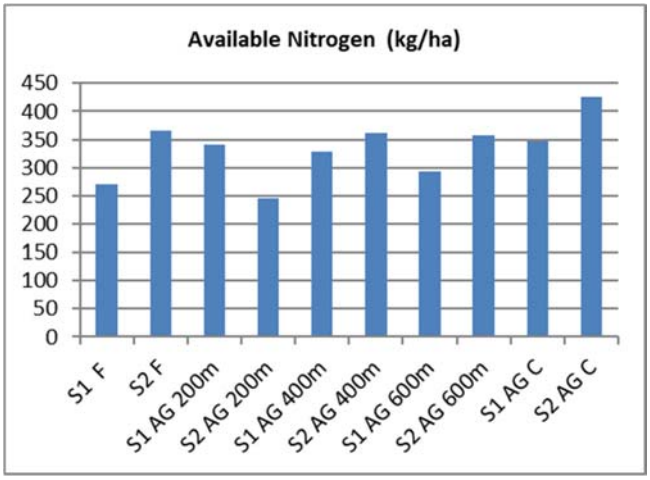
Table 4: Nutrient index of the study area

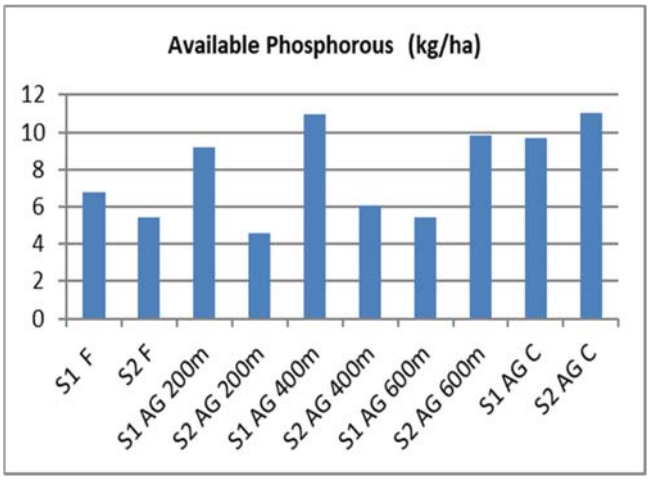
		Bermo						Pipradih					
Variable	Site	Low	Moderate	High	NI Values	NI	FS	Low	Moderate	High	NI Values	NI	FS
pH	Forest	0	3	0	2	II	Medium	0	3	0	2	II	Medium
	Ag land 200m	0	3	0	2	II	Medium	2	1	0	1.33	I	Low
	Ag land 400m	3	0	0	1	I	Low	0	3	0	2	II	Medium
	Ag land 600m	1	2	0	1.66	I	Low	0	3	0	2	II	Medium
	Ag land control	0	3	0	2	II	Medium	0	3	0	2	II	Medium
Organic carbon	Forest	0	1	2	2.66	III	High	0	0	3	3	III	High
	Ag land 200m	0	0	3	3	III	High	0	1	2	2.66	III	High
	Ag land 400m	0	1	2	2.66	III	High	0	0	3	3	III	High
	Ag land 600m	0	3	0	2	II	Medium	0	0	3	3	III	High
	Ag land control	0	1	2	2.66	III	High	0	0	3	3	III	High
Available Nitrogen	Forest	3	0	0	1	I	Low	0	3	0	2	II	Medium
	Ag land 200m	0	3	0	2	III	High	3	0	0	1	I	Low
	Ag land 400m	1	2	0	1.66	I	Low	0	3	0	2	II	Medium
	Ag land 600m	2	1	0	1.33	I	Low	0	3	0	2	II	Medium

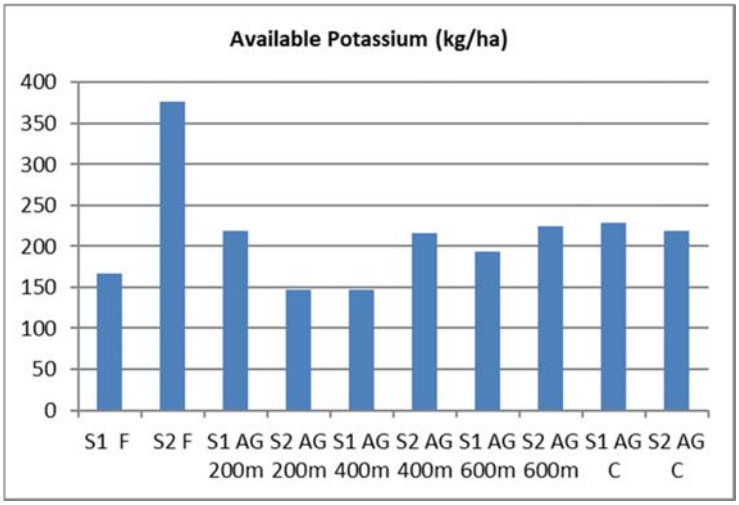
	Ag land control	0	3	0	2	II	Medium	0	3	0	2	II	Medium
Available Phosphorous	Forest	3	0	0	1	I	Low	3	0	0	1	I	Low
	Ag land 200m	2	1	0	1.33	I	Low	3	0	0	1	I	Low
	Ag land 400m	1	2	0	1.66	I	Low	3	0	0	1	I	Low
	Ag land 600m	3	0	0	1	I	Low	1	2	0	1.66	I	Low
	Ag land control	1	2	0	1.66	I	Low	1	2	0	1.66	I	Low
Available Potassium	Forest	0	3	0	2	II	Medium	0	1	2	2.66	III	High
	Ag land 200m	0	3	0	2	II	Medium	0	3	0	2	II	Medium
	Ag land 400m	0	3	0	2	II	Medium	0	3	0	2	II	Medium
	Ag land 600m	0	3	0	2	II	Medium	0	3	0	2	II	Medium
	Ag land control	0	3	0	2	II	Medium	0	3	0	2	II	Medium











S1=Bermo, S2=Pipradih, F=Forest, AG=Agricultural land, C=Control

Fig 3: Graphs showing variation of soil quality parameters among various locations of study area

Conclusion

According to the soil fertility tests based on the calculated nutrient index of pH, SOC, macronutrient (N, P, K), the soil of Bokaro shows medium to high fertility status in both the villages except for P which shows low fertility status in all the locations (forest & agricultural land) of both the villages of the study area.

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