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SOIL CHARACTERISTICS IN AND AROUND THE KALINGANAGAR TATA STEEL PROJECT SITE AT JAJPUR DISTRICT, ODISHA

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Kalinganagar Project site of Tata Steel, lateritic soil, soil pH, metals (biologically available form), organic fertilizer

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ABSTRACT

We analyzed the surface soil in five different locations in and around the Kalinganagar Project site of Tata Steel in the Jajpur district of Odisha. The soil is lateritic with poor organic carbon percentage leading to low fertility. The pH of the soil ranges from slightly acidic to strongly acidic having value between 4.0 to 6.1 in the present geographical locale. Metals (biologically available form) like Fe, Zn, Mn and Cu were analyzed in the surface soil collected from the sampling sites and the order of accumulation is Fe > Zn > Mn > Cu. The present quality of the soil is not congenial for the growth of floral species in the area and hence use of organic fertilizer is recommended.

INTRODUCTION

Green evolution has boost up the plant production in the Indian sub-continent, but continuous cultivation using chemical fertilizer have led to depletion of native nutrients in the soil. Recently emphasis on nutrient management has been imparted to increase the survival and growth of the planted species.

In the state of Odisha, lateritic soils occupy 0.70 m ha of lands in the districts of Puri, Khurda, Nayagarh, Cuttack, Dhenkanal, Keonjhar, Mayurbhanja and Sambalpur. Lateritic soils are characterized by compact vesicular structure and rich in hydrated oxides of iron and aluminium with small amounts of manganese, titanium and quartz. Degraded laterites are honey combed structure and found in the districts of Khurda and Cuttack. These soils are loamy sand to sandy loam in the surface having hard clay pan in the subsoil. Presence of higher amount of exchangeable aluminium and manganese results in slightly acidic to strongly acidic soil with pH ranging between 4.5 to 5.8[1]. Acidification of soil influences the biodiversity of the floral community. A study in the Netherlands examined the correlation between soil pH and soil biodiversity in soils with pH below 5[2]. It was observed that as the soil pH decreased the biodiversity reduced significantly[2]. The results were similar in grasslands as well as heath lands (Roem and Berendse, 2000)[2]. Particularly concerning is the evidence showing that this acidification is directly linked to the decline in endangered species of plants, a trend recognized since 1950[2]. The adverse role of soil pH on the growth and diversity of floral species has also been witnessed in the present area by earlier workers[3].

On this background, the present study aims to (i) analyze the soil nutrients (Fe, Zn, Mn and Cu) and (ii) soil pH in the selected sites. Recommendation for upgradation of the soil quality is also an important objective of the present study.

MATERIALS AND METHODS

Selection of sampling sites

Five sites were selected in and around the Kalinganagar Project site of Tata Steel in the Jajpur district of Odisha (Table 2).

Analysis of surface soil pH

The measurement of soil pH was done in the field with a micro pH meter (Systronics, Model No, 362) with glass – calomel electrode (sensitivity ± 0.01) and standardized with buffer 7.0.

Surface Soil Organic Carbon

The total organic carbon in the soil samples (collected from the selected sites) was analyzed by the standard rapid dichromate oxidation method[4]. of Walkley and Black (1934).

Analysis of biologically available metal in surface soil

Soil samples from surface (1 cm depth) were collected by scrapping using a pre-cleaned and acid washed plastic scale and immediately kept in clean polythene bags, which were sealed. The samples were dried in an oven at 105^{o}C for 5 – 6 hours, freed from visible shells or shell fragments, ground to powder in a mortar and stored in acid washed polythene bags. Analyses of biologically available metals were done after re-drying the samples, from which 1 gm was taken and digested with 0.5 (N) HCl as per the standard procedure[5]. The resulting solutions were then stored in polythene containers for analysis. The solutions were finally aspirated in the flame Atomic Absorption Spectrophotometer (Perkin Elmer: Model 3030) for the determination of metal concentrations. No detectable trace metals were found in the reagent blank. Analysis of the NIES Sargasso sample was carried out to assure the quality of the data (Table 1).

Table 1 – Analysis of reference material (NIES Sargasso sample) for sediments obtained from the National Institute of Environmental Studies, Japan

Element	Certified value (µg g^{-1})	Laboratory results (µg g^{-1})
Zn	28.6	26.2
Cu	14.9	13.7
Pb	2.4	2.9

RESULTS

Surface soil pH:

The surface soil pH ranged from 4.0 to 6.1 (Table 2, Fig.1)

Surface Soil Organic Carbon:

The value ranged from 0.34 % to 0.49 % (Table 2, Fig. 2).

Biologically available metal in surface soil:

Surface soil exhibited the metal level as per the order Fe > Zn > Mn > Cu (Table 2,Figs.3-6).

Table 2 – Soil characteristics in and around Kalinganagar Project site of Tata Steel

Site	Coordinates	pH	Organic carbon (%)	Biologically available heavy metals (ppm dry wt.)			
				Fe	Zn	Mn	Cu
Near Parking lot at Gate No. 1	20^{0}58′16.5″ N 85^{0}59′35.7″ E	5.2	0.46	61.83	40.29	26.85	20.09
Near Gate 2 Labour Colony	20^{0}58′45.6″ N 85^{0}59′49.2″ E	5.6	0.39	70.35	38.46	24.21	19.86
Non-fertilized soil site	20^{0}58′44.0″ N 86^{0}01′13.6″ E	4.0	0.34	59.55	34.85	30.03	21.30
Khrunti Plantation site	28^{0}58′25.2″ N 86^{0}01′59.8″ E	4.8	0.47	65.69	46.20	27.69	20.55
Pankpal Road	20^{0}58′27.5″ N 86^{0}01′58.4″ E	6.1	0.41	71.43	41.85	38.02	22.43

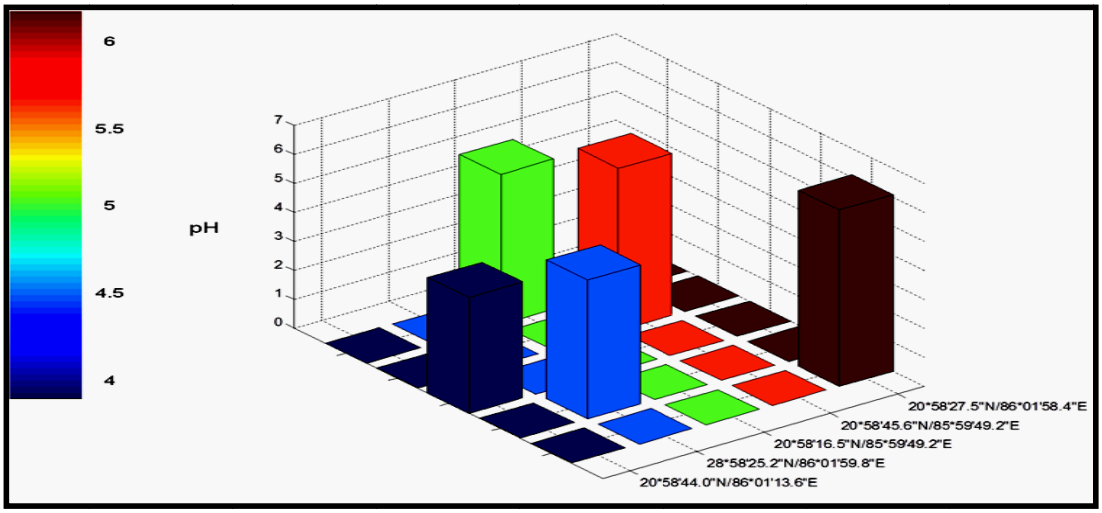

Figure 1: pH of surface soil in selected sites in and around Kalinganagar Project site of Tata Steel

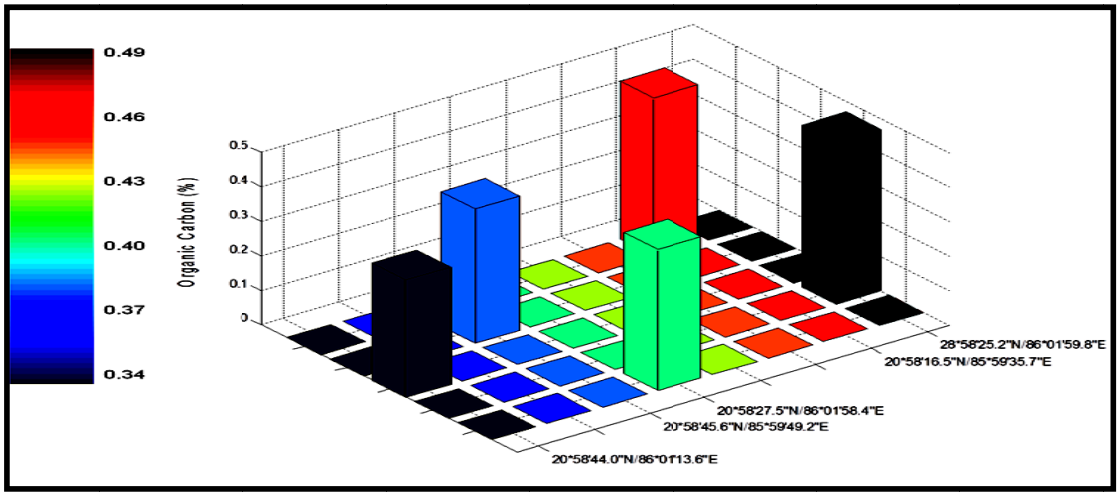

Figure 2: Organic carbon (%) of surface soil in and around Kalinganagar Project site of Tata Steel

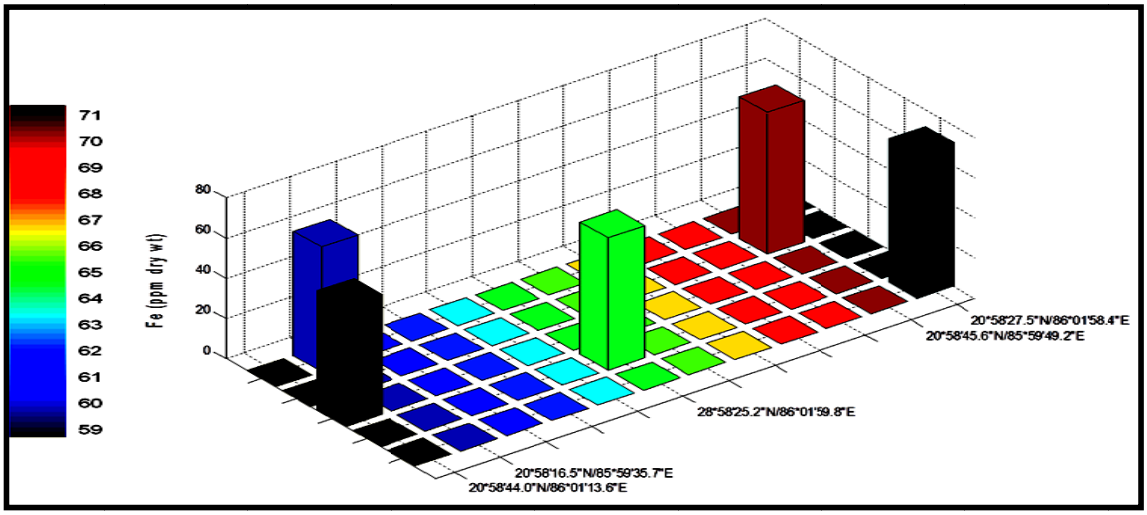

Figure 3: Biologically available Fe (in ppm dry wt.) in surface soil in and around Kalinganagar Project site of Tata Steel

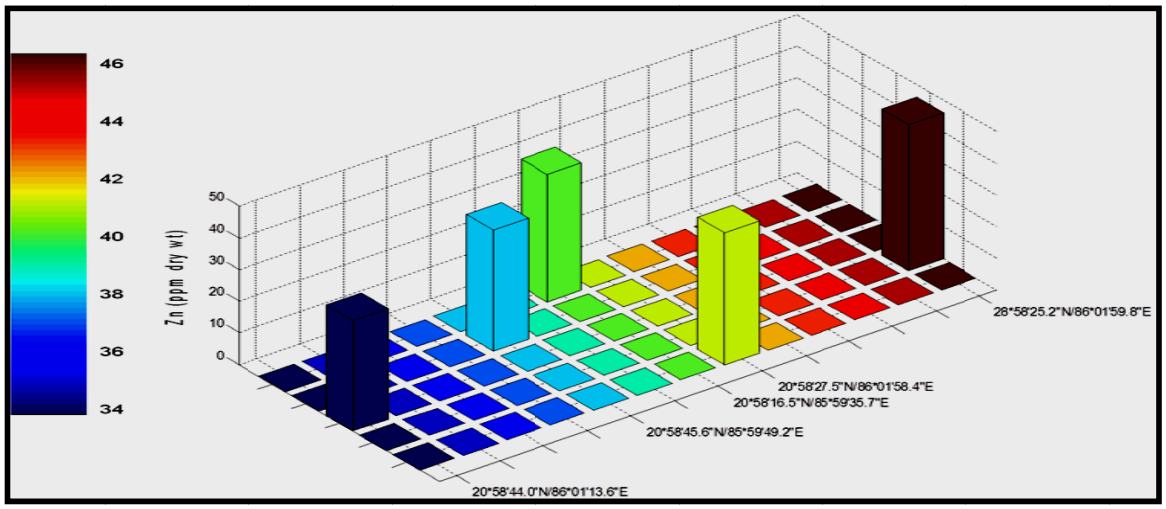

Figure 4: Biologically available Zn (in ppm dry wt.) in surface soil in and around Kalinganagar Project site of Tata Steel

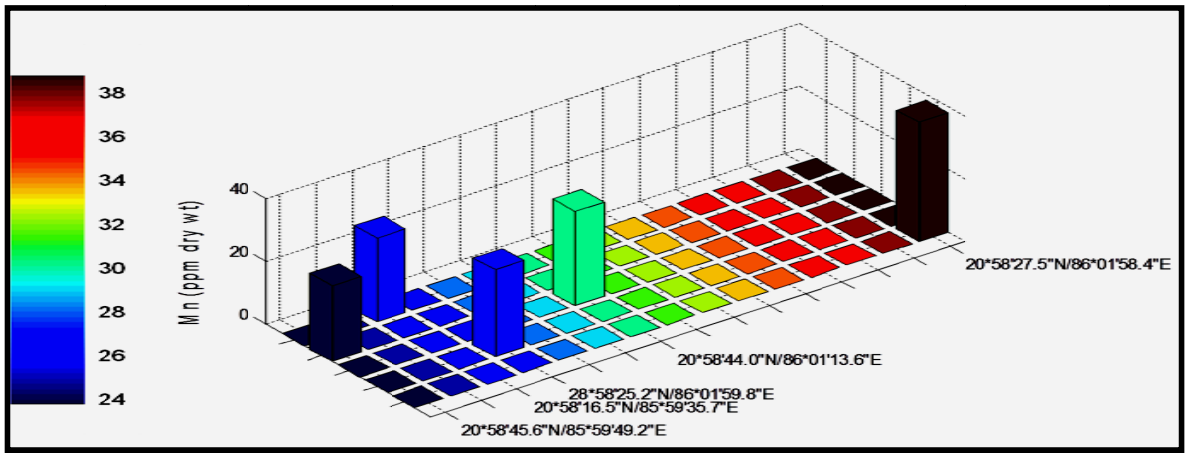

Figure 5: Biologically available Mn (in ppm dry wt.) in surface soil in and around Kalinganagar Project site of Tata Steel

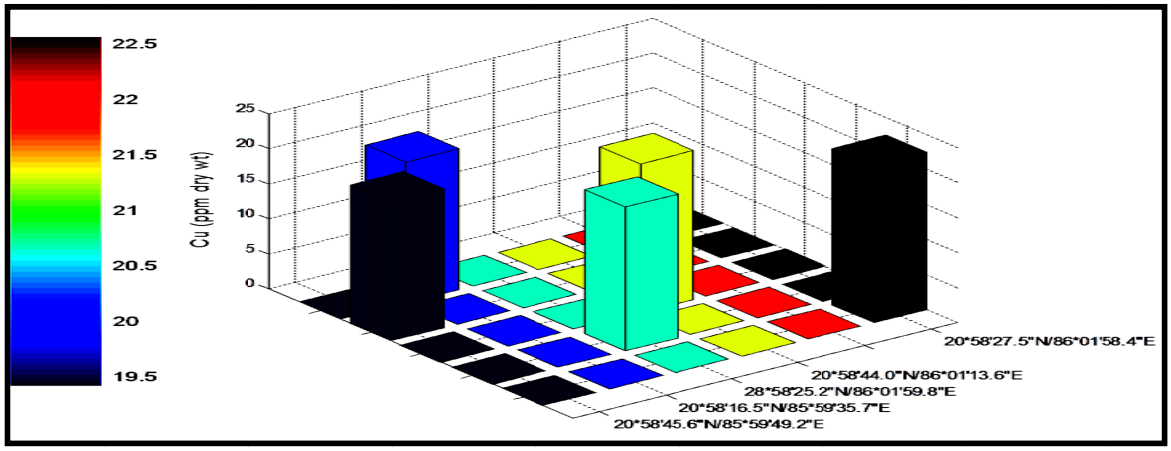

Figure 6: Biologically available Cu (in ppm dry wt.) in surface soil in and around Kalinganagar Project site of Tata Steel

DISCUSSION

Odisha is a maritime state in the Indian sub-continent, where the soils are poorly fertile with low organic matter. Available nitrogen and phosphate are low and potash is medium. Nitrogen is lost due to leaching and phosphate becomes unavailable due to fixation by Fe and Al oxides. Cation exchange capacity of the soil is low and it is low in percentage base saturation. Sulphur is absorbed as pyrites or zinc sulphide[1]. The state has large deposits of ores and minerals of heavy metals like Fe, Mn, Cr, Pb and Ni. As per the record Directorate of mines (Odisha), 27.1 % Fe ore, 28.4 % Mn ore, 98.4 % Cr ore of the country are present in the state. This may be one of the reasons of considerable amount of biologically available Fe, Zn, Mn, and Cu in the soil of the study area. Combustion of coal through thermal plants transfer large amount of pollutant elements to the soil. The thermal plant at Talcher daily burns 9000 T of coal from which 3600 T of fly ash is produced[6]. This fly ash contains total 424 ppm Fe, 34 ppm Zn, 39 ppm Cu, 241 ppm Mn, 33 ppm Pb, 13 ppm Cr and 4.5 ppm Cd. Thus total fly ash deposits daily 1526 kg Fe, 122.9 kg Zn, 140 kg Cu, 867 g Mn, 119 kg Pb, 47 kg Cr and 16 kg Cd[7]. The level of biologically available metals in the present study may thus be attributed to both natural and anthropogenic factors.

The influence of soil in defining species and plant community distributions is well known[8,9]. In the present study area, soil pH seems to play a crucial role in plant–soil chemical relations, particularly the availability of micronutrients and toxic ions, due to its influence on solubility. There is also another important issue related to low soil pH, which promotes the fast availability of metals to floral species leading to bioaccumulation. Hence use of lime with organic fertilizer (Annexure 1) is recommended as continuous use of chemical fertilizers reduces the soil pH in long run[3].

Annexure 1: Composition of organic fertilizer ingredients

Ingredient	N	P_2O_5	K_2O	Ca	Mg	S	Comments
Blood (dried)	12-15	2-3	1	BDL	BDL	BDL	Good source of nutrients
Blood meal (steamed)	15	0.5-1	1	BDL	BDL	BDL	Good source of nutrients
Bone meal (steamed)	~ 1.8	10-20	0	18-30	0	0	Low nitrogen and moderate source of nutrients
Compost (garden)	V	V	V	V	V	V	Depending on the ingredients and technology, the composition varies
Cotton seed meal	6-7	2.5	1.5	BDL	BDL	BDL	Good source of nutrients
Cotton seed hull ash	0	0	27	BDL	BDL	BDL	Noted for high potassium level
Fish scrap (Acidulated)	8.5-9.5	1-2	0	BDL	BDL	2.0	Rich in nitrogen, but bioaccumulated heavy

							metals and pesticides are causes of concern
Dried fish meal	8.5- 10.0	0	0	5.8	BDL	BDL	Rich in nitrogen, but bioaccumulated heavy metals and pesticides are causes of concern
Legume	2-3	2.4	2.4	1.2	0.2	0.3	Balanced nutrient level
Cattle manure	0.5-2	1.5	1.1-1.2	1.1	0.3	BDL	-
Broiler litter	2-3	3.0	2.0	1.6-1.9	0.4	0.3	Balanced nutrient level
Seaweed	0.5-0.8	0.8	4.7	BDL	BDL	BDL	Bioaccumulation of conservative pollutants is reported depending on the habitat

V = Variable; BDL = Below Detectable level

REFERENCES

1. Sahu, G.C. and Mishra, A. Soil of Orissa and Its Management. Orissa Rev., 2005.
2. Roem, W.J and Berendse, F. 2000. Soil acidity and nutrient supply ratio as possible factors determining changes in plant species diversity in grassland and heathland communities. Biol. Cons., 92 (2), 151–161.
3. Mitra, A., Parkhi, U.S., Pramanick, P., Fazli, P. and Zaman, S. 2015. Floral Biodiversity of Kalinganagar Project site, TATA Steel, Odisha, India. J. Environ. Sci. Comp. Sci. Eng. Tech., 4 (1), 234 - 247.
4. Walkley, A. and Black, I.A. 1934. An examination of Degtjareff method for determining soil organic matter and a proposed modification of the chromic acid titration method. Soil Sci., 37, 29-37.
5. Malo, B.A. 1977. Partial extraction of metals from aquatic sediments. Environ. Sci. Tech., 11, 277–288.
6. Kundu, D.K., Singh, R. and Mahapatra, B.S. 2013. Soil Health and Water Quality Issues for Sustainable Agricultural Production in the Eastern Region of India. J. Agri. Phys., 13 (1), 1-12.
7. Sahu, S.K. 2003. Influence of heavy metals on environment and health problem. *In* Winter School on Characterization and Sustainable Management of Acid Soils of Eastern India. OUAT, Bhubaneswar.
8. Beadle, N. 1954. Soil phosphate and the delimitation of plant communities in eastern Australia. Ecol., 35, 370–375.
9. Russo, S.E., Brown, P., Tan, S. and Davies, S. 2008. Inter-specific demographic trade-offs and soil-related habitat associations of tree species along resource gradients. J. Ecol., 96, 192–203.