International Journal of Science Academic Research
Vol. 03, Issue 03, pp.3603-3606, March, 2022
Available online at http://www.scienceijsar.com
ISSN: 2582-6425

Research Article

SOIL PHYSICO- CHEMICAL CHARACTERISTICS OF DIFFERENT VILLAGE AREA NEAR BHUSAN STEEL PLANT OF JHARSUGUDA DISTRICT, ODISHA

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Received 11th January 2022; **Accepted** 16th February 2022; **Published online** 30th March 2022

Abstract

"Soil pollution" is the presence of chemicals or substances in the soil out of place or present at a higher than normal concentration that has adverse effects on any non-targeted organism. Soil pollution often cannot be directly assessed or visually perceived, making it a hidden danger. The Status of the World's Soil Resources Report (SWSR) identified soil pollution as one of the main soil threats affecting global soils and the ecosystems services provided by them. Concerns about soil pollution are growing in every region. A work was undertaken in the year 2018-19 and to study the physico -chemical characteristics of the village area near Bhusan steel plant of Jharsuguda District, Odisha. Organic carbon and Organic matter, N, P, K, Zn, Mn and Cu were analyzed following the standard methods. It did not show any significant difference between the five sampling stations. Phosphorous and Potassium content of soil in the five stations showed significant difference. Further, there was no significant difference of Zn and Fe concentration between the stations however the Manganese content of soil showed a significant difference.

Keywords: Soil Pollution, Conductivity, NPK, Micro Nutrients.

INTRODUCTION

Soil pollution is mostly related to human activities such as industry, agriculture, burning of fossil fuels, mining and metallurgical processes and their waste disposal. Soil is a dynamic, natural body that occurs on the earth's surface which supports the growth of plants (Lad and Samant, 2013). Soils are formed by the decomposition of rock and organic matter over many years (Zaware, 2014). Industry causes negative environmental effects such as deforestation, degradation of water quality, loss of forest and wildlife, landscape deterioration, spreading of spoils creating wasteland, noise pollution and degradation of agricultural lands (Lamare and Singh, 2014). Any industry affects the agricultural land area and induces human settlement pattern thereby causing disruption of social relations (Anetor and Akinrinde 2006). Mining and metallurgical activities causes greater devastation both in terrestrial and aquatic environments. Recently, the United Nations Environmental Assembly (UNEA-3) adopted a resolution calling for accelerated actions and collaboration to address and manage soil pollution Friedel *et al.* 2000. The main anthropogenic sources of soil pollution are the chemicals used in or produced as byproducts of industrial activities, domestic, livestock and municipal wastes (including wastewater), agrochemicals, and petroleum-derived products. These chemicals are released to the environment accidentally, for example from oil spills or leaching from landfills, or intentionally, as is the case with the use of fertilizers and pesticides, irrigation with untreated wastewater, or land application of sewage sludge. Soil pollution can severely degrade the major ecosystem services provided by soil Daniel and Perinaz (2012). Soil pollution reduces food security by both reducing crop yields due to toxic levels of contaminants and by causing crops produced from polluted soils to be unsafe for consumption by animals and humans Kansal (1992).

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In the present research, a work was undertaken to study the physico- chemical characteristics of soil the industrial area of Jharsuguda District, Odisha. The villages were 1.Landupalli (S_1) 2. Gumkarma (S_2) 3. Patrapalli (S_3) 4. Thelkoli (S_4) 5. Sirpura (S_5). Five random soil samples from each village were collected at 0-10 cm depth for physicochemical parameters like pH, Bulk density, water holding capacity, conductivity, organic carbon, organic matter, N, P, K, Zn, Mn and Cu were analyzed following the standard methods.

MATERIALS AND METHODS

Study Sites

Bhushan Power and Steel Limited (BPSL) is located at Rengali of Sambalpur district in the State of Odisha, between latitudes 21° 44' N to 21° 46' N and longitudes 84° 01'E to 84° 03'E and 204 m above mean sea level (MSL). The Rourkela - Jharsuguda - Sambalpur road state highway No. 10 passes on the west of the existing plant site. The nearest railway station is Lapanga on Jharsuguda - Sambalpur line. The major raw materials required for the production are coking coal, PCI coal and SMS grade limestone would be met through import. Iron ore fines, lump, BF grade limestone, dolomite and quartzite would be procured from indigenous sources.

Methods of Sampling

The soil samples were collected from 5 randomly selected points in each crop field of the selected sites using spade, Khurpa and knife. The sample was collected by cutting a V shaped slice to the proper depth soil is taken from about 0-10 cm depth. The centre of the samples was then cut, lifted with the help of a knife and was collected in plastic bag to carry to the laboratory. The samples were collected from the selected sites at the same time around 9.00 AM morning. Large soil aggregates were crushed by hand into smaller one and were further reduced by grinding Mortar. Grinding provides a maximum surface area for physical and chemical reactions and reduces the heterogeneity. Grinding was followed by sieving for which 0.5 mm sieve was used (Aira *et al.,* 2006).

Determination of Soil Physico-chemical properties

pH

Soil pH was determined in the laboratory using pH meters. The pH was determined in distilled water at a soil: water ratio of 1:1. For each sample collected, pH was determined in water by weighing 20 g of soil (air-dried, < 2 mm) into a 100 ml beaker after which 20 ml water was added and stirred vigorously. The suspension was made to stand for about 30 min stirred again and the pH of the suspension measured.

Bulk Density

Total soluble salts are estimated from electrical conductivity (EC) of aqueous soil extracts. Bulk density, was determined by Baver (1956)

Water holding capacity

Water holding capacity (WHC) was determined with the help of Hilguard apparatus (Piper, 1950)

Electrical Conductivity

Electrical Conductivity is important in order to determine the concentration of soluble salts present in the soil suspension. 20 g of air-dry soil and 40 ml of distilled water were shaken on a rotary shaker (Sorensen and Dalsgaard, 2005) for 10 to 15 minutes. After this solution was filtered through Whatman filter paper No. 1 and a clear solution was obtained. The Electrical Conductivity of the clear solution thus obtained was then determined using a Microprocessor based digital Conductivity Meter (Systronics – 306).

Nitrogen

Nitrogen was determined by the Auto Kjeltech method (Jackson, 1973).

Organic Carbon

Organic carbon determined by (Walkely and Black, 1934) method.

Phosphorous and Potassium

Phosphorous was determined by the molybdenum blue method by Olsen et al., 1954 and Potassium contents was analyzed by Flame photometric method by Hesse, 1971.

Zinc, Manganese and Copper

Zn, Mn and Cu were analyzed following the standard methods of Atomic Absorption Spectrophotometer.

RESULTS AND DISCUSSION

pH which determines the basic and acidic properties of soil, plays a significant role as nutrients namely Nitrogen (N), Potassium (K) and Phosphorus (P) are carried by soil which are needed by plants in varying amounts for their growth (Biswal and Mukherjee, 1994). The electrical conductivity is directly related to the cations present in the soil solution. The more is the absorption of cation in the soil fraction, the more will be their availability in the soil solution (Brady, 1990). The result shows in Table-1 and Fig-1 the minimum and maximum values for pH varied between 5.0-6.0 and conductivity between (µs/cm) 28.6 – 42.3.

Table 1. Soil Physico- chemical characteristics of five sampling stations

Parameters	S_1	S_2	S_3	S_4	S_5
pH	5.6	5.7	6.0	5.0	5.1
Bulk Density (gm/cc)	1.35	1.33	1.45	1.42	1.34
Water Holding Capacity (%)	30.07	35.3	36.61	35.48	33.49
Conductivity (µs/cm)	42.3	40.8	32.6	28.6	38.9
OC%	1.46	2.41	0.86	1.06	2.33
OM%	1.50	2.62	0.31	1.38	2.48
N (kg/Hec)	568	419	396	225	196
P (Kg/Hec)	29	33	25	28	38
K (Kg/Hec)	152	218	149	158	190
Zn (mg/Kg)	2.0	2.9	0.98	0.97	1.9
Mn (mg/ Kg)	9.75	12.8	9.4	22.9	29.7
Cu (mg/Kg)	1.65	1.46	1.89	1.15	2.9

(S_1) Landupalli village (S_2) Gumkarma village (S_3) Patrapalli village (S_4) Thelkoli village (S_5) Sirpura village

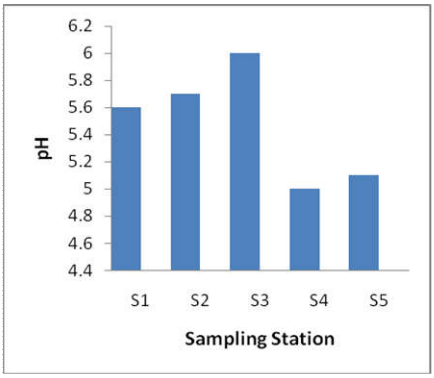

Fig. 1. pH at the Five Sampling Stations

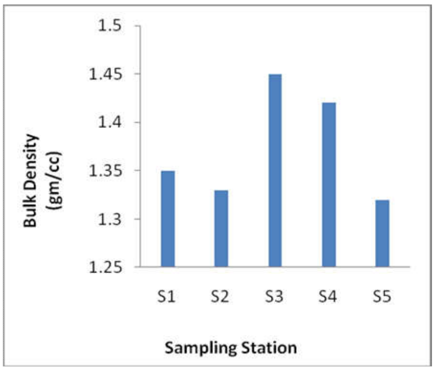

Fig. 2.Bulk Density (gm/cc) at the Five Sampling Stations

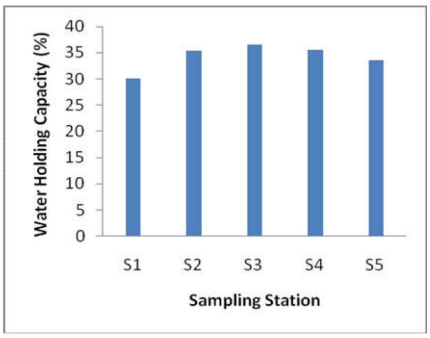

Fig. 3.Water Holding Capacity (%) at the five sampling Stations

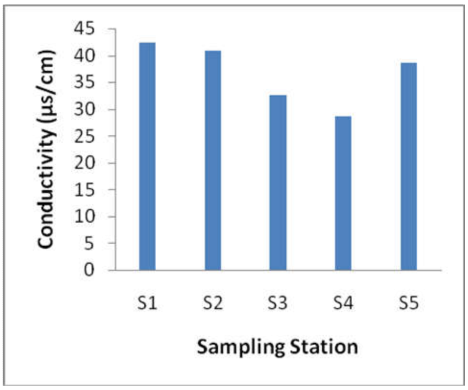

Fig. 4. Conductivity (µs/cm) at the Five sampling station

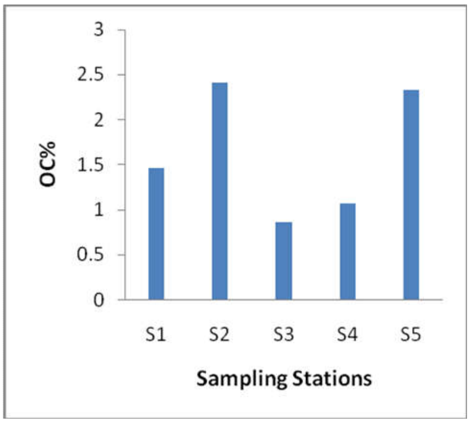

Fig. 5. Organic Carbon (%) at the five sampling stations

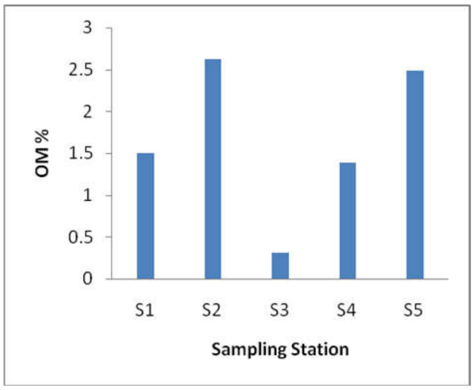

Fig. 6. Organic Matter (%) at the five sampling station

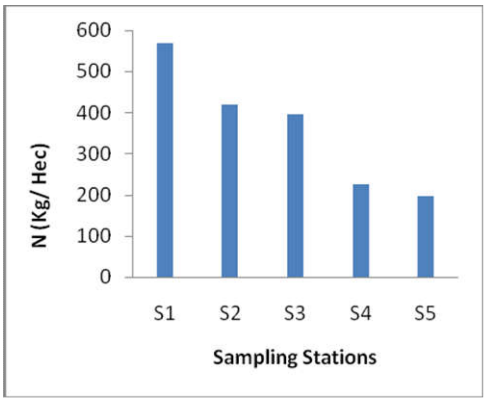

Fig. 7. Nitrogen (Kg/Hec) at the five sampling stations

The bulk density (gm/cc) and water holding capacity (%) were found maximum in the sampling station S_3 shown in table-1 and Fig-2 and 3 respectively. In Fig-5, 6 Organic carbon % and Organic matter % are the important parameters of any soil, which improves both the physical and chemical properties of soil and has several favorable effects on soil quality. In the present study, OC (%) varied between 0.86- 1.06 and OM (%) between 0.31- 2.62. NPK as a fertilizer plays an important role for plant growth. Nitrogen is the chief growth promoting nutrient element which influences soil productivity and is an important element for plant development. Phosphorus is an essential element classified as macro- nutrient. It is required in relatively large amounts by the plants. Potassium as a key nutrient plays a vital role in the building of protein and reduction of diseases in plants. In the present work Nitrogen (kg/Hec), Phosphorous (kg/ Hec) and Potassium (kg /Hec) content of soil in the five stations showed significant difference shown in Table-1. Nitrogen content was found to be maximum at S_1 (568 kg/Hec) and minimum at S_5 (196 kg/Hec) depicted in fig-7. Similarly in the fig-8 and 9 the phosphorous and potassium content varied and found maximum inS_5 and S_2 (38 kg/Hec and 218 kg/Hec) respectively and minimum both in S_3 sampling stations (25 kg/Hec and 149 kg/Hec) respectively. Zn in soil remains strongly absorbed and in aquatic environments it predominantly binds to suspended material before finally accumulating in the sediment. Manganese is one of the abundant metals in soil which occurs as oxides and hydroxides. Zn, Mn and Cu content of soil were also analyzed in the above five stations. The result showed significant difference between the stations in S_2 it was maximum and in S_4 it was minimum shown in fig -10. However the Mn content of soil showed significant difference.i e (9.4-29.7 mg/Kg) shown in fig-11. Cu is an essential micronutrient required for the growth and metabolism of plants, animals and human beings. In fig-12 it shows that maximum and minimum amount of Cu is found in S_5 and S_4 site i.e. 2.9 and 1.15 mg/Kg respectively .Management of the fertility of Indian soil demands fertilizers, critical farm inputs and play a significant role for achieving high crop productivity.

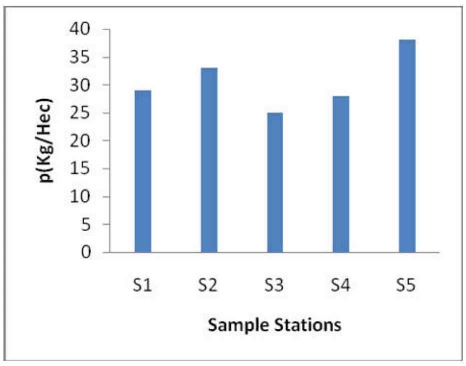

Fig. 8. Phosphorus (Kg/Hec) at the Five Sampling Stations

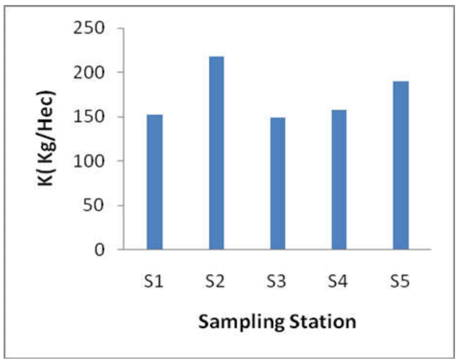

Fig. 9. Potassium (Kg/Hec) at the Five Sampling Stations

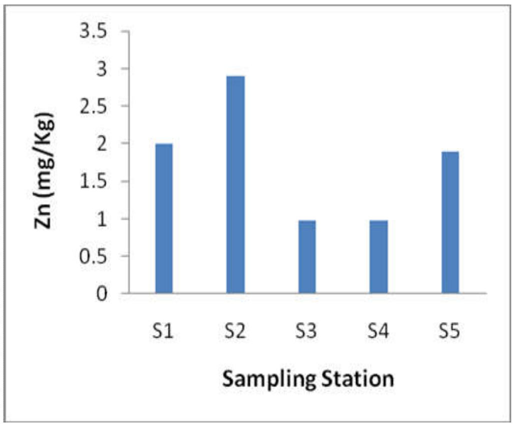

Fig-10. Zinc (mg/Kg) at the Five Sampling Stations

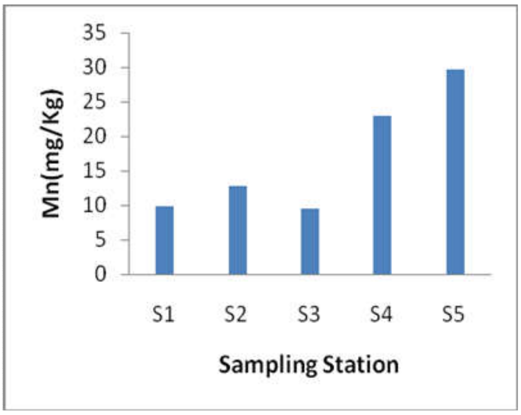

Fig-11. Manganese (mg/Kg) at the Five Sampling Stations

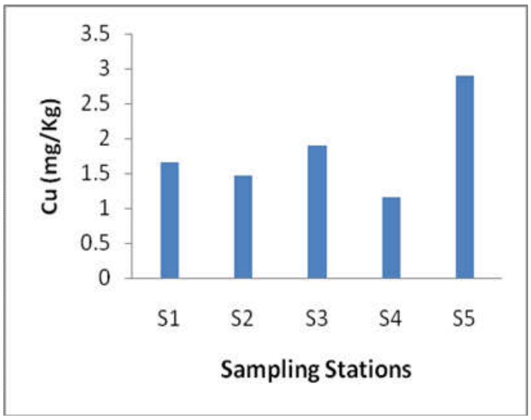

Fig-12. Copper (mg/Kg) at the five sampling stations

Conclusion

Soil pollution is mostly related to activities of human, using modern technology, industrialization, deforestation and mining plays an important role to change the soil physicochemical properties which also affect the growth and development of flora and fauna which ultimately affects the ecosystem of the area. In the present study it was observed that, variation in soil characteristic was mostly due to the industrialization and allied activities taking place in that area that destroy the fertility of the soil within a short time.

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