ASSESSMENT OF SOIL HEALTH AND SOIL QUALITY OF BOKARO, DISTRICT, JHARKHAND, INDIA

ABSTRACT

Taking care of soil health is most importance for sustainable crop production. Soil quality is a blending of soil processes and provides to a measure change in soil condition as related to following factors such as land use, climate patterns, cropping sequences and farming systems. In the present investigation analysis of different physical and chemical characteristics were made to determine soil health of Bokaro district. Results show that soil bulk density was in normal range, soil pore space % varied from 39.85 to 48.32 g cm^{-3}, particle density ranged from 2.24 to 2.69 Mg m-3, water holding capacity varied from 34.23 to 43.86 %. Soil pH and EC were found to be acidic and non-saline in nature respectively while soil organic carbon and available phosphorus were in medium to high range. Available nitrogen and potassium were found to be low to medium range i.e., 197.0 to 219.0 Kg ha^{-1} and 201.96 to 266.01 Kg ha^{-1} and the range of phosphorus varied from 16.96 to 26.68 kg ha^{-1} respectively. Deficiency of sulphur followed by zinc was found in soils of Bokaro district.

Keywords: Soil health, soil quality, pH, EC, sulphur, zinc, soil

INTRODUCTION

"Soil plays a very important role in sustaining life on the planet. And all of the food that humans consume and except for what is harvested from the marine environments, is grown in the Earth's soils.And the functions that soils provide humans include fiber for paper and clothing, fuelwood production, and foundations for roads and buildings. And the functions that soils serve are providing a medium to attenuate pollutants and excess water, groundwater recharge, nutrient cycling, and habitat for microorganisms and biota".**(Schoonover et al 2015)**

Soil heterogeneity is the case where soil in a exceedingly small vicinity varies significantly in texture, fertility, topography, moisture content material, drainage etc. Soil heterogeneity is the motives for the numerous nature of cropping and production sample. Soil consists of a solid segment (minerals and organic count) in addition to a porous phase that holds gases and water (Latha and Janaki). Soils providenutrients, water and area for trees, herbs and different plant life and hence are the basis for existence on the planet. As soil formation is predominantly a vertical system related to climate, parent material, comfort, organisms, time and spatial function and as weathering and humus input is most powerful at the floor and reduces with depth, most soil residences are depth-dependent. The deeper the soil layers are positioned, the decrease is the impact of plant cowl and soil biota and the higher is the impact of weathering, main to specific

depth capabilities for soil houses. for example, soil organic carbon (SOC) decreases with growing soil intensity as natural material enters the soil predominantly from the top after which eventually is incorporated into deeper soil layers.

"Soils vary depplyas a function of their position on of the landscape and agricultural management, land use, and overto cultivation intensity". (**Ayele *et al*.,2020**)

India isone of the second most populous nations globally following China, overall, wherein a huge part of the populace is the based upon the agriculture. There are the stay stock population of India also constitutes 1/6th one of the international populations. To satisfy the food call for growing human population and forage demand of massive farm animals' populace, herbal forests are not best converted to pasture and the rural fields, however agricultural fields are the additionally put under the excessive strain because of the conventional technique of agricultural practices which in the long run results in the deterioration of soil fitness in converted ecosystems. "Indian soils not handiest show deficiency of number one nutrients like (Nitrogen, Phosphorous and Potassium) but additionally rest of secondary nutrients (Sulphur, Calcium and Magnesium) and micro nutrients (Boron, Zinc, Copper and Iron and many others.) in maximum important parts of the United States. Instated of these three number one nutrients (N, P, k), deficiency of Sulphur and micro nutrients like Zinc and Boron in many of States, and of Iron, Manganese and Molybdenum in a few States, has been grow to be a restricting component in growing meals productivity"**.(Source:Book-Compendium on Soil Health)**

"Maintaining soil health/quality is indispensable for sustaining the agricultural productivity at higher level. Soil quality includes three groups of mutually interactive attributes i.e. soil physical, chemical and biological quality, which must be restored at its optimum to sustain productivity". (**Kumar *et al.*,2012**)

MATERIALS AND METHODS

Bokaro district is lies within the eastern part of Jharkhand nation. It isbounded by the district of Giridih within the north, West Bengal in the south, Dhanbad in the east and Hazaribag in the west. It has a place of 2861 sq. kmarea and populace of 17,seventy five,961 humans (Census of India, 2001). The district comprises subdivision (Chas and Bermo) and 8 development blocks viz.Chas, Bermo, Gomia, Chandankyari, Jaridih, Kasmar, Peterwar and Nawadih.

Bokaro district is located at Eastern part of Jharkhand state. The climate of the area is moderate to extreme and characterized by hot summer and cold winter. Rainfall in this area is also very moderate… The major cultivated crops in this district are paddy, wheat, maize, pulses, fruits, vegetables etc.

The district has climatic condition slightly distinctive due to less elevation and less forest cover. The summers are hot and winters are frigid. The highest temperature is recorded as 46degreesCelsius. in wintry weather season temperature come down to 3 to 4 degreesCelsius. whilst frigid wind blows, otherwise the temperature tiers among 10 to 15 degreesCelsius. The average rainfall is 1570 mm. Soil samples was collected only from open spaces from depths of 0-15 cm, 15-30 cm and 30-45 cm from different Blocks of Bokaro district, Jharkhand.

3. RESULTS AND DISCUSSION

3.1 Physical Properties of Soil

3.1.1 Bulk density

The Table 1 depicted that the maximum the maximum mean bulk density found at (V7) Utasara (1.62 g cm^{-3})and the (V7) was significant higher then (V4) Kamalapur (1.59 g cm^{-3}), (V8) Darid (1.55 g cm^{-3}), (V6) Gomanjara (1.46 g cm^{-3}), (V5) Baraikalan (1.44 g cm^{-3}), (V1) Bandhdih (1.41 g cm^{-3}). The bulk density decrease with increase in soil depth due to low organic matter and less aggregation. Decrease in bulk density was an indicator for improvement in soil physical properties and congenial environment for crop growth. And the similar finding was reported by **Kumar *et al*. (2010)**

3.1.2 Percent Pore Space

The Table 1 depicted that the maximum The maximum mean pore space (%) found at (V2) Baradih (46.3 %)and the (V1) Bandhdih (45.8 %)was significant higher then (V3) Bharu(44.9 %), (V6) Gomanjara (44.3%), (V5) Baraikalan (43.8 %), (V7) Utasara (42.4%) then (V9) Keswari (41.6 %), (V8) Darid (41.3%). Decrease in pore space is attributed Increase in compaction in the soil. And the similar finding was reported by **Kumar *et a*l. (2010**)

3.1.3 Water holding capacity

The Table 1 depicted that the maximum Mean Water Holding Capacity (%) found at (V2) Baradih (42.0 %)and the (V1) Bandhdih (41.0%)was significant higher then (V3) Bharu(40.8 %), (V6) Gomanjara

(40.02%),(V5) Baraikalan (39.2 %),(V8) Darid (37.2%) then (V7) Utasara (37.5 %),(V9) Keswari (37.0%). Decrease in pore space is attributed Increase in compaction in the soil. And the similar finding was reported by **Kumar *et al*. (2010)**

Table 1. Bulk density (Mg m-3), particle density (Mg m-3), pore Space (%) and water holding capacity (%) of soil at different depth

S.No.	Soil bulk density			Soil partical density			Pore Space (%)			Soil waterholding capacity		
	0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm	0-15 Cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
V_1	1.40	1.41	1.42	2.27	2.29	2.32	47.42	45.84	44.28	43.86	41.56	40.18
V_2	1.36	1.41	1.48	2.35	2.36	2.39	48.32	46.75	43.86	44.28	42.39	39.36
V_3	1.38	1.41	1.44	2.24	2.26	2.30	47.98	44.54	42.26	43.56	40.12	38.95
V_4	1.56	1.61	1.62	2.65	2.67	2.69	44.35	42.64	41.32	40.95	39.25	38.86
V_5	1.42	1.44	1.46	2.56	2.57	2.57	45.52	43.86	41.86	40.28	39.86	37.62
V_6	1.44	1.46	1.50	2.54	2.56	2.61	46.52	44.32	42.16	41.86	40.18	38.78
V_7	1.57	1.64	1.67	2.51	2.52	2.55	44.32	42.89	40.28	39.62	38.76	34.23
V_8	1.53	1.54	1.59	2.42	2.44	2.47	42.25	41.89	39.96	38.76	37.56	35.42
V_9	1.52	1.56	1.58	2.52	2.53	2.53	43.76	41.38	39.85	38.26	37.89	34.89
F-test	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**	**S**
S.Em. (±)	0.0099	0.0261	0.0304	0.024	0.035	0.038	0.6365	0.6845	0.6409	0.4950	0.5149	0.0429
C.D@5%	0.0294	0.0778	0.0506	0.073	0.106	0.113	1.8911	2.0338	1.9044	1.4707	1.5298	0.1276

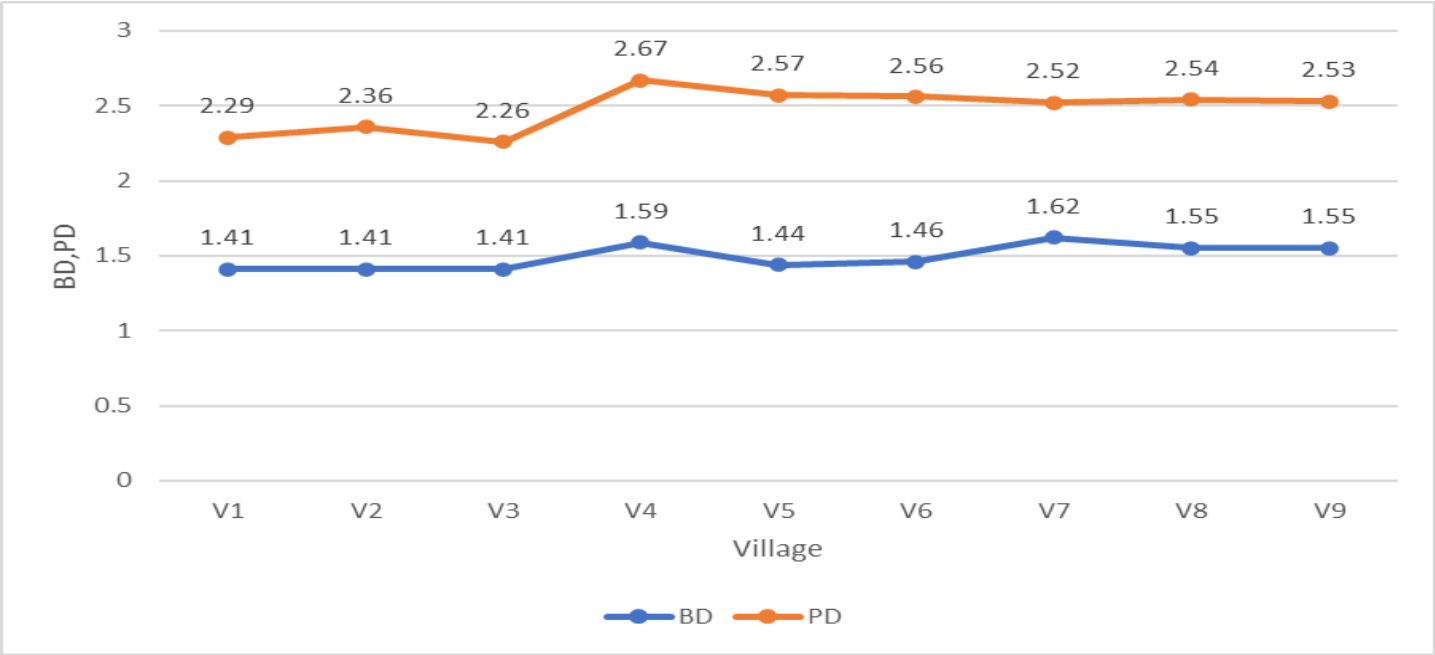

Fig1: BulkDensity (Mg m^{-3}) and Partical Density(Mg m^{-3})

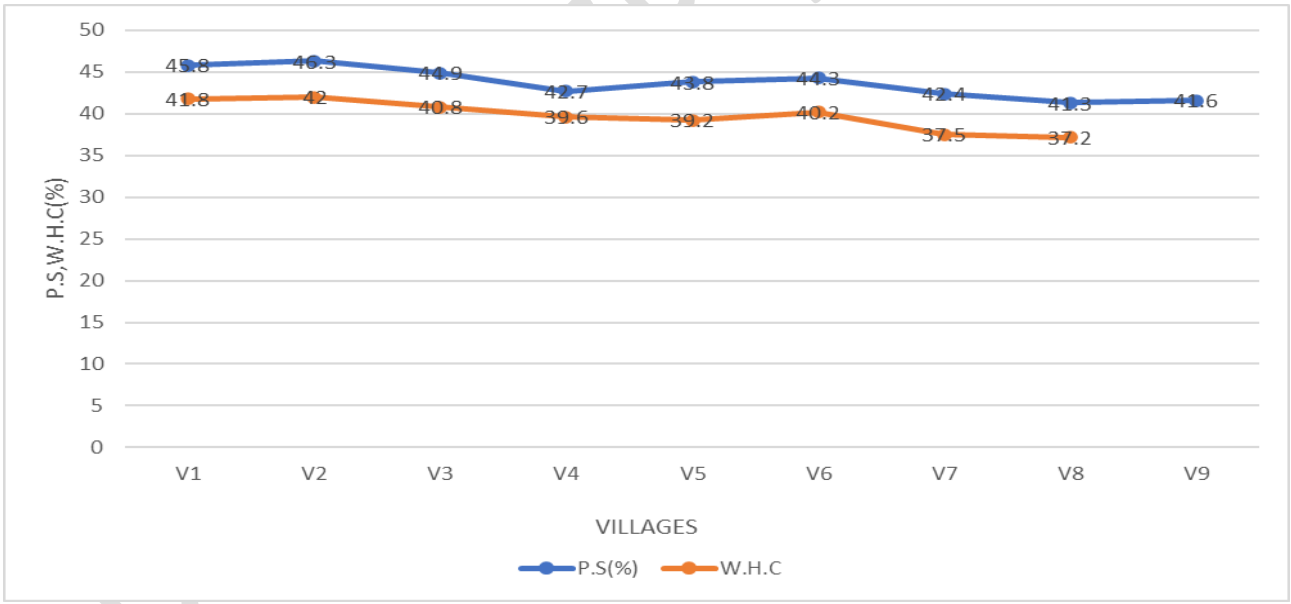

Fig2:Pore Space(%) and Water Holding Capacity(%)

3.2 Chemical Properties

3.2.1 Soil pH

The Table 2 depicted thatthe maximum mean soil pH (V9 and V2) of 6.91 was found at Village (Keswari and Baradih) and the minimum pH was found at (V3) 6.47(Bharu),(V6) 6.34(Gomanjara),(V5) 5.94 (Barikalan), (V7) 5.74 (Utasara),(V8) 5.68 (Darid),(V1) 5.52 (Bandhidh), (V4) 5.19 (Kamalapur).Hence, the soil acidity minimum and a major crop production constraint in the study area And the similar finding were reported by **Kumar *et al*.(2010)**.

3.2.2 EC (dS m-1)

The Table 2 depicted thatthe highest mean EC was in (V6)- Gomanjara, (0.06 ds m -1) and lowest mean (V1)-Bandhdih (0.02 ds m $^{-1}$) from Hence, all the soils under the study area are safe for all types of crop production with respect to the soluble salt content. And the similar finding was reported by **Kumar *et al*. (2010**)

3.2.3 Organic carbon

Table 2 shows the maximum value of organic carbonmean was in (V6)0.45% in village (Gomanjara),then in (V5) 0.43% (Barikalan),(V3) 0.41(Bharu),and (V1 and V2) show 0.40 % of village (Bandhidih to Bharu), where the (V2) show 0.39% , (Baradih), (V7) 0.37% (Utasara) and (V8-V9) has 0.36% (Darid-Keswari) Soil organic carbon status was found to be medium to high which enables the soil for higher crop production. Medium to higher organic carbon in the study area could be attributed to its presence in the bottom of dense. And the similar finding was reported by **Kumar *et al*. (2010)**

3.2.4 Available nitrogen

The Table 3 depicts that the maximum value of nitrogen is found in soil and the mean value was in (V4)-Kamalpur (213.00 kg ha $^{-1}$) ,(V2)-Baradih (212.00 kg ha $^{-1}$),(V6)-Gomanjara (211.00 kg ha $^{-1}$),(V3)-Baradih (210.00 kg ha $^{-1}$),(V1-V9)-Bandhidh and Keswari show (209.00 kg ha $^{-1}$), (V5)-Barikalan (208.00 kg ha $^{-1}$) ,(V7)-Utasra (203.00 kg ha $^{-1}$) ,(V8)-Darid (200.00 kg ha $^{-1}$).The available -nitrogen status in the entire study area was found to be low to medium. The reason may be amibuted to the fact that nitrogen content is positively correlated with organic matter content which decreases with depth. And the similar finding was reported by **Kumar *et al*. (2010)**

3.2.5 Available Phosphorus

The Table 3 depicts that the maximum mean was shown in village (V5)-Barikalan (22.99 Kg ha -1),then after that (V3)-Bharu show minimum range then other (V5) which was (21.94 Kh ha $^{-1}$),(V3)-Bharu (21.94 kg ha $^{-1}$) ,(V2) -baradih(21.36 kg ha -1),(V1)- Bandhdih (21.35 kg ha $^{-1}$),(V7)-Utasara (20.96 kg ha $^{-1}$),(V8) -Darid (20.13 kg ha $^{-1}$) ,(V6)- Gomanjara (20.01 kg ha $^{-1}$),(V9)-Keswari (19.03 kg ha $^{-1)}$The available phosphorus status in the entire study area was found to be medium to high. And the similar finding was reported by **Kumar*et al.* (2010)**

3.2.6 Available potassium

The Table 3 depicts theThehighest range available potassium was found at (V5) -Baraikalan (250.43 kg ha $^{-1}$) and the lowest mean available potassium was found at (V7)-Utasara(211.81 kg ha $^{-1}$). The available potassium status in the entire study area was found to be low to medium. The highest K content observed in the surface horizon and showed more or less decreasing trend with depth. This might be atributed to more intense weathering and release of liable K from organic residues.And the similar finding was reported by **Kumar *et al.* (2010)**

3.2.7 Available Sulphur

The Table 4 depicts that thehighest mean available sulphur was in (V3 toV6)-Bharu and Gomanjara (2.59 ppm) and lowest mean available sulphur was found at (V2)-Baradih (0.20 ppm). High deficiency of S in Bokaro soils might be attributed to the upland (Alfisols) leading to leaching of anionic nutrients. Available sulphur was found to be in the range of low to medium and the simliar finding was seen by**Kumar *et al*.(2010)**

3.2.7 Available Zinc

The Table 4 depicts that the highest mean available zinc was found at(V6) (0.59 ppm)-Gomanjara and lowest mean (V2 and V7) (0.33 ppm)-Baradih and Utasara. Zn deficiency was observed in all blocks of the Bokaro district. And the similar finding was reported by **Kumar *et al*. (2010)**

Table 2. pH(w/v), EC (dS m-1), organic carbon (%) of soil at different depth

S.No	Soil pH	EC (dS m^{-1})	organic Carbon (%)

	0-15cm	15-30cm	30-45cm	0-15cm	15-30cm	30-45cm	0-15cm	15-30cm	30-45cm
V_1	5.02	5.60	5.95	0.02	0.02	0.02	0.42	0.41	0.39
V_2	6.86	6.90	6.99	0.03	0.04	0.05	0.41	0.39	0.38
V_3	6.18	6.28	6.97	0.04	0.05	0.06	0.43	0.41	0.40
V_4	4.66	5.01	5.91	0.02	0.04	0.06	0.42	0.41	0.39
V_5	5.87	5.92	6.03	0.02	0.03	0.04	0.45	0.43	0.42
V_6	6.97	6.01	6.05	0.05	0.05	0.06	0.47	0.45	0.43
V_7	5.70	5.14	6.40	0.03	0.03	0.04	0.39	0.37	0.36
V_8	5.94	6.07	6.07	0.03	0.05	0.06	0.38	0.37	0.35
V_9	6.85	6.98	6.98	0.03	0.06	0.09	0.37	0.36	0.35
F-test	S	S	S	NS	NS	NS	S	S	S
S.Em. (±)	0.5378	0.5668	0.6618	0.008	0.006	0.009	0.03651	0.036514	0.0365
C.D. @ 5 %	0.1154	0.1354	0.2154	…..	……	…….		6.9376	6.2073

Table 3. Available Nitrogen (Kg ha-1), available phosphorous (Kg ha^{-1}), available potassium (Kg ha^{-1}) of soil at different depth

S.no	Available Nitrogen (Kg ha^{-1})			Available phosphorus (Kg ha^{-1})			Available potassium (Kg ha^{-1})		
	0-15cm	15-30cm	30-45cm	0-15cm	15-30cm	30-45cm	0-15cm	15-30cm	30-45cm
V1	215.00	209.00	203.00	24.36	20.75	18.96	224.85	212.18	203.56
V2	218.00	213.00	205.00	23.68	21.12	19.28	246.55	231.93	222.36
V3	217.00	209.00	204.00	25.12	22.85	17.85	253.56	242.85	233.72
V4	220.00	213.00	207.00	23.42	21.28	18.54	244.75	236.38	229.63
V5	215.00	208.00	201.00	26.68	22.42	19.87	266.01	249.91	235.37
V6	219.00	212.00	204.00	22.68	19.92	17.45	258.89	246.22	232.65
V7	209.00	203.00	199.00	23.86	20.17	18.86	220.96	211.65	202.84
V8	205.00	200.00	197.00	22.37	20.67	17.37	230.34	220.75	204.12
V9	216.00	210.00	203.00	21.52	18.62	16.96	219.79	205.62	201.96
F-test	S	S	S	S	S	S	S	S	S
S.Em. (±)	2.6239	3.2501	0.4487	0.347482	0.37250	4.2394	3.2857	3.0338	0.2376
C.D. @ 5 %	7.7962	2.7816	1.3348	1.03242	1.10678	1.5961	9.7623	9.0138	0.2376

Table.4 Sulphur(ppm) and Zinc(ppm) of soil of different depth

S. N0	Sulphur(ppm)	Zinc (ppm)

	0-15cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45cm
V1	3.70	2.77	1.84	0.56	0.37	0.18
V2	0.37	0.18	0.06	0.58	0.33	0.08
V3	2.77	2.59	2.41	0.35	0.18	0.01
V4	3.70	2.22	0.74	0.85	0.40	0.05
V5	2.96	2.40	1.84	0.59	0.37	0.15
V6	2.75	2.59	2.43	0.77	0.59	0.41
V7	3.70	2.59	1.48	0.59	0.33	0.07
V8	2.96	2.40	1.84	0.96	0.40	0.16
V9	3.34	2.22	1.10	0.85	0.57	0.29
F-test	S	S	S	S	S	S
S.Em. (±)	0.0377	0.0447	0.0365	0.0115	0.006	0.032
C.D. @ 5 %	0.0215	0.0055	0.00233	0.0343	0.0186	0.0955

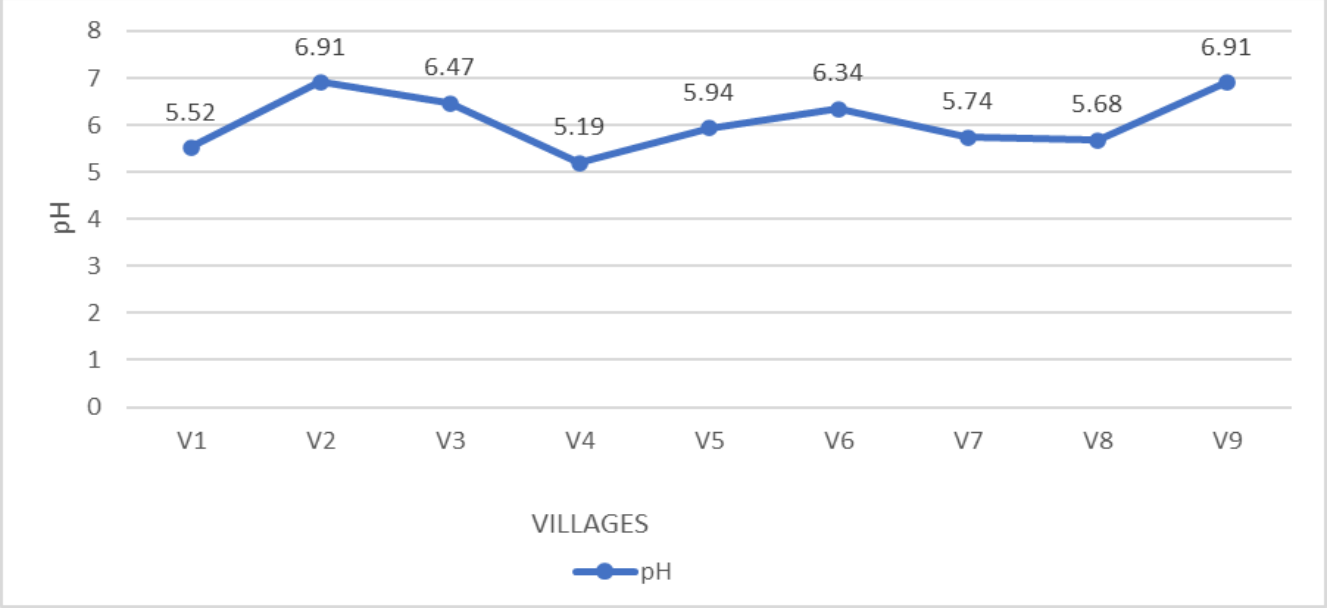

Fig3:pH

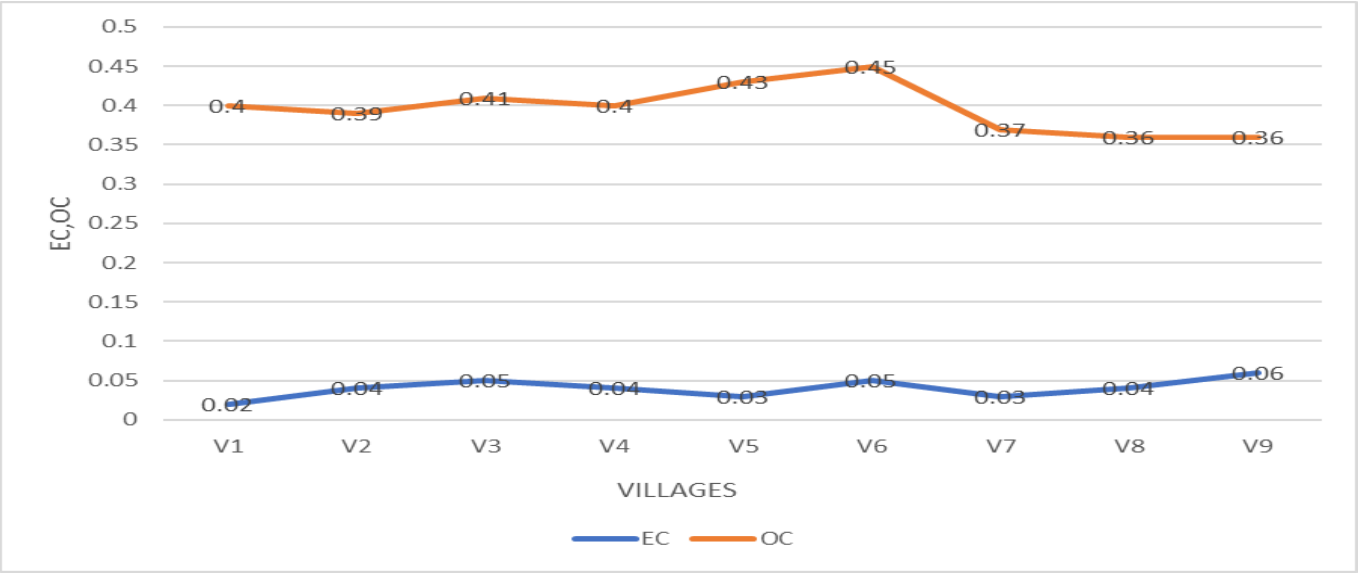

Fig4:EC (ds m^{-1})and OC (%)

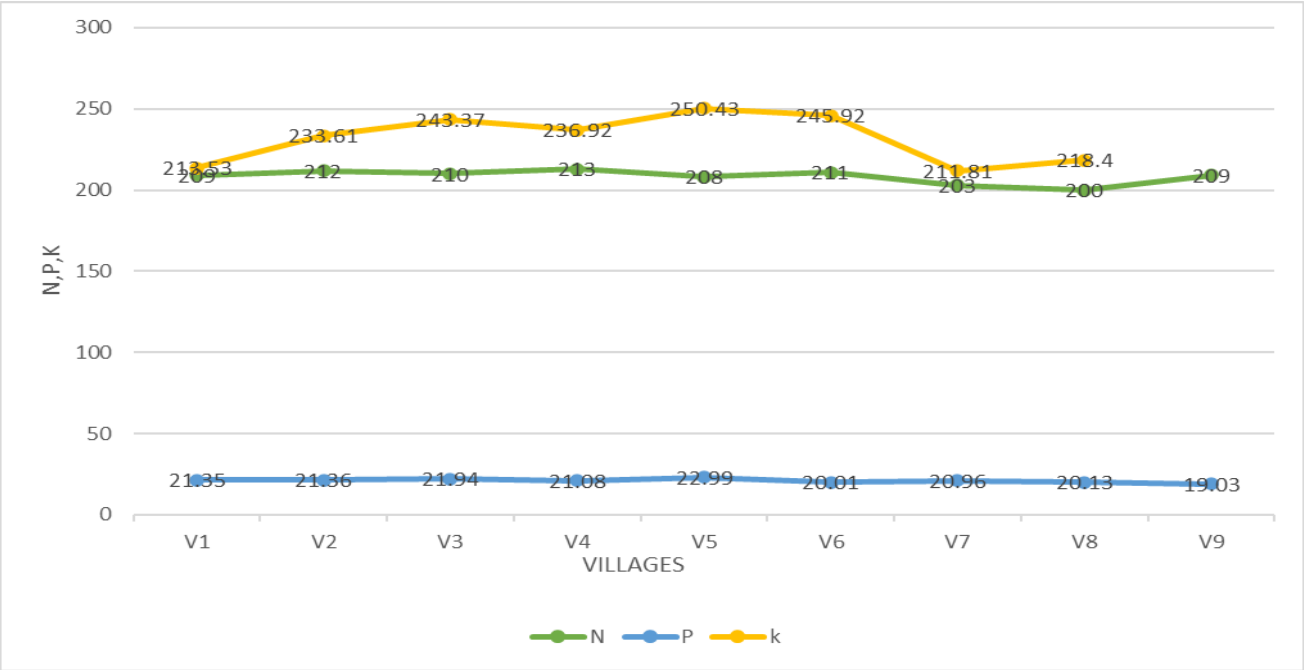

Fig5: Available Nitrogen, Phosphorous and Potassium (Kg ha^{-1})

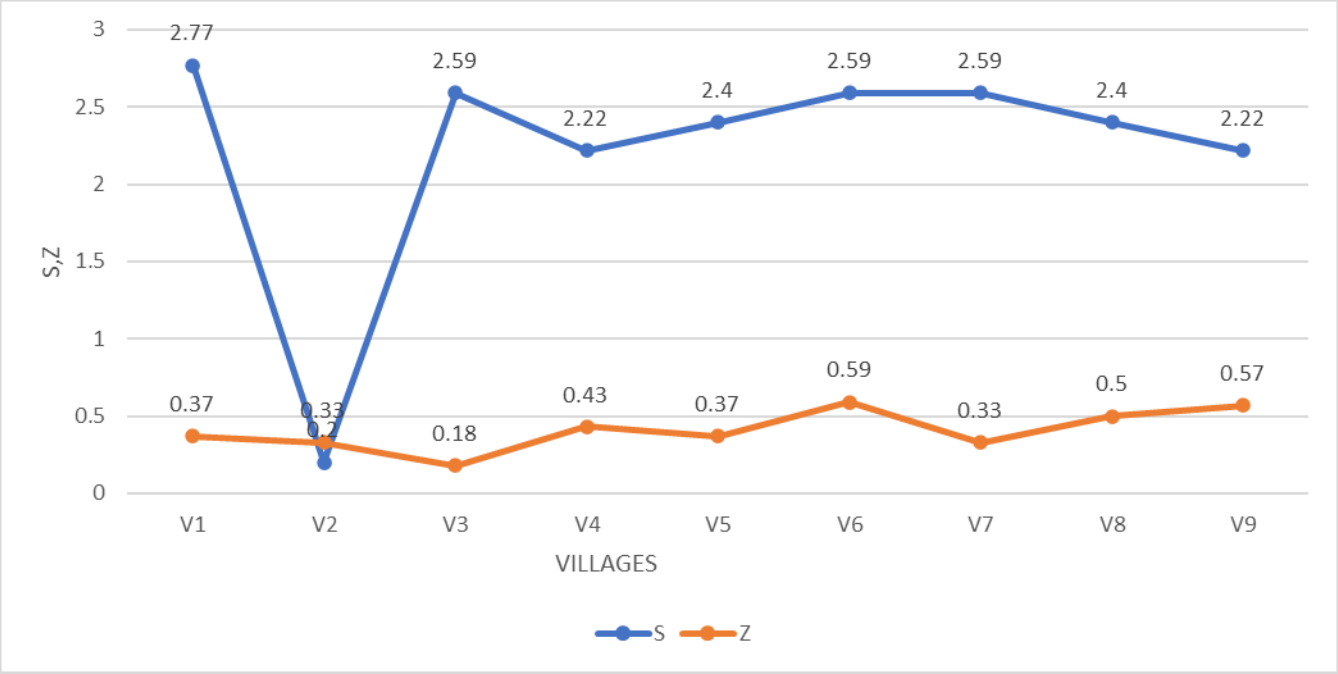

Fig6:sulphur(ppm) and zinc(ppm

CONCLUSION

It can be concluded that the soils of Bokaro District of Jharkhand state are in good physical and chemicalcondition'. The major crop production constraint in the study area was found to be soil slightly acidity. Due to soil erosion and water logging, most of the soils were found to be deficient in available nitrogen, potassium, zinc and sulphur content. So, application of liming materials along with application of soil test based nitrogenous, potassic, zinc and sulphur containing fertilizers and manures will help to obtain higher crop production as well as sustaining soil health. Hence, it is concluded that to obtain better soil health and soil quality a more attention is needed to pay in the role of macronutrient enhancement in the soil which will lead to optimum economic yield. And for maintaining soil health and soil quality adoption of organic farming will be an essential step.

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