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Research Article

SPATIAL AND TEMPORAL VARIABILITY OF SULPHUR CONCENTRATION IN SOME DESURFACED SOILS OF ROHTAK DISTRICT, HARYANA (INDIA)

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ABSTRACT

The study was carried out in National Capital Region (NCR), Rohtak District of Haryana state to assess the impact of soil desurfacing/surface mining due to brick kiln activity on Sulphur status of soil. Study revealed that the sulphur concentration invariably decreased significantly in desurfaced soil of the study area (Rohtak District) in the order of 88.15% in Meham block/zone, 85.11% in Lakhan Majra block/zone, 89.29% in Rohtak block/zone, 78.40% in Sampla block/zone, and 70.19 % in Kalanaur block/zone, respectively, as compared to normal soil. The evaluation and delineation of desurfaced soil in the study area was done using geographical information system (GIS) and remote sensing technique. Significant area falling in National Capital Region (NCR) is prone to desurfacing process due to brick kiln activities, because of unprecedented spurt in infrastructural development in the study area.

INTRODUCTION

Deficiency of Sulphur (S) is wide spread in agro-ecological zones (AEZ) of Haryana state. Most of the soils with light texture are low in available sulphur or these soils have depleted due to continuous cropping, regular use of S free fertilizers or manmade degradation of soil like soil desurfacing, mostly prevalent in urban areas and part of NCR due to brick kiln activities. Green revolution, which was first witnessed in northern states particularly Haryana and Punjab, made the country self-sufficient in food grain production, yet it resulted in faster depletion of secondary nutrient like sulphur. The soils of Rohtak district are coarse to medium in texture and alkaline in reaction. Another reason of low sulphur content may be attributed especially to the increasing use of high analysis fertilizers, lesser addition of organic manures and no recycling of crop residues, resulting in low availability of available sulphur.

Sulphur is considered very important constituent of some amino acids like cystein, cystine and methionine, abundantly found in oil seed crops, which are grown on large scale in Rohtak district, where irrigation facilities are scarce. Sulphur deficiency, which were sparse and sporadic initially are becoming widespread as a result of certain specific reason like soil desurfacing / surface mining due to brick kiln activities. Large area of Rohtak district falls in National Capital Region (NCR), which is very prone to soil desurfacing / surface mining activities. Although under normal conditions Sulphur nutrition as per GIS mapping, according to which situation is not as alarming, as per CCH-HAU reporting. GIS mapping of soil available sulphur can be helpful in making appropriate decisions regarding cropping sequence along with selection of fertilizer and schedules. Spatial and temporal distribution of sulphur fertility can provide better insights of its deficiency. With the help of modern technology of remote sensing (RS), geographic information system (GIS) and global positioning system (GPS), now it has become easier to monitor soil fertility and crop health through such systematic and scientific approach.

Problem Statement

In the study of land degradation due to soil desurfacing/surface mining for brick making, remote sensing technique applied to monitor trends of land degradation as well as to identify and characterize form and their temporal dynamism. Methods and technique needed to be critically selected, taking into account their suitability, applicability and adaptability to prevailing situation and local conditions. In the light of that, it is imperative to assess the damage being caused due to soil desurfacing to the sulphur status of soil because of brick kiln activities in the Rohtak district. For this purpose, following objectives have been envisaged:

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Objectives

1. To study spatiotemporal variability of S concentration in some desurfaced soils of Rohtak district, falling in National Capital Region (NCR) of Haryana state (India),
2. 2. Integrating use of remote sensing technique in monitoring of S depletion in desurfaced soil and fusing laboratory analysis data and field observations

MATERIAL AND METHODS

Location

Study area (Rohtak District) lies in 28° 23′′ to 29° 6′′ North latitude and 76° 13′′ to 76° 58′′ East longitude of the National Capital Region (NCR) of Haryana state (India). It is 70 km in northwest from national capital, New Delhi and located 235 km southeast of state capital, Chandigarh. More than 40 % area of Haryana state falls in NCR and whole of study area is the part of NCR. Geographical area of the study area is 1745 km^2. It is in the elevation range of 222 m from the average sea level. There is a gentle slope from north to south, *i.e*., 19 cm per km. It is comprised of following five community development blocks / zones (CDB/Z),

1. Meham 2. Lakhan Majra 3. Rohtak 4. Sampla 5. Kalanaur

Position of study area in survey of India (SOI) topographical sheet

The study area falls in the survey of India (SOI) topographical sheet No. 53C/8, 53C/12, 53D/01, 53D/5, 53 D/6, 53D/9, 53D/10, 53D/13, 53D/14, (Fig. 1). Map-Scale 1:25000

Climate

The normal annual rain is 576.2 mm, which is unevenly distributed throughout the year. The southwest monsoon sets in from last week of June and withdraws in the end of September, contributing about 85 % of the rainfall. Hot in summer, highest day temperature ranging between 23°C-45°C. Sub-tropical, semi-arid, continental mainly rains bring by southwest monsoon in the season July- August- September. Rains are scanty to normal. The climate classified as tropical steppe, semi-arid and hot, which is mainly dry and hot with dry summer except monsoon months, *i.e*., July to September when moist air of oceanic origin penetrates into the land. Winters are also extremely cold and mostly dry where night temperature falls to as low as 2-3°C. The mean seasonal temperature during *kharif* and *Rabi* season are 29-31°C and 16-18°C with relative humidity of 70% and 55%, respectively. The area slopes towards Northeast to South-West with an average gradient of 0.19 m/km. The general elevation ranges between 215-222 m from sea level.

Soil

The soil of the study area are fine to medium textured, sandy loam in Rohtak and Sampla block, Lakhan Majra, loamy sand with occasional clay loam in Kalanaur and Meham.

Data acquisition and use

Data acquired from Haryana Space Application Center (HARSAC-CCS HAU-Campus), Hisar (INDIA)-125004, and on screen digitization of desurfaced soil in study area was performed for assessment.

Satellite details

1. ***Cartosat-I:*** Cartosat-I carries two state-of-the-art panchromatic (PAN) cameras that takes black and white stereoscopic images of the earth in the visible region of the electromagnetic spectrum. The swath covered by these high-resolution PAN cameras is 30 km and their spatial resolution is 2.5 meters (Table 1).
2. ***Worldview-II:*** Worldview-II is a commercial earth observation satellite owned by Digital Globe (DG). Worldview-II provides commercially available panchromatic imagery of 0.46 m resolution, and eight-band multispectral imagery with 1.84 m (6 ft) resolution. It launched on October 8, 2009 to become Digital Globe's third satellite in orbit, joining Worldview-II, which launched in 2007.

Table 1 Details of Satellite Data

Sr. No.	Satellite	Sensor	Month/Date of Acquisition	Number of Images
1.	Cartosat–I=Study Area	PAN and Multispectral	16 January, 27 February, 17April, 28 September, 12 December, 2007	1, 2, 2, 2, 1, respectively
2.	Worldview-II=Study Area	PAN and Multispectral	12 March, 12 April, 11 May, 12 May, 11 October, 11 December, 2012	31, 25, 73, 12, 7, 13, respectively

Cartosat-I satellite gathered stereoscopic images on 16 January (1), 27 February (2), 28 September (2), 12 December (1), 2012, and worldview-II, on 12 March (31), on 12 April (25), 11 May (73), 12 May (12), 11 October (7), 11 December (13), 2012 with the help of, sensors PAN and Multispectral, Table 2. Number of images indicated in parentheses as shown in Table 1.

Table 2 *GPS locations of sampling sites* (Ground Truth Points, Fig. 1)

Sr.No.	Block (Zone) (Study Area)	Latitude	Longitude
1	Meham	N 28 59′ 8.52″	E 76 19′45.228″
2	Lakhan Majra	N 29 02′29.148″	E 76 27′37.512″
3	Rohtak	N 28 56′32.208″	E 76 43′5.628″
4	Sampla	N 28 49′48.612″	E 76 49′40.548″
5	Kalanaur	N 28 51′.592″	E 76 40′.520″

GPS locations of sampling sites in Meham (N 28 59′ 8.52″, E 76 19′45.228″), Lakhan Majra (N29 02′29.148″, E 76 27′37.512″) Rohtak (N 28 56′32.208″, E 76 43′5.628″) Sampla (N 28 49′48.612″, E 76 49′40.548″) and Kalanaur zones (N 28 51′.592″, E 76 40′.520″) are depicted in Table 2, along with latitude and longitude values indicated in parentheses.

Ground truth points

Sampling sites: Fig. 1 depicts GPS ground truth points visible in the figure, taken at the time of investigation survey of the study area.

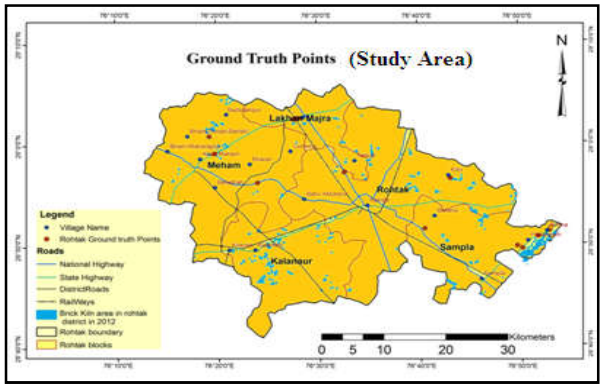

Fig. 1 Ground Truth Points and sampling sites

Collection and preparation of soil samples

In order to assess the sulphur status of desurfaced soils of study area (Rohtak district), geo-referenced surface (0-15 cm) and desurfaced soil (90 cm) samples representing different blocks / zones as per soil map prepared on 1:25000 scale, were collected using GPS (Fig.1). Exact location of soil sample sites from all the blocks /zones of Rohtak district were recorded making use of GPS equipment. The soil samples were ground and processed as per the standard procedures for laboratory chemical analysis of various soil physic-chemical characteristics and available sulphure content.

Soil Characteristics

Texture and Textural Class

Table 3 Textural class in different blocks/zones

S.No.	Block	Sand (%)	Silt (%)	Clay (%)	Textural Class	
		N	N	N	N	D
		D	D	D		
1	Meham	70.00	12.70	17.30	SL	
		61.30	20.10	18.60		L
2	LakhanMajra	71.19	13.10	15.80	SL	
		60.89	19.50	19.70	L	
3	Rohtak	70.90	12.90	16.20	SL	
		62.00	19.70	19.30	L	
4	Sampla	71.50	13.20	15.30	SL	
		60.50	21.00	24.20	L	
5	Kalanaur	72.00	12.30	15.70	SL	
		60.50	21.50	18.00	L	
6	Mean	71.10	12.84	16.06	SL	
		60.02	20.36	19.62	L	

N=Normal, D=Desurfaced, SL=Sandy Loam, L=Loam

Normal surface soils of this district are sandy loam and desurfaced soils/ exposed soils are invariably loam.

SOIL pH

The acidity, neutrality or alkalinity of a soil measured in term of hydrogen ion activity (active concentration) of the soil-water system (1:2) at room temperature with pH-meter having glass electrode.

Elecrical Conductivity

Electrical conductivity was determined in 1:2 soils: water suspension with a sol bridge conductivity meter at 25^{o}C as described by Richards (1954).

Organic Carbon

The organic Carbon content of soil estimated by using the following method given by Walkley and Black, (1934)

Available-S

Available-S in soil was extracted with 0.15% $CaCl_2$, solution and sulphur in extract was determined turbidimetrically using $BaCl_2$ crystals as per the method of Chesnin and Yien (1950)

Statistical Analysis

Statistical analysis of data performed using online Statistical Analysis Tools-OPstat, web site 9 http://hau.ernet.in/opstat/ and applied for various observations using randomized soil sampling technique and effects compared using least significant differences ($LSD_{0.05\ and 0.01}$), Standard deviation, and Mean values.

Table 4 Available Sulphur in normal and desurfaced soils

Sr. No.	Block	Kiln Site	L-S	TC	Av-S ($mgkg^{-1}$)
1	Meham	Kheri Meham	N	SL	91.0
2	Meham	Kheri Meham	D	L	8.5
3	Meham	Bhaini Chanderpal	N	SL	88.0
4	Meham	Bhaini Chanderpal	D	L	12.8
5	Lakhan Majra	Lakhan Majra	N	SL	23.7
6	Lakhan Majra	Lakhan Majra	D	L	3.2
7	Lakhan Majra	Tatauli	N	SL	43.5
8	Lakhan Majra	Tatauli	D	L	6.8
9	Rohtak	kiloi	N	SL	85.3
10	Rohtak	Kiloi	D	L	9.2
11	Sampla	Hasangarh	N	SL	78.9
12	Sampla	Hasangarh	D	L	15.2
13	Sampla	Rahna	N	SL	88.8
14	Sampla	Rahna	D	L	23.1
15	Kalanaur	Kherari	N	SL	110.5
16	Kalanaur	Kherari	D	L	35.2
17	Kalanaur	Kalanaur	N	SL	97.8
18	Kalanaur	Kalanaur	D	L	28.6

L-S=Land Surface, TC=Textural class, N=Normal soil (Surface soil, Depth 0 - 15 cm), D=Desurfaced soil (Depth 90 - 105 cm), SL=Sandy Loam, L=Loam, N=Normal, D=Desurfaced, Av-S=Available S

Table 5 Descriptive Statistics of the soil of the study area

Character	Group	Assumptions	t	d.f.	Probability
BD	1&2	Equal Variances Assumed	5.9 **	16	0
		Unequal Variances Assumed	5.9	10.96	0.0001
HC	1&2	Equal Variances Assumed	18.6 **	16	0
		Unequal Variances Assumed	18.61	12.16	0
pH	1&2	Equal Variances Assumed	2.92 *	16	0.01
		Unequal Variances Assumed	2.92	15.5	0.0103
EC	1&2	Equal Variances Assumed	4.15 NS	16	0.0008
		Unequal Variances Assumed	4.15	15.42	0.0008
OC	1&2	Equal Variances Assumed	6.93 **	16	0
		Unequal Variances Assumed	6.93	14.06	0
P	1&2	Equal Variances Assumed	4.07 **	16	0.0009
		Unequal Variances Assumed	4.07	14.43	0.0011
K	1&2	Equal Variances Assumed	11.3 **	16	0
		Unequal Variances Assumed	11.34	13.43	0
S	1&2	Equal Variances Assumed	10.4 **	12	0
		Unequal Variances Assumed	10.46	12.43	0

** Significant ($LSD_{0.01}$), * Significant ($LSD_{0.05}$), NS=Non significant

RESULTS AND DISCUSSION

The present study revealed that the soil desurfacing has enormously harmed the sulphur fertility status of soils in all the blocks of Rohtak district as is evident from Table 4 and Fig.2. Normal soil of Meham block had 89.5 mg/kg S and desurfaced soil-10.6 mg/kg, a net decline of 88.15%, Lakhan Majra block -

33.60 mg/kg S in normal and 5.0 mg/kg in desurfaced soil, 85.11% decrease, Rohtak block -85.3 mg/kg S in normal soil and 9.2 mg/kg S in desurfaced soil, a net decrease of 89.29%, Sampla block-83.80 mg/kg S in normal soil and 18.10 mg/kg S in desurfaced soil with a decrease of 78.40%, whereas in Kalanaur block-104.10 mg/kg S in normal soil and 31.10 mg/kg S in desurfaced soil with a net decrease of 70.19% as compared to normal soil.

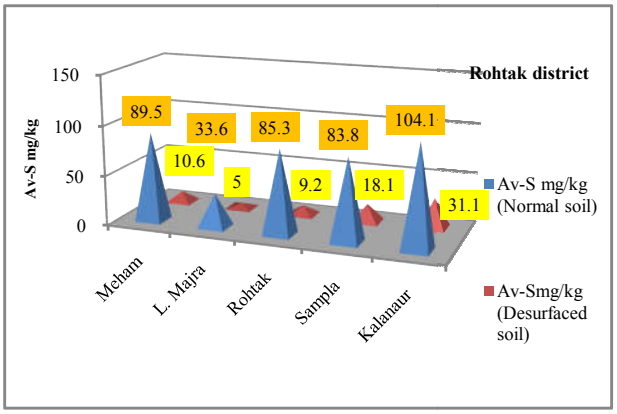

Fig. 2 Available S (Av-S) in normal and desurfaced soils in different blocks/Zones

The decreasing trend of Sulphur in desurfaced soil may be attributed to the removal of organic matter from the top soil due to soil desurfacing process, which is a common phenomenon in brick manufacturing operation. Organic matter is considered reservoir of all primary and secondary nutrients including micronutrients, (Zhang and Fang, 2007).

CONCLUSION

The present study demonstrates that the study area is highly engulfed in brick kiln activity. Soil desurfacing by brick kilns for making bricks is on exponential increase and a potential threat to the soil health and soil productivity, particularly in rapidly developing urban areas of national capital region (NCR) of Haryana including Rohtak district, which is quite adjacent to national capital, New Delhi (India).

The study revealed that decreasing trend of Sulphur (S) concentration was found quite prevalent in desurfaced soils of all the blocks/zones of Rohtak district, when compared with normal soils in the following order:

- Meham- Sulphur (S) concentration decreased by 88.15% in desurfaced soils,
- Lakhan Majra- Sulphur (S) concentration decreased by 85.11% in desurfaced soils,
- Rohtak- Sulphur (S) concentration decreased by 89.29% in desurfaced soils,
- Sampla- Sulphur (S) concentration decreased by 78.40% in desurfaced soils
- Kalanaur- Sulphur (S) concentration decreased by 70.19% in desurfaced soils

Study also demonstrates that almost all physical and chemical properties of soils of study area have deteriorated in their capacity of fertility (Gollany *et al*, 1992), which may affect soil productivity, (Grewal *et al*, 1997, Priyanka, Singh *et al*, 2014).

References

1. Brady, N.C. and Weil, R.C., (2012). *The Nature and Properties of Soils* (14th Edition) Revised.
2. Campbell, J.B., (1978). Spatial variation of sand content and pH within single continuous delineation of two soil mapping units, *Soil Sci. Soc. Am. J.*, **42**:460-464
3. Chopra, S.L. and Kanwar, J.S. (1968) Effect of some factors on the transformation of elemental sulphur in soil. Indian soc. Soil Sci. **16:** 83-88.
4. Dalel, J.L., Kanwar, J.S. and Saini, J.S. (1963). Investigation of soil sulphur and CaSO4 as a fertilizer for ground in Punjab. Indian J. Agri. Sci. **33**: 199-204.
5. Chesnin, L. and Yien C.H. (1950). Turbidimetric determination of Available Sulphur. *Soil sci. soc.Am. Proc.* **15:** 149-151.
6. Gollany, H.T; Shcumacher, T.E., Evenson, P.D; Lindstorm, M.J; and Lemme, G.D., (1992). Topsoil depth and desurfacing effects on properties and productivity of a Typic Agriustoll. *Soil Sci. Soc. Am.J.* **56**: 220-225.
7. Grewal, M.S., Dahiya, I.S., and Kumar, A., (1997). Spatial vriability of some chemical properties in alluvial plains of northwest India. Arid Soil Research and Rehabilitation, **11**:255-264.
8. Indorante, S.J., Jansen, I.J., and Boast, C.W., (1981), Surface mining and reclamation. Initial changes in soil character. *J. Soil Water cons.* **36**: 347-350
9. Parkash, O., R.S. Malik, K. Singh, R.P. Narwal and K. Ram. (2003). Depth wise distribution of S in some paddy soils of Haryana, India. *Indian J. Agric. Res.* **37**
10. Piper, C.S., (1950). *Soil and Plant Analysis*, the University of Adelaide Press, Adelaide, Austrailia, 368 p.
11. Priyanka, Singh, Rani Devi, Hooda, R.S., and Grewal, M.S., (2014). Soil Desurfacing: A potential threat to soil health, productivity and fertility. *Research on Crops*. **15** (3): 722.
12. Tressen, H., Cuevas, E., and Chacon, P., (1994). The role of soil organic matter in sustaining soil fertility. *Nature* **371**: 783-785.
13. Walkley, A., and Black, C.A., (1934). An examination of method for determination of soil organic matter and a proposed modification of the chromic acid titration method, *Soil Science* Vol.**37**: 29-34.
14. Zhang, M.K., and Fang, L.P., (2007). Effect of tillage, fertilizes and green manure cropping On soil quality at an abandoned brick kiln site. *Soil and Tillage Research* **93**, 87-93.

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