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Description and Comparative Analysis of Status of Soil Fertility in Suwana Block of Bhilwara District of Rajasthan, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present research took place from Suwana block in Bhilwara district of Rajasthan for analyze the fertility of the soils on cultivated land both close to and far from industrial areas was carried out at the SHUATS, Prayagraj. Department of Soil Science and Agricultural Chemistry formerly called Naini Agricultural Institute, (U.P.). During the year 2023-2024. The soil samples were collected at the single-depth ranges: 0–15 cm from 30 different villages of one block of Bhilwara district, a total

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of 90 samples collected and analyzed for their physical and chemical parameter by using SLT. The outcome demonstrated that the soil samples' pH was observed from neutral, slightly alkaline to strongly alkaline. The EC-1 became secure variety for cultivated land. %OC range was found in low to medium range. Available nitrogen was low, phosphorous was moderately to low., potassium levels ranged from medium to high, Sulphur was range from low too high in range in soils of Suwana block. Ca and Mg had been enough in variety of research area.

Keywords: Physical; parameters; Suwana; Bhilwara; standard laboratory technique.

1. INTRODUCTION

"Soil" is a loose material consisting of worn rock and other things, including partly decomposed OM. It is sometimes referred to as the soul of infinite life. It serves as a storehouse for nutrients and is essential to the development of plants and other crops that keep the environment on Earth clean. It additionally acts as a supply and sinks for atmospheric gases (Ratan et al., 2011). Soil provides habitant to millions, fuel and feed to support the basic needs of humans and animals; as the population of humans and animals grows, there is a growing need for more food production. However, the soil's ability to produce is restricted, and intrinsic qualities determine the boundaries of production., agroecological setting, use and management.

In order to create a land use system that works, it is necessary to systematically assess soil resources in terms of their quantity, distribution, qualities, behaviours, and potential for use. For augmenting agricultural manufacturing on sustainable basis (FAO, 1993). “Soil trying out makes whole nutrient manipulate a possibility; fertilizer experiments are being patterned to decide economically surest costs of vitamins utility excessive yields with low manufacturing expenses according to contemporary farming, unit area is essential. Farmers of today are in different mind to the failure is more certain and sooner unless they are obtaining reasonably high yields, improved drainage, many improved cultural practices, better varieties, and control of insects and disease have helped to set the stage for high yields” (Joshi et al., 2013). Soil is formed by the weathering of rocks, and it can take up to 1000 years to develop one cm of soil. The horizons of the soil are composed of both organic and mineral materials that are split into different depths and have different morphologies, compositions, physical and chemical characteristics, and biological characteristics from the parent material. While pedology studies soil production, classification, surveying, and geological distribution, edaphology studies soil in connection to higher plants.

2. MATERIALS AND METHODS

Fig. 1 depicts the researched area chosen from the Bhilwara district in the Suwana block. The location of it is 25°3407"N latitude and 74°6313"E longitude, respectively. The area under study is part of the Central Plateau and Hills Region (VIII) Agro Climatic Zone (NARP) Sub Humid Southern Plain Zone (RJ-06), Hot Semi-Arid Eco Region Agro Climatic Zone (Planning Commission), and Sub Agro ecological Sub Region (ICAR) Northern Plain (And Central Highlands) Including Aravalli's. Because of Rajasthan's arid geography and little rainfall, Bhilwara district has dry weather.

Table 1. Characterisation of soil test value for different nutrients

Nutrients	**Evaluation of the soil test results**		
	Low	**Medium**	**High**
OC (%)	<0.5	0.5-0.75	>0.75
Available N (kg ha^{-1})	<280	280-560	>560
Available P (kg ha^{-1})	<10	10-25	>25
Available K (kg ha^{-1})	<110	110-280	>280
Available S (kg ha^{-1})	<10	10-20	>20
	Inadequate		**Adequate**
Ca^{2+} (Cmol(P+) kg^{-1})	<1.5		>1.5
Mg^{2+} (Cmol(P+) kg^{-1})	< 1		> 1

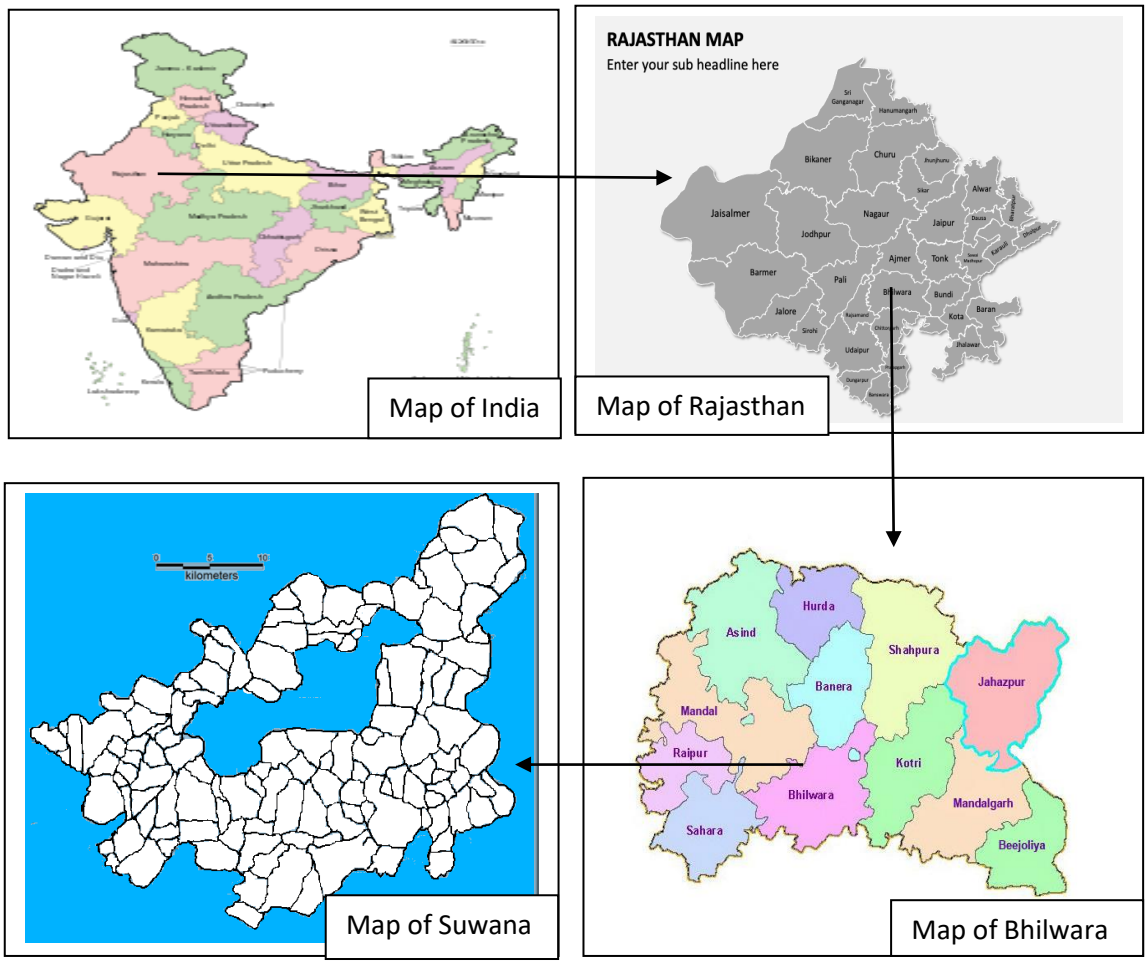

Fig. 1. Location of Suwana block in Bhilwara dist. of (Raj.)

Its humid environment, with average rainfall and a mean annual temperature of above 22 degrees Celsius is 550 mm. Using khurpi, soil samples were randomly gathered to a depth of 015 cm from farmed land in several villages within the Suwana block. After, the soil samples were well combined, 500 grams of composite soil samples were collected for examination.

Using certain standard protocols for primary and macronutrients, the processed soil samples were examined for various nutrients.Using a pH mete, conductivity meter, bulk density, particle density, porosity, and pycnometer, the soil's pH, EC, and water holding capacity were all assessed. A measuring cylinder was also used to record the data.

The OM content was extracted by Walkey and Black [1] method, available N was estimated by alkaline KMnO4 method, available phosphorus was extracted by 0.5 M Sodium bicarbonate solution pH 8.5. Available potassium was determined by 1N NH_4Oc method, with the help of flame photometer. Sulphur was estimation by $CaCl_2$ method. Ex. Ca and Mg were analyzed by complexometric titration methods.

3. RESULTS AND DISCUSSION

3.1 Physical Properties of Soil

The Status of physical properties is shown in Table 2. Out of the total 90 soil samples, pH in categories as 5 (5.55%) soil samples were neutral, 67 (87.77%) soil samples were alkaline and 10 (5.84%) soil samples were strongly alkaline in condition. The electrical conductivity was varied from 0.28 to 3.1 dSm-1 with an average value of 0.71 dSm^{-1}. Out of 90 soil samples, 38 (31.11 %) soil samples under in safe use, 55 soil samples (66.66%) are normal range of use and 2 sample (2.22 %) is unsafe range of use so, studies present in soil EC, no harm in germinating of seed and normal growth of plant, as maximum number of samples. The BD and

PD ranges from 1.13-1.49 and 2.12-2.76 Mgm^{-3} respectively with a mean of 1.33 and 2.53 Mgm^{-3}. WHC of soil ranges from 31.34 to 47.24 %, with a mean of 37.68 %. Porosity of soil ranges from 37.25 to 53.7%, with a mean of 46.57%. The data on % OM content was ranges from 0.15 to 0.69 with a mean value of 0.38. Out of 90 soil samples to 69 soil samples (76.66 %) were found low, 21 soil samples (23.33%) were found medium in OM. Thus, majority of the soil samples of Suwana block are low and few samples were medium in %OC due to the arid area is responsible low in OM accumulation and some areas were medium in OM percent due to use of farm yard manure each year and crop residues left after harvesting. The similar results were also reported by Aggarwal and Kumar (1994), Prakash (2001), Meena *et al.,* [2] and Yadav and Meena (2009) and Dinesh Khadka *et al.,* [3] in ARS, Belachapi, Dhanusha, Nepal.

3.2 Status of 1^0 nutrients in soil

The status of nitrogen, phosphorous and potassium has been shown in Table 2. Available nitrogen content of collected soils was ranged from 110.52 to 312.89 kg ha-1 with a mean value of 199.81 kg ha-1. Out of 90 collected soil samples, 85 soil samples (94.44 %) were range low, and 5 (4.67%) samples were range in medium. Climatic condition has also a major role on availability of nitrogen, max. soil samples were in low range, it may be due to denitrification by denitrifying bacteria, arid climatic condition and application of low amount of organic manure, in situ green manures and use of chemical fertilizers [4,5].

The available P content in these collected soils samples was in range from 8.5 to 32.50 Kg ha^{-1} with a mean value of 14.21 Kg ha^{-1}. Out of 90 soil samples collected, 28 (31.11%) soil samples were in range of low, 60 (66.66%) soil samples were in range of medium and 2 (2.22%) soil samples were high in Phosphorus content. These results are strongly supported by the findings of Kumar and Seth (1983) who reported that the soil was medium in available phosphorus [6].

The K value in these collected soil samples was ranged of 204.32 to 383.69 kg ha^{-1} with a mean value of 283.13 kg ha^{-1} K. Out of 90 collected soil samples, 49 soil samples (54.44 %) were medium in range and 41 soil samples (45.55 %) were in high range, this high range of potassium is due to presence of K containing primary and secondary minerals (muscovite, biotite and anorthite). As per criterion laid down by Muhr *et al.,* (1965), “maximum soils samples 72.72% were found under high category (above 280 kg K_2O ha-1) of available potassium”. “Hence, it is found that all soils of the study area were high in available potassium” [7,8].

3.3 Status of 2^0 nutrients in Soil

The status of Sulphur, Calcium and Magnesium is present in Table 2. The available S content in soils of Suwana block was ranged from

Table 2. Nutrients status in soil

Features of the Soil	Range	Mean	SD	CV (%)
pH (Soil: water) (1:2.5)	7.2-8.6	8.20	0.40	3.86
EC (dSm^{-1})	0.25-2.2	0.78	0.30	42.20
B.D. (Mg m^{-1})	1.13-1.49	1.34	0.08	5.68
P.D (Mg m^{-1})	2.12-2.77	2.54	0.16	6.52
W.H.C. (%)	23.23-54.68	37.68	6.43	7.89
Porosity (%)	37.25-52.7	47.12	3.15	6.46
OC%	0.15-0.69	0.39	0.14	36.64

Features of the Soil	Range	Mean	SD	CV (%)
Available N (kg ha^{-1})	110.52-312.89	199.81	57.75	28.90
Available P (kg ha^{-1})	8.5-32.50	14.22	3.87	27.25
Available K (kg ha^{-1})	204.32-383.69	283.13	45.78	16.17
Features of the Soil	**Range**	**Mean**	**SD**	**CV (%)**
Available S (kg ha-1)	3.71-19.95	12.54	3.29	26.20
Available Ca (Cmol (P+) (kg^{-1})	2.24-18.50	12.54	3.53	46.47
Available M (Cmol (P+) (kg-1)	0.31-7.11	0.46	3.53	51.06

Table 3. Comparison between cultivation soils near cloth industry area, steel plant, bricks industry, sewage water irrigation and area away from industry

S.No.	Parameter	Area Near Industries (Cultivation Area)				Area Far away from Industries (Cultivation Area)
		Steel Plant	Cloth Industry	Sewage Water Irrigation	Brick Industry	
1	pH	7.81	7.63	7.65	8.25	8.19
2	EC (dSm^{-1})	0.62	1.17	1.07	0.64	0.65
3	BD ($Mg\ m^{-3}$)	1.42	1.31	1.32	1.35	1.33
4	PD ($Mg\ m^{-3}$)	2.63	2.37	2.42	2.56	2.55
5	WHC (%)	38.16	32.01	42.59	38.7	40.95
6	OC (%)	0.43	0.39	0.61	0.36	0.35
7	N ($Kg\ ha^{-1}$)	192.33	192.33	240.42	165.09	200.63
8	P ($Kg\ ha^{-1}$)	12.12	13.84	14.81	12.99	14.49
9	K ($Kg\ ha^{-1}$)	237.63	271.93	306.31	282.29	285.06
10	S ($Kg\ ha^{-1}$)	14.30	13.83	11.46	13.54	12.14
11	Ca ($Cmol(p+)Kg^{-1}$)	5.14	6.19	13.09	9.37	7.59
12	Mg ($Cmol(p+)Kg^{-1}$)	2.90	2.29	3.24	2.44	2.49

4.61–19.95 kg ha^{-1} with an average value of 12.54 kg ha-1. Out of total 90 soil samples, 18 soil samples (20.00 %) were range from of low, 72 soil samples (80.00 %) were range of medium in Suwana block. The similar results were found by Jat and Yadav [9] in soils of Entisol of Jaipur District, (Raj).

The ex. calcium content of these soils was ranges from 2.24 to 18.50 Cmol (P+) kg^{-1} with a mean of 7.59 Cmol (P+) kg^{-1}. Out of 90 collected soil samples, all the 90 soil samples (100.00 %) were found sufficient in available Ca^{2+} content. It may be due to use of Ca^{2+} rich fertilizer and application of gypsum on the soil of studied area. The similar trend was also recorded by Nayak *et al.,* [10] in swell and shrink soils of Vertisol order in Vidarbha region.

"The ex. magnesium value in soils of Suwana block were in range of 0.31 to 7.11 Cmol (P+) Kg^{-1} with a mean of 2.55 Cmol (P+) kg^{-1}. Out of 90 soil samples, all the 90 soil samples (100.00%) were found sufficient in available Mg^{2+}" [11]. The similar results were observed by Prasad *et al.* (2006) in swell-shrink orange cropped soils of Nagpur District [12].

4. CONCLUSION

The Suwana block of the Bhilwara district's soil is classified as neutral to alkaline with a slightly sali ne reaction; the soluble salt level is within a safe l imit and has no effect on crop germination.

In the soils of the examined area, %OC is in the l ow to medium range.

The research areas soils have low levels of N, P and S, medium levels of S, and medium to high l evels of K.There was also enough magnesium a nd calcium found in the Suwana block's soils.Wit h the exception of WHC, which is higher in sewa ge water irrigated areas than in nonindustrial areas, all areas display comparable B.D. and P.D. values.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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