



Spatial Analysis of Soil Physical Parameters at Different Depth in Sikrai Tehsil of Dausa, R, India

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Authors' contributions

This work was carried out in collaboration among all authors. Author PCB designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author KKS who suggest me this topic. Author Rani Saxena help to prepared the fertility maps. Authors RKB and RV help to analyzed the biological properties. Authors R. Sammauria and RSM managed the analyses of the study. Author HPP managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

An investigation, was carried out during year 2021-22. Total 190 soil samples were collected from two depth (i.e., 0 to 15 and 15 to 30 cm). Sand content varied from 73.20 to 82.10 and 71.70 to 80.50 per cent, silt content varies from 9.20 to 14.60 and 10.30 to 15.30 and clay content ranged from 8.20 to 12.80 and 9.20 to 13.20 per cent. The bulk density was ranged from 1.45 to 1.54 and 1.46 to 1.55 Mg m⁻³, while, particle density was ranged from 2.47 to 2.65 and 2.48 to 2.66 Mgm⁻³. Porosity of surface and sub-surface soils ranged between 38.87 to 45.08 and 38.71 to 44.91%. Based on sand, silt and clay contents, these soils classified into sandy loam and loamy sand textural classes. Out of 95 surface soil samples 19 (20.00%) fell in loamy sand and 76 (80.00%) samples fell in sandy loam texture class. while, in sub-surface 2 (2.11%) fell in loamy sand and 93 (97.89%) were in sandy loam category. Therefore, the majority of soils were belonged to sandy loam in texture. The depth wise distribution of soil physical properties is valuable to the scientific community for various applications, particularly in agriculture, civil engineering, and efforts to combat environmental degradation and optimum land use plan for maximizing agricultural production.

Keywords: *Environmental degradation; sandy loam; soil physical parameters; spatial analysis.*

1. INTRODUCTION

Soil is the most vital and precious natural resource that sustains life on the earth. It takes almost 1000 years to produce an inch of topsoil (Chandra and Singh 2009). The most important constituents in soil are organic matter, an appreciable amount of it in soil tremendously increases soil fertility. Decay of organic matter release nitrogen, phosphorus and mineral nutrients in forms available to plants. Soil is a component of the lithosphere and biosphere system. It is a vital natural resource that supports life system and socio-economic development. Soil productivity and sustainability depends on a dynamic equilibrium between its physical and chemical properties. The study of soil use in its spatial context is essential to understand the area of optimum soil use and degraded areas. The comprehensive study of soil use is of immense value to ensure better returns from the soil to meet future requirements for food and industrial raw materials and successful planning of agricultural growth (Alamouti & Navabzadeh, 2007). The natural resources like soil, water and vegetation form an integral part of tropical ecosystem warranting due attention to ensure ecological security and sustainable socio-economic development. Soil is an important component in human's total stock of natural resources which underpins food production. However, the characterization of soil

physical, properties is lacking in the studied area. A systematic study of soils is necessary for better utilization of land and water resources to tackle soil and water problems. Understanding the physical properties of soil at various depths is essential for assessing soil health, fertility, and crop suitability and productivity. The findings might be helped farmers and agricultural planners in making informed decisions about crop selection and soil management. It can provide insights into water retention, drainage, and nutrient availability are crucial for sustainable land use. Generally, the research contributes to understanding the effects of land use changes and environmental factors on soil quality, impacting agriculture and policy in the Dausa district and beyond for similar agro - ecological zone.

At this juncture, soil testing along with GPS reading and GIS based mapping would enable to assess the soil fertility status of the particular location. The GPS and GIS helps in collecting a systematic set of georeferenced samples and generating spatial data about the distribution of nutrients (Sharma, et al., 2004).

2. MATERIALS AND METHODS

The soil samples were collected from 95 villages apart from Sikrai tehsil, having variations in slope/topography, colour and cropping pattern and behavior. Two depth-wise samples viz., "0 to

15" cm, "15 to 30" cm was collected and analyzed. Samples were collected only from the open places. The samples were analysed for physical properties. A sample collection sheet is prepared for proper tagging and packing of the samples on the site. Dausa district lying between latitude 26° 23' and 27° 15' and longitude 76° 0' and 77° 02'). The area studied lied in the agroclimatic zone IIIA (Semi-arid eastern Plains) of Rajasthan. Sikrai tehsil is located between 76° 69 East Longitude (degrees) and 26° 91 North latitude (degree). The climate of the Dausa is semi-arid. Soil Samples were collected from Two depth viz., "0 to 15" and "15 to 30" cm only from the open places. The samples were analysed for physical

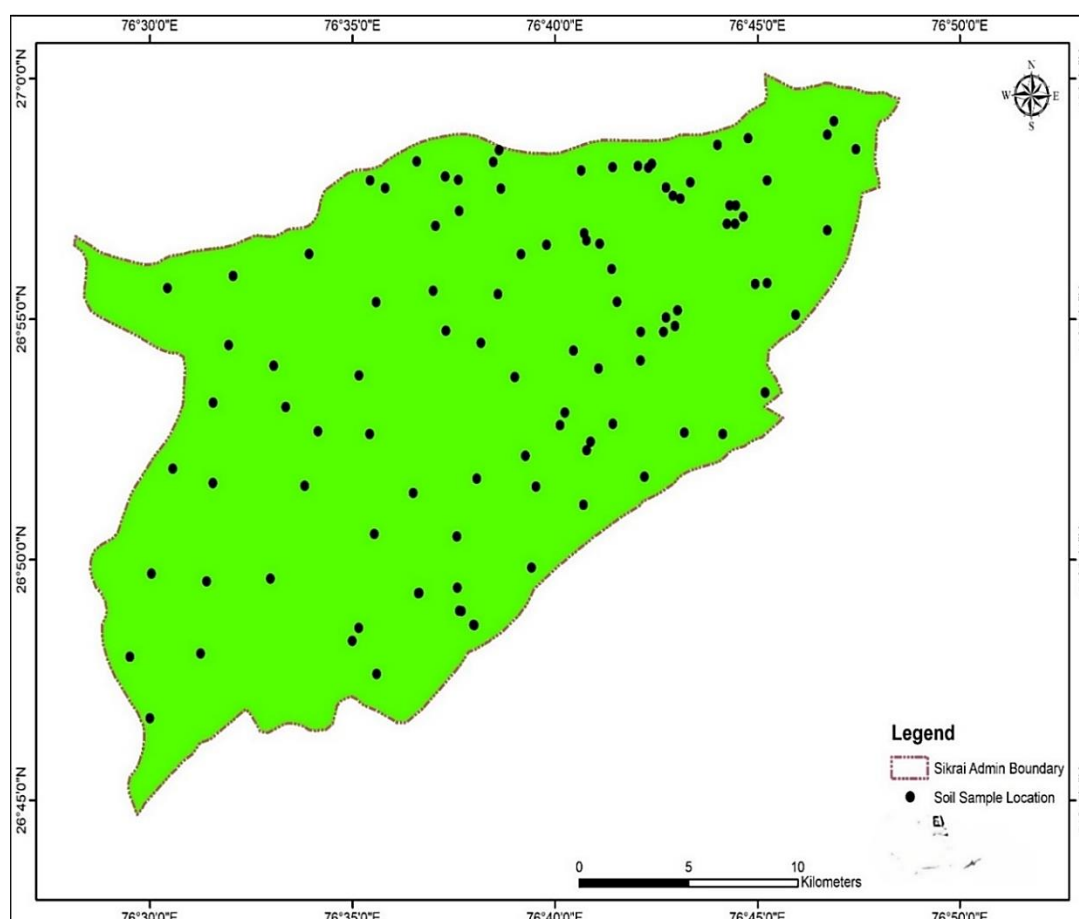
properties. A sample collection sheet is prepared for proper tagging and packing of the samples on the site. Dausa district lying between latitude 26° 23' and 27° 15' and longitude 76° 0' and 77° 02'). Sikrai tehsil is located between 76° 69 East Longitude (degrees) and 26° 91 North latitude (degree). The climate of the Dausa is semi-arid. In summer, maximum temperature varies from 38 to 45°C, whereas, in winter generally minimum temperature lies between 5 and 18°C. The mean annual rainfall of the locality is 450 mm, most of this is received during monsoon season. Main source of irrigation is tube well. A maximum 52 to 58°C soil temperature has been recorded at surface during summer months.

Table 1. Details of location of soil sampling sites of Sikrai tehsil

S. No.	Sample Code No.	Name of village	Name of Farmers	Longitude	Latitude
1	2	3	4	5	6
1	S ₁	Chandera	Ramshai S/O Mulya Ram	76.7765	26.9806
2	S ₂	Surer	Nahar Singh S/O Chhotya	76.7814	26.9852
3	S ₃	Brihmbad	Malkhan S/O Hari Ram	76.7905	26.9755
4	S ₄	Parli	Chet Ram Kajodmal	76.6218	26.9126
5	S ₅	Gurjarsimla	Babu Lal S/O Chhaju	76.7591	26.9647
6	S ₆	Uaipura	Manoj S/O Ramkhiladi	76.7633	26.9498
7	S ₇	meena simla	Omprakash S/O Mallu	76.7787	26.9475
8	S ₈	Karodi	Ramkesh S/O Ramkhiladi	76.7461	26.9793
9	S ₉	Jopada	Babli S/O Pyare Lal	76.7386	26.9561
10	S ₁₀	Khadarpura	Harkesh S/O Jal Singh	76.7335	26.9770
11	S ₁₁	Jodhpura	Ram Singh S/O Raghu Nath	76.7065	26.9705
12	S ₁₂	Theekariya	Ram Kishan S/O Kishan	76.7539	26.9647
13	S ₁₃	Patti Salehsingh	Ranglo S/O Laxman	76.7442	26.9521
14	S ₁₄	Darjapura	Mangal S/O Kajodmal	76.7374	26.9497
15	S ₁₅	Sultanpura	Gomniwash S/O Kalu Ram	76.7408	26.9497
16	S ₁₆	Kheda Pahadpur	Ropal S/O Ghashi Ram	76.7411	26.9561
17	S ₁₇	Peelodi	Khiladi S/O Ramhet	76.7183	26.9584
18	S ₁₈	Aasatwada	Sita Ram S/O Jagan Singh	76.7051	26.9691
19	S ₁₉	Heengi	Chetram S/O Ramphal	76.6900	26.9340
20	S ₂₀	Rampura Gujran	Omprakash S/O Kajod	76.7008	26.9697
21	S ₂₁	Khedi Ramla	Suwa Lal S/O Dhaturiya	76.7152	26.9594
22	S ₂₂	Nikatpuri	Kapuri Devi S/O Hari Singh	76.6904	26.9693
23	S ₂₃	Manpur	Ramawtar S/O Mool Chand	76.6774	26.9682
24	S ₂₄	Pacholi	Rameshwar S/O Manna	76.6787	26.9464
25	S ₂₅	Khedla	Kanhaiya S/O Bhola Ram	76.6796	26.9439
26	S ₂₆	Murlipur	Ishwar S/O Ramdhan	76.6851	26.9428
27	S ₂₇	Kundera Dungar	Bahadur Singh S/O Kalodmal	76.7018	26.9023
28	S ₂₈	Sikrai Dungar	Mishri Lal S/O Rampal	76.7019	26.9123
29	S ₂₉	Namner	Ishwar S/O Murlya	76.6905	26.8804
30	S ₃₀	Mored	Kanhaiya Lal S/O Ramshai	76.6707	26.8843
31	S ₃₁	Moondiyakheda	Chhaju Lal S/O Ghudya	76.6846	26.8996
32	S ₃₂	Kailai	Sharwan S/O Girdhari Lal	76.6743	26.9058
33	S ₃₃	Nandri	Bharosi S/O Devkul	76.7491	26.9289
34	S ₃₄	Nyaganv	Ballu S/O Bhajni	76.7539	26.9291
35	S ₃₅	Bhalpur	Ramkishore S/O Girdhari	76.7596	26.9325
36	S ₃₆	Sikrai	Madan S/O Mool Chand	76.6922	26.9227

S. No.	Sample Code No.	Name of village	Name of Farmers	Longitude	Latitude
1	2	3	4	5	6
37	S ₃₇	Piplaki	Todarmal S/O Beerbal	76.6444	26.9619
38	S ₃₈	Dhulkot	Ram Singh S/O Dhanna Lal	76.6632	26.9424
39	S ₃₉	Seekri	Giriraj S/O Kanwar Pal	76.6527	26.9392
40	S ₄₀	Indan	Bhonri Devi W/O Malla Ram	76.7357	26.8769
41	S ₄₁	Basedi	Chhote Lal S/O Sonarayan	76.7199	26.8773
42	S ₄₂	Bhawgarh	Jagram S/O Muthrya	76.7035	26.8621
43	S ₄₃	Garota	Ramesh S/O Khayali Ram	76.6784	26.8523
44	S ₄₄	Naharkhohra	Vinod S/O Girdhari Lal	76.7531	26.8913
45	S ₄₅	Lakhanpur	Lakhan S/O Surajmal	76.7532	26.8912
46	S ₄₆	Hingwa	Ram Singh S/O Giriraj	76.7113	26.9123
47	S ₄₇	Girdharipura	Lokesh Bharat Lal	76.7713	26.9159
48	S ₄₈	Chandusa	Siya Ram S/O Tholi Ram	76.7123	26.9172
49	S ₄₉	Ganipur	Ram Manohar S/O Jagdeesh	76.7171	26.9197
50	S ₅₀	Kundela khurd	Indra S/O Mukesh	76.7123	26.9623
51	S ₅₁	Chak Ganipur	Ramjilal S/O Chetram	76.7171	26.9197
52	S ₅₂	Rameda	Pawan S/O Lallu Ram	76.7161	26.9143
53	S ₅₃	Ghumna	Jhamman S/O Mangya	76.6588	26.8586
54	S ₅₄	Gadoli	Chhuttan Lal S/O Mool Chand	76.6570	26.8306
55	S ₅₅	Jaysinghpura	Malkhan S/O Chhotu Ram	76.6545	26.8693
56	S ₅₆	Gadhi	Sugna Devi S/O Somtya Ram	76.6797	26.8712
57	S ₅₇	Jagsahaypura	Lokesh S/O Rajendra	76.6687	26.8799
58	S ₅₈	Banepura	Mooli Devi S/O Ramkishore	76.6813	26.8742
59	S ₅₉	Patan	Dhansi Ram S/O Bhoja Ram	76.6250	26.8576
60	S ₆₀	Bujot	Mooli Devi Ramshai	76.6210	26.8464
61	S ₆₁	Chainpura	Seela Devi S/O Hanshraj	76.6345	26.8614
62	S ₆₂	Kalwan	Prahlad S/O Magan Lal	76.6432	26.9253
63	S ₆₃	Giladi	Krishan Lal S/O Ramshai	76.6362	26.9084
64	S ₆₄	Geejgarh	Hanuman Shai S/O Laxminarayan	76.6501	26.8597
65	S ₆₅	Kalakhon	Balbeer S/O Prahlad	76.6361	26.8092
66	S ₆₆	Chak Kalakhon	Sumer S/O Badri	76.6358	26.8093
67	S ₆₇	Ambadi	Giriraj S/O Kishori	76.6273	26.8156
68	S ₆₈	Jagrapura Patti	Mool Chand S/O Sukhdeva	76.6265	26.8236
69	S ₆₉	Gadhora	Jagdeesh S/O Gopi Ram	76.6282	26.8155
70	S ₇₀	Johhya	Nawal Kishore S/O Jeeta Ram	76.6095	26.8097
71	S ₇₁	Bahrawanda	Mangal Ram S/O Dalla Ram	76.5833	26.8052
72	S ₇₂	Divankar	Tara Chand S/O Ramkishore	76.5933	26.7938
73	S ₇₃	Bharaw	Kherati S/O Ramsukha	76.5496	26.8268
74	S ₇₄	Pharashpura	Ramkishan S/O Dharam Singh	76.5923	26.8422
75	S ₇₅	Mohlai	Kalu Ram S/O Somtya	76.6104	26.8217
76	S ₇₆	Geroji	Kishan Lal S/O Nathu Lal	76.6108	26.8218
77	S ₇₇	Bad Bahranwda	Jag Ram S/O Surjan	76.7224	26.9641
78	S ₇₈	Rampura	Ramshai S/O Dhutha	76.6175	26.9490
79	S ₇₉	Sikandra	Shanti W/O Kishan Lal	76.5968	26.9621
80	S ₈₀	Leekhali	Sadar S/O Banai Singh	76.6436	26.9752
81	S ₈₁	Ganwdi	Rameshwar S/O Kanhaiya Lal	76.6413	26.9711
82	S ₈₂	Mariyada	Hari Prasad S/O Shri Narayan	76.6269	26.9649
83	S ₈₃	Sanwash	Suresh S/O Ramdhan	76.6272	26.9541
84	S ₈₄	Bapanpada	Seeta Ram S/O Bhoril Lal	76.6098	26.9713
85	S ₈₅	Padli Bad	Satyainarayan S/O Badri	76.6215	26.9661
86	S ₈₆	Mohchingpura	Vijai Singh S/O Badri	76.4916	26.8063
87	S ₈₇	Moroli	Sukh Lal S/O Ghasi Lal	76.4974	26.8048
88	S ₈₈	Ranoli	Banwari S/O Mool Chand	76.5207	26.8002
89	S ₈₉	Shekpura	Ashok S/O Ramswroop	76.4961	26.8597
90	S ₉₀	Gumanpura	Kelash S/O Narayan	76.6504	26.8555

S. No.	Sample Code No.	Name of village	Name of Farmers	Longitude	Latitude
1	2	3	4	5	6
91	S ₉₁	Gandrawa	Gyarshi Lal S/O Rewadmal	76.5635	26.8590
92	S ₉₂	Gangandwari	Syam Lal S/O Bhagwanshai	76.5691	26.8768
93	S ₉₃	Reta	Hariprasad S/o Rmprasad	76.5080	26.9260
94	S ₉₄	Dolika	Hariom S/O Ramphool	76.5513	26.8999
95	S ₉₅	Dubbi	Jairam S/O Mool Chand	76.5342	26.9317



Map 1. Details of location of sampling sites of Sikrai tehsil of Dausa district

Table 2. Methods used for soil analysis

Sl. No.	Test parameter	Methods	References
A.	Soil analysis		
(i)	Mechanical Analysis		
1.	Soil texture	International Pipette Method	Piper (1950)
(ii)	Physical Properties		
1	Bulk Density	Method No. 38 of USDA Hand Book No. 60	Richards (1954)
2	Particle Density	Method No. 39 of USDA Hand Book No. 60	Richards (1954)
3	Porosity (percent)	Method No. 40 of USDA Hand Book No. 60	Richards (1954)

2.1 Collection of Soil Sample

Geo-referenced surface soil samples at the depth of “0 to 15” and “15 to 30” cm were collected from Sikrai tehsils. The latitude and

longitude of sampling sites were recorded with the help of different Global Positioning System. Selection of field in village in such a way that it should be representative of whole area of the village and sample was taken from progressive

farmers. Total 190 surface and sub- surface soil samples were collected from the entire selected villages at the depth of “0 to15” and “15 to 30” cm with the help of khurpi and hand- held global positioning system (GPS) over the entire area.

2.2 Process of Soil Sampling

After collecting the soil samples, they were brought to the laboratory. These samples were dried under shade. After that the processing was done as follows: After the air drying under the shade the unwanted materials like roots, stones, and others are should be discarded. The clods in the sample would be broken by using the wooden mallet. After that the samples should be sieved with 2 mm sieve. Sieved samples should be stored in polybags for further estimation of different physical parameters. All the precautions and standard procedures were used to estimate the physical properties of the soil and followed the procedure described by Jackson.

2.3 Statistical Analysis

The data obtained for different parameters of soil analysis were statistically analyzed for correlation using the procedure given by Snedecor and Cochran (1967).

2.4 Methods Used for Soil Analysis

The soil samples were analyzed as per methods given in Table 2.

3. RESULTS AND DISCUSSION

3.1 Physical Properties

3.1.1 Particle size distribution

It was found that most of the soils of villages of Sikrai tehsils having lot of variability in the relative percentage of sand, silt and clay. The data presented in Table 3 revealed that sand content in 190 surface (0-15) and sub-surface (15-30 cm) soil samples of Sikrai tehsil ranged from 73.20 to 82.10 and 71.70 to 80.50 per cent, with mean value of 77.98 and 76.32 percent having, standard deviation 1.93 and 1.92 and coefficient of variation 2.47 and 2.51 per cent. Maximum sand percentage (82.10 and 80.50%) were recorded in Bad Bahranwda (S-77) village while, minimum (73.20 and 71.70%) was recorded in Giladi (S-63) village in both the layers respectively. The silt content ranged from

9.20 to 14.60 and 10.30 to 15.30 per cent, maximum silt percentage (14.60 and 15.30%) was recorded in Giladi village (S-63) in both the layer, minimum (9.20 and 10.30%) was found in Ghumna (S-53) and Bad Bahranwda (S-77) villages with mean value of 11.80 and 12.67 per cent having, standard deviation 1.17 and 1.16 and coefficient of variation 9.90 and 9.17 per cent respectively. As the clay percentage is concerned, the clay content ranged from 8.20 to 12.80 and 9.20 to 13.20 per cent, maximum clay percentage (12.80 and 13.20%) were recorded in Kundela khurd (S-50) village however, minimum (8.20 and 9.20 %) was found in Bapanda (S-84) and Bad Bahranwda (S-77) with mean value of 10.22 and 11.01 per cent having, standard deviation 1.01 and 0.96 and coefficient of variation 9.90 and 8.68 per cent under both the layers respectively. Recorded observations revealed that out of Out of 95 surface soil samples 19 (20.00%) fell in loamy sand and 76 (80.00%) samples fell in sandy loam texture class. while, in sub-surface 2 (2.11%) fell in loamy sand and 93 (97.89%) were in sandy loam texture class. Therefore, the majority of soils were belonged to sandy loam texture class.

per cent sand content is decreased with increased in the depth of soil while, per cent of silt and clay content increased with increased the depth of soil and its vice versa. The clay content was higher in the sub-surface as compared to the surface due to clay illuviation (Chandrakala, et al., 2018). Increase in clay content with depth which might be due to downward translocation of finer particles from the surface layers (Murthy, 1988). Gradual increased in clay content with increasing depth was observed from surface to sub-surface depth (“15 to 30” cm). Thus, increase in clay percentage with depth might be due to attributed to vertical migration or translocation of clay (Mustafa, et al., 2011). Silt content in general also exhibited a regular trend with increasing depth which might be due to variation in parent material, topography or in-situ weathering and translocation of clay (Kumar and Naidu, 2012). On the basis of textural analysis, it is found that most of soils of Sikrai tehsil of Dausa district were sandy loam in texture having lot of variability in relation to proportion of sand, silt and clay. Similar results were observed by Vyas, et al. (1974) in soils of Jaipur district, in soils of Nagaur tehsil of Rajasthan and Mathur, et al. (2006) in soils of North-west plain of Rajasthan. The variation in relative percentage of sand, silt and clay was mainly because of deposition of finer fraction.

Table 3. Physical properties of soils of Sikrai tehsil

S. No.	Sample code No	Sand (%)		Silt (%)		Clay (%)		B D (Mg m ⁻³)		P D (Mg m ⁻³)		Porosity (%)		Textural Class	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	S ₁	79.60	78.20	10.80	11.30	9.60	10.50	1.50	1.52	2.61	2.62	42.53	41.98	Sandy Loam	Sandy Loam
2	S ₂	76.10	74.40	13.40	14.30	10.50	11.30	1.47	1.48	2.48	2.49	40.73	40.56	Sandy Loam	Sandy Loam
3	S ₃	79.10	76.90	11.70	12.70	9.20	10.40	1.49	1.51	2.63	2.65	43.35	43.02	Sandy Loam	Sandy Loam
4	S ₄	79.10	77.20	11.20	12.30	9.70	10.50	1.49	1.51	2.48	2.50	39.92	39.60	Sandy Loam	Sandy Loam
5	S ₅	78.40	75.90	11.20	12.50	10.40	11.60	1.48	1.50	2.60	2.61	43.08	42.53	Sandy Loam	Sandy Loam
6	S ₆	77.80	75.80	11.30	12.20	10.90	12.00	1.47	1.48	2.63	2.64	44.11	43.94	Sandy Loam	Sandy Loam
7	S ₇	76.70	75.30	12.10	12.60	11.20	12.10	1.46	1.48	2.65	2.65	44.91	44.15	Sandy Loam	Sandy Loam
8	S ₈	78.90	76.90	11.40	12.30	9.70	10.80	1.49	1.51	2.57	2.58	42.02	41.47	Sandy Loam	Sandy Loam
9	S ₉	77.20	75.80	11.90	12.50	10.90	11.70	1.49	1.50	2.59	2.60	42.47	42.31	Sandy Loam	Sandy Loam
10	S ₁₀	76.60	74.30	12.10	14.10	11.30	11.60	1.45	1.47	2.64	2.65	45.08	44.53	Sandy Loam	Sandy Loam
11	S ₁₁	78.80	77.30	10.90	11.40	10.30	11.30	1.48	1.49	2.49	2.50	40.56	40.40	Sandy Loam	Sandy Loam
12	S ₁₂	76.60	74.20	12.30	13.50	11.10	12.30	1.47	1.49	2.62	2.63	43.89	43.35	Sandy Loam	Sandy Loam
13	S ₁₃	80.00	78.00	10.40	11.40	9.60	10.60	1.50	1.51	2.63	2.64	42.97	42.80	Loamy Sand	Sandy Loam
14	S ₁₄	78.30	76.90	11.10	11.70	10.60	11.40	1.48	1.50	2.61	2.62	43.30	42.75	Sandy Loam	Sandy Loam
15	S ₁₅	76.10	74.60	12.80	13.10	11.10	12.30	1.48	1.49	2.62	2.63	43.51	43.35	Sandy Loam	Sandy Loam
16	S ₁₆	79.00	77.60	11.50	12.10	9.50	10.30	1.51	1.52	2.61	2.62	42.15	41.98	Sandy Loam	Sandy Loam
17	S ₁₇	79.00	77.00	10.70	11.90	10.30	11.10	1.49	1.50	2.61	2.62	42.91	42.75	Sandy Loam	Sandy Loam
18	S ₁₈	76.30	74.30	11.90	13.10	11.80	12.60	1.46	1.48	2.64	2.65	44.70	44.15	Sandy Loam	Sandy Loam
19	S ₁₉	78.50	76.80	12.60	13.40	8.90	9.80	1.47	1.49	2.58	2.59	43.02	42.47	Sandy Loam	Sandy Loam
20	S ₂₀	79.40	77.20	11.50	12.60	9.10	10.20	1.49	1.50	2.50	2.51	40.40	40.24	Loamy Sand	Sandy Loam
21	S ₂₁	79.10	77.00	10.80	11.90	10.10	11.10	1.48	1.50	2.63	2.64	43.73	43.18	Sandy Loam	Sandy Loam
22	S ₂₂	75.40	74.20	12.90	13.60	11.70	12.20	1.46	1.48	2.64	2.65	44.70	44.15	Sandy Loam	Sandy Loam
23	S ₂₃	75.40	73.00	13.10	14.40	11.50	12.60	1.46	1.47	2.64	2.65	44.70	44.53	Sandy Loam	Sandy Loam
24	S ₂₄	79.10	77.00	11.20	12.10	9.70	10.90	1.49	1.51	2.59	2.60	42.47	41.92	Sandy Loam	Sandy Loam
25	S ₂₅	80.40	78.00	10.70	12.30	8.90	9.70	1.51	1.52	2.60	2.60	41.92	41.54	Loamy Sand	Sandy Loam
26	S ₂₆	78.80	77.60	11.90	12.10	9.30	10.30	1.48	1.50	2.57	2.58	42.41	41.86	Sandy Loam	Sandy Loam
27	S ₂₇	75.90	74.40	13.50	14.50	10.60	11.10	1.47	1.49	2.58	2.59	43.02	42.47	Sandy Loam	Sandy Loam
28	S ₂₈	81.30	79.50	10.10	11.20	8.60	9.30	1.52	1.53	2.60	2.61	41.54	41.38	Loamy Sand	Sandy Loam
29	S ₂₉	80.40	79.00	10.40	11.10	9.20	9.90	1.47	1.49	2.63	2.65	44.11	43.77	Loamy Sand	Sandy Loam
30	S ₃₀	75.20	73.90	13.60	14.00	11.20	12.10	1.45	1.47	2.63	2.65	44.87	44.53	Sandy Loam	Sandy Loam
31	S ₃₁	78.90	77.40	11.00	12.10	10.10	10.50	1.46	1.48	2.59	2.61	43.63	43.30	Sandy Loam	Sandy Loam
32	S ₃₂	76.60	75.20	12.20	12.90	11.20	11.90	1.53	1.54	2.60	2.61	41.15	41.00	Sandy Loam	Sandy Loam
33	S ₃₃	75.60	73.80	12.60	13.70	11.80	12.50	1.49	1.50	2.58	2.59	42.25	42.08	Sandy Loam	Sandy Loam

S. No.	Sample code No	Sand (%)		Silt (%)		Clay (%)		B D (Mg m ⁻³)		P D (Mg m ⁻³)		Porosity (%)		Textural Class	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
34	S ₃₄	79.20	77.60	11.70	12.10	9.10	10.30	1.47	1.49	2.61	2.63	43.68	43.35	Loamy Sand	Sandy Loam
35	S ₃₅	78.20	77.30	11.30	11.80	10.50	10.90	1.48	1.50	2.61	2.62	43.30	42.75	Sandy Loam	Sandy Loam
36	S ₃₆	76.70	75.60	13.60	13.90	9.70	10.50	1.50	1.51	2.51	2.52	40.24	40.08	Sandy Loam	Sandy Loam
37	S ₃₇	74.70	73.40	13.20	13.70	12.10	12.90	1.54	1.55	2.63	2.64	41.44	41.29	Sandy Loam	Sandy Loam
38	S ₃₈	76.00	74.80	13.80	14.10	10.20	11.10	1.51	1.53	2.59	2.61	41.70	41.38	Sandy Loam	Sandy Loam
39	S ₃₉	79.70	78.50	11.20	11.90	9.10	9.60	1.48	1.50	2.65	2.65	44.15	43.40	Loamy Sand	Sandy Loam
40	S ₄₀	78.20	77.20	11.00	11.60	10.80	11.20	1.51	1.52	2.59	2.60	41.70	41.54	Sandy Loam	Sandy Loam
41	S ₄₁	76.20	74.80	12.90	13.60	10.90	11.60	1.50	1.52	2.62	2.63	42.75	42.21	Sandy Loam	Sandy Loam
42	S ₄₂	76.30	75.40	12.60	13.50	11.10	11.10	1.46	1.48	2.62	2.63	44.27	43.73	Sandy Loam	Sandy Loam
43	S ₄₃	79.30	77.60	11.20	12.30	9.50	10.10	1.45	1.47	2.52	2.54	42.46	42.13	Sandy Loam	Sandy Loam
44	S ₄₄	80.80	79.10	10.30	11.10	8.90	9.80	1.46	1.48	2.64	2.65	44.70	44.15	Loamy Sand	Sandy Loam
45	S ₄₅	78.70	77.70	11.80	11.80	9.50	10.50	1.46	1.48	2.64	2.65	44.70	44.15	Sandy Loam	Sandy Loam
46	S ₄₆	79.00	77.50	11.60	12.20	9.40	10.30	1.54	1.55	2.61	2.62	41.00	40.84	Sandy Loam	Sandy Loam
47	S ₄₇	81.20	79.40	9.50	10.50	9.30	10.10	1.49	1.51	2.65	2.66	43.77	43.23	Loamy Sand	Sandy Loam
48	S ₄₈	79.80	78.30	10.30	11.40	9.90	10.30	1.51	1.52	2.47	2.48	38.87	38.71	Sandy Loam	Sandy Loam
49	S ₄₉	75.50	73.60	12.70	13.80	11.80	12.60	1.46	1.48	2.52	2.54	42.06	41.73	Sandy Loam	Sandy Loam
50	S ₅₀	74.00	72.60	13.20	14.20	12.80	13.20	1.48	1.50	2.63	2.65	43.73	43.40	Sandy Loam	Sandy Loam
51	S ₅₁	77.10	75.40	11.60	12.70	11.30	11.90	1.48	1.49	2.49	2.50	40.56	40.40	Sandy Loam	Sandy Loam
52	S ₅₂	77.00	75.60	12.90	13.80	10.10	10.60	1.49	1.50	2.63	2.64	43.35	43.18	Sandy Loam	Sandy Loam
53	S ₅₃	82.10	80.10	9.20	10.50	8.70	9.40	1.46	1.47	2.62	2.63	44.27	44.11	Loamy Sand	Loamy Sand
54	S ₅₄	79.20	77.70	11.70	11.80	9.10	10.50	1.47	1.48	2.62	2.63	43.89	43.73	Loamy Sand	Sandy Loam
55	S ₅₅	80.30	78.80	10.30	11.10	9.40	10.10	1.48	1.50	2.63	2.65	43.73	43.40	Loamy Sand	Sandy Loam
56	S ₅₆	76.10	75.60	12.60	13.10	11.30	11.30	1.45	1.46	2.64	2.65	45.08	44.91	Sandy Loam	Sandy Loam
57	S ₅₇	76.30	74.60	12.00	13.30	11.70	12.10	1.46	1.48	2.59	2.60	43.63	43.08	Sandy Loam	Sandy Loam
58	S ₅₈	78.50	76.40	11.90	13.10	9.60	10.50	1.45	1.47	2.52	2.53	42.46	41.90	Sandy Loam	Sandy Loam
59	S ₅₉	79.30	76.90	11.40	12.50	9.30	10.60	1.49	1.50	2.64	2.65	43.56	43.40	Sandy Loam	Sandy Loam
60	S ₆₀	77.10	74.80	11.60	12.90	11.30	12.30	1.51	1.52	2.58	2.59	41.47	41.31	Sandy Loam	Sandy Loam
61	S ₆₁	77.50	76.10	13.10	13.80	9.40	10.10	1.51	1.52	2.62	2.62	42.37	41.98	Sandy Loam	Sandy Loam
62	S ₆₂	79.00	77.50	10.90	11.80	10.10	10.70	1.53	1.54	2.56	2.57	40.23	40.08	Sandy Loam	Sandy Loam
63	S ₆₃	73.20	71.70	14.60	15.20	12.20	13.10	1.46	1.47	2.58	2.59	43.41	43.24	Sandy Loam	Sandy Loam
64	S ₆₄	76.90	75.20	12.20	13.40	10.90	11.40	1.50	1.51	2.60	2.61	42.31	42.15	Sandy Loam	Sandy Loam
65	S ₆₅	75.30	72.90	14.10	15.30	10.60	11.80	1.46	1.47	2.61	2.62	44.06	43.89	Sandy Loam	Sandy Loam
66	S ₆₆	78.00	76.30	11.50	12.30	10.50	11.40	1.45	1.47	2.52	2.54	42.46	42.13	Sandy Loam	Sandy Loam
67	S ₆₇	80.50	79.00	10.50	11.10	9.00	9.90	1.46	1.48	2.59	2.61	43.63	43.30	Loamy Sand	Sandy Loam
68	S ₆₈	80.30	78.70	10.40	11.10	9.30	10.20	1.50	1.52	2.58	2.60	41.86	41.54	Loamy Sand	Sandy Loam
69	S ₆₉	79.90	78.50	10.20	11.10	9.90	10.40	1.50	1.52	2.64	2.65	43.18	42.64	Sandy Loam	Sandy Loam

S. No.	Sample code No	Sand (%)		Silt (%)		Clay (%)		B D (Mg m ⁻³)		P D (Mg m ⁻³)		Porosity (%)		Textural Class	
		0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm	0-15 cm	15-30 cm
70	S ₇₀	78.10	77.00	11.30	11.90	10.60	11.10	1.54	1.55	2.57	2.58	40.08	39.92	Sandy Loam	Sandy Loam
71	S ₇₁	79.30	77.00	11.20	12.50	9.50	10.50	1.46	1.48	2.60	2.61	43.85	43.30	Sandy Loam	Sandy Loam
72	S ₇₂	76.20	74.70	11.90	13.10	11.90	12.20	1.45	1.47	2.62	2.63	44.66	44.11	Sandy Loam	Sandy Loam
73	S ₇₃	76.80	74.90	13.10	14.20	10.10	10.90	1.45	1.46	2.62	2.63	44.66	44.49	Sandy Loam	Sandy Loam
74	S ₇₄	79.90	78.30	10.80	11.30	9.30	10.40	1.46	1.48	2.59	2.60	43.63	43.08	Loamy Sand	Sandy Loam
75	S ₇₅	79.90	78.40	10.10	11.40	10.00	10.20	1.47	1.48	2.54	2.55	42.13	41.96	Sandy Loam	Sandy Loam
76	S ₇₆	79.50	78.30	11.20	11.80	9.30	9.90	1.53	1.54	2.54	2.55	39.76	39.61	Loamy Sand	Sandy Loam
77	S ₇₇	82.10	80.50	9.60	10.30	8.30	9.20	1.53	1.54	2.62	2.63	41.60	41.44	Loamy Sand	Loamy Sand
78	S ₇₈	77.40	75.80	13.20	13.90	9.40	10.30	1.46	1.48	2.61	2.62	44.06	43.51	Sandy Loam	Sandy Loam
79	S ₇₉	78.60	76.90	12.10	12.50	9.30	10.60	1.50	1.52	2.58	2.60	41.86	41.54	Sandy Loam	Sandy Loam
80	S ₈₀	74.50	72.80	14.20	14.90	11.30	12.30	1.46	1.48	2.54	2.56	42.52	42.19	Sandy Loam	Sandy Loam
81	S ₈₁	79.20	77.00	11.10	12.80	9.70	10.20	1.53	1.54	2.61	2.62	41.38	41.22	Sandy Loam	Sandy Loam
82	S ₈₂	78.30	76.80	11.60	12.10	10.10	11.10	1.48	1.50	2.64	2.65	43.94	43.40	Sandy Loam	Sandy Loam
83	S ₈₃	79.80	78.20	10.60	11.20	9.60	10.60	1.50	1.52	2.59	2.61	42.08	41.76	Loamy Sand	Sandy Loam
84	S ₈₄	81.10	79.20	10.70	11.40	8.20	9.40	1.48	1.50	2.62	2.64	43.51	43.18	Loamy Sand	Sandy Loam
85	S ₈₅	77.40	76.20	12.80	13.50	9.80	10.30	1.47	1.49	2.59	2.61	43.24	42.91	Sandy Loam	Sandy Loam
86	S ₈₆	76.10	75.60	12.60	13.10	11.30	11.30	1.45	1.46	2.64	2.65	45.08	44.91	Sandy Loam	Sandy Loam
87	S ₈₇	76.30	74.60	12.00	13.30	11.70	12.10	1.46	1.48	2.59	2.60	43.63	43.08	Sandy Loam	Sandy Loam
88	S ₈₈	78.50	76.40	11.90	13.10	9.60	10.50	1.45	1.47	2.52	2.53	42.46	41.90	Sandy Loam	Sandy Loam
89	S ₈₉	79.30	76.90	11.40	12.50	9.30	10.60	1.49	1.50	2.64	2.65	43.56	43.40	Sandy Loam	Sandy Loam
90	S ₉₀	77.10	74.80	11.60	12.90	11.30	12.30	1.51	1.52	2.58	2.59	41.47	41.31	Sandy Loam	Sandy Loam
91	S ₉₁	77.50	76.10	13.10	13.80	9.40	10.10	1.51	1.52	2.62	2.62	42.37	41.98	Sandy Loam	Sandy Loam
92	S ₉₂	79.00	77.50	10.90	11.80	10.10	10.70	1.53	1.54	2.56	2.57	40.23	40.08	Sandy Loam	Sandy Loam
93	S ₉₃	73.20	71.70	14.60	15.20	12.20	13.10	1.46	1.47	2.58	2.59	43.41	43.24	Sandy Loam	Sandy Loam
94	S ₉₄	76.90	75.20	12.20	13.40	10.90	11.40	1.50	1.51	2.60	2.61	42.31	42.15	Sandy Loam	Sandy Loam
95	S ₉₅	75.30	72.90	14.20	15.20	10.60	11.80	1.46	1.47	2.61	2.62	44.06	43.89	Sandy Loam	Sandy Loam
Range	Maximum	82.10	80.50	14.60	15.30	12.80	13.20	1.54	1.55	2.65	2.66	45.08	44.91	-	-
	Minimum	73.20	71.70	9.20	10.30	8.20	9.20	1.45	1.46	2.47	2.48	38.87	38.71	-	-
	Mean	77.98	76.32	11.80	12.67	10.22	11.01	1.48	1.50	2.59	2.61	42.82	42.48	-	-
	SD	1.93	1.92	1.17	1.16	1.01	0.96	0.02	0.02	0.04	0.04	1.41	1.34	-	-
	CV	2.47	2.51	9.90	9.17	9.90	8.68	1.68	1.54	1.69	1.65	3.29	3.16	-	-

3.1.2 Bulk density

The data shown in Table 3 indicated that bulk density of surface and sub-surface soils of Sikrai tehsil ranged between 1.45 to 1.54 and 1.46 to 1.55 Mg m^{-3} . The maximum value was 1.54 Mg m^{-3} and 1.55 Mg m^{-3} and minimum value 1.45 Mg m^{-3} and 1.46 Mg m^{-3} was recorded in both the layers respectively. The corresponding mean value of BD were 1.48 and 1.50 Mg m^{-3} , standard deviation 0.02 and 0.02 and coefficient of variation 1.68 and 1.54 per cent in surface ("0 to 15" cm) and sub-surface ("15 to 30" cm) soil samples respectively. The bulk density increased with depth which might be due to more compaction, low organic matter, less aggregation and secondary orientation or accumulation of clay in pre-space increased the bulk density or apparent density of sub surface soil. Similar results also reported by Kameriya (1995) in soils Agro-climatic zone – IIA of Rajasthan. These findings are in conformity with the work of Singh and Agrawal (2005).

3.1.3 Particle density

The data shown in Table 3 indicated that particle density of surface and sub-surface soils of Sikrai tahsil ranged between 2.47 to 2.65 and 2.48 to 2.66 Mg m^{-3} . The maximum value of particle density was 2.65 and 2.66 Mg m^{-3} and minimum value of particle density were recorded 2.47 and 2.48 Mg m^{-3} under surface ("0 to 15" cm) and sub- surface ("15 to 30" cm) layers. The corresponding mean value of particle density were 2.59 and 2.61 Mg m^{-3} , standard deviation 0.04 and 0.04 and coefficient of variation 1.69 and 1.65 per cent in surface and sub-surface soil samples respectively. The increase in particle density with depth could be due to a decrease in organic carbon. Minor variation in particle density might be due to changes in mineralogical composition of soil. Similar observation was also made by Kameriya (1995), Vyas, et al. (1974), Naga (1984).

3.1.4 Porosity

The data shown in Table 3 indicated that per cent porosity of surface ("0 to 15" cm) and sub-surface ("15 to 30" cm) soils of Sikrai tehsil ranged between 38.87 to 45.08 and 38.71 to 44.91%. The maximum (45.08 and 44.91%) in Gadhi (S-56) village and minimum (38.87 and 38.71%) were recorded in Chandusa (S-48) and Village in both layers respectively. The

corresponding mean value of percent porosity were 42.82 and 42.48%, standard deviation 1.41 and 1.34 and coefficient of variation 3.29 and 3.16 per cent in surface and sub-surface soil samples respectively. The pore space (%) decrease abruptly with increase in depth. Lower porosity under sub-surface ("15 to 30" cm) layer as compare to surface layer ("0 to 15 cm) might be due to compaction and low organic carbon in lower layer and variation in silt and sand fractions and their arrangement. Similar results were reported by Meena et al., (2017).

4. CONCLUSION

Based on soil texture analysis, the soils of studied area have been classified as loamy sand and sandy loam textural classes. In general, majority of soils of the study area were belongs to sandy loam in nature. The almost soils of Sikrai tehsils were found to be dominant as sandy loam in texture.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares 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 this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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