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Assessment of chemical properties of soil of different blocks of Dehradun District, Uttarakhand, India

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Abstract
Soil samples were collected from 5 blocks of the Dehradun district of two depth *viz*. 0-15 cm and 15-30 cm for the assessment of the chemical properties of soil of Dehradun district, Uttarakhand was carried out in 2018-19. Ten sampling points in different villages were selected for the analysis. Chemical analysis comprised of soil pH which ranges from 6.2 to 7.84. The EC ranges from 0.217 to 0.49 dSm^{-1}. The O.C ranges from 0.76 to 1.14%. The O.M ranges from 2.18 to 1.31%. The N ranges from 390.2 to 149.1 kg ha^{-1}. The P ranges from 16 to 23 kg ha^{-1}. The K ranges from 76.3 to 183.7 kg ha^{-1}. The Ca ranges from 11 to 24 (mg/g) The Mg ranges from 8.26 to 22.29 (mg/g), The Na ranges from 15 to 31(ppm), The Fe ranges from 0.01 to 0.22 (ppm), The Zn ranges from 0.0 to 0.03 (ppm) and The Cu ranges from 0.0 to 0.68 (ppm).

Keywords: Soil analysis, district, Dehradun, assessment, comprised, soil sampling

Introduction
The term soil is the sum of bio-chemical weathering of the parent material and its formation is influenced by the soil forming factors like climate, living organism, parent material, relief and time. Soil word has been derived from Latin word *solum* which means earthy material in which plants grows. The study of soil is known as *Soil Science or pedology* (pedo means earth) and (logy means to study). This study is also known as *Edaphology* (Edaphos means Soil). Soil may also be explained as the part of the earth crust in which humus is present as in organic form. (Tiwari G *et al*., 2016) [14]**.** chemical properties are pH, electrical conductivity, cation exchange capacity, organic carbon, organic matter and soil nutrients (*i.e* divided as macro and micro nutrient). (Nautiyal and Kumar, 2004) If the pH of soil is less than 6 therefore it is said to be an acidic soil which has a good conc. of H^+ Al^{2+} Fe^{2+}, the pH range from 6-8.5 it's a neutral soil and greater than 8.5 then it is said to be alkaline soil which contains good conc. of OH^- Ca^+ Mg^+. E.C measure the ions conc. present in solution. The electrical conductivity of a soil solution increases with the increased concentration of ions. Electrical conductivity is a very quick, simple and inexpensive method to check health of soils. If the soil is poor in organic matter, then it enhances the process of soil erosion. The presence of the higher content of organic matter in the soil can be another possible reason for lowering of the pH. Soil organic matter content has decreased from surface to subsoil due to levelling. Nitrogen gas diffuses into water where it can be "fixed" (converted) by blue-green algae to ammonia for algal use. Nitrogen can also enter lakes and streams as inorganic nitrogen and ammonia. Because nitrogen can enter aquatic systems in many forms, there is an abundant supply of available nitrogen in these systems. Phosphorus is a most important element It is essential for plant growth and most often limits nutrients remains present in plant nuclei and act as an energy storage and is used for growth of roots in plant. Potassium plays an important role in different physiological processes of plants, it is one of the important element for the development of the plant and is used for flowering purpose, it is also required for building of protein, photosynthesis, fruit quality and reduction of diseases It is involved in many plant metabolism reactions, for regulation of photosynthesis and production of plant sugars that are used for several plant metabolic activities (SS Kekane *et al*., 2015).Calcium is an essential part of plant cell wall, which provides normal transport and retention of other elements. (Bilal Bashir Bhat *et al*., 2015). Fe helps in formation of chlorophyll and acts as a oxygen carrier. Zn influences formation of growth hormone and helps in reproduction and associated with water uptake.

Cu effects nodule formation and act as electron carrier in enzymes for the oxidation-reduction reaction.

Materials and Method

Study Area

Uttarakhand occupying area = 53,483 sq km, including area of Dehradun =3088sqkm in which urban area constitute =272,30 sq km and rural constitute =2815,70 sqkm. With latitude and longitude of Dehradun = Lat.-30.3165^{0}N and Lon.-78,0322^0 E. This research study includes 5 blocks of Dehradun district i.e Dehradun-Sadar, Vikasnagar, Chakrata, Kalsi, Doiwala.

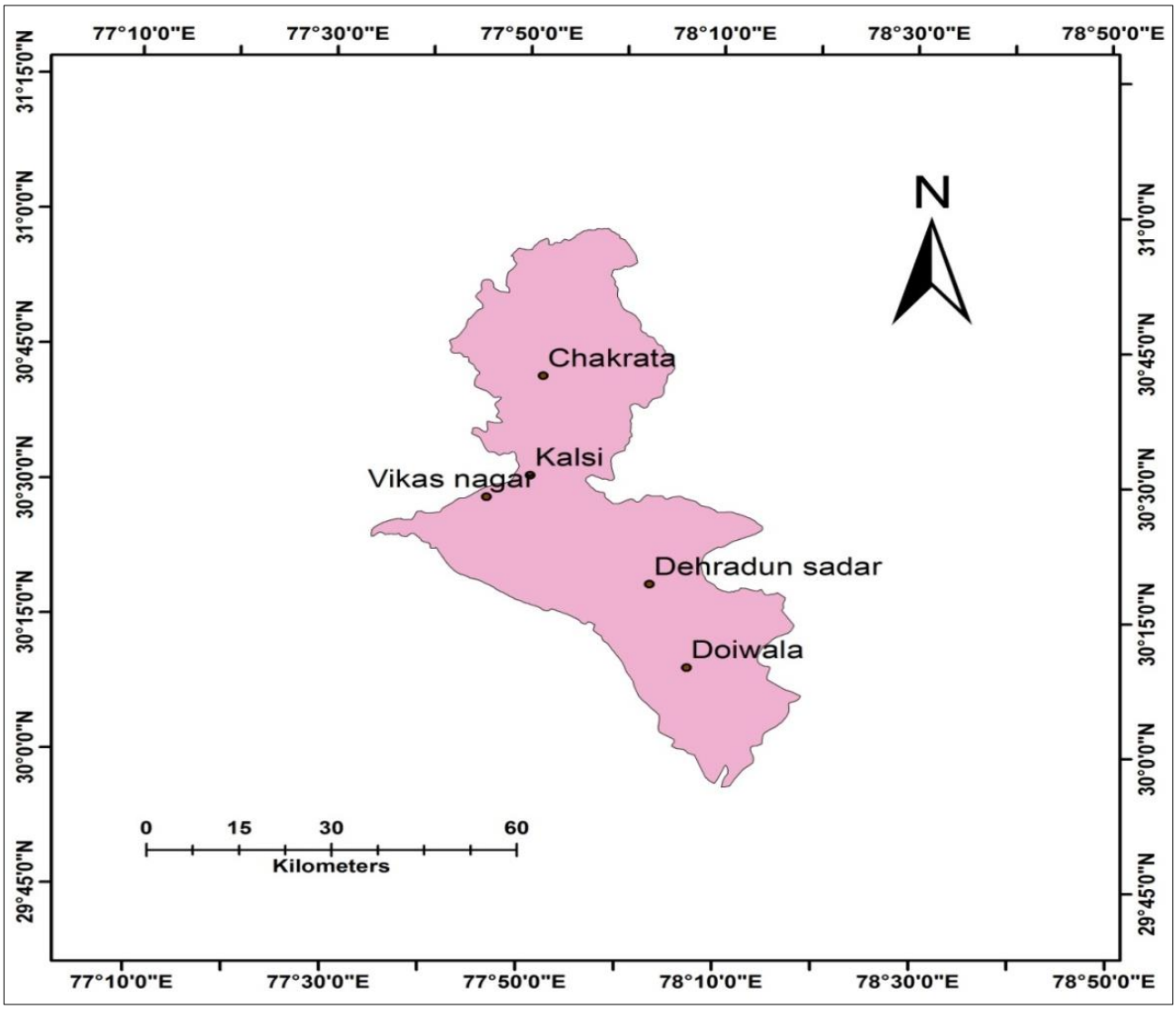

Fig 1: Different blocks from where soil samples were collected

Site Specification

The samples were collected periodically from the selected sites at the same time in the *kharif* season *i.e* (Rice, Maize, Soybean, Cowpea *etc* crop) grown in this season. Soil samples have been collected at a depth of 0- 15 cm and 15-30 cm at the site. Samples have been collected only from the open places. Sampling dates have been selected in such a way that these represent the major seasons of the year *viz*. autumn, winter, spring, dry summer, and wet summer. Separate sampling calendar has been made for each parameter to be studied. Some of the chemical characteristics like pH and conductivity have been determined at the spot using a portable soil analysis kit. A comparison of the Chemical Characteristics of some of the soils of different regions of the Uttarakhand state has been undertaken by comparing the results of the present study with the studies done earlier in the other regions of the state.

Sampling and Analysis

Collection of the soil samples

Soil samples were collected randomly from a site using soil auger and screw auger, Khurpa Knife at the depth of (a) 0-15cm and (b) 15-30 cm. All these samples will be mixed and the mixed sample has been divided into four parts and then among them two samples are collected and only half kg sample is being taken for the soil analysis by the conning and quartering method.

Table 1: Values of chemical properties derived from the different soil samples

Village/	Parameter	pH		E.C		O.C		O.M		Na	
Samples	Depth	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
Dehradun											
S1		6.5	6.61	0.42	0.44	1.14	1.2	1.96	2.06	18	23
S2		6.46	6.52	0.29	0.27	1.12	1.17	1.93	2.01	25	28
Vikasnagar											
S1		6.34	6.51	0.4	0.43	0.86	0.83	1.48	1.43	15	19
S2		6.74	6.31	0.29	0.33	1.26	1.09	2.17	1.87	26	31
Chakrata											
S1		6.84	6.5	0.22	0.36	1.27	1.14	2.18	1.96	23	29
S2		6.42	6.36	0.21	0.19	1.22	1.01	2.1	1.74	17	22
Kalsi											
S1		6.43	6.46	0.21	0.2	0.85	0.63	1.46	1.08	27	30
S2		6.45	6.6	0.59	0.5	0.91	0.99	1.56	1.7	20	29
Doiwala											
S1		6.2	6.78	0.49	0.42	1.01	0.99	1.74	1.63	18	24
S2		6.78	6.99	0.33	0.41	0.76	1.2	1.31	2.17	21	28
F-TEST		NS	NS	S	NS	NS	NS	NS	NS	S	S
S.ED		0.03	0.14	0.006	0.111	0.006	0.155	0.016	0.588	3.7	3.9
C.D @5%		0.48	0.6	0.0009	0.688	0.13	0.89	0.13	0.83	3.17	5.11

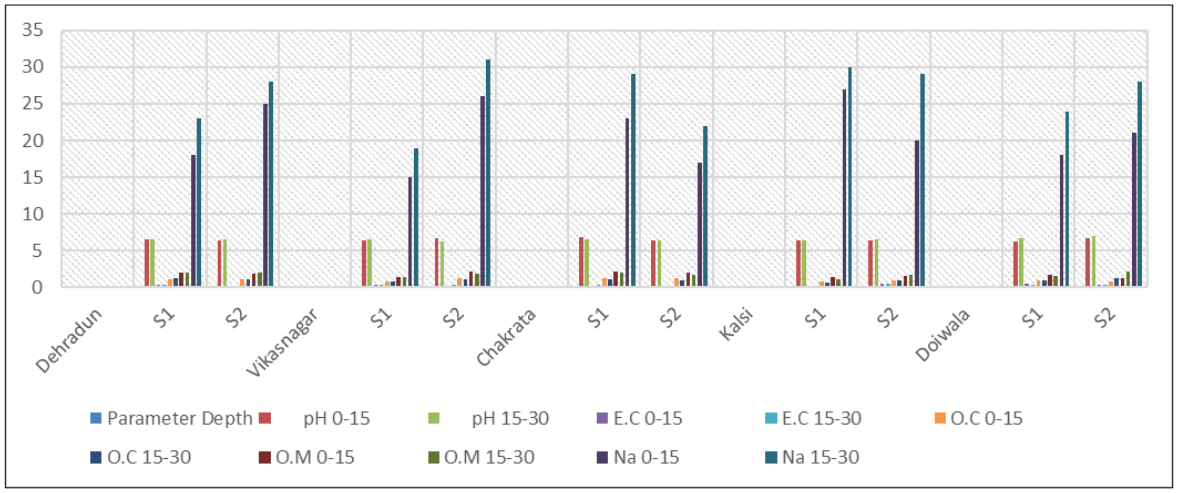

Fig 2: Chemical parameters of soil samples

Processing of soil samples

After sampling the samples were air dried in shade and then these samples were processed for various chemical tests. After drying all the unwanted materials like roots, stones and others were removed. The clods formed were broken by using wooden mallet. Then the samples were sieved with 2 mm sieve**.** Sieved samples were stored in polybags for further estimation of different physical and chemical parameters.

Table 2: Values of macro and micro nutrient found in different soil samples

Village/	Parameter	N		P		K		Ca		Mg		Fe		Zn		Cu	
Samples	Depth	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30	0-15	15-30
Dehradun																	
S1		285.2	230.45	23	21	76.3	90.5	24	11.2	13.36	12.29	0.03	0.09	0.0029	0.001	0.0006	0.0057
S2		350.4	268.7	18	15	120.6	111.7	21.2	21	10.44	8.26	0.1	0.1	0.002	0.002	0.001	0.0019
Vikasnagar																	
S1		168.99	207.3	22	16	83.4	96.1	21.4	20	14.33	13.36	0.15	0.11	0.002	0.003	0.006	0.0007
S2		390.2	307.32	17	14	170.8	156.4	11.6	18.4	22.29	20.09	0.01	0.09	0.001	0.002	0.003	0.0012
Chakrata																	
S1		232.06	244.6	16	20	183.7	164.2	16	13.2	12.39	11.6	0.08	0.04	0.002	0.002	0.005	0.001
S2		172.54	221.8	19	21	108.9	83.5	16.8	12.2	10.44	9.37	0.02	0.01	0.002	0.001	0	0.001
Kalsi																	
S1		293.2	261.9	19	15	168	151.9	16.2	12	9.23	8.42	0.1	0.13	0.001	0.001	0.001	0.001
S2		149.12	153	22	18	172.3	97.4	11.6	12.4	13.36	10.44	0.02	0.05	0.001	0	0	0.001
Doiwala																	
S1		370.4	310.4	17	20	140.8	107.7	11	17.2	9.72	8.26	0.11	0.22	0	0.001	0	0
S2		188.16	376.3	23	16	150.1	136.5	11.2	2	15.79	13.36	0.04	0.01	0.007	0.003	0.001	0.001
F-TEST		NS	NS	NS	NS	S	S	NS	NS	S	S	S	NS	NS	NS	NS	NS
S.ED		1.3	65.8	1.4	2.2	12.6	32.1	6.1	4.8	1.7	3.4	4.6	0.05	0.0003	0.002	0.0003	0.0013
C.D @5%		0.08	0.94	0.47	0.12	0.004	0.049	0.33	0.53	3.1	5.1	0.03	0.27	0.092	0.33	0.68	0.66

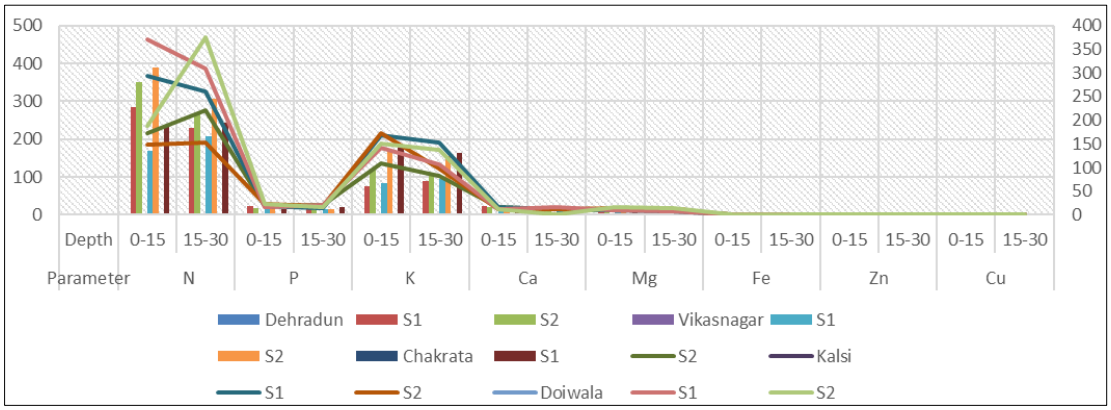

Fig 3: Amount of macro-micro nutrients found in soil samples

Analysis of the soil

Analysis of the soil samples have been done under the following steps-

Soil pH - using digital pH meter (Jackson, 1958) [3].

Soil EC (dS m^{-1}) - using digital EC meter (Wilcox, 1950) [19].

Soil organic carbon (%) - Determined by rapid titration method as described by (Walkley and black, 1947).

Organic matter (%) - By rapid titration method as described by (Walkley and black, 1934) [18].

Available nitrogen in soil (kg ha^{-1}) - Determined through Kjeldahl apparatus (Subbiah and Asija 1956) [13]

Available phosphorus in soil (kg ha^{-1}) - Determined through Colorimeter (Olsen *et al.*, 1954) [9].

Available potassium in soil (kg ha^{-1}) - Determined by Flame Photometer (Toth and Prince, 1949) [15].

Cation Exchange Capacity (CEC) - Determined by Flame photometer

Calcium and Magnesium - By titrated with 0.01N EDTA

Available Fe, Zn and Cu - The diethylene triamine Penta acetic Acid (DTPA) test of (Lindsay and Norvell 1978) [6]

Statical Analysis and Interpretation of Data - The implemented design of experiment in the analysis was CRD (completely randomised design).

Table 3: 0-15 cm depth Correlations

	pH	EC	OC	OM	Na	N	P	K	Ca	Mg	Fe	Zn	Cu
pH	1						-						
EC	-.430	1											
OC	.298	-.374	1		.			.					
OM	.266	-.364	.999**	1									
Na	.464	-.474	.151	.147	1								
N	-.062	-.139	.374	.383	.526	1							
P	-.094	.450	-.615	-.623	-.475	-.590	1						
K	.477	-.128	.024	.014	.669*	.128	-.483	1					
Ca	-.208	-.183	.165	.179	-.226	-.045	.249	-.759*	1				
Mg	.575	.052	.174	.159	.161	.121	.099	.169	-.273	1			
Fe	-.454	-.027	-.363	-.343	-.118	.098	-.161	-.214	.320	-.455	1		
Zn	.529	-.160	-.321	-.356	-.095	-.394	.568	-.147	.021	.224	-.221	1	
Cu	.336	-.248	.106	.108	-.035	-.130	-.156	-.005	.244	.359	.454	-.001	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4: 0-15 cm depth Correlations

	pH	EC	OC	OM	Na	N	P	K	Ca	Mg	Fe	Zn	Cu
pH	1												
EC	.539	1											
OC	.302	.307	1										
OM	.339	.295	.992**	1									
Na	-.053	-.159	.091	.111	1								
N	.484	-.140	.292	.326	.285	1							
P	.112	.178	.264	.211	-.468	-.320	1						
K	-.076	-.224	-.045	-.016	.759**	.491	-.461	1					
Ca	-.576	-.109	-.198	-.281	-.180	-.305	-.219	-.129	1				
Mg	-.201	.243	.271	.297	.188	.245	-.373	.360	.017	1			
Fe	.057	.095	-.389	-.468	-.139	.124	-.084	-.036	.551	-.234	1		
Zn	.200	.011	.203	.263	-.138	.526	-.449	.317	.009	.436	-.164	1	
Cu	-.026	.155	.415	.404	-.152	-.168	.288	-.279	-.138	.098	-.118	-.162	1

**. Correlation is significant at the 0.01 level (2-tailed).

Results

According to the present study of the several soil samples the pH value ranged from 6.2 to 7.84 and the highest value was recorded in Doiwala. The Electrical conductivity ranged from

0.217 to 0.490 dSm^{-1} and the maximum value was recorded from Kalsi. The value of Organic Carbon (%) varied from 0.76 to 1.14% and the organic carbon content was found highest in Vikasnagar. The value of Organic matter (%) varied from 2.18 to 1.31%. Available Nitrogen content of soil ranged from 390.2 to 149.1 kg ha^{-1} and overall nitrogen content was decreases with increase in depth. Available Phosphorous content of soils ranged from 16 to 23 kg ha^{-1} thus phosphorous content was found reducing from 0-15 to 15-30. Available Potassium content of soil ranged from 76.3 to 183.7 kg ha^{-1}, thus potassium content was reducing with the depth, having the highest value recorded at Kalsi. The Ca ranges from 11 to 24 (mg/g), The Mg ranges from 8.26 to 22.29 (mg/g), The Na ranges from 15 to 31 (ppm). Ca and Mg reduces with the depth increases while Na increases with depth increase, The Fe ranges from 0.01 to 0.22 (ppm). The Zn ranges from 0.0 to 0.03 (ppm) The Cu ranges from 0.0 to 0.68 (ppm). The Fe, Zn, Cu also reduces according to the depth. The Correlation in parameters within 0-15 cm depth organic matter showed significant negative correlation with organic carbon (-0.999 @ CD P=0.01%) and the available potassium showed significant positive correlation with sodium (0.669 @ CD P=0.05%). The exchangeable calcium showed significant negative correlation with available potassium (-0.759 @ CD P=0.05%), and within 15-30 cm depth organic matter showed significant positive correlation with organic carbon (0.992 @ CD P = 0.001%) and available potassium showed significant positive correlation with sodium (0.759 @ CD P=0.001%)

Conclusion

The pH value ranged from 6.2 to 7.84 and the highest value was recorded in Doiwala. The Electrical conductivity maximum value was recorded from Kalsi. The value of Organic Carbon content was found highest in Vikasnagar. Available Nitrogen content of soil was decreases with increase in depth. Available Phosphorous content of soils was found reducing from 0-15 to 15-30cm. Available Potassium content of soil was reducing with the depth, having the highest value recorded at Kalsi.Ca and Mg reduces with the increase in depth while Na increases with depth increases. The Fe, Zn, Cu also reduces according to the depth. It is concluded that soil parameters were studied during the course of investigation responded that pH is acidic to neutral, EC, Nitrogen, Organic carbon, Potassium and phosphorus in adequate range having good amount of Ca-Mg range and in micronutrients having deficiency of Fe, Zn, Cu in soil sample Cultivation is mainly confined to *Kharif* season but on availability of irrigation *Rabi* crops are also grown. Wheat, rice, barley, minor millet, sugarcane, potato and lentil are the major crops of the hills. The main crops grown in Bhabhar and Tarai region are rice, wheat, sugarcane, maize and pulses. Soybean cultivation has also picked up in these regions especially, in the Bhabar soils. Gram and lentil are the major pulse crops while toria is the major oilseed crop of the regions. Tarai soils need improvement in drainage for successful production of crops like maize, soybean, arhar,

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