Physicochemical Assessment of Soil in Doiwala Dehradun District of Uttrakhand (India)

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Abstract:
In the present research work, studies on soils with physical and chemical properties of soils have been done. Soil samples were collected from Four differ-ent locations covering Doiwala Dehradun, District (Uttrakhand) India. The soil parameters like soil moisture, pH, EC, Carbon, Calcium carbonate, TDS, Magnesium, Calcium,Nitrogen, Copper, Potassium and Phosphorous content, were analyzed in the month of October 2010 to May 2011. The values of pH indicated that all samples of the soils are alkaline, all samples were containing moderate amounts of available micronutrients.

Keywords: Physico-Chemical analysis, Parame-ters, Doiwala, Soil quality.
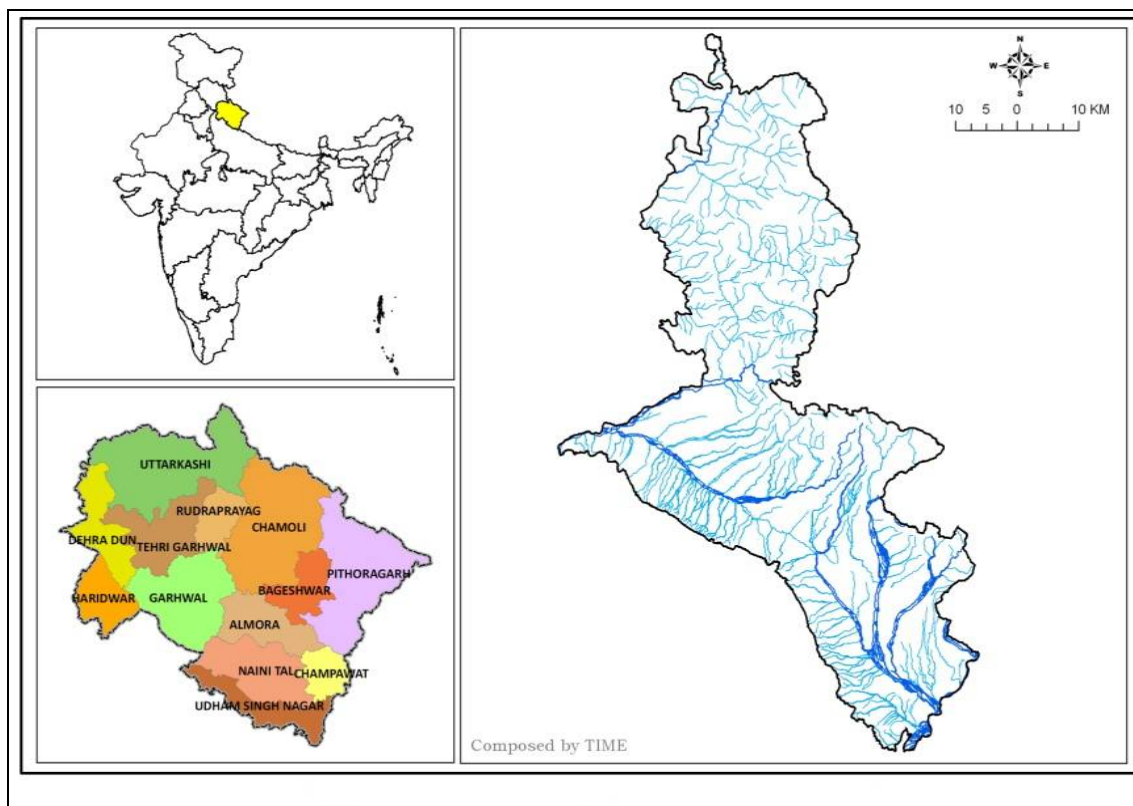
1. Introduction

Figure 1: Location Map of Dehradun District

Soil is a vital component, medium of unconsolidated nutrients and materials, forms the life layer of plants. It is a basic life support components of biosphere. The physicochemical study of parameters is important to agricultural chemists for plants growth and soil management. A collection of soil samples from four sites of village Doiwala Dehradun (site 1. Railway track drain, site 2. Sugar mill field 1, site 3. Sugar mill field 2 and site 4. Chand mari Agricultural field). The soil samples were collected by standard procedure and collected in polythene bags. All the samples were collected in six months. In laboratory these samples were analyzed to measure various physical and chemical parameters by standard methods. Analysis of soil is carried out for the studies of various parameters like total Organic Carbon, Nitrogen (N), Phosphorus (P2O5) and Potassium [K2O]. The pH, conductivity and estimations of Mg^{2+}, Ca^{2+}, K^+, HCO_3^-, PO_4^-, NO_3. % of soil was studied. The fertility of the soil depends on the concentration of N, P, K, organic and inorganic materials, conductivity. The physicochemical properties such as moisture content, specific gravity Nitrogen as a fertilizer required for the growth of plant. Potassium is used for flowering purpose, it is also required for building of protein, photosynthesis, fruit quality and reduction of diseases and phosphate is used for growth of roots in plants. Calcium is an essential part of plant cell wall, which provides normal transport and retention of other elements.

1.1. Study Area
Dehradun, also known as the Doon Valley, is situated in the state of Uttaranchal. Lying at the foothills of the Shivalik ranges in India, the city is said to have been founded by Guru Dronacharya (as per the Hindu Epic of Mahabharata).
Doiwala is a fast developing town of the state of Uttarakhandi along Haridwar – Dehradun. It is a proposed magnet mega city. City is growing as a transition town and works as a central market for the nearby villages. It is a small town area surrounded by many small villages as Bhaniyawala, Jolly Grant, Laltappar, Chiddarwala, Teliwala, Hansuwala etc.

1.2. Sampling Sites

S#	Sampling Sites	Site
1.	Railway track drain	01
2.	Sugar mill field 1	02
3.	Sugar mill field 2	03
4.	Chand mari Agricultural field	04

Table 1

- Research site-I:-Railway track drain:- This site was located about 100 meters from sugar mill near at railway track Doiwala. Soil sample of the drain which is close to railway track was selected as control site. The sediment taken was highly turbid and muddy black in appearance. The drain starts from sugar mill and passes through the slum area
- Research Site-II:-Sugar Mill Field:-This site was located about 200 meters from site-1.The soil sample of the agricultural field was selected as site-II.The agricultural field was influenced by human settlements. The site were the Soil was collected had wheat crop at germinating stage.The soil taken from this site was clayey in texture.
- Research Site III:-Sugar Mill Field 2:- It was located about 5 km down from the site II. The soil sample was taken from the agricultural field which was along the roadside. The crop sown in such agricultural field was sugarcane. The soil sample taken from this site was sandy in texture.
- Research Site- IV:-Chandmari Agricultural field:- It was located about 1 km from the site III, near Chandmari village. The crop sown in this agricultural field was sugarcane. This field was also surrounded by heavy settlements. The soil taken from the site was clayey in the texture.

2. Material and Methods
All the samples were collected for sewage water of sugar mill and the near by agricultural fields from four different Sites, situated at Doiwala Dehradun, 5 - 6 km from clock tower of Dehradun city [Site-I]. It was being irrigated with sewage water and agricultural practices are done in the different plots, and samples for Canal water irrigated land were collected behind railway tract of Doiwala [Site-II]. This site was located about 200 meters from site-1.The soil sample of the agricultural field was selected as site-II.The agricultural field was influenced by human settlements. The site were the Soil was collected had wheat crop at germinating stage.The soil taken from this site was clayey in texture. Site II: - It was located about 5 km down from the site II.The soil sample was taken from the agricultural field which was along the roadside. The crop sown in such agricultural field was sugarcane. The soil sample taken from this site was sandy in texture Site- IV:-Chandmari Agricultural field: - It was located about 1 km from the site III, near Chandmari village. The crop sown in this agricultural field was sugarcane. This field was also surrounded by heavy settlements. The soil taken from the site was clayey in the texture. The soil samples were collected from 3 different plots of each Site with the help of auger. Approximately about 500 gm soil was collected from a depth of 0-15 cm from each Site. The soil samples were taken and placed in a clean polythene bag. Two samples were collected from each Site. Various physico-chemical parameters of each land area were analyzed by different techniques in the laboratory.

3. Result and Discussion

S. No.	Physical parameters	November	January	May	Min. value	Max. value	Mean value
1	Colour	Grey	Grey	Grey	Grey		
2	Texture	Slity – clay	Slity – clay	Slity – clay			
A	Sand (%)	20	15	20	15	20	18.33
B	Clay (%)	60	65	55	55	65	60
C	Slit (%)	20	20	25	20	25	21.66
3	Porosity	0.0166	0.231	0.152	0.152	0.231	0.183
4	Conductivity (µmho)	0.095	0.205	0.023	0.095	0.205	0.107
5	Total dissolved solids (TDS)	109.2	151.9	112.9	109.2	151.9	124.66
	Chemical parameters						
1	pH	7.5	8.0	7.6	7.5	8.0	7.7
2	Total Alkanlity (TA)	175	138	125	125	175	146
3	Chlorie (cl$^-$)	33.011	29.011	33.033	30.692		
4	Calcim (Ca++)	64.88	54.41	48.096	48.096	64.88	55.795
5	Magnesium (mg++)	54.09	54.09	44.26	34.90	54.09	44.416
6	Sodium (Na+)	19.00	24.00	27.00	19.00	27.00	23.33
7	Potassium (K$^+$)	15.00	12.00	9.00	9.00	15.00	12.00
8	Phosphate – phosphorous (PO$_4$ – p)) mg/L	0.038	0.50	0.21	0.21	0.50	0.186
9	Nitrate – nitrogen (NO^3 – N)	1.68	1.95	1.95	0.68	1.95	1.81
10	Organic matter (%)	3.67	3.62	5.32	3.62	5.32	4.20

Table 2: physico – chemical characteristics of Agricultural soil at Site 1

Table – 2: physico – chemical characteristics of Agricultural soil at Site – II.

S no.	Physical parameters	November	January	May –2011	Min. value	Max. value	Mean value
1	Colour	Dark grey	Dark grey	Dark grey			
2	Texture	clayey	clayey	Clayey			
3	Sand (%)	15	20	15	15	20	16.66
4	Clay (%)	60	75	65	60	75	66.66
5	Slit (%)	25	15	20	15	25	20
6	Porosity (%)	0.121	0.161	0.122	0.121	0.161	0.135
7	Conductivity (µmho)	0.127	0.258	0.222	0.022	0.258	0.136
8	Total dissolved solids (TDS)	154.8	120.1	157.2	120.1	157.2	144.33
	Chemical parameters						
1	pH	8.5	7.2	7.5	7.2	8.5	7.733
2	Total Alkalinty (TA)	150	126	130	126	150	135.33
3	Chloride (cl$^-$)	30.33	34.24	44.04	30.33	44.04	36.104
4	Calcium (Ca++)	72.4	68.41	32.06	32.06	72.4	57.623
5	Magnesium	47.6	28.26	29.2	28.23	47.6	35.02
6	Sodium (Na+)	30.00	27.00	30.00	27.00	30.00	29.00
7	Potassium (K$^+$)	21.00	16.00	9.00	9.00	21.00	15.33
8	Phosphate – phosphorous (PO$_4$ – p))	0.061	0.45	0.012	0.012	0.061	0.039
09	Nitrate – nitrogen (NO^3 – N)	1.120	1.103	1.108	1.103	1.120	0.777
10	Organic matter (%)	4.99	4.99	7.06	4.99	7.06	5.68

Table 3: physico – chemical characteristics of Agricultural soil at Site – II.

S#	Physical parameters	November	January	May – 2011	Min. value	Max. value	Mean value
1	Colour	Grey	Grey	Grey			
2	Texture	Sandy	Sandy	Sandy			
3	Sand (%)	70	75	75	70	75	73.333
4	Clay (%)	10	10	15	10	15	11.666
5	Slit (%)	20	15	10	10	20	15
6	Porosity (%)	0.102	0.141	0.112	0.102	0.141	0.118
7	Conductivity (umho)	0.758	0.165	0.013	0.013	0.758	0.312
8	Total dissolved solids (TDS)	98.8	113.7	69.9	69.9	113.7	94.133
	Chemical parameters						
1	pH	8.8	7.6	7.8	7.6	8.8	8.066
2	Total Alkalinty (TA)	180	142	140	140	180	154
3	Chloride (cl⁻)	28.02	32.04	28.03	28.02	32.04	29.363
4	Calcium (Ca++)	42.0	51.42	26.03	26.03	51.42	39.816
5	Magnesium (mg++)	18.00	41.24	23.96	18.00	41.24	27.733
6	Sodium (Na+)	24.00	27.00	25.00	24.00	27.00	25.333
7	Potassium (K⁺)	14.00	19.00	9.00	9.00	19.00	14.00
8	Phosphate – phosphorous(PO4-P)	0.03	0.041	0.016	0.03	0.041	0.029
9	Nitrate – nitrogen ($NO^3 – N$)	1.129	1.060	1.075	1.060	1.129	1.088
10	Organic matter (%)	5.44	4.31	8.01	4.31	8.01	5.92

Table 4: physico – chemical characteristics of Agricultural soil at Site III.

S#	Physical parameters	November	January	May – 2011	Min. value	Max. value	Mean value
1	Colour	Grey	Grey	Grey			
2	Texture	Sandy	Sandy	Sandy			
3	Sand (%)	75.00	80.00	80.00	75.00	80.00	78.33
4	Clay (%)	10.00	10.00	10.00	10.00	10.00	10.00
5	Slit (%)	15.00	10.00	10.00	10.00	15.00	11.66
6	Porosity (%)	0.102	0.182	0.108	0.102	0.182	0.131
7	Conductivity (μmho)	0.839	0.068	0.016	0.016	0.839	0.308
8	Total dissolved solids (TDS)	200	153.2	101.6	101.6	200	151.6
	Chemical parameters						
1	pH	8.2	7.8	7.8	7.8	8.2	7.933
2	Total Alkalinity (TA)	135	145	126	126	145	135.33
3	Chloride (cl⁻)	35.41	41.04	21.52	21.52	41.04	32.534
4	Calcium (Ca++)	62.2	63.28	34.01	34.01	63.28	53.163
5	Magnesium (mg++)	17.8	19.41	24.99	17.8	24.99	20.733
6	Sodium (Na+)	25.00	21.00	23.00	21.00	23.00	23.00
7	Potassium (K⁺)	17.00	14.00	8.00	8.00	17.00	13.00
8	Phosphate – phosphorous ($PO_4 – p$)	0.041	0.083	0.011	0.011	0.083	0.045
9	Nitrate – nitrogen ($NO^3 – N$)	1.105	1.032	1.092	1.032	1.105	1.076
10	Organic matter (%)	4.76	3.67	6.92	3.67	6.92	5.11

Table 5: physico – chemical characteristics of Agricultural soil at Site-IV
All the values given above are in mg/100g, otherwise mentioned

4. Discussion
Physical chemical properties of soil samples was studied, all the samples are gray and dark grey in color and have unpleasant smell. The pH of soil is one of the most important physicochemical parameter. It affects mineral nutrient soil quality and much microorganism activity.

The present study is the first attempt to document the physico chemical characteristics of agricultural soil of surrounding area of Doiwala sugar mill. The results of the investigation are detailed in the table.

The six months data on physico-chemical analysis of agricultural soil of surrounding area of Doiwala sugar mill at four sampling sites (site I – site IV) are presented in the table given later.

4.1. Colour

Soil colour is important as it affects absorption and reflection of solar radiation and indicates chemical composition of soil. The colour of soil found in catchment area of Doiwala sugar mill are grey. It was observed that the colour of soil found in open water zone was light grey in colour were as it was dark grey in vegetation covered zone.

4.2. Texture

Texture is one of the most important physical properties of soils as it affects water retention nutrient availability, poor space, slope stability aeration and erosion susceptibility. In general soil was silty clay in texture were as sediment was sandy in texture. The composition of clayey was observed (10% -75%) in all the samples were as proportion of silt ranged from 5 % to 25 % and sand 20 - 80% respectively. Texture of soil influence the quality of soil and an excess of particle size may adversely affect the physical and chemical properties of soil required for vegetation growth   (Donazzola et al. 1984, Singh, 1997).

4.3. pH

PH is one of the important parameter in water quality monitoring as it governs most of chemical reactions in water. At extremely high or low Ph values, many plants, animals and other aquatic biota may die and may pose hazardous impact on human and animal health.
The pH of the agriculture soil of catchment area of Doiwala sugar mill in the present study was found to, be slightly alkaline to moderate throughout the study period. It was ranged from 7.5 -8.0 mg/100 g, 7.2 – 8.5 mg/100g,7.6-8.8mg/100g and 7.8-8.2mg/100g in agricultural soil respectively from site I-IV. The average mean value of pH in agricultural soil ranged between 7.7 – 8.66 respectively.

4.4. Conductivity

Conductivity is a measure of salt content of a sediment suspension and is therefore an indirect measure of osmotic pressure that plant roots must overcome for plant to take up water and nutrients. The conductivity of agriculture soil in the catchment area of Doiwala sugar mill varied from 0.095-0.205 mg /100g,0.022-0.258 mg/100g,0.013-,0.758mg/100gand 0.016-0.839mg/100g in agricultural soil from site I to site IV respectively. The average mean value of conductivity in agricultural soil was ranged between 0.107-0.312.
Relatively higher conductivity observed in open water area of lake might be attributed to salt bearing materials probably reached to the lake sediment.

4.5. Total Alkanity (T.A.)

Total alkanity concentration was ranged between 125-175mg/100g in agricultural soil from site I to site IV respectively. The average mean value of alkanity in agricultural soil was 135.33-154.
Chloride:-
In the present study the chloride content in the soil and river sediments varied from 29.011-33.033mg/100g,30.033-44.04mg/100g,28.02-32.04 mg/100g and 21.52-41.4mg\100g in agricultural soil from site I to IV respectively. The average mean value of chloride in agricultural soil was ranged between 29.363-36.104.

4.6. Porosity

The porosity of the agricultural soil sample of catchment area of Doiwala sugar mill ranged from 0.152-0.231mg/100g, 0.121-0.161mg/100g,0.102 -0.141mg/100g and 0.102-0.182mg/100g respectively from I to IV. The average mean value of porosity in agriculture soil was ranged between 0.118-0.183.
Total dissolved solids (T.D.S):-
T.D.s in agricultural soil of catchment area of Doiwala sugar mill ranged from 109.2-151.9mg/100g,69.9-113.7mg/100g and 101.6-200mg/100g respectively frpm site I to IV. The average mean value of T.D.S in agricultural soil was ranged between 94.133-151.6.
Calcium (ca):-
Calcium content in the soil ranged from 64.88mg/100g,32.06-72.4mg/100g,26.03-51.42mg/100g and 34.01-63.28mg/1oog in agricultural soil from site I – IV respectively. The average mean value of calcium in agricultural soil was ranged between 39.816-57.623.

4.7. Magnesium (Mg)

Magnesium content in the agricultural soil ranged between 34.90-54.09 mg/100g,28.26-47.6mg/100g,18.00-41.24mg/100g and 17.8 -24.99mg/100g in agricultural soil from site I _ IV respectively. The average mean value of magnesium in agricultural soil was ranged between 20.733-44.416.

4.8. Sodium (Na)

The sodium content in soil was varied from 19.00-27.00 mg\100g,27.00-30.00mg\100g,24.00-27.00mg/100g and 21.00-23.00mg/100g in agricultural soil from site I to Iv respectively. The average mean value of sodium in agricultural soil was ranged between 23.00-29.00.

4.9. Potassium (K+)

The value of potassium in agricultural soil of catchment area of Doiwala sugar mill ranged from 9.00-15.00mg/100g,9.00-21.00mg/'100g,9.00-19.00mg/100g and 8.00-17.00 in agricultural soil from site I-IV respectively. The average mean value of potasium in agricultural soil was ranged between 12.00-15.33.

4.10. Nitrate (No3-)

Agricultural wastes are generally organic materials. It includes crop residues, animal manure, poultry manure, fertilizers and pesticides. Due to increasing use of commercial fertilizers, effluents containing phosphate is being discharged into water which is then used for irrigation purposes in agricultural fields. The value of nitrate concentration of soil ranged from 1.068-1.095mg/100g,1.103-1.120mg/`100g,1.060-1.129mg/100g and 1.032-1.105mg/100g from site I –IV respectively. The average mean value of nitrate in agricultural soil was ranged between 0.77-1.088.

4.11. Phosphate-phosphorus (Po4-p)

The value of phosphorus in the agricultural soil of catchment area of Doiwala sugar mill ranged from 0.021-0.050mg/100g,0.012-0.061mg/100g,0.03-0.041mg\100g and 0.011-0.083mg/100g from site I-site IV respectively. The average mean value of phosphate-phosphorus in agricultural soil was ranged between 0.029-0.186.

4.12. Organic Matter

Organic matter in agricultural soil or in catchment area of Doiwala sugar mill ranges from 3.62 – 5.32 mg/100g, 4.99 – 7.06 mg/100g, 4.31- 8.01mg/100g and 3.67 – 6.92 mg/100g respectively from site 1 to site IV. The average mean value of organic matter in agricultural soil was ranged between 4.20 – 5.92.

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