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PHYSICOCHEMICAL ASSESSMENT OF SOIL IN KYUNJA GAD WATERSHED, DISTRICT RUDRAPRAYAG, UTTRAKHAND, INDIA

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Abstract

Physicochemical analysis of soil provides information about the current environmental status of the regions. In this present study we focus on agricultural soils with physical and chemical properties. Soil samples were collected from three different depth viz., 0-10, 10-20 and 20-30 cm from agriculture land and also from six different locations covering Kyunja Gad Watershed, district Rudraprayag (Uttrakhand) India during the month of January to December 2016. Part of analysis contain in soil texture (sand 83.70% to 99.61%, silt 1.89 % to 13.74 % and clay 0.11–2.93%), water holding capacity (23.8% to 33.04%), pH (6.6 to 7.4), Carbon (0.56% to 0.82%), potassium (112-190.4 kg^{-ha}). phosphorous (27.3 Kg/hectare to 41.7 Kg/hectare) and Sulfur ranged from 14.58 ppm to 18.38 ppm. Physiochemical results showed that agriculture soil of study area had nutrient rich.

Key words : Agriculture, parameters, physico-chemical analysis, Kyunja Gad Watershed.

Introduction

Soil physico-chemical properties are related to field morphology and regulate the qualitative and quantitative characteristics of plant growth to a considerable level. Thus the importance of physico-chemical properties of soil in the domain of system analysis needs to be taken into consideration (Mahajan and Sharma, 2015). The Central Himalaya has enormous kind of topography, climate and soil status, which form a very intricate ecosystem. Since, the vegetation zones in this region clearly reflect edaphic factor and climatic changes (Bhatt, Purohit, 2009 and Bhatt, 1991 and Upreti *et al*., 2016) and at the same time the information of physic-chemical properties of agricultural soils and climatic conditions of Central Himalaya is small. However, the present study was undertaken to investigate the soil properties in relation to agricultural land of the Kyunja Gad Watershed, District Rudraprayag, Uttrakhand, India.

Study area

The present study area is Kyunja Gad Watershed lies in the Augustmuni block of District Rudraprayag, Uttarakhand. Kyunja Gad Watershed is located in north part of the district. Geographically, the Watershed lies between the $30^{0}28'$ to 30^{0} 22'7'' N latitudes and $79^{0}4'2''$ to $78^{0}10'6''$ E longitude which covers an area of 32.14 km^2. Kyunja Gad is a tributary of river Mandakini and originates from the Mohankhal peak (2,400 m). Nil Gad, Loha Gad, Bhanaj Gad are the main sub-streams/ tributaries of the Kyunja Gad. The Kyunja Gad joins the Mandakini River near Chandrapuri (800 m). The elevation in the Kyunja Gad Watershed ranges from 800 to 3,000 m above SL. Most of the village settlements are situated between 800 and 2,400 m elevation. The study area falls in Survey of India (1:50,000) toposheets No 53 N/3. The entire Kyunja Gad Watershed covered of 46 villages. Geologically the study area lies in the Lesser Himalayan region. The watershed area has been located in the Garhwal Group between two major fault zones *viz*. Alaknada fault towards south and MCT towards north. The two local faults kande fault, which runs parallel to the MCT and Chimothi faults also pass through this area (Fuchs and Sinha, 1978). Mainly Phyllite, Granite gnenisses are exposed in the Kyunja Watershed. While the Partoli quartzites are exposed in the upper part of the Bhanaj ridge.

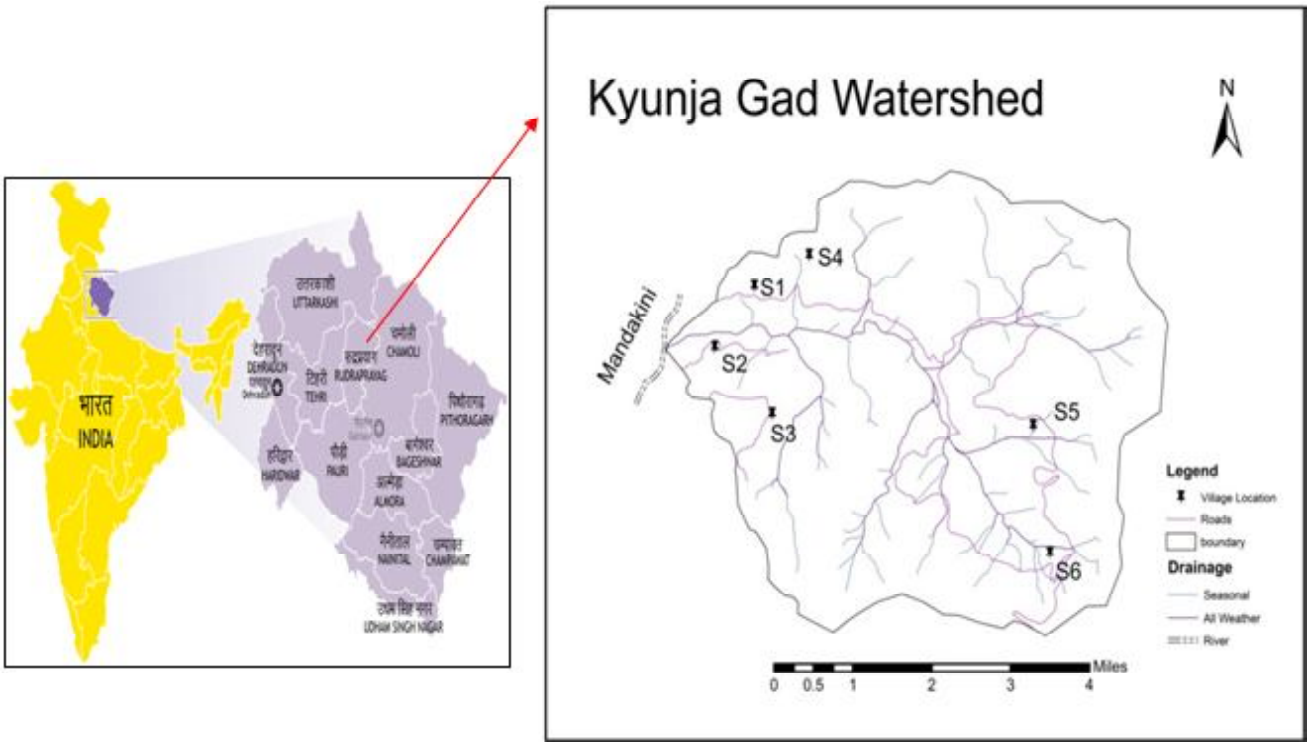

Fig. 1 : Location map of Kyunja Gad Watersheds with sampling point.

The livelihood strategies in the Kyunja gad watershed depend on two main activities; first Agriculture activities-agriculture product sale and livestock and livestock produce sale; second Non-agriculture activities – salaried job, labor work, carpentry/masonry, pension, remittance, and business/trading. The Landuse pattern of Watershed broadly divided into Agriculture: 1473.51(ha) *i.e* (45.82%); Forest: 1322.47 (ha) *i.e* (41.13%); water area: 171.38(ha) *i.e* (5.33%) and settlement; 256.84(ha) *i.e.* (7.99%). The main crops grown in the Watershed are wheat (*Triticum aestivum*) and paddy (*Oryza sativa*) and others like cereals and pulses. In watershed the major cash crops are barley (*Hordeum vulgare*), barnyard millet (*E. frumentacea*), maize (*Zea mays*) Fingel millet (*Eleusine coracana*), pigeon pea (*Cajanus cajan*), lentil (*Lens esulenta*), pea (*pisum sativum*), horse gram (*M. uniflorum*), bhat, soyabean (*Glycine max*), sonta, turmeric, ginger, chillies, etc. and vegetables like potato (*Solanum tuberosum*), pumpkin (*Cucurbita maxima*), onion (*Allium cepa*), radish (*Raphanus sativus*), brinjal (*Solanum melongena*), cucumber (*Cucmis melo*), amarnathus (*A. oleracea*) etc.

Materials and Methods

Representative soil samples were collected from agriculture land from six different villages in the watershed. Soil sample of about 500 gm approx., were collected from three different depth viz, 0-10, 10-20 and 20-30 cm in the year 2016. The area of the sampling was cleaned from herbs, plant remains, Plant residue and stone piece where it was removed by hand and then soil sample was transferred to airtight polythene sample bag. Sampling date, location of the sample and sample number were marked on the bags and brought to the laboratory at the earliest and analyzed for physical properties such as water holding capacity, soil texture as well as for chemical properties like pH organic carbon, phosphorous, potassium and sulfur using different techniques in the laboratory.

Soils textural

Soils textural were determined by sieve method using the USDA texture triangle. Determination of soil texture in the sample was carried out by sieves method. Soil samples were placed in hot air oven at 105^{0}c. After driying, soil samples was placed on the sieve having different sieve openings; sieve of 8mm, 16mm, 30mm, 60mm, 150mm, 300mm, and 500mm and were used for separation of the different soil particles. Seive with soil sample were shaked with electric seive shaker. Soil particles with respective size were accumulated inside the different seive after 1-2 hour of shaking. Accumulated soil particles were collected and the total percentage of sand, silt, and clay were estimated on the basis of different seive opening for each of the texture class.

Water holding capacity

The Water holding capacity of the soil was determined

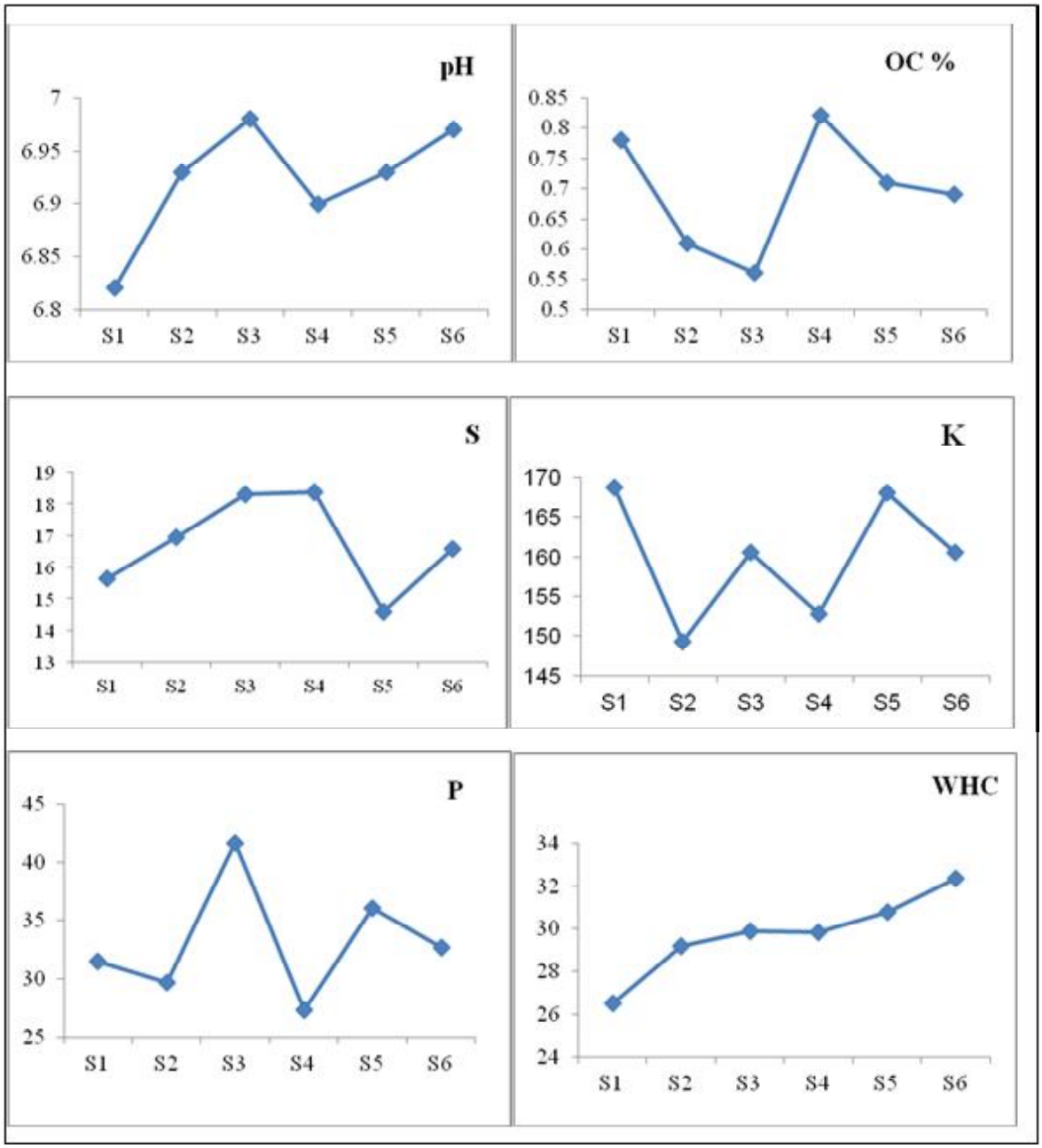

Fig. 2 : Variations of parameters like pH, OC%, S, K, P and WHC in agricultural soil samples.

as the methods described by Misra (1968). The water holding capacity of soil was calculated as follows :

$$WHC = \frac{W_1 - W_2}{W} \times 100$$

Where, W_1 = weight of the crucible plus soil and W_2 = weight of crucible plus soil withhold water

Organic carbon

Organic carbon in soil sample was determined as per the method described by Walkley-Black (1934).

$$Organic\ carbon(\%) = 10\frac{(B-T)}{B} \times \frac{(0.003 \times 100)}{W}$$

Where, B = Volume (ml) of ferrous (ammonium) sulphate solution required for blank titration.

T = Volume of ferrous (ammonium) sulphate needed for titration of soil sample.

W = Weight of soil (gms).

Phosphorus

Phosphorus in soil samples were determine the by the method of Olsen's and Sommers (1982).

Calculation

$$Phosphorus\ (\%) = \frac{c(mg) \times Solution\ volume(mL)}{Sample\ weight(gm)}$$

Potassium

Potassium in soil sample was determined by using flame photometer. The soil extract was prepared and standard curve was developed for the estimation of exchangeable potassium (K). A standard (calibration) curve was developed through the testing of standard solutions of various ppm concentrations in flame photometer. 5.0 gm thoroughly mixed soil sample was taken into 100 ml Erlenmeyer flask and 25 ml of neutral ammonium acetate was poured into it .Then the sample was shaken for 30 minutes with reciprocating shaker (approximately 180 oscillations/minute), and immediately after this the soil deferment was filtered by the Whatman no.1 filter paper. The samples were again shaken immediately before pouring the suspension into the funnel for filtration. The first new drops from the filtered funnel were rejected for the accuracy of result.

Calculation

$$Potassium\ (\%) = \frac{C(ppm) \times Solution\ (mL)}{Weight\ of\ soil\ taken}$$

The soil extract was prepared and standard curve was developed for the estimation of exchangeable potassium (K).

Results and Discussion

The present study was investigated to determine the physio-chemical properties of agricultural soil status. The results of the investigation are given in the table 2.

Texture

Soil texture is one of the most important physical properties of soils as it affects water holding, nutrient availability, poor space, slope stability, aeration and erosion susceptibility. Soil texture is simply defined as the relative proportion of sand, silt and clay separates (particles) found in the soil. The composition of sand soil were find out the (83.70%-99.61%) in all the samples. Whereas proportion of silt ranged from 1.89% to 13.74% and clay ranged from 0.11 – 2.93% respectively. The textural analysis of the soil samples revealed that the soil in the area was Sandy. The findings of (Bhat and Mir, 2015 and Kapoor e*t al.*, 2015 and Mahajan and Sharma, 2015) have been in the same with the present findings.

Water Holding Capacity (WHC)

The water holding capacity for agricultural land use was estimated across the three soil depth (0-10, 10-20, 20-30 cm) by taking three soil samples from each of the depth class. The Water Holding Capacity (WHC) of soil determines the actual amount of water (moisture) present inside the pore spaces at a given period of time under natural climatic conditions. WHC varied from 23.8% to 33.04% in the Kyunja gad watershed. The similar findings of Bhat and Mir (2015) and Mahajan and Sharma (2015).

pH

The pH of soil 6.8 to 8.0 has been admired as optimum range for plants growth. An examination of soil samples (table 2) shows that the values for pH range from 6.6 to 7.4 indicating that the agriculture soils is slightly acidic to moderate in the Kyunja Gad Watershed throughout the study period. The normal mean value of pH in agricultural soil of the study area ranged between 6.82–6.98. The Soil pH changes the soil's physical and chemical properties, as well as it impact growth of plant. Crops like corn, wheat, oats, barley, soybean, etc. grow best if pH is close to neutral i.e. (pH 6 to 7.5) because of maximum nutrient availability. The findings of Bhat and Mir (2015), Smith and Doran (1996) and Mahajan and Sharma (2015) have been in the same with the present findings.

Organic carbon

Organic carbon is the key for the nitrogen content in the soil. The source of OC in the cultivated soil included crop residue, cover crops, green manure, animal manure and organic fertilizer etc. The data on organic carbon (%) ranges from 0.56% to 0.82% and that represent "soil is useful for the agricultural practices". The findings of

Table 1 : Selected sites for soil sample collation of the catchment (Kyunja Gad Watershed).

S. no.	Sampling Sites	Sampling ID	Landuse Type	Altitude (m)	Latitude	Longitude
1	Kandara	S1	Agriculture land	1167	N 30°26.046	E 079°04.627
2	Kakola	S2	Agriculture land	1104	N 30°25.493	E 079°04.760
3	Pillu	S3	Agriculture land	1347	N 30°24.842	E 079°05.518
4	Kanyas	S4	Agriculture land	1452	N 30°26.311	E 079°05.481
5	Kontha	S5	Agriculture land	1832	N 30°24.849	E 079°08.616
6	Kinjyani	S6	Agriculture land	1981	N 30°26.980	E 079°05.537

Table 2 : Physico-chemical characteristics of Agricultural soil.

S. no.	Physical parameters	Depth	S1	S2	S3	S4	S5	S6
1	Sand (%)	0-10	94.36	96.67	88.65	88.49	91.66	94.22
		10-20	93.93	97.03	87.81	92.02	95.44	97.63
		20-30	89.54	99.61	91.08	83.70	96.10	98.32
		Mean	**92.61**	**97.77**	**89.18**	**88.07**	**94.40**	**96.72**
2	Slit (%)	0-10	5.11	2.37	8.04	9.72	6.01	4.31
		10-20	4.53	1.89	8.74	6.50	3.46	2.01
		20-30	7.53	0.27	6.14	13.74	3.21	1.38
		Mean	**5.72**	**1.51**	**7.64**	**9.99**	**4.23**	**2.57**
3	Clay (%)	0-10	0.54	0.96	3.31	1.79	2.33	1.47
		10-20	1.54	1.08	3.45	1.48	1.10	0.37
		20-30	2.93	0.11	2.79	2.57	0.68	0.30
		Mean	**1.67**	**0.72**	**3.18**	**1.95**	**1.37**	**0.71**
4	WHC	0-10	27.38	31.03	32.2	28.67	29.54	31.49
		10-20	28.3	25.6	29.61	29.95	30.77	32.61
		20-30	23.8	30.97	27.85	30.86	32.03	33.04
		Mean	**26.49**	**29.20**	**29.89**	**29.83**	**30.78**	**32.38**
	Chemical Parameters							
1	pH	0-10	6.75	6.85	7.1	6.85	6.95	7.4
		10-20	6.9	6.75	7.2	6.95	6.95	6.6
		20-30	6.8	7.2	6.65	6.9	6.9	6.9
		Mean	**6.82**	**6.93**	**6.98**	**6.90**	**6.93**	**6.97**
2	Organic carbon (%)	0-10	0.78	0.26	0.65	0.65	0.78	0.91
		10-20	0.78	0.65	0.52	1.04	0.78	0.58
		20-30	0.78	0.91	0.5	0.78	0.56	0.58
		Mean	**0.78**	**0.61**	**0.56**	**0.82**	**0.71**	**0.69**
3	Available phosphorous(kg^{-ha})	0-10	**20.7**	35.1	**47.7**	22.5	40.5	31.5
		10-20	36.9	27.9	45.9	22.5	30.7	36
		20-30	36.9	26.1	31.5	36.9	36.9	30.6
		Mean	**31.5**	**29.7**	**41.7**	**27.3**	**36.03**	**32.7**
4	Potassium (kg^{-ha})	0-10	181.44	212.8	179.2	162.4	134.4	168
		10-20	190.4	123.2	168	154.7	179.2	134.4
		20-30	134.4	**112**	134.4	141.12	**190.4**	179.2
		Mean	**168.75**	**149.33**	**160.53**	**152.74**	**168.00**	**160.53**
5	Sulfur (ppm)	0-10	19.83	21.47	12.64	13.1	12.64	22.75
		10-20	12.92	18.29	22.93	18.1	10.64	17.01
		20-30	14.19	11.1	19.29	23.93	20.47	10.01
		Mean	**15.65**	**16.95**	**18.29**	**18.38**	**14.58**	**16.59**

Bhat and Mir (2015) and Mahajan and Sharma (2015) have been in the same with the present findings.

Potassium

The range of potassium in agricultural soil at catchment area of Kyunja gad watershed is 112-190.4 kg^{-ha}. The mean value of potassium in agricultural soil was ranged between 149.33-168.75 kg^{-ha}. Application of phosphorus (P) is one of the key macronutrient essential for maintaining the plant nutrients and ensuring the normal growth of the crop. The findings of the present is similar with the findings of Cakmak (2002) and Mahajan and Sharma (2015) and Sharma and Chaudhary (2017).

Phosphorus

The value of phosphorus in agricultural soil of study watershed varies from 27.3 Kg/hectare to 41.7 Kg/ hectare.

Sulfur

From the analyzed samples, concentrations of sulfur show ranged from 14.58 ppm to 18.38 ppm in the agricultural land.

Conclusion

A physicochemical study of soil samples from six places of the Kyunja Gad watershed shows that all the soil parameter is of normal range. Physiochemical properties of soil texture is (sand 83.70%-99.61%, silt 1.89 % to 13.74 % and clay 0.11–2.93%), water holding capacity is (23.8% to 33.04%), pH is (6.6 to 7.4), Carbon is (0.56% to 0.82%), potassium is (112-190.4 kg^{-ha}) , phosphorous is (27.3 Kg/hectare to 41.7 Kg/hectare) and Sulfur ranged from 14.58 ppm to 18.38 ppm. Physiochemical results showed that agriculture soil of study area is nutrient rich and thus is good for many crops like corn, wheat, oats, barley, soybean etc.

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