Biological Forum – An International Journal **13(3): 543-549(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Evaluation of Physico-chemical Properties of Soil from Different Blocks of Kaimur District, Bihar, India

Ajit Kumar Singh[1*], Tarence Thomas[2], Narendra Swaroop[3] and Tarun Kumar[4]

[1]M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj-211007, (Uttar Pradesh), India.
[2]Professor and Head, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj-211007, (Uttar Pradesh), India.
[3]Associate Professor, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj-211007, (Uttar Pradesh), India.
[4]Ph.D. Scholar, Department of Soil Science and Agricultural Chemistry, NAI, SHUATS, Prayagraj-211007, (Uttar Pradesh), India.

(Corresponding author: Ajit Kumar Singh)*
(Received 07 June 2021, Accepted 17 August, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: An appraisement of Physico-chemical properties of the soil of 'Kaimur District' an allied area of Bihar was carried out in 2020-2021. The Prime objectives of this study was to carried out the survey, collection of information of sampling sites and analysis of physical properties of soil and macro-micro nutrient status and its relation to various chemical properties of soil. For assessment 9 sampling sites were selected. Soil samples were collected with respect of depth of 0-15 cm, 15-30 cm, and 30-45 cm and analyzed the Physico-chemical properties and nutrient status of the soil. The study revealed that particle density ranges from 2.61 to 2.85 Mg m^{-3}, bulk density ranges from 1.05 to 1.33 Mg m^{-3}, water retaining capacity ranges from 37.44% to 63.94%. Soil textural classes were clay loam, sandy loam and sandy clay loam. The pH value ranges from 6.09 to 8.28 and electrical conductivity ranged from 0.07 dS m^{-1} to 0.29 dS m^{-1}. Nitrogen (N), Phosphorus (P), Potassium (K) ranged from 223.2133 kg ha^{-1} to 289.45 kg ha^{-1}, 9.744 kg ha^{-1} to 17.8 kg ha^{-1} and from 82.04 kg ha^{-1} to 163.607 kg ha^{-1}. Organic carbon and Organic matter ranges from 1.41 % to 1.88 % and 1.49% to 3.12%. It clearly indicated that soil has good water holding capacity and has good physical condition and pH and Electrical conductivity was found to be normal. The nitrogen, phosphorus, potassium values are found to be low to medium in all villages. There is an increasing awareness of need to pay greater attention in the role of macro nutrient enhancement in the soil for good soil health and proper nutrition of plant so as to attain optimum economic yield and soil in suitable for all major tropical and sub-tropical crops. This information will help farmers to determine economically optimum rates of nutrients application, high yields with low production costs per unit area in modern farming.

Keywords: Kaimur district, physico-chemical properties, Tropical crops, yield etc.

INTRODUCTION

Soil testing makes complete nutrient control a possibility, fertilizer experiments are being patterned to determine economically optimum rates of nutrients application high yields with low production costs per unit area must in modern farming. Farmers of today are different in 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. As a result, the demand on the soil has gradually increased. Soil testing lets farmers know how much and what kind of fertilizer they must apply to be sure of returns from their investments in other improved practices (Joshi *et al.*, 2013). Soil formation is a constructive as well as destructive process. Soil is composed of particles of broken rock that have been altered by chemical and mechanical processes that weathering and erosion. Soil has a complex function which is beneficial to human and other living organism Soil is not merely a group of mineral particles. It has also a biological system of living organism as well as some other components. The climate and other factor largely affect the soil formation. Soil farming factors interaction results into the properties of soil. Physico-chemical characteristics of different soils vary in space and time due to variation in topography, climate, physical weathering processes, vegetation cover, microbial activities, and several other biotic and abiotic variables (Tale and Ingole 2015).

The physical and chemical properties of the soil and the impact of the pollutants were investigated in the different soil ecosystem (Upadhyay *et al.,* 2020). The more you know about your soil, the better you can care for it. Standard soil tests have primary focused on the soil chemical composition. Recommendations generated from these analyses have been applying soil amendments (fertilizers, gypsum, lime etc.) for increasing crop yields, but not for improving intrinsic soil conditions. The biological and physical conditions of the soil are often overlooked. Soil is a living biological ecosystem (habitat for microbes) and the impacts of some soil management activities negatively

affect its physical and chemical conditions. Soil biological functions are related to nutrient cycling, soil aggregation and soil water fate, among the soil properties (Zavala *et al.*, 2015).

Combined application of manures and fertilizers played a pivotal role in the improvement in soil physico-chemical properties, macro and micronutrients distribution and their transformations under different cropping systems. Intensive cropping systems lead to N, P, K, Zn, Cu, Fe, and Mn deficiencies in surface and subsurface soil, which could be refreshed with combined application of manures and fertilizers. The application of manures and fertilizers controls the pH and electrical conductivity of soil (Dhaliwal *et al.*, 2019). Inclusion of a legume crop in a cropping system can improve soil physical and chemical properties, particularly in predominantly rice cultivating areas (Kumar *et al.*, 2020). A balanced application of organic and inorganic fertilisers could be beneficial to both soil nutrient availability, soil health and crop growth (Das *et al.*, 2021).

Bihar is situated on the World's fertile alluvial plain of Gangetic Valley which extends from the foothills of the Himalayas in the north to a few miles south of the river Ganges as it flows through the State from the west to the east. Variation in relief, precipitation, vegetation, and parent rocks have resulted in various soil varieties due to the region relief features.

The foothills of Kaimur consist of alluvial soil and are naturally fertile. But the soil becomes harder as one proceeds southwards. As one moves up the foothills, the soil becomes stony and poor in fertility. The Kaimur plateau is an undulating tableland having thin shrub jungles and the land is not very fertile. The proposed work is to be undertaken for the analyses of the soil for its physical state, its constituents and the nutrients, present in the soil. Different physico-chemical characteristics of the Kaimur (formerly known as Bhabua) region of Bihar State has been determined by using standard methods.

MATERIALS AND METHODS

Bihar occupying area 94,163.00 sq. kms, including area of Kaimur 3,362 km² in which urban area constitute 12.45 sq. km and rural constitute 3319.55 sq.km with latitude and longitude of Kaimur Latitute 25.04059°N Longitute 83.61241°E. This research study includes 3 blocks of Kaimur district i.e., Rampur, Kudra and Bhabua.

Soil samples were collected from farm of 9 villages using soil auger and screw auger and khurpi at the depth of 0-15cm, 15-30 cm and 30-45cm. After sampling the samples were air dried in shade and then these samples were processed for various physical and chemical tests.

The data was recorded during the course of investigation were subjected to statistical analysis by analysis of Completely Randomized Design (CRD) as per the method of "Analysis of Variance" (ANOVA) technique.

Table 1: Procedure used for physico-chemical analysis of soil.

Particulars	Methods	Scientist (years)
Texture	Bouyoucos Hydrometer	Bouyoucos (1927)
Soil Colour	Munsell Colour Chart	Munsell, (1971)
Particle Density (Mg m^{-3})	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Bulk Density (Mg m^{-3})	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Pore Space (%)	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Water retaining capacity (%)	Graduated measuring cylinder	Muthuaval *et al*., (1992)
Soil pH	Digital pH meter	Jackson, (1958)
Electrical Conductivity	Digital EC meter	Wilcox, (1950)
Organic Carbon (%)	Rapid titration method	Walkley and Black, (1947)
Available Nitrogen (kg ha^{-1})	Kjeldahl method	Subbaiah, (1956)
Available Phosphorous (kg ha^{-1})	Calorimetric method	Olsen *et al*., (1954)
Available Potassium (kg ha^{-1})	Flame photometer method	Toth and Prince, (1949)
Calcium and Magnesium (meq/100g)	EDTA method	Tucker and Kurtz, (1961)
Zinc (meq/100g)	DTPA method	Lindsay and Norvell, (1978)

RESULT AND DISCUSSION

A. Physical Properties

The soil colour (dry method) of soil varied from light olive brown to dark greyish brown. Soil colour (Wet Method) of the soil varied from dark greyish brown to very dark greyish brown. Dark colour corresponds to high organic matter content. Similarly, results were reported by Sahu and David (2014).

The textural identified were clay loam, sandy loam and sandy clay loam. The sand, silt and clay percentage ranges from 39-70%, 12.8-36.9% and 17.2-36.5% respectively. The high content of clay in most of the soil sample show that the soil is suitable for cultivation of paddy. The same research was done by Thakre, (2012).

Particle density of different soil depths varied from 2.61 to 2.85 Mg m^{-3} and the highest particle density was found in V_1 (Kukudha) and V_9 (Mahuat). The particle density decreases with the increase in soil depth. Particle density is density of just the solid parts of the soil, it does not include any pore space. Particle density varies according to mineral content in the soil particles. Same analysis was done by Parmar and Negi, (2017).

The maximum mean bulk density was found 1.33 and minimum 1.05 Mg m^{-3} and the highest bulk density was found in V_5 (Gokulpur). The bulk density decreases with the increase in soil depth. Different levels of

erosion of soil depending upon slop and management practices also responsible for higher bulk density which might be due to greater compaction that might have occurred in the lower horizons of the soil profiles with time. Same analysis was done by Jain and Singh, (2013).

The mean percent pore space varied from 54.06% to 60.82% and the highest percent pore space was found in V_1 (Kukudha). Pore space was found to decrease with increase in depth in some of the villages. Addition of organic matter increases the porosity of the soil. Same result was done by Sahu and David (2014).

The mean water holding capacity varied from 37.44% to 63.94% and the highest water holding capacity was found in V_9 (Mahuat). These variations were due to the silt, clay and organic carbon content and low WHC in sandy soils due to high sand and less silt content. The irregular trend of WHC with depth due to illuviation and eluviation of finer fraction in different horizons. Similarly reported by Chaudhari *et al.*, (2013).

Table 2: Soil Colour.

Block	Village	Dry Condition			Wet Condition		
		0-15 cm	15-30 cm	30-45 cm	0-15 cm	15-30 cm	30-45 cm
Rampur	Kukudha	Light Olive Brown	Light Olive Brown	Light Yellowish Brown	Dark Greyish Brown	Dark Greyish Brown	Very Dark Greyish Brown
	Badka Gaon	Olive Brown	Light Olive Brown	Olive Yellow	Very Dark Greyish Brown	Greyish Brown	Light Yellowish Brown
	Banauli	Yellow	Yellow	Olive Yellow	Light Olive Brown	Light Olive Brown	Olive Brown
Kudra	Sakari	Olive Yellow	Pale Yellow	Olive Yellow	Very Dark Greyish Brown	Light Olive Brown	Light Olive Brown
	Gokulpur	Olive Brown	Light Olive Brown	Light Yellowish Brown	Dark Greyish Brown	Dark Greyish Brown	Greyish Brown
	Meura	Light Yellowish Brown	Light Yellowish Brown	Light Yellowish Brown	Dark Greyish Brown	Greyish Brown	Dark Greyish Brown
Bhabua	Khaira	Light Brownish Grey	Light Grey	Light Brownish Grey	Very Dark Greyish Brown	Dark Greyish Brown	Greyish Brown
	Odar	Light Brownish Grey	Light Yellowish Brown	Light Brownish Grey	Dark Greyish Brown	Dark Greyish Brown	Dark Greyish Brown
	Mahuat	Very Dark Grey Brown	Greyish Brown	Light Grey	Very Dark Greyish Brown	Light Olive Brown	Dark Greyish Brown

Table 3: Soil Texture.

Block	Village	%Sand	%Silt	%Clay	Textural Class
Rampur	Kukudha	42.5	23.6	33.9	Clay Loam
	Badka Gaon	54.2	17	28.8	Clay Loam
	Banauli	70	12.8	17.2	Sandy Loam
Kudra	Sakari	56.2	15.4	28.4	Sandy Clay Loam
	Gokulpur	49.5	14	36.5	Clay Loam
	Meura	52.6	18.7	28.7	Clay Loam
Bhabua	Khaira	46.8	23	30.2	Clay Loam
	Odar	39	29.7	31.3	Clay Loam
	Mahuat	46.4	19	34.6	Clay Loam

Table 4: Particle Density (Mg m^{-3}).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	2.85	2.66	2.85	2.786
	Badka Gaon	2.5	2.5	2.85	2.61
	Banauli	2.66	2.85	2.5	2.67
Kudra	Sakari	2.35	2.85	2.85	2.68
	Gokulpur	2.5	2.85	2.85	2.733
	Meura	2.85	2.85	2.85	2.85
Bhabua	Khaira	2.85	2.85	2.85	2.85
	Odar	2.85	2.5	2.85	2.73
	Mahuat	2.85	2.85	2.66	2.78
		2.69	2.75	2.79	
			F-test	S.ED(±)	C.D.@5%
Due to Depth			NS	0.047	0.52
Due to site			NS	0.125	0.72

Table 5: Bulk Density (Mg m^{-3}).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	1.05	1.11	1.11	1.09
	Badka Gaon	1.11	1.25	1.11	1.15
	Banauli	1.17	1.17	1.17	1.17
Kudra	Sakari	1.11	1.11	1.11	1.11
	Gokulpur	1.11	1.33	1.33	1.25
	Meura	1.05	1.25	1.11	1.13
Bhabua	Khaira	1.11	1.17	1.11	1.13
	Odar	1.17	1.25	1.17	1.19
	Mahuat	1.05	1.17	1.25	1.15
		1.11	1.19	1.17	
			F-test	S.ED(±)	C.D.@5%
Due to Depth			NS	0.045	0.079
Due to site			NS	0.049	0.007

Table 6: Percent Pore Space (%).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	63.15	58.27	61.05	60.82
	Badka Gaon	55.6	50	61.05	55.55
	Banauli	58.9	61.05	53.2	57.71
Kudra	Sakari	52.7	61.05	61.05	58.26
	Gokulpur	55.6	53.3	53.3	54.06
	Meura	63.15	56.1	61.05	60.1
Bhabua	Khaira	61.05	58.94	61.05	60.34
	Odar	58.94	50	58.94	55.96
	Mahuat	63.15	58.94	53	58.36
		59.13	56.40	58.18	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			NS	1.38	0.36
Due to site			NS	2.33	0.45

Table 7: Water Holding (%).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	52.5	55.88	51.42	53.26
	Badka Gaon	52.63	48.64	51.42	50.89
	Banauli	14	20	42.85	25.61
Kudra	Sakari	30.76	39.47	42.1	37.44
	Gokulpur	58.33	55.55	51.42	55.1
	Meura	44.44	52.94	57.57	51.65
Bhabua	Khaira	47.36	48.64	54.05	50.01
	Odar	54.05	55.55	52.77	54.12
	Mahuat	80.55	58.33	52.94	63.94
		48.29	48.33	50.72	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			S	1.39	0.776
Due to site			NS	11.16	0.001

B. Chemical Properties: The pH value ranges from 6.09 to 8.28 and the highest value was recorded in V_7 (Khaira). The low pH values could be due to low level of organic matter and leaching of some of nutrient elements. Similar results were reported by Upadhyay and Chawla (2014).

The electrical conductivity ranged from 0.07 dS m^{-1} to 0.29 dS m^{-1} and the highest EC was found in V_9 (Banauli) the soil was found to be normal. EC value 0.5 dS m^{-1} is good for soil. When EC value exceed this value, the germination of almost all crops would be seriously affected resulting in much reduced yield. Similar results were reported by Belwal and Mehta, (2014).

The soil organic carbon percentage varied from 1.41 % to 1.88 % and the highest soil organic carbon % was found in V_8 Odar. The organic carbon content of these soils was found to be low to medium. The organic carbon content decreased with depth and this is due to the addition of plant residues and farm yard manures to surface horizons than lower horizons. Similar results were reported by Upreti *et al.*, (2016).

The organic matter (%) ranges from 1.49% to 3.12% and the organic matter percentage found in V_8 (Odar). The low organic matter content in the soils might be attributed to the prevalence of tropical condition, where the degradation of the organic matter occurs at a faster rate coupled with low vegetation cover, there by leaving less organic carbon in soil. Similar results were reported by Upreti *et al.*, (2016).

The Available Nitrogen ranges from 223.21 kg ha^{-1} to 289.45 kg ha^{-1} and the highest available nitrogen was found in V_9 (Mahuat). The available nitrogen content found to be maximum in surface layer and decreases regularly with depth which mainly due to decreasing trend of organic carbon with depth and cultivation of crops are confided to the rhizosphere only at regular interval the depleted nitrogen content is supplemented by external application of fertilizer at the time of cultivation of crops. Similar results were reported by Upadhyay *et al.*, (2014).

The Available Phosphorus ranges from 9.744 kg ha^{-1} to 17.8 kg ha^{-1} and the highest available phosphorus was found in V_9 (Mahuat). The available phosphorous

content found to be maximum in surface layer and randomly it varies with depths. It might due to the confinement of the crop cultivation the rhizosphere and supplementing the exhausted "P" by external sources like fertilizers and presence of free iron oxide and Exchangeable Al^{+3} in little amounts. Similar results were reported by Sannappa and Manjunath (2013).

The Available Potassium ranges from 82.04 $kgha^{-1}$ to 163.60 kg ha^{-1} and the highest available potassium was found in V_1 (Kukudha). It might attribute to more intense weathering, release of liable K from the organic residues, application of K fertilizers and upward translocation of K from lower depths along the capillary rise of ground water. Similar results were reported by Patel, (2015).

The Available calcium ranges from 13.85 mg g^{-1} to 20.55 mgg^{-1} and the highest available calcium was found in V_5 (Gokulpur). The Available magnesium ranges from 4.15 mg g^{-1} to 7.99 mg g^{-1} and the highest available magnesium was found in V_9 (Mahuat). Calcium and magnesium both increases the soil pH as its availability increases in soil. Similar results were reported by Joshi *et al.*, (2013).

The Available zinc ranges from 0.59 ppm to 1.36 ppm and the highest available magnesium was found in V_9 (Mahuat). Availability of zinc decreases with increase in soil pH. Similar results were reported by Shukla, (2015).

Table 8: pH value.

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	6.5	7.15	7.5	7.05
	Badka Gaon	7.45	7.7	7.76	7.63
	Banauli	5.06	6.2	7.01	6.09
Kudra	Sakari	7.65	7.68	7.9	7.74
	Gokulpur	7.33	7.7	7.98	7.67
	Meura	7.4	7.05	7.5	7.31
Bhabua	Khaira	7.85	8.25	8.75	8.28
	Odar	7.71	8	8.75	8.15
	Mahuat	7.45	8.05	7.78	7.76
		7.15	7.53	7.88	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			S	0.36	0.000791
Due to site			S	0.06	0.00001

Table 9: EC (dS m^{-1}).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	0.12	0.14	0.14	0.13
	Badka Gaon	0.2	0.27	0.2	0.22
	Banauli	0.04	0.09	0.08	0.07
Kudra	Sakari	0.14	0.15	0.12	0.13
	Gokulpur	0.06	0.23	0.21	0.16
	Meura	0.18	0.38	0.31	0.29
Bhabua	Khaira	0.23	0.12	0.37	0.24
	Odar	0.14	0.19	0.32	0.21
	Mahuat	0.35	0.27	0.26	0.29
		0.16	0.20	0.22	
			F-test (±)	S.ED	C.D.@5%
Due to Depth			S	0.31	0.20
Due to site			NS	0.075	0.001

Table 10: Organic Carbon (%).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	0.825	2.05	1.8	1.55
	Badka Gaon	0.9	2.085	1.68	1.55
	Banauli	1.05	1.95	1.8	1.6
Kudra	Sakari	0.9	2.1	2.055	1.68
	Gokulpur	1.05	1.725	2.55	1.77
	Meura	0.675	1.725	2.55	1.65
Bhabua	Khaira	1.05	2.4	1.69	1.71
	Odar	1.65	1.875	1.90	1.81
	Mahuat	0.375	1.845	2.02	1.41
		0.941	1.972	2.00	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			S	0.60	0.0001
Due to site			NS	0.33	0.9079

Table 11: Organic Matter (%).

Block	Village	0-15cm	15-30cm	30-45cm	Mean
Rampur	Kukudha	1.42	3.53	3.10	2.68
	Badka Gaon	1.55	3.59	2.89	2.68
	Banauli	1.81	3.36	3.1032	2.75
Kudra	Sakari	1.55	3.62	3.54	2.90
	Gokulpur	1.81	2.97	4.39	3.0601
	Meura	0.67	2.97	4.39	2.6817
Bhabua	Khaira	1.16	4.13	2.92	2.74116
	Odar	2.84	3.23	3.28	3.12044
	Mahuat	0.64	3.18	3.49	2.43946
		1.49	3.40	3.45	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			S	1.11	0.0001
Due to site			NS	0.21	0.93

Table 12: Nitrogen (kg ha^{-1}).

Block	Village	0-15 cm	15-30 cm	30-45cm	Mean
Rampur	Kukudha	318.32	272.84	220.62	270.59
	Badka Gaon	315.18	279.45	202.34	265.65
	Banauli	267.2	252.74	198.17	239.37
Kudra	Sakari	265.64	250.73	220.14	245.50
	Gokulpur	310.54	265.45	212.21	262.73
	Meura	298.47	250.65	168.47	239.19
Bhabua	Khaira	273.41	234.21	162.02	223.21
	Odar	304.11	265.45	195.12	254.89
	Mahuat	336.54	292.47	239.35	289.45
		298.82	262.66	202.04	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			S	48.89	0.00016
Due to site			S	19.98	2.15

Table 13: Phosphorous (kg ha^{-1}).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	18	14.8	12	14.93
	Badka Gaon	18.2	15	13.3	15.5
	Banauli	10.87	9.52	8.84	9.74
Kudra	Sakari	11.44	11.02	9.51	10.65
	Gokulpur	16.45	14.69	13.71	14.95
	Meura	15.84	13.78	11.41	13.67
Bhabua	Khaira	19	16.87	12.83	16.23
	Odar	17.52	13.47	12.25	14.41
	Mahuat	20.21	17.64	15.55	17.8
		16.39	14.08	12.15	
			F-test	S.ED (±)	C.D.@ 5%
Due to Depth			S	2.12	1.39
Due to site			S	2.56	1.56

Table 14: Potassium (kg ha^{-1}).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	170.7	163.62	156.5	163.60
	Badka Gaon	157.18	162.11	148.62	155.97
	Banauli	76.3	88.4	81.4	82.03
Kudra	Sakari	84.23	94.2	87.65	88.69
	Gokulpur	159.28	122.4	148.83	143.50
	Meura	85.32	92.28	101.54	93.04
Bhabua	Khaira	96.58	88.98	95.52	93.69
	Odar	156.68	132.51	148.26	145.81
	Mahuat	212.63	165.89	109.95	162.82
		133.21	123.37	119.80	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			NS	6.94	0.335
Due to site			S	35.04	0.0006

Table 15: Calcium (mg g^{-1}).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	22	18.22	17.5	19.24
	Badka Gaon	21.2	19.56	19.1	19.95
	Banauli	15.52	13.84	12.21	13.85
Kudra	Sakari	16.45	15.21	14.23	15.29
	Gokulpur	19.24	21.32	21.1	20.55
	Meura	18.23	18.23	17.58	18.01
Bhabua	Khaira	19.54	21.2	20.56	20.43
	Odar	20.54	17.24	16.24	18.006
	Mahuat	22.89	17.21	15.27	18.45
		19.512	18.003	17.08	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			S	1.224	0.01735
Due to site			S	2.294	0.001013

Table 16: Magnesium (mg g^{-1}).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	9.45	7.14	6.11	7.56
	Badka Gaon	8.12	6.47	6.12	6.90
	Banauli	6.4	4.25	4.15	4.93
Kudra	Sakari	5.94	5.44	4.84	5.40
	Gokulpur	7.63	5.52	5.22	6.12
	Meura	6.98	6.5	6.45	6.64
Bhabua	Khaira	6.54	6.54	5.23	6.10
	Odar	6.45	6.21	5.56	6.07
	Mahuat	8.92	7.89	7.16	7.99
		7.38	6.21	5.64	
			F-test	S.ED (±)	C.D.@5%
Due to Depth			S	0.882947	0.000015
Due to site			S	0.975229	0.000072

Table 17: Zinc (ppm).

Block	Village	0-15 cm	15-30 cm	30-45 cm	Mean
Rampur	Kukudha	1.22	0.85	0.52	0.86
	Badka Gaon	1.33	0.85	0.71	0.96
	Banauli	0.82	0.52	0.45	0.59
Kudra	Sakari	1.1	1.1	0.9	1.03
	Gokulpur	1.05	0.96	0.73	0.91
	Meura	1.14	0.67	0.67	0.82
Bhabua	Khaira	0.97	0.85	0.78	0.86
	Odar	1.01	0.76	0.52	0.76
	Mahuat	1.76	1.38	0.96	1.36
		1.15	0.88	0.69	
			F-Test	S.Ed (±)	C.D.@5%
Due To Depth			S	0.23	2.9952
Due To Site			S	0.21	0.00015

CONCLUSION

The foothills of Kaimur consist of alluvial soil and are naturally fertile. Soil nutrients decreases with increasing of depths because of the plant uptake and leaching. Amount of organic matter was medium in soil. pH of the soil plays an important role in soil, amount of macro and micro nutrients present in soil depends on ranges of pH. Based on this analysis soil from Kaimur district was good for cultivation and soil is having good fertility and productivity. Wheat, paddy, arhar, gram, lentil, lineseed, mustard and vegetables like tomato, brinjal, chilli, broad beans, cabbage and cauliflower can grow.

Strategies to feed the expanding population in the study area will have to seek a sustainable solution that better addresses integrated soil management. To improve the soil health and reduce the cost of cultivation, the proper integrated soil management should be practices. Use of organic fertilizer and proper agronomic practices help in improving the soil health.

Acknowledgement. I express my gratitude to the Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. for providing necessary equipment, laboratory for analysis and other basic infrastructure.

Conflict of Interest. As a Corresponding Author, I Ajit Kumar Singh, confirm that none of others have any conflicts of interest associated with publication.

REFERENCES

Belwal, M., & Mehta, S. P. S. (2014). The Physico-chemical properties of the main soil types of Ranikhet region of Kumaun (Uttarakhand). *Journal of Chemical and Pharmaceutical Research*, *6*(4): 682-688.

Bouyoucos, G. L. (1927). The hydrometer as a new method for the mechanical analysis of soils. *Soil Sci., 23*: 343-353.

Chaudhari, P. R., Dodha, V. A., Vidya, D. A., Chkravarty, M., & Maity, S. (2013). Soil Bulk Density as related to Soil Texture, Organic Matter Content and available total Nutrients of Coimbatore Soil. *International Journal of Scientific and Research Publications, 3*(2).

Das, R., Kumar, M., Singh, S. K., Jha, S., & Sahoo, S. (2021). Soil Physico-chemical Properties as affected by Long-term Application of Organic and Inorganic NPK Fertilisers under Rice-wheat Cropping System in Calcareous Soil of Bihar. *International Journal of Environment and Climate Change*, 100-107.

Dhaliwal, S. S., Naresh, R. K., Mandal, A., Walia, M. K., Gupta R. K. & Singh, R. (2019). Effect of manures and fertilizers on soil physical properties, build-up of macro and micronutrients and uptake in soil under different cropping systems. *Journal of Plant Nutrition, 42*(20): 2873-2900.

Jackson, M. L. (1958). The pH was determined in 1:2 soil water suspensions using digital pH meter. *Soil Chemical Analysis, Prentice Hall, Inc. Englewood. cliffe. N.J.*

Jain, P., & Singh (2013). Analysis the physico-chemical microbial diversity of different variety of soil collected from Madhya Pradesh, India. *Scholarly Journal of Agricultural Science*, 103-108.

Joshi, P. C., Pandey, P., & Kaushal, B. R. (2013). Analysis of some physico-chemical parameters of soil from a protected forest in Uttarakhand. *Nature and Science, 11*(1): 136-140.

Kumar, U., Mishra, V. N., Kumar, N., Srivastava, L. K., & Bajpai, R. K. (2020). Soil Physical and Chemical Quality under Long-Term Rice-based Cropping System in Hot Humid Eastern Plateau of India. *Communications in Soil Science and Plant Analysis, 51*(14): 1930-1945.

Lindsay, W. L., & Norvell, W. A. (1978). Development of a DTPA soil test for zinc, iron, manganese, and copper. *Soil Sci. Soc. Amer. J., 42*: 421-428.

Munsell, A. H. (1971). Munsell soil colour chart. *Munsell Color Company Inc. 2441 N, Baltimore, Maryland.*

Muthuaval, P., Udayasoorian, C., Natesan, R., & Ramaswami, P. R. (1992). Introduction of Soil Analysis. *Tamil Nadu Agricultural University, Coimbatore.*

Parmar, M. K., & Negi, R. S. (2017). Study were undertaken in Takoli Gad watershed, Uttarakhand. *International Journal of Applied and Pure Science and Agriculture (IJAPSA),* 03.

Patel, K. P. (2015). Analysis of soil quality using Physico-Chemical parameters of shehra Taluka District, Panchmahal, Gujarat. *Indian journal of Applied Research, 5*(9): 466-468.

Sahu, V. K., & David, A. A. (2014). Soil health assessment of research farm of Allahabad wchod of Agriculture SHIATS-DU Allhabad. *The Allahabad farmer,* LXoIX(2).

Sannappa, B., & Manjunath, K. G. (2013). Fertility Status of Soils in Selected Regions of the Western Ghats of Karnataka, India. *Scholars Academic Journal of Biosciences, 1*(5): 200-208.

Shukla, A. K. (2015). Worked on mapping current micronutrient deficiencies in soils of Uttarakhand for precise micronutrient management. *International Journal of Fertilizer, 11*(7): 52-63.

Subbaiah, B. V. (1956). A rapid procedure for estimation of available nitrogen in soil. *Curr. Sci., 25*: 259-260.

Tale, S., & Ingole, S. (2015). Worked on the role of phsico-chemical properties in soil quality *Chemical Science Review and Letter, 4*(13): 57-66.

Thakre, Y. G. (2012). Physico-chemical characterization of Red and Black soils of Wardha *Region. Int. J Chem. and Phys. Sci., 1*(2): 60-66.

Toth, S. J., & Prince, A. L. (1949). Estimate of Cation exchange capacity and exchangeable Ca, K, Na, content of soil by flame photometer technique. *Soil Sci., 67*: 439-445.

Tucker, B. B., & Kurtz, L. T. (1961). Calcium and Magnesium Determinations by EDTA Titrations. Soil science society of America Journal. *Soil science society of America Journal, 25*: 27-29.

Upadhyay, M., & Chawla, J. K. (2014). Chemical characteristics of soil in parts of Dharmtari district of Chhattisgarh. *IJMCA, 4*(13): 146-149.

Upadhyay, M., Nadeemashaban, & Rishapaul, M. (2014). Physico-chemical properties of soil Kusmunda area district Korba (Chattisgarh), *Indian Journal of Pharmaceutical Science and Research, 4*(3): 139-143.

Upadhyay, K.K., Sharma, K., Singh, M.K. and Pandey, A. C. (2020). Physico-Chemical Study of Soil in Dholpur City. *International Journal of Theoretical & Applied Sciences, 12*(1): 01-03.

Upreti, B. M., Tewari, L., Tewari, A., & Joshi, N. (2016). Physiochemical characterization of soil collected from sacred and non sacred forests of Uttarakhand: A comparative study. *Journal of Chemical Engineering and Chemistry Research, 3*(11): 989-992.

Walkley, A., & Black (1947). A critical examination of a rapid method for determining organic carbon in soils: Effect of variations in digestion conditions and of organic soil constituents. *Soil Sci., 63*: 251- 263.

Wilcox, L. V. (1950). Electrical conductivity, *Amer. Water Works Assoc. J., 42*: 775-776.

Zavala, L. M., Pereira, P., Cerdà, A., Úbeda, X., Mataix, S. J. & Arcenegui, V. (2015). Modelling the impacts of wildfire on ash thickness in short-term period. *Land Degradation & Development, 26*(2): 180-192.

How to cite this article: Singh, A.K., Thomas, T., Swaroop, N. and Kumar, T. (2021). Evaluation of Physico-chemical Properties of Soil from Different Blocks of Kaimur District, Bihar, India. *Biological Forum – An International Journal, 13*(3): 543-549.