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Assessment of soil fertility under different land uses in Sevai river of Uttar Pradesh

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Abstract
A study was conducted Rasoolpur village of Jaunpur district of Uttar Pradesh of India. 70 Sample were collected from study area in which 50 sample from level land and 20 sample from slopy land for evaluating physical properties bulk density, particle density and porosity, and chemical properties pH, EC, Organic carbon, soil macronutrient N, P, and K. It can be concluded that the soils were neutral to slightly alkaline in reaction. All soils were observed low in organic carbon, available nitrogen and potassium, while available phosphorus was in medium category. Soils of slopy land were lower in fertility, compared to level agriculture land soils due to soil erosion and low nutrient retention capacity. It is suggested that farmers should follow soil test based fertilizer recommendation to get higher yield. Construction of bunds across the slope, use of erosion resisting crop and cover crop should be practiced to minimize adverse effect of slope in slopy land soils.

Keywords: Macronutrient, physico-chemical properties, River bank soils

Introduction
Soil is a critical component of the earth system, functioning not only for the production of food, fodder and fiber but also in the maintenance of local, regional and global environmental quality. Soil is crucial for life on earth and is thus one of the most important natural resources. It is at the heart of terrestrial ecology, and an understanding of the soil system is a key to successful human use of the land and environmental harmony. Soil is the base of the life, which support all the living organisms of the earth. Plant depends upon the nutritional status of the soil for their growth and completion of the life cycle. The major crop of Indo-Gangetic plain is rice wheat cropping system. This system has played a major role during green revolution, raised the level of food grain production to make the country self-sufficient. However, the question of this sustainability has been raised and there are signs of fatigue and decline in yield. Due to excessive mining of nutrients by these two cereal crops, the fertility status of soils is dealing at alarming rate. Present investigation deals with the determination of physico-chemical characteristic of soil along the banks of Sewai River. It is an important tributary of river Sai. The soil on bank is mainly used for agricultural practices and ultimately it leads to the agricultural runoff to the river system. Hence, the study was carried out to analyses the physicochemical characters of soil. Assessing soil fertility status in different slope positions is difficult because most soil chemical properties either change very slowly or have large seasonal fluctuations; in both cases, it requires long-term research commitment Therefore, research findings in relation to soil fertility status in line with slope position can provide information on soil suitability for crop production, diagnosing soil constraints for agriculture and improve effective technique for future rehabilitation program and, as a basis for fertilizer recommendations.

Materials and Methods
Study area
The study area was located at Rasoolpur village of Jaunpur district, Uttar Pradesh of India. It belongs to Varanasi Division. It is 40 KM away from district headquarters Jaunpur, 9 KM from Shahganj, 4km from Khuthan. Rasoolpur village is surrounded by Suitha Kala Tehsil towards west, Shahganj Tehsil towards South, Pawai Tehsil towards North, Akhand Nagar Tehsil towards north. Jaunpur, Mau, Azamgarh, Tanda are the nearby cities to Rasoolpur. The study area extends between 25ß 45¾ to 26ß 05¾ N and 82ß 22¾ to 82ß 50¾ E. covering a geographical area of 1723.27 $km^{2,}$ the area is irrigated by the Sharda Sahayak canal system. Physio graphically, the area forms a nearly level to very gently sloping alluvial plain. The soils of the area are developed from the Indo-Gangetic alluvium of Pleistocene age. The area is drained by the river Gomati, a tributary of the river Ganga.

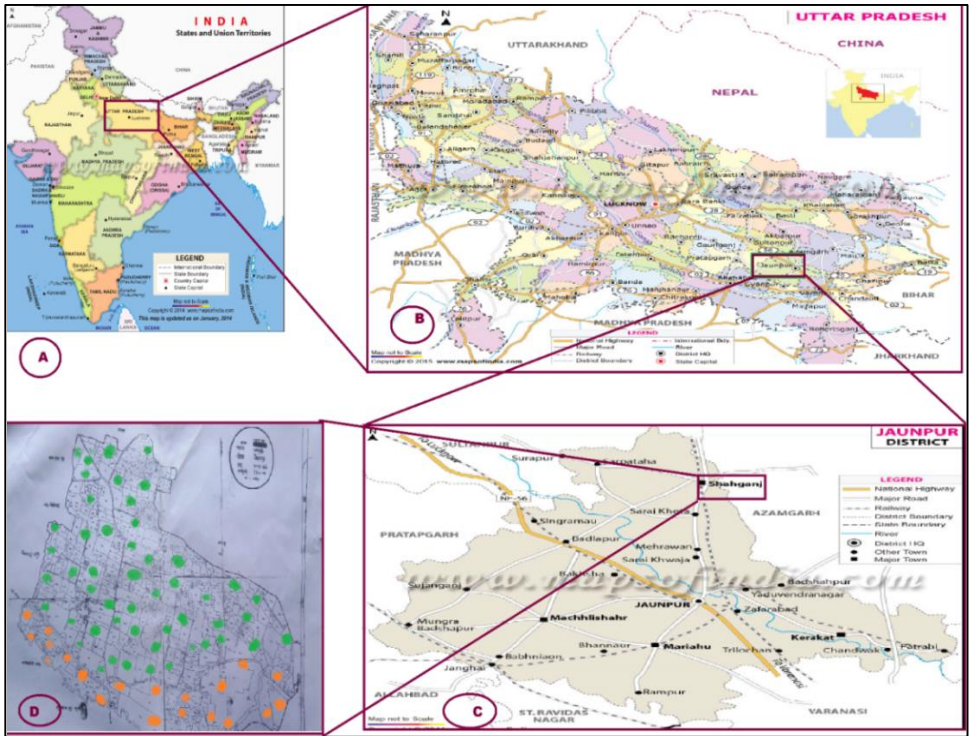

Fig 1: Represent map of (A) India (B) Uttar Parades (C) Jaunpur district (D) Rasoolpur village (Sample Site)

Soil sampling and analysis

Surface soil of the farmer's field from different villages of Rasoolpur village of Jaunpur district, were sampled randomly to a depth of 0-15 cm in V shape with the help of Khurpi. Each soil sample was mixed thoroughly and about a half kilogram of composite sample from farmer's fields was analyzed. The physical properties of soil *viz*. bulk density by core method, particle density by pycnometer method and porosity was measured following the procedure of Klute and Dirksen. Soil pH and electrical conductivity (EC) of the soil samples in soil: water suspension (1:2.5) was measured using a glass electrode in a digital pH meter and systronics electrical conductivity meter, respectively. Organic carbon was determined by wet digestion method of Walkley and Black, available Nitrogen by Alkaline permanganate method, Available Phosphorus by colorimetric method using sodium bicarbonate, Available Potassium by ammonium acetate extraction method, Available Sulphur by turbidimetric method.

Table 1: Description of the soil sampling site of level agricultural level land

S.N.	Sample No.	Cropping system (Kharif-Rabi-Zaid)
1	S_1	Maize – vegetable
2	S_2	Tomato – Radish
3	S_3	Rice – Spinach - Sponge gourd
4	S_4	Maize – potato – wheat
5	S_5	Paddy – sugarcane – wheat
6	S_6	Chaulai–cabbage-sponge gourd
7	S_7	Maize – wheat
8	S_8	Maize – mustard – wheat
9	S_9	Maize – vegetable – wheat
10	S_{10}	Maize -berseem- wheat
11	S_{11}	Maize - mustard – wheat
12	S_{12}	Maize – mustard – wheat
13	S_{13}	Maize - pea - mustard,
14	S_{14}	Maize – mustard – wheat
15	S_{15}	Paddy - mustard – wheat
16	S_{16}	Maize – potato – wheat
17	S_{17}	Maize - gram – wheat
18	S_{18}	Sesamum -potato – wheat
19	S_{19}	Maize- potato- wheat,
20	S_{20}	Maize- potato- wheat,
21	S_{21}	Maize- potato- wheat,
22	S_{22}	Maize- potato- wheat,
23	S_{23}	Maize- potato-mustard
24	S_{24}	Paddy- vegetable- wheat
25	S_{25}	Paddy- coriander- wheat
26	S_{26}	Paddy- pea- wheat
27	S_{27}	Paddy- berseem-wheat

28	S_{28}	Maize- potato- wheat
29	S_{29}	Maize- pea- wheat
30	S_{30}	Maize- Chari- wheat
31	S_{31}	Maize- chari- wheat
32	S_{32}	Maize- potato -pea
33	S_{33}	MP-chari- potato,
34	S_{34}	Paddy – potato- wheat
35	S_{35}	Maize – pea – wheat
36	S_{36}	Maize – gram – wheat
37	S_{37}	Maize- berseem -potato
38	S_{38}	Maize- berseem -wheat
39	S_{39}	Paddy- potato- wheat
40	S_{40}	Maize-wheat
41	S_{41}	Maize-wheat
42	S_{42}	Vegetable
43	S_{43}	Maize-vegetable
44	S_{44}	Maize-wheat -watermelon
45	S_{45}	Maize- mustard -wheat
46	S_{46}	Maize- chari-wheat
47	S_{47}	Maize- mustard- wheat
48	S_{48}	Maize- pea, wheat
49	S_{49}	Maize-vegetable
50	S_{50}	Maize-vegetable

Table 2: Description of soil sampling site of slopy land

S.N.	Sample No.	Cropping
1	S_1	Mustard
2	S_2	Fallow
3	S_3	Mustard
4	S_4	Linseed
5	S_5	Fallow
6	S_6	-
7	S_7	Mustard
8	S_8	Fallow
9	S_9	Mustard
10	S_{10}	Fallow
11	S_{11}	Mustard
12	S_{12}	Fallow
13	S_{13}	-
14	S_{14}	Fallow
15	S_{15}	Fodder
16	S_{16}	-
17	S_{17}	Mustard
18	S_{18}	Rice
19	S_{19}	-
20	S_{20}	Mustard

Nutrient Index

The characterization of the soils of the study area as a whole in to the three fertility classes was done according to the nutrient index values calculated from the soil test summaries giving their percentage distribution into low, medium and high categories. The nutrient index (Mohr *et al*., 1965) [8] was given by- Nutrient index = [% in high category × 3 + % in medium category × 2 + % in low category × 1]/100 In this percent assessment, a nutrient index less than 1.5 denotes low category and that falls between 1.5 to 2.5 represents the medium fertility class. Value of 2.5 and above (maximum 3.00) signifies a high fertility class in respect of the particular nutrient.

Statistical Analysis

Data obtained from all the observation were statistically analysed. Correlation between various parameters, Low, High, Range, Mean, and standard deviation

Results and Discussion

Physico-chemical properties of Soil

Physico-chemical properties of Soil The data on pH, EC, B.D., P.D. and organic carbon are presented in Table 3 and 4 which revealed that the pH of soils ranged varies the pH of level agricultural land soils ranged from 6.7 to 7.5 with the mean value of 7.06. Among the 20 soil samples of the slopy land 13 soil sample (65%) neutral and 7 soil sample (35%) were slight alkali in nature. pH of slopy land was higher than level agricultural land. (Kumar and Babel [11], Nigam *et al.* [13] Singh *et al.* [10] also recorded similar findings.)

Electrical conductivity ranged from 0.29 to 0.21 $dSm^{-1}$with mean value 0.25 $dSm^{-1}$of surface soil of level agriculture land. In case of slopy land of river bank, maximum EC observed 0.28 dSm^{-1} and minimum EC was found 0.15 with mean value 0.21 dSm^{-1}. Soil organic carbon depicted in Table No. 4 Organic carbon content in agricultural level land ranged from 0.21%-0.52%, organic carbon was higher in S_7 due to the addition of organic matter. The lower organic carbon content was observed in all samples except S_7, 98% soil sample was found low in organic carbon content and 2% soil sample were found in medium Range. Maximum value of organic carbon 0.52% and lowest value 0.21% was observed. Maximum Organic carbon of slopy land of river bank was 0.28%, while the lowest value was 0.12% with mean value 0.21%, there is a significant difference between organic carbon content in level agriculture land and river bank slopy land. In case of slopy land all sample was low in organic carbon content.

Available macronutrient N, P and K status of agriculture level land and slopy land

Available nitrogen varied from 128.58 to 269.7 kg ha^{-1} with an average content of 203.08 in presented table no 5. Available nitrogen content of slopy land ranged from 172.48 to 103.48 with mean value 150.53. Soil sample were found in the low category of available nitrogen in both soils. Continuous crop removal and leaching loss of nitrate contributes towards low nitrogen content in these farmers' fields. Slopy land soil was low in nitrogen content in comparison to level land due to improper management, runoff, low retention capacity of nutrient and high leaching. And low organic carbon content is main factor of low nitrogen content of soils. Available nitrogen of level land soils was higher than slopy land due to high organic carbon content. The available phosphorus of soils depicted in table

no.5, available phosphorus content ranged between 14.8 to 24.8 kg ha^{-1} with mean value of 21.25 kg ha^{-1} of the agriculture level land soils. In case slopy land of river bank soils available phosphorus content ranged from 10.3 to 16.2 with an average content of 12.78 kg ha^{-1}. The data clearly showed that the available phosphorus of level agricultural land was medium in range. All soil samples were observed in medium range of soil phosphorus. This observation suggested that farmers were using continuously phosphatic fertilizer in their field for cultivating crops without testing the soils. Medium level of phosphorus in the soils indicated P build up with 22 added water soluble phosphatic fertilizers. Phosphorus availability is not a problem because of having neutral soil reaction (Mandal and Chatterjee, 1972) [7]. Available potassium the data on available potassium content was presented in table No.5. Available potassium content ranged from 101 to 281 kg/ha^{-1} with mean value 210.90 kg/ha^{-1} soils of level agricultural land, In case of slopy land of river bank soil available potassium content ranging 135 to 270 kg/ha^{-1}, with mean value 199.8 kg/ha^{-1}, The soil exhibit medium to high in potassium availability 96% soil samples were medium range of available potassium and 2% sample were in low and 2% soil sample in high category.

Table 3: Comparative study of physical properties of agriculture level land and slopy land rive bank soil

S.N.	Statistical parameter	B.D Mg m^{-3}	P.D Mg m^{-3}	B.D Mg m^{-3}.	P.D. Mg m^{-3}
1	Mean	1.30	2.61	1.17	2.53
2	Maximum	1.37	2.68	1.23	2.69
3	Minimum	1.26	2.43	1.09	2.27
4	S.D.	0.031	0.05	6.043	0.1

Table 4: Comparative study of chemical properties of level agricultural land soils & slopy land soils

S.N	Statistical parameter	Level agricultural land			Slopy land of river bank soil		
		pH	E.C	O.C.%	pH	E.C	O.C.%
1	Mean	7.06	0.25	0.41	7.47	0.219	0.213
2	Maximum	7.5	0.29	0.52	7.7	0.28	0.28
3	Minimum	6.7	0.21	0.32	7.0	0.15	0.12
4	S.D.	0.217	0.024	0.55	0.557	0.15	0.12

Table 5: Comparative study of N, P, and K content of agricultural level land and slopy land of River bank

S. n	Statistical parameter	Level agricultural land			Slopy land of river bank soil		
		N Kg/ha	P Kg/ha	K Kg/ha	N Kg/ha	P, Kg/ha	K Kg/ha
1	Mean	203.08	22.50	210.90	150.53	12.78	199.8
2	Maximum	269.7	24.8	281	172.48	16.2	270
3	Minimum	128.58	14.8	101	103.48	10.3	135
4	S.D.	30.54	2.99	41.05	19.69	1.69	34.75

Table 6: Rating limits for soil test values used in India (Muhr's *et al.* 1965) [1].

S.N.	Parameter	Nutrient Rating of the soil test value		
		Low	Medium	High
1	Organic carbon (%)	< 0.5	0.5-0.75	>0.75
2	Available N kg/ha	< 280	280 - 560	>560
3	Available P kg/ha	< 12.5	12.5 - 25	>25
4	Available K kg/ha	< 135	135 - 335	>335

Table 7: Classification OC% and available Macro nutrients status content in soils of Rasoolpur village of Jaunpur district

Organic Carbon	Low	Medium	High
Limit	<0.5	0.5-0.75	>0.75
Level land	-	-	-
No. of analysed soil samples	49	1	0
% of analysed soil samples	98	2	0
Slopy land	-	-	-
No. of analysed soil samples	20	0	0
% of analysed soil samples	100	0	0

Table 8: organic carbon range of level agricultural land and slopy land along river bank soils

S.N.	Parameter	Nutrient Rating of the soil test value		
		Low	Medium	High
1	Organic carbon (%)	< 0.5	0.5-0.75	>0.75
2	Available N kg/ha	< 280	280 - 560	>560
3	Available P kg/ha	< 12.5	12.5 - 25	>25
4	Available K kg/ha	< 135	135 - 335	>335

Table 9: Available nitrogen range of level agricultural land and slopy land along river bank soils

Available N (kg ha^{-1})	No. of sample	% of sample
Level land	-	-
Low (<280)	50	100
Medium (280-560	0	0
High (>560	0	0
Slopy land	-	-
Low (<280)	20	100
Medium (280-560)	0	0
High (>560)	0	0

Table 10: Available phosphorus range of level agricultural land soils and slopy land along river bank soils

Available P (kg ha^{-1})	No. of sample	% of sample
Level land		
Low (<10)	0	0
Medium (10-25)	50	100
High (>25)	0	0
Slopy land		
Low (<10)	0	0
Medium (10-25)	20	100
High (>25)	0	0

Table 11: Available potassium range of level agricultural land soils and slopy land along river bank soils

Available K (kg ha^{-1})	No. of sample	% of sample
Level land soil		
Low (<108)	1	2
Medium (108-280)	48	96
High (>280)	1	2
Slopy land soil		
Low (<108)	0	0
Medium (108-280)	20	100
High (>280)	0	0

Nutrient Index of soils of agricultural level land and slopy land along the river bank

Nutrient index of both soils presented in table No.12. The nutrient index value of available macronutrients (N, P, and K) level agricultural land and slopy land along river bank soil of Rasoolpur village of Jaunpur. The nutrient index value far soil of level agricultural land and slopy land of Rasoolpur village

of Jaunpur district were low for nitrogen, medium for phosphorus and potassium. The value of nutrient index for Nitrogen, Phosphorus and Potassium are 1.0, 2.0 and 2.0 respectively, against the nutrient index value <1.5 for low, 1.5 to 2.5 for medium and >2.5 for high fertility status of area (Kumar and Shekar, 2013) [11].

Table 12: Nutrient index values of level agricultural land and slopy land along the river bank

S.N.	Available Nutrient	NIV (Level land)	NIV (Slopy land)	Category
1	Nitrogen	1	1	Low
2	Phosphorus	2	2	Medium
3	Potassium	2	2	Medium

Conclusions

It can be concluded that, the soils were neutral to slight alkaline in reaction. Organic carbon content of soil samples ranged from 0.32 to 0.52% with a mean value of 0.41 ± 0.21% level land soils However, organic carbon ranged from 0.12 to 0.0.28 % with a mean value of 0.21± 0.16 percent Slopy land along river bank soils showed low organic matter content in comparison to agricultural level land. This might be due to climatic conditions and rainfall amount. Available nitrogen content in the soils ranged from 128 to 269 kg ha^{-1} with mean value of 203.08 ± 141.12 kg ha^{-1} of level land while, available nitrogen ranged from 103,48 to 172.48 kg $ha^{-1}$with mean value of 150.53± 99 kg ha^{-1} in the soils of Slopy land along river bank Soil. The availability of nitrogen in the soils of both the land level and slopy was observed low. Available phosphorus content of soils ranged from 14.8 to 24.8 kg $ha^{-1}$with an average content of 25.5± 10 kg $ha^{-}$and of Slopy land along river bank ranged from 10.3-16 kg ha with an average content of 12.78± 5.9 kg ha^{-1}. Available potassium content soils ranged from 101 to 281 kg $ha^{-1}$with an average content of 281 ± 180 kg ha^{-1} level agricultural land soils while, available K content ranged from 135to 270 kg ha^{-1} with an average content of K 199.8± 135 kg ha^{-1}Slopy land along river bank soils. It is suggested that farmer should follow soil test based fertilizer recommendation to get higher yield. Construction of bunds across the slop, use of erosion resisting crop and cover crop should be practiced to minimize adverse effect of slope in slopy land soils.

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