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Genesis and Characterisation of the Soils Across Gaggar Flood Plain in Rajasthan

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Abstract Four typical pedons representing physiographic positions across the Gaggar flood plain were studied for their characteristics and genesis. Soils on the dunes are deep, sandy, without horizonation, whereas on the hummocky plain, stability of the landform has allowed leaching of lime and structural development. Soils of the flood plain formed by aeofluvial action showed development of a Cambic horizon, whereas soils of the plain showed Natric horizon.

Key words Gagger flood plain, Physiography, Soil genesis.

The Gaggar river originates from the Siwaliks, flows through the plains of Punjab and Haryana and gets extinct into the deserts of Rajasthan, leaving very fine material at the terminal points and soluble salts in the soil. Talati *et al.* (1975) reported alkali hazard in the soils of this flood plain. Information on the characteristics and genesis of the Gagger flood plain soils in Rajasthan is lacking, hence an attempt has been made and reported in this paper.

Materials and Methods

The study site located between 29° 16' to 29° 25' N latitudes and 75° 55' to 73° 30' E longitudes (west of Suratgarh in Rajasthan), has sand dunes in the south and aeofluvial plain in the north. The climate is arid with maximum air temperature of 45° C and an average annual rainfall of 260 mm which is sporadic in nature. Based on information of reconnaissance soil survey, typical pedons, one each representing four physiographic units, were selected for the study. Samples were collected from each horizon of the pedons, air dried, ground and 2mm sieved samples were analysed for various parameters following procedures outlined by Page (1986).

Results and Discussion

Characteristics : The coppice dunes having a slope of 8-15% are migratory in nature, suffer severe erosion and excessive drainage. The soils (P1) are single grain (Fig. 1) and low in organic matter (Table 1) and devoid of pedogenic manifestation and horizonation.

The hummocky plain have 3-8% slope and soils suffer moderate erosion and are excessively drained. The soils (P4) are deep, coarse loamy, low in organic matter, have weak fine peds and accumulation of clay and $CaCO_3$ (Fig. 1). Further the A horizon shows a significantly higher sand content which may be an overburden deposited by wind action, while the last two horizons show an increment in calcium carbonate, presumed to have occurred as a result of leaching through the Cambic horizon.

The flood plain is nearly flat (Fig. 1), has none to very slight erosion and imperfectly drained. The soils (P2) are deep and show soil development as evidenced by columnar structure and colour in 7.5 YR hue with higher value and chroma (Fig. 1).The irregular particle size distribution (Table 1) may be the result of aeofluvial nature of parent material. Irregular organic carbon distribution also points to lithologic discontinuities.

The plain which is situated higher, is very gently sloping (1- 3%), very slightly eroded and is well drained. The soil (P3) is deep with strong prismatic structure and significant clay accumulation as evidenced by fine clay to total clay ratio (Table 1).

Pedogenic consideration : Pedon 2 and P4 of the flood plain and hummocky plain show structure development, slight clay accumulation and leach-

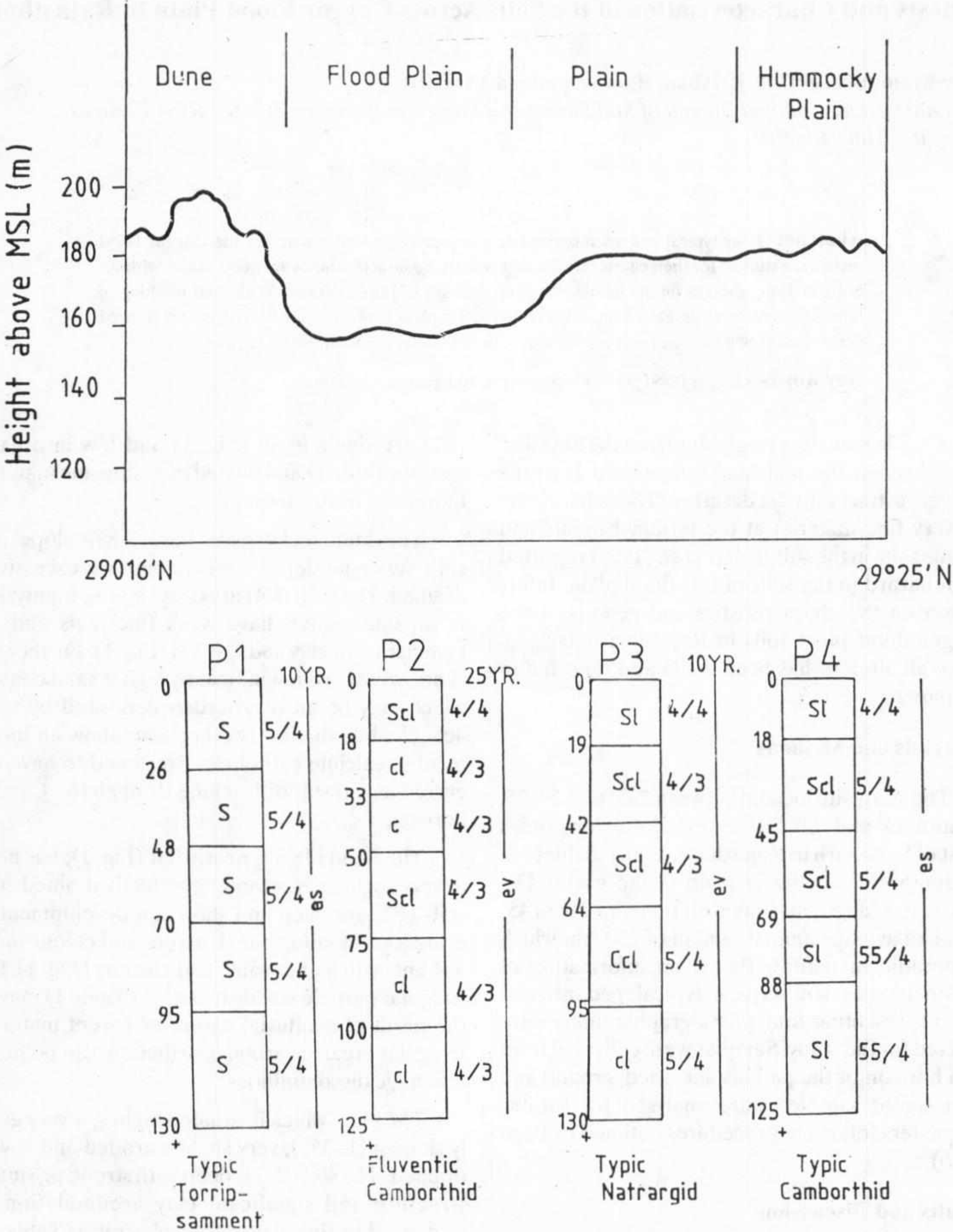

Fig 1 Soilscape Across Gagger Plain

Table 1. *Physical and chemical characteristics of the soils*

Horizon	Depth (cm)	Sand % (2.0-0.5) mm	Silt % (0.05–0.002 mm)	Sand / silt	Clay %			Fine clay / Coarse clay	Fine clay / Total clay	pH (1:2.5)	EC dSm^{-1}	Org—anic c%	$CaCO_3$
					Total	Coarse	Fine						
P1 on Dune (Typic Torripsamment)													
A1	0—26	95.3	1.0	—	3.7	—	—	—	—	8.4	0.09	0.06	2.3
AC	26—48	92.3	3.2	—	4.5	—	—	—	—	8.5	0.09	0.08	4.7
C1	48—70	90.4	3.8	—	5.8	—	—	—	—	8.4	0.09	0.08	5.3
C2	70—95	93.8	0.8	—	5.4	—	—	—	—	8.5	0.08	0.06	4.8
C3	95—130	93.2	1.2	—	5.6	—	—	—	—	8.5	0.08	0.03	4.5
P2 on Flood Plain (Fluventic Camborthid)													
Ap	0—18	50.6	16.9	2.9	32.5	16.6	15.9	0.96	0.49	7.9	0.21	0.27	2.6
B21w	18—33	39.4	17.9	2.2	42.7	20.9	21.8	0.04	0.51	8.3	0.16	0.19	3.6
B22w	33—50	37.8	17.7	2.1	44.5	22.3	19.2	0.76	0.43	8.3	0.31	0.17	7.1
IIC1	50—75	50.6	18.3	2.7	31.3	13.3	17.8	1.34	0.57	8.4	0.18	0.14	4.6
IIC2	75—100	40.0	28.9	1.3	31.1	12.6	18.5	1.47	0.59	8.0	0.61	0.18	5.5
IIC3	100—125	35.5	35.2	1.0	29.3	12.9	16.4	1.27	0.56	9.0	0.23	0.08	5.4

Contd...2

Horizon	Depth (cm)	Sand % (2.0-0.5) mm	Silt % (0.05–0.002 mm)	Sand / silt	Clay % Total	Clay % Coarse	Clay % Fine	Fine clay / Coarse clay	Fine clay / Total clay	pH (1:2.5)	EC dSm^{-1}	Org—anic c%	$CaCO_3$
P3 on flood plain (Fluventic Camborthid)													
Ap	0—19	68.2	18.9	3.6	12.9	7.3	5.6	0.76	0.43	8.2	0.24	0.33	4.9
B21n	19—42	57.4	22.4	2.5	20.2	11.0	9.2	0.83	0.46	9.3	0.43	0.22	10.9
B22n	42—66	52.8	25.2	2.0	22.0	10.9	11.1	1.02	0.50	9.5	1.03	0.16	17.0
B23n	66—95	47.2	20.2	2.3	32.6	14.1	18.5	1.31	0.56	9.1	1.83	0.10	19.4
BC	95—125	38.0	26.2	1.4	35.8	13.4	22.4	1.67	0.62	8.6	2.51	0.08	19.5
P4 on Hummocky Plain (Typic Camborthid)													
Ap	0—18	80.7	6.0	13.4	13.3	5.8	7.5	1.29	0.56	8.6	0.15	0.12	3.3
B21w	18—45	69.3	13.3	5.2	17.4	8.9	8.5	0.95	0.49	8.6	0.12	0.10	7.2
B22w	45—69	68.4	14.3	4.7	17.3	9.3	8.0	0.86	0.46	8.6	0.10	0.10	8.8
B23 K	69—88	67.3	16.1	4.1	16.6	8.0	8.6	1.07	0.52	8.5	0.10	0.09	11.3
B24 K	88—130	68.8	15.5	4.4	15.7	7.2	8.5	1.18	0.54	8.7	0.13	0.08	12.8

Table 2 *Physico-chemical characteristics of soils*

Depth (cm)	CEC	Extractable cations				Base saturation %	ESP
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}		
		c mol (P^{+}) kg^{-1}					
				P1			
0–26	3.5	2.0	0.6	0.18	0.16	84	5.1
26–48	5.3	2.6	1.6	0.13	0.15	84	2.4
48–70	4.9	3.4	0.4	0.09	0.08	81	1.8
70–95	4.8	3.2	0.8	0.13	0.08	87	2.7
95–130	4.2	2.6	1.0	0.09	0.05	89	2.1
				P2			
0–18	16.6	10.4	8.4	0.27	0.58	88	1.7
18–33	18.4	9.4	6.4	0.48	0.36	90	2.6
33–50	20.5	10.0	7.2	0.87	0.23	89	4.2
50–75	17.8	13.0	2.8	0.43	0.10	91	2.4
75–100	23.9	16.2	2.4	0.65	0.13	89	11.0
100–125	17.3	11.2	3.0	1.22	0.05	88	7.5
				P3			
0–19	11.4	5.4	2.0	1.42	0.48	86	10.8
19–42	14.6	7.4	2.8	3.09	0.72	91	21.2
42–66	20.1	8.4	3.0	6.95	0.38	93	34.3
66–95	24.4	10.0	1.8	11.8	0.31	95	46.3
95–125	33.9	11.6	1.6	16.95	0.36	90	50.0
				P4			
0–18	11.9	8.0	2.6	0.39	0.31	94	3.3
18–45	12.8	9.8	1.4	0.3	0.43	93	2.3
45–69	14.4	11.6	1..6	0.17	0.20	94	1.2
69–88	15.7	11.2	2.6	0.22	0.10	89	1.4
88–130	15.2	11.0	2.4	0.39	0.03	91	2.7

ing of $CaCO_3$, thereby providing evidences for the formation of a Cambic horizon (Soil Survey Staff 1975). Though the fine clay to total clay ratio shows an increase in the second layer of P2, its non-confirmance to the thickness criterion precludes its inclusion in the argillic horizon.

Increase in clay content, 1.2 times greater in the B horizon of P3 to that of the overlying A horizon, a steady increase in fine clay to total clay ratio right to the BC horizon and profile distribution of fine and coarse clay provide evidence of clay translocation and formation of argillic horizon. Since the clay enriched horizon is relatively thick, this suggests its formation and development under a humid climate of the Pliestocene age rather than in the present arid climate (Gile 1975). Besides illuvial clay accumulation this horizon has an $ESP > 15$ and a $PH > 8.5$, qualifying to be designated as a natric horizon (Table 2).

It has been observed that soils in the Gaggar plain have been formed as a result of aeofluvial action and topography. The paleo climate, however lent variation in soil profile development.

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