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Santosh Kumar
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Ramjeet Yadav
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Mamta Kumari
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

YK Singh
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Rajkishore Kumar
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

BK Vimal
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Ragini Kumari
Department of Soil Science and Agricultural Chemistry, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Anamika Kumari
Department of Entomology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Corresponding Author
Anamika Kumari
Department of Entomology, Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India

Effect of slope on physiochemical properties of some selected pedon in hydromorphic soils in Khagaria district using remote sensing and GIS

Santosh Kumar, Ramjeet Yadav, Mamta Kumari, YK Singh, Rajkishore Kumar, BK Vimal, Ragini Kumari and Anamika Kumari

Abstract
The present investigation was carried out on "Impact of slope on physiochemical properties of some selected Pedon in Hydromorphic Soils" Khagaria district, and six selected profile was investigated in P_1 (Parbatta), P_2 (Gogri), P_3 (Alauli), P_4 (Mansi) and P_5 (Khagaria), respectively. These soils belong to deep to very deep with varying texture and drainage classes and have some typical features over pedogenesis under impeded drainage condition. Overall, results indicated that degree of hydromorphism in these soils has been determined by the extent and distribution of mottles and gleys in the profiles, which reflects the effect of the fluctuating groundwater table and depth of the permanent water table. consideration organic carbon content, there was deficient in organic matter content. Thereby, application of judicious use of fertilizer by farmers, maintain the soil fertility status, and overall increased the soil health and soil quality.

Keywords: Slope, physiochemical, properties, pedon, hydromorphic, GIS

Introduction
The existing Yazoo-type of landscapes, affected greatly by the Ganga and partly by the Kosi rivers. This state of permanent or temporary water saturation in the soil associated with conditions of reduction is considered as Hydromorphism (Hussain *et al*. 1974) [5] and this state has considerable effects in the composition, properties, genesis and evolution of the soil (Jacob and Otte, 2003) [8]. These features are widely being brought from world reference bases (WRB) or soil classification. Since, they are classified as per diagnostic criteria of USDA soil taxonomy (Soil Survey Staff, 1999; WRB,1998) [14], and evidence of hydromorphic soils have been observed worldwide (Bouma *et al*.1990) [3], and predominant in different soil order like *Histosols*, *Inceptisols*, *Entisols*, and rarely in *Alfisols* order. But at meanwhile, a hydromorphic soil was being placed under *Inceptisols* and it's occupying the *Aquic* moisture regimes (*Aquepts*) as per Indian context (Gangopadhyay *et al*. 2015 and Bhattacharyya *et al*. 2013a) [4, 1]. As per Soil Resource Mapping developed by NBSS& LUP at smaller scale (1:250 K), these soils were placed under recent alluvial plains with several pockets, and brought under prolonged waterlogged situations, and severally affected the growth and yield of various suitable crops in this region.
Keeping the above facts in mind, the present study was planned "Effect of slope on physiochemical properties some selected Pedon in Hydromorphic Soils in Khagaria District Using Remote Sensing and GIS"

Material and Method
General description of the study area
Location and extent
The state of Bihar lies in between latitude 24°20'10" N to 27°31'15" N. and longitude 82°19'50 "E to 88° 17' 40" E. Latitude covering a total geographical area of 94,163 Km^2.This accounts for nearly 2.86 percent of the total geographical area of the country. Its northern boundary forms the international boundary with Nepal. It is bounded by UP and MP in the west, Jharkhand in the South and West Bengal in the east. Khagaria, as a district, is only thirty years old. It was a part of Munger district. The district is situated North of river Ganga. The district spanning in 1485.8 sq. km, is situated between North latitudes 25^0 15/ N and 25^0 44/ N and E longitudes 86^0 17/ E and86^0 52/ E represent FCC image and block boundary of Khagaria

district). The whole tract of Khagaria district was flat alluvial plain and abounds in marshy and swampy land.

Detail study of study areas

The physio-chemical properties have also been analysed in the laboratory like pH, EC is determined by Jackson, (1973) [6] in Soil: Water (1:2.5) suspension ratio, organic carbon (Walkley and Black, 1934), available nitrogen (Subbiah and Asija, 1956) [12], available phosphorus (Olsen *et al*. 1954) [10], available potassium (Jackson, 1979) [7]

Remote Sensing and GIS

The different hardware and software like free open-source software (FOSS) like QGIS 3.16 was used for visual interpretation of hydromorphic areas. The SRTM data have been used for delineation of slope in studied areas.

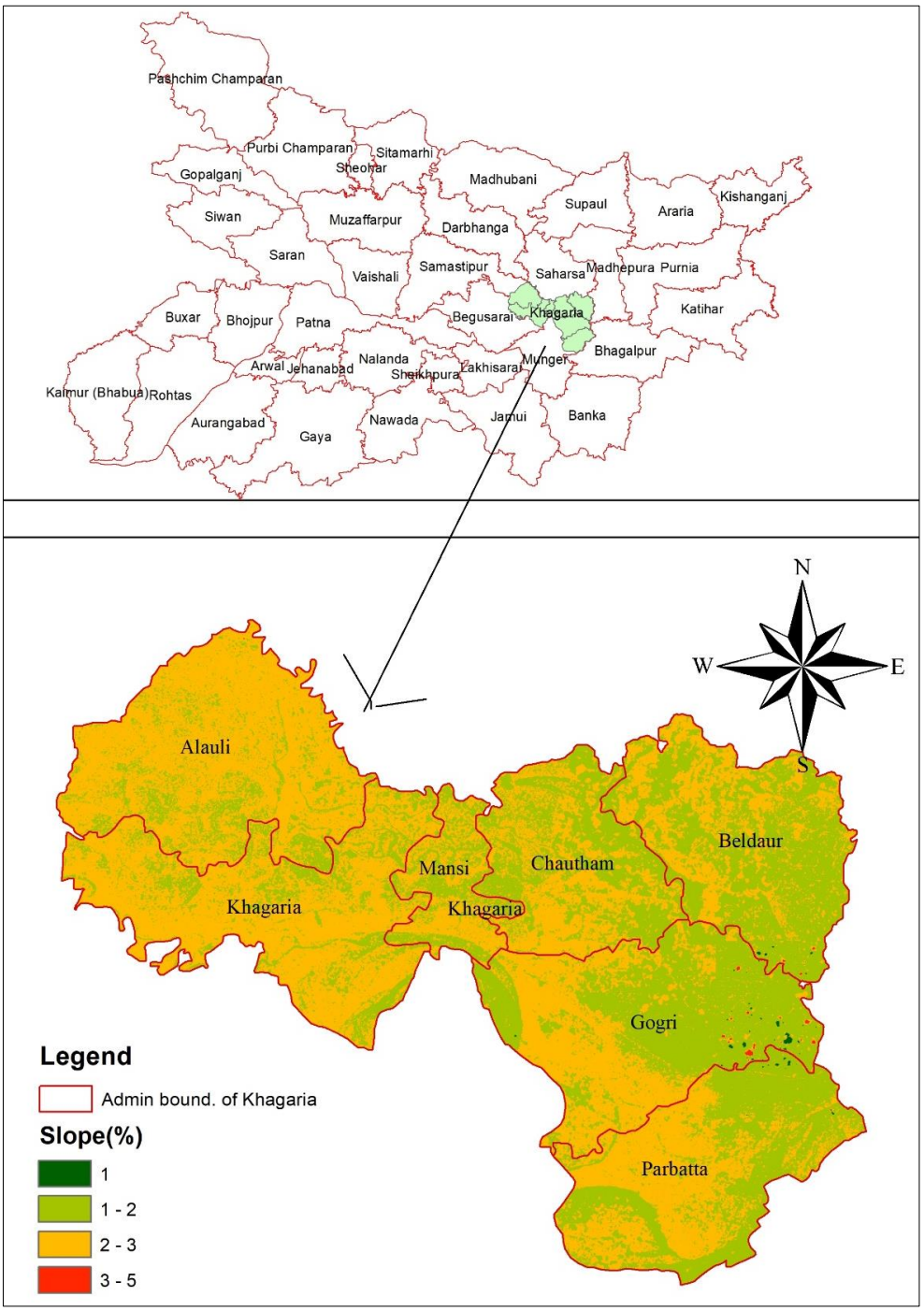

Fig 1: Location map of hydromorphic areas with variation of slope (Khagaria district)

Result and Discussion

Physico-chemical properties

Soil reaction (pH1:2.5 soil: water ratio) of the pedons (P1 to P5) varied from 7.00 to 8.00. Soil of the pedons (P_1 to P_5) was neutral to alkaline conditions, and all the cases pH value increased towards downward the value towards downward the slope, and low salt content was observed throughout the profile (Table 1). Similar results were reported by Esu *et al.*, (2009) [16] who noted that, there was wide variation observed towards soil reaction throughout the soil profile in surface and subsurface layers.

Organic carbon

The organic carbon content of the selected pedons (P_1 to P_5)

varied from 0.16 to 0.74 per cent (with a mean value of 0.41 per cent) and is high at surface layer and decreasing trends was observed towards depth except P_3 (Table 1). It might be due to influence of fluvial activity faced each and every year in studied areas. The high organic carbon content of the hydromorphic soils was also reported Ponnamperuma (1972) [17]. In consequently, the higher organic carbon content in the surface layer leads to accumulation of organic matter from the surrounding upland area and is valuable for sequestering atmospheric carbon (Shrawat *et al*. 2005 and Bhattacharya *et al* 2008) [8, 19].

Table 1: Physiochemical properties some selected pedons in hydromorphic soils

Pedon-1 (Parbatta): *Fine, Mixed, Hyperthermic, Vertic Haplaquept*				
Horizon	**Soil depth**	**pH (1:2.5)**	**EC (1:2.5)**	**OC (%)**
Ap	0-13	7.60	1.02	0.49
Bw_1	13-48	7.60	0.98	0.31
Bw_2	48-90	7.70	0.98	0.30
C+	90-130+	7.70	0.95	0.34
Pedon-2 (Gogri): *Fine, Mixed, Hyperthermic, VerticHaplaquent*				
Ap	0-12	7.60	1.00	0.50
$2A_1$	12-23	7.60	0.98	0.57
$2A_2$	23-63	7.70	0.94	0.74
$2C_1$	63-75	7.70	0.96	0.72
$3C_2$	75-94	7.50	0.96	0.43
$3C_3$	94-120	7.40	0.94	0.16
Pedon-3 (Alauli): *Moderately Fine, Clay loam, Hyperthermic, Vertic Fluvaquent*				
Ap	0-13	7.80	1.02	0.49
$2A_1$	13-36	7.00	0.94	0.42
$3A_2$	36-107	7.80	0.94	0.31
C	107-116	7.00	0.93	0.28
Pedon 4 (Mansi): *Fine, Illitic,Hyperthermic, Typic Fluvaquent*				
Ap	0-12	7.00	1.00	0.71
$2A_1$	12-41	7.00	1.01	0.49
$2A_2$	41-66	7.00	1.09	0.43
$2C_1$	66-110	8.00	1.09	0.27
$3C_2$	110-151	7.80	0.94	0.32
$3C_3$	151-170+	7.00	0.89	0.22
Pedon-5 (Khagaria): *Fine, Mixed, Hyperthermic, Illitic Typic Fluvaquent*				
Ap	0-11	8.00	0.98	0.44
A_1	11-42	7.80	0.99	0.36
$2A_2$	42-55	7.80	0.89	0.36
$3A_3$	55-86	7.60	0.90	0.34
$4C_1$	86-115	7.70	0.81	0.29
4CKm	115-179+	7.00	0.94	0.16

Conclusion

From ongoing discussion, we can conclude that hydromorphic soils belong to neutral to alkaline in nature with low salt content. While, consideration organic carbon content, there was deficient in organic matter content. Thereby, application of judicious use of fertilizer by farmers, maintain the soil fertility status, and overall increased the soil health and soil quality.

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