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Madhu BM
Research Scholar, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, [Naini Agricultural institute] (U.P. state Act No. 35 of 2016, as passed by the Uttar Pradesh Legislature) [Formerly-Allahabad Agricultural Institute], Allahabad, Uttar Pradesh, India

Arun A David
Associate Professor, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, [Naini Agricultural institute] (U.P. state Act No. 35 of 2016, as passed by the Uttar Pradesh Legislature) [Formerly-Allahabad Agricultural Institute], Allahabad, Uttar Pradesh, India

T Thomas
Associate Professor, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, [Naini Agricultural institute] (U.P. state Act No. 35 of 2016, as passed by the Uttar Pradesh Legislature) [Formerly-Allahabad Agricultural Institute], Allahabad, Uttar Pradesh, India

Abdouslam M Rassem
Research Scholar, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, [Naini Agricultural institute] (U.P. state Act No. 35 of 2016, as passed by the Uttar Pradesh Legislature) [Formerly-Allahabad Agricultural Institute], Allahabad, Uttar Pradesh, India

Correspondence
Madhu BM
Research Scholar, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, [Naini Agricultural institute] (U.P. state Act No. 35 of 2016, as passed by the Uttar Pradesh Legislature) [Formerly-Allahabad Agricultural Institute], Allahabad, Uttar Pradesh, India

Soil morphological characteristics of Jamuna paar region of Allahabad District, Uttar Pradesh

Madhu BM, Arun A David, T Thomas and Abdouslam M Rassem

Abstract
Twelve soil pedons representing jamuna paar region of Allahaabd district, Uttar Pradesh, in this area samples were collected from Chaka, Jasra and Karchana blocks, four pedons of each block randomly selected on the basis cropping system, morphological characteristics using google earth image and tehsils map. The soils were moderately to deep soils and soil colour varied from 2.5 YR 4/4 (olive brown) to 10 YR 4/4 (dark yellowish brown) in moist condition, subsurface horizons of most of the pedons have falling under weak to moderate, fine to medium, and most of the pedons were sub-angular blocky structure. In case of texture of soil belong to sandy clay loam to clay loam. The consistence of soil pedons varied from slightly hard to hard when dry, friable to firm when moist, non sticky to slightly sticky and non plastic to slightly plastic when wet condition and fine to medium roots noticed in the some pedons.

Keywords: Soil Morphology, Colour, Structure, Texture, Consistency and Roots

Introduction
The natural resources, (soil, climatic features and water) profoundly influence the cropping patterns and control crop productivity in specified region. Literally the lands for agriculture are under a threat due to multisectoral demand, severe soil degradation and conversion of good fertile land for civilian and other infrastructural development. There is a remote possibility of expanding agriculture to new areas in the country (Kanwar, 1994) [4]. It has been observed that the per capita land availability is decreased from 0.48 ha in 1951 to 0.26 ha in 1981 and has further decreased to 0.14 ha during 2000. It may narrow down to 0.09 ha by 2020 A.D. It is therefore imperative that the land resource needs to be interpreted in terms of their suitability for different agricultural uses with a view to maximize production of food, fuel and fibre.
The per capita availability of land will be reduced as a result of population explosion. The ever increasing population pressure, irrational exploitation of resources base for quick, short term gains and economic prosperity, and intensification of agriculture with inappropriate technology, especially in developing countries, have caused deterioration of environment with cumulative effects. The most crucial question facing the planners is, therefore, the integration of the process of agricultural development with the protection of environment, maintaining the character of land, and retaining the cultural traits of the area, while at the same tune satisfying the essential requirements of the present population and that of the generations to follow.
For the sustainable development of a region the resources particularly soil and land need, not only protection and reclamation but also a scientific basis for the management in harmony with environment. These resources should be managed on a sustainable manner so that the changes proposed to meet the needs of development are brought out without diminishing the potential for their future use (Kanwar, 1994) [4].
Soils differ in their morphology, physicochemical characteristics, inherent productivity and fertility and their responses to management practices differ accordingly. Thus, it is imperative to study the soils of a particular area for characterization and evaluate the soils of a particular area for their sustainable land use, keeping these objectives in mind, the present study was soil morphological survey in jamuna paar areas of chaka, jasra and karchana blocks in Allahabad district of Uttar Pradesh.

Materials and Methods
The study area is situated in the South-Eastern part of the State Uttar Pradesh, Allahabad. It lies between the parallels of 25°16'46" to 25°23'59" north latitudes and 81°44'03" to 81°56'58"east longitudes. Allahabad district has such tropical climate that the average maximum temperature ranges between 43°C- 45°C which may go as high as 46°C during peak summers. The minimum average temperature is 8-9°C which may fall as low as 4°C during peak winter months (Dec. Jan.)

The average rainfall of the district is 960 mm and the monsoon season is spread between July-September. The area is under *'Ustic'* soil moisture regime and *'Hyperthermic'* soil temperature regime. Dhak (*Buteamanosparma*), Kakor (*Ziziphusgloberrima*), Aonla (*Emblicaofbicinalis*), Kahwa (Terminaliaarjuna), Jharberi (*Ziziohusnumilaria*), Mahua (*Madhuca indica*), neem (*Azadiracta indica*) Chiraunji (*Buchanania ianzo*) Semal (*Salmaniamalabarica*), and Bahera (*Terminaliabelerica*) are the predominant trees found in the study area.

Soil survey was carried out for using Tehsils map mainly three blocks are selected, within these blocks each block randomly selected four villages. *i.e*. Chaka (Marauka uparhar-P_1, Tigonotha-P_2, Semera-P_3 and Mohiuddinpur-P_4), Jasra (Semara kalban-P_5, Kottvarankapura-P_6, Pandar-P_7 and Parsara-P_8) and Karchana (Mungori-P_9, Bendo-P_{10}, Munglaha-P_{11} and Galibabhadh-P_{12}) This area is henceforth called in this entitled as "Jamuna Paar Region". The location of the Jamuna paar region is shown in Fig.1

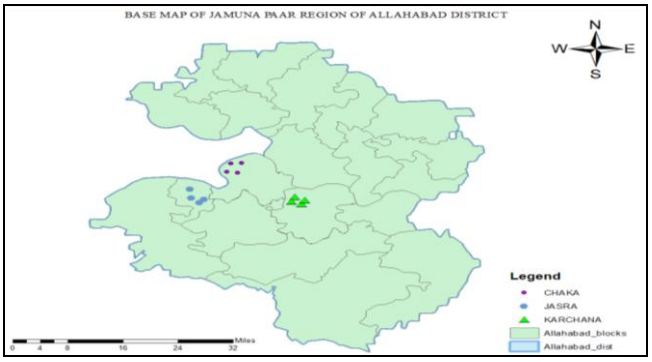

Fig 1: Base map of Jamuna paar region of Allahabad District, (U. P.)

A tracing film was overlaid on the Tehsils map covering the study area. Boundary of the Jamuna paar and important land features like boundary, blocks and villages etc., were extracted. This map having the above land feature was used as a base map for preparing soil and interpretation maps. Google earth image is used for general view of lands and soils for traversing land classification and selection of pedons for soil study. Google earth image is represented in (Plate 1).

Plate 1: Google earth map in Jamuna paar region of Allahabad (U. P.)

The land units were further traversed and representative locations for soil study were found. Each of these locations, pedons were dug as 3ft × 2 ft, depth up to parent material appeared and examined. The examination of pedons was carried out as per soil survey manual, USDA (2009) [6]. The typical pedons were selected in land units for laboratory analysis. The morphological characteristics studied were depth of solum, boundary, rooting depth, depth of each horizon, texture, structure, consistency at dry, moist and wet conditions, size and quantity of lime nodules etc. The morphological properties were described as per Soil Survey Staff (1951) [7]. The horizons were identified and designated according to revisions in Soil Taxonomy (Soil Survey Staff, 1999) [8]. The property of an object that depends on the wavelength of light it reflects on emits. The soil was determined by Munsell Soil Colour Chart as described in Handbook of United State Department of America (USDA 1994) [11].

Soil samples were collected from three different blocks each block were studied four pedons horizon-wise soil samples were collected from total twelve pedons. The morphological characteristics of the pedons were studied. Locations of the pedons were recorded with the help of GPS device.

Results and Discussion

Table 1. discussed as soil depth is an important property that directly influences the yield of crops. The deep solum provides higher soil volume for nutrient and water extraction (Hajare *et al*. 1990) [3]**.** The derived soil climatic parameters viz soil effective rainfall and the length of growing period (LGP) were directly associated with soil depth and showed yield of rice, wheat guava, mango, potato, rose, pearl millet sugarcane and potato (Yadav, *et al.* 1995) [10]. The depth of soils in the study area varied from 90 to more than 160 cm. the soils on the chaka block having depth of 90, 100, 120 and 140 cm, jasra block having 140,150 and 160 cm. Karchana block having 120, 130, 150 and 160cm respectively. Whereas the soils on the ravenous area, piedmont plain having depth of more than 100 to more than 160cm. the variation in soil depth is due to topography and slope on which soils forms the soils on the upper and steep side slopes experienced erosion, while those on bottom ones such as nearly plain and plain gets deposit of soil materials (Prasad and srivastav, 1993) [5].

Soil colour is one of the important basic properties that helps to identify the kinds of soil and recognize the successions of soil horizons in soil profiles. Soil colour also help in directly in the enhancement of chemical and biogeochemical reaction by the absorption of solar heat on the soil surface (Bhattacharjee, 1997) [1]. The soils in the study area having lighter colour in the surface than subsurface horizons. Soils on the chaka blocks area P1, P2, P3 and P4 having colour varied from 2.5 YR 4/4 (olive brown) to 10 YR 4/4 (dark yellowish brown) in moist condition. Similarly jasra block area P5, P6, P7 and P8 colour varied from 2.5 YR 4/2 (dark greyish brown) to 2.5 YR 4/4 (olive brown). Soils on karchana block area P9, P10, P11 and P12 having colour varied from 2.5 YR 4/4 (olive brown) to 7.5 YR 5/6 (strong brown) in moist condition as mentioned in table 1.

The soil structure refers to the aggregation of the primary soil particles in to larger units known as ped. It was described in terms of grade, class and type. All the soils have massive structure in surface horizons (Table 1). Profiles 1, 5, 7 and 8, showed massive structure throughout the profiles some subsurface horizons of other profiles have structure of fine to medium weak and sub-angular blocky. The weak structure development in these soils might be due to low clay and organic carbon content as confirmed by laboratory analysis. Single grain structure was found in lower horizons of P5 and P8 indicating lithological discontinuity of these soils.

The consistence of soil pedons varied from slightly hard to hard when dry, friable to firm when moist, slightly sticky to very sticky and slightly plastic to very plastic when wet. This physical behavior of soils was not only due to the textural make up but also due to type of clay minerals present in these soils (Thangasamy *et al.*, 2005 and Dasog and Patil, 2011) [9, 2]**.**

Table 1: Morphological characteristics of the soils of pedons in Jamuna Paar region of Allahabad District, (U. P.)

Horizon	Depth (cm)	Boundary	Matrix color	Texture	Structure	Consistence			Roots
			Moist			Dry	Moist	Wet	
Pedon 1, Block - Chaka, Village –Marauka uparhar : Fine-silty, mixed, active, hyperthermic Typic Ustifluvents									
Ap	0-10	gs	10YR4/3	l	0 f sbk	l	fr	so&po	f f t
Bw_1	10-32	dw	10YR4/4	sil	1 f sbk	sh	fr	ss&sp	m m t
Bw_2	32-56	gw	10YR4/4	sil	1 f sbk	sh	fr	ss&sp	m vf t
Bw_3	56-90	gw	10YR4/3	sil	2 m sbk	sh	fr	ms&mp	c vf p
Pedon 2, Block - Chaka, Village –Tigonotha: Fine-loamy, mixed, active, hyperthermic Dystric Fluventic Eutrudepts									
Ap	0-12	cw	10YR3/3	sl	1 m sbk	sh	fr	so&po	m f t
Bt_1	12-35	gw	10YR4/4	l	1 f sbk	sh	fr	ss&sp	f f t
Bt_2	35-78	gw	10YR4/4	scl	1 f sbk	sh	fr	ss&sp	f vf p
BC	78-120	cw	10YR4/3	scl	2 m sbk	sh	fr	so&po	f vf p
CR	120^+	-	10YR4/3	sl	2 m sbk	sh	fr	so&po	f vf p
Pedon 3, Block - Chaka, Village – Semera: Fine-silty, mixed, active, hyperthermic Typic Ustipsaments									
Ap	0-13	cw	2.5YR4/4	sl	1 f sbk	sh	fr	ss&sp	m f t
Bt_1	13-36	gw	2.5YR4/4	sil	2 m sbk	h	fr	ms&mp	f f t
Bt_2	36-70	gw	2.5YR4/4	sil	2 m sbk	h	fr	ms&mp	f f p
Bt_3	70-100	-	2.5YR4/4	sil	2 m sbk	vh	fr	ms&mp	-
Pedon 4, Block - Chaka, Village –Mohiuddinpur: Fine-loamy, mixed, super-active, hyperthermic Typic Ustifluvents									
Ap	0-20	cs	2.5YR4/4	sil	1 f gr	sh	fr	vs&vp	f c mp
Bw_1	20-38	cw	2.5YR4/4	l	2 m sbk	h	fi	ms&mp	f f c
Bw_2	38-80	gw	10YR4/4	l	2 m abk	h	fr	vs&vp	f c c
Bw_3	80-115	gw	2.5YR4/4	l	3 m abk	h	fr	vs&vp	-
Bw_4	115-140	-	2.5YR4/4	l	3 m abk	h	fr	vs&vp	-
Pedon 5, Block - Jasra, Village – Semara kalban: Fine-loamy, mixed, semi-active, hyperthermic Typic Ustipsaments									
Ap	0-24	gw	2.5YR4/4	sil	1 f sbk	sh	fr	ss&sp	m c t
Bw_1	24-55	dw	2.5YR4/4	sil	1 f sbk	sh	fr	ss&sp	c f t
Bw_2	55-85	gw	2.5YR4/4	sicl	2 f sbk	sh	fr	so&po	m f t
Bw_3	85-130	gw	2.5YR4/4	sicl	0 f sg	l	l	so&po	f f t
Bw_4	130-160	gw	2.5YR4/4	sicl	0 f sg	l	l	so&po	f f t
Pedon 6, Block - Jasra, Village – Kottvarankapura: Coarse-silty, mixed, active, hyperthermic Typic Ustifluvents									
Ap	0-20	gs	2.5YR4/4	sil	0 f sbk	l	fr	so&po	f f t
Bw_1	20-40	dw	2.5YR4/4	sil	1 f sbk	sh	fr	ss&sp	m m t
Bw_2	40-80	gw	2.5YR4/4	l	1 f sbk	sh	fr	ss&sp	m vf t
Bw_3	80-120	gw	2.5YR4/4	l	2 m sbk	sh	fr	ms&mp	c vf p
Bw_4	120-150	-	2.5YR4/4	l	2 m sbk	sh	fr	ms&mp	c vf p
Pedon 7, Block - Jasra, Village – Pandar: Coarse-loamy, mixed, super-active, hyperthermic Typic Haplustepts									
Ap	0-38	gw	2.5YR4/4	sl	0 l sg	l	l	So&po	m f t
Bw_1	38-60	gw	2.5YR4/4	sl	1 f sbk	sh	fr	Ss&sp	f f t
Bw_2	60-98	cw	2.5YR4/4	l	1 m sbk	sh	fr	Ss&sp	f f p
Bw_3	98-115	gw	2.5YR4/4	l	1 m sbk	sh	fr	Ss&sp	f m p
Bw_4	$115-140^+$	-	2.5YR4/4	sil	1 m sbk	sh	fr	ms&mp	-
Pedon 8, Block - Jasra, Village – Parsara: Coarse-loamy, mixed, active, hyperthermic Typic Haplustepts									
Ap	0-35	cw	2.5YR4/4	sl	1 l sg	l	l	so&po	m f t
Bw_1	35-56	gw	2.5YR4/4	sl	1 f sbk	sh	fr	ss&sp	c f p
Bw_2	56-72	cs	2.5YR4/4	scl	1 f sbk	sh	fr	ss&sp	m vf p
Bw_3	72-134	cw	2.5YR4/2	scl	0 l sg	l	l	so&po	f f p
Bw_4	$134-150^+$	-	2.5YR4/2	scl	2 m sbk	sh	fr	ms&mp	-
Pedon 9, Block - Karchana, Village – Mungori: Fine-silty, mixed, sub-active, hyperthermic Udic Ustifluvents									
Ap	0-18	gw	10YR4/4	sil	1 f gr	sh	fr	ms&mp	m f t
Bw_1	18-40	gw	10YR4/4	sicl	1 f sbk	sh	fr	vs&vp	c f t
Bw_2	40-68	gw	10YR4/4	sic	2 m sbk	sh	fr	vs&vp	f f c
Bw_3	68-96	cs	10YR4/4	sic	2 m sbk	sh	fr	vs&vp	c f c
Bw_4	$96-120^+$	-	10YR4/4	sic	2 m sbk	h	fr	Vs&vp	-
Pedon 10, Block - Karchana, Village – Bendo: Coarse-silty, mixed, semi-active, hyperthermic Udic Ustifluvents									
Ap	0-18	gw	7.5YR5/6	sil	2 m sbk	h	fr	ms&mp	m f t
Bw_1	18-44	gw	7.5YR5/6	sil	2 m sbk	sh	fr	ss&sp	f f t
Bw_2	44-96	cw	7.5YR5/6	sil	2 m sbk	sh	fr	ss&sp	-
Bw_3	96-135	cs	7.5YR5/6	sil	2 m sbk	h	fr	ms&mp	f f mc
Bw_4	$135-160^+$	cw	7.5YR5/6	sil	2 m sbk	h	fr	ms&mp	f f mc
Pedon 11, Block - Karchana, Village – Munglaha: Coarse-silty, mixed, active, hyperthermic Typic Ustipsaments									
Ap	0-14	gw	2.5YR5/4	sil	1 f gr	sh	fr	ms&mp	m f mt
Bw_1	14-26	cw	2.5YR5/4	sil	2 f sbk	h	fr	ms&mp	f f p
Bw_2	26-55	gw	2.5YR5/6	l	2 m abk	h	fr	ms&mp	-
Bw_3	55-94	gs	2.5YR5/6	l	3 m abk	h	fi	ms&mp	-
Bw_4	94-150	-	2.5YR5/6	sil	3 m abk	h	fi	ms&mp	-
Pedon 12, Block - Karchana, Village – Galibabhadh: Coarse-silty, mixed, active, hyperthermic Typic Ustipsaments									
Ap	0-13	cs	2.5YR5/6	sil	1 f gr	sh	fr	ms&mp	m f mt
Bw_1	13-40	cs	2.5YR5/6	sil	2 m sbk	sh	fr	ms&mp	f f c
Bw_2	40-57	cs	2.5YR5/6	sil	2 m sbk	h	fr	ms&mp	f f c
Bw_3	57-88	gw	2.5YR5/4	l	3 m sbk	h	fi	ms&mp	-
Bw_4	88-130	-	2.5YR5/4	l	3 m abk	h	fi	ms&mp	-

Note: - Boundary (gs-gradual smooth, dw-diffuse wavy, gw-gradual wavy, cw-clear wavy, cs-clear smooth), Texture (l-loam, sil-silty loam, sicl-silty clay loam sl-sandy loam, scl-sandy clay loam), Structure (f-fine, m-medium, sbk-sub-angular blocky, sg-single grain), consistency (l-loose, vh-very hard, h-hard, sh-slightly hard, fr-friable, fi-firm, l-loose), Roots(c-common, c-cracks, f-fine, vf-very fine f-few, m-many, t-throughout, p-peds)

From the study it is thus apparent that intensive cultivation has a clear impact on nutrient distribution and availability. The variations of soil morphology and physicochemical properties between land use types indicate the risk to the sustainable crop production in the area. Therefore, strategies to feed the expanding population in the study areas will have to seek a sustainable solution that better addresses integrated soil management. In addition, improvement in the management of the soil resources for sustainable agricultural use would be one of the most useful strategies that could help to protect biological diversity from agricultural land expansion. Generally, governmental and non-governmental rural development programs and strategies should be flexible in responding to the various agro-ecological zones, local resource endowment and farmers' capacity to invest in affordable integrated soil fertility management techniques.

The information thus generated in the form of table was used to arrive at meaningful and workable potential land use plan for the Jamuna paar area to bring back the glory of sustainable agriculture. The land resource information system thus generated for the Jamuna paar area can be used as a decision support system to the land users, policy makers and administrators.

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