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CHARACTERIZATION AND MANAGEMENT OF SOILS IN SEMI-ARID REGION OF WESTERN UTTAR PRADESH FOR SUSTAINABLE AGRICULTURE

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ABSTRACT

Using remote sensing data an investigation was carried out to characterize and classify the soils of Meerut district of Uttar Pradesh. Eight typifying pedons each representing an identified soil series occurring on old alluvial plain, recent alluvial plain, levee plain and active flood plains were selected for present study. The soils were very deep, moderately well to somewhat excessively drained, structured to single grain, sandy to coarse loamy in texture, neutral to moderately alkaline in reaction with higher values of EC and OC in surface horizon that decreases with soil depth and CEC varied with clay content since the soils are low in OC content. Taxonomically, the soils of old / recent alluvial plains are Coarse loamy / Fine loamy Typic Haplustepts and those occurring on levee and active flood plains are Typic Ustipsamments and Coarse loamy over sandy Fluventic Haplustepts. Soils of levees and active flood plain suffers from low fertility, poor physical condition and seasonal inundate and overflow and these are marginally suitable agriculturally important crops whereas soils of old / recent alluvial plains suffers from ground water depletion, nutrient deficiency and at places salinity / sodicity and are suitable to all climatically adapted crops.

Key words: Geo-coded satellite data, physiography, classification, amelioration

INTRODUCTION

Owing to an ever increasing population, there is an immense pressure and over exploitation of our limited and shrinking soil resource, leading to its degradation at an alarming rate, jeopardizing our food security. Since no two soils are alike so have their own potential and/or problems and behave differently to same management inputs, therefore, their use as per their capability is imperative for the sustainable agriculture production. Information on spatial distribution of soils, their kind and extent is necessary for optimising land use on sustainable basis. With this in view a soil resource inventory of the Meerut district of Uttar Pradesh was undertaken using remote sensing data for evolving proper soil and water management strategies so as to optimize and sustain agriculture production.

MATERIALS AND METHODS

The study was undertaken in Meerut district of Uttar Pradesh, located between 28^{o} 44' to 29^{o} 18' N latitudes and 77^{o} 8' to 78^{o} 8' E longitudes, covering an area of 3,91,100 ha at an elevation between 205-240 meters above mean sea level (MSL). The area is drained by the rivers Ganga, Yamuna, Hinden and their tributaries. The soils of the area are developed on the alluvium of these rivers system. The climate of the area is semiarid, subtropical and monsoonic with annual rainfall of 915 mm, of which nearly 80% is received during monsoon season. The mean maximum and minimum temperatures are 40^{o}C and 23^{o}C in summer and 21^{o}C and 8^{o}C in winter respectively. The temperature regime therefore is hyperthermic and moisture regime is ustic. The natural vegetation in the area are Vilayati babool (*Prosopis juliflora*), Babool (*Acacia species*), Ber (*Ziziphus jujuba*), Neem (*Azadirichta indica*), Shisham (*Dalbergia sissoo*), Jamun (*Synigium cumin),* Pipal (*Ficus religiosa)* and grasses like Munj (*Saccharum munja*), Kans (*Saccharum spontaneum*) and Dub (*Cynodon dactylon*). An innovative three-tier approach (Sehgal *et al*, 1987) consisting of image interpretation; field investigation, laboratory characterization and cartography and GIS was adopted for the present investigation. An IRS-IC, LISS-III geo-coded satellite data of 1:50,000 scale was visually interpreted for landform analysis and delineating the physiographic units, considering the various image characteristics like tonal variation, shape and size of features etc. The four major physiographic units delineated are old alluvial plain, recent alluvial plain, levee plain and active flood plain. The ground truth data in respect of soil and land use was collected during the field traverse through studies of mini pits and pedons. Eight pedons, each representing an identified series occurring on different physiographies were investigated. Each pedon was studied for their morphological characteristics following the methods described in Soil Survey Manual (Soil Survey Staff, 1966; AIS & LUS, 1970). Typifying pedons were sampled horizon wise for laboratory characterization using standard analytical methods (Black, 1965; Sarma *et al*, 1987; Jackson, 1973). Soils were classified taxonomically (Soil Survey Staff, 1998).

Table 1: Soil site characteristics of soils

Soils Series	Coordinates	Physiogra-phy	Slope (%)	Drainage*	Erosion*	Flooding	Land Use
Icholi	28° 57' N lat. 77°36.9' E long	Old alluvial plain	0-1	MWD	Nil to very slight	Nil	Cultivated
Masuri	29° 9.1' N lat. 77° 41.2'E long	Old alluvial plain	0-1	MWD	Nil to very slight	Nil	Cultivated
Parichharh	28° 56.4' N lat. 77°47.9' E long	Recent alluvial plain	0-1	W D	slight	Nil	Cultivated
Jiwana	29° 8.2' N lat. 77°20.3' E long	Recent alluvial plain	0-1	W D	slight	Nil	Cultivated
Mawana	29° 10.8' N lat. 77°31.6'E long.	Recent alluvial plain	0-1	W D	slight	Nil	Cultivated
Hastinapur	28° 56.7'N lat. 78° 2.1'E long.	Levee plain	3-5	S W E D	moderate	Nil	Thin forest /scrub
Khanpur	29° 3.1' N lat. 77° 11.6'E long	Active flood plain	1-3	W D	Slight to moderate	F1-F2	Cultivated
Jagaus	29° 1.8'N lat. 77°26.4'E long.	Active flood plain	1-3	S W E D	Slight to moderate	F1-F3	Cultivated

** Drainage: MWD>Moderately well drained, WD>Well drained and SWED> Somewhat excessively drained; Flooding: F1-Occasional, F2- Moderate and F3-Severe*

RESULTS AND DISCUSSION

Morphological Characteristics

Icholi and *Masur*i soil series occurring on nearly level (0-1 %) old alluvial plains are very deep, moderately well drained, brown to dark yellowish brown (10YR 4/3 to 5/4M) in colour and loam to clay loam in texture (Table 2), whereas *Parichhatgarh*, *Jiwana* and *Mawana* soil series occuring on nearly level to very gently sloping (0-3% slope) recent alluvial plain. are very deep, well drained, yellowish brown to dark yellowish brown (10YR 5/4 to 4/4M) in colour and sandy loam to clay loam in texture showing considerable homogeneity in profile development (Ap-AB-Bw). They are moderately productive soils and are cultivated to sugarcane, wheat, mustard, sorghum, berseem, vegetable crops etc. In contrast *Hastinapur* and *Jagaus* soil series occuring on gently sloping landscape (3-5 %) levees are very deep, somewhat excessively drained, single grain, brown to yellowish brown and brownish yellow (10YR 5/3 to 5/4 and 6/6 M) in colour and sand to loamy sand in texture. The entire soil mass is dynamic in nature due to continuous redeposition of fluvial material and lack profile development (A/Ap-AC-C) while *Khanpur* soils occuring on very gently sloping landscape (1-3 %) active flood plain are very deep, well drained, yellowish brown to dark yellowish brown (10YR 5/4 to 4/4 M) in colour, calcareous, sandy loam to loamy sand. Variation in texture with depth may be attributed to the differential deposition of alluvium at various stages of erosion-deposition cycle. The morphological description further reveals that the soils have weak sub angular structure however below 76 cm depth, structure becomes single grain, indicating lack of development due to sandy parent material (Ap-Bw-C). The major constraints of these soils are inundation during monsoon, which reduces the length of growing period of these soils substantially (Singh et al, 2000). They are however cultivated to wheat, sugarcane and vegetable crops like cucurbits etc. in flood free season.

Physico-chemical characteristics

The physico-chemical characteristics of the soils (Table 3) indicated that sand and silt fractions constitute the major portion in mechanical composition. Sand content increases with depth in *Hastinapur*, *Khanpur* and *Jagaus* soils of active flood plain and levees, could be due to sandy parent material whereas it showed decreasing trend in the soils of old / recent alluvial plains. In general subsurface horizons of old / recent alluvial plain soils exhibit higher clay content as compared to surface one's except soils of active flood plain and levees indicating an increased degree of weathering, soil development and clay translocation from the upper layers in the former. The *Masuri, Jiwana, Khanpur* and *Jagaus* soils are calcareous whereas *Icholi, Parichhatgarh, Mawana* and *Hastinapur* soils are non calcareous. Except pedons of *Parichhatgar*h and *Hastinapur* where soils are neutral in reaction, rest of the soils are slightly to strongly alkaline in nature. The organic carbon content was low and generally decreased with depth in all the soils (Verma *et al.* 2012) The higher pH values of *Masuri, Jiwana, Khanpur* and *Jagaus* soils might be due the lime rich parent material (Gawande and Tamhane, 1971) whereas in *Mawana* soils, pH is high due to salinity (chloride and sulphates of calcium and magnesium). Nearly 43.8 % area of the district is moderately to strongly alkaline, of which around 12.63 is saline/sodic. It was further revealed that the organic carbon content decrease gradually with soil depth. The CEC of soils varied from 0.32 to 15.48 cmol $(p^+)kg^{-1}$ and values in general increased in subsurface horizons as compared to surface horizons except in the soils of active flood plain and levees which is mainly due to variation in their clay content since all these soils are low in organic carbon.

Table 2: Morpholigical characteristics of soils

Horizon	Depth (cm)	Boundary	Colour (M)	Texture	Structure	Concre-tions ($CaCO_3$)	Efferve-scence (with dil. HCl)
1. Icholi soils: Fine loamy, Typic Haplustepts							
Ap	0-12	cs	10YR 5/4	sandy loam	f 1 sbk	nil	nil
AB	12-30	gs	10YR 5/5	loam	m 1 sbk	-	-
Bw1	30-52	gs	10YR 4/4	clay loam	m 2 sbk	-	-
Bw2	52-82	gs	10YR 4/4	clay loam	m 2 sbk	-	-
Bw3	82-108	gs	10YR 4/4	clay loam	m 2 sbk	-	-
Bw4	108-132	gs	10YR 4/4	clay loam	m 2 sbk	-	-
Bw5	132-150		10YR 4/4	clay loam	m 2 sbk	-	-
2. Masuri soils: Fine loamy (Calcareous), Typic Haplustepts							
Ap	0-18	cs	10YR 4/3	sandy loam	m 1sbk	-	e
AB	18-45	cs	10YR 4/3	loam	m 2 sbk	-	e
Bw1	45-70	gs	10YR 4/4	clay loam	m 3 sbk	-	e
Bw2	70-92	gs	10YR 4/4	clay loam	m 3 sbk	vf-f f	e
Bw3	92-113	gs	10YR 4/4	clay loam	m 3 sbk	vf-f f	e
Bw4	113-136	gs	10YR 4/4	clay loam	m 3 sbk	vf-f c	e
Bw5	136-160		10YR 4/4	clay loam	m 3 sbk	vf-f c	e
3. Parichhatgarh soils: Fine loamy, Typic Haplustepts							
Ap	0-14	cs	10YR 5/4	Sandy loam	f 1 sbk	nil	nil
AB	14-34	gs	7.5YR 5/5	sandy loam	m 1sbk	-	-
Bw1	34-59	gs	7.5YR 5/5	loam	m 2 sbk	-	-
Bw2	59-82	gs	7.5YR 4/4	clay loam	m 2 sbk	-	-
Bw3	82-110	gs	7.5YR 4/4	clay loam	m 2 sbk	-	-
Bw4	110-128	gs	7.5YR 5/4	clay loam	m 2 sbk	-	-
Bw5	128-150		7.5YR 5/6	loam	m 2 sbk	-	-
4. Jiwana soils: Fine loamy (Calcareous), Typic Haplustepts							
Ap	0-15	cs	10YR 4/4	sandy loam	m 1 sbk	nil	e
AB	15-31	cs	10YR 4/4	sandy loam	m 1 sbk	-	e
Bw1	31-57	gs	10YR 4/4	loam	m 2 sbk	-	e
Bw2	57-86	gs	10YR 4/4	loam	m 2 sbk	-	e
Bw3	86-118	gs	10YR 4/4	loam	m 2 sbk	-	e
Bw4	118-140	gs	10YR 4/4	loam	m 2 sbk	-	e
Bw5	140-158		10YR 5/6	loam	m 2 sbk	-	e
5. Mawana soils: Coarse loamy Typic Haplustepts							
Ap	0-16	cs	10YR 4/4	sandy loam	m 1 sbk	nil	nil
AB	16-42	cs	10YR 4/4	sandy loam	m 1 sbk	-	-
Bw1	42-75	gs	10YR 4/4	sandy loam	m 1 sbk	-	-
Bw2	75-105	gs	10YR 4/4	sandy loam	m 1 sbk	-	-
Bw3	105-130	gs	10YR 4/4	sandy loam	m 1 sbk	-	-
Bw4	130-155		10YR 4/4	sandy loam	m 1 sbk	-	-
6. Hastinapur soils: Typic Ustipsamments							
A	0-16	cs	10YR 5/4	loamy sand	sg	nil	nil
AC	16-40	gs	10YR 5/4	loamy sand	sg	-	-
C1	40-68	gs	10YR 5/5	loamy sand	sg	-	-
C2	68-95	gs	10YR 5/6	sand	sg	-	-
C3	95-124	gs	10YR 5/5	sand	sg	-	-
C4	124-155		10YR 5/5	sand	sg	-	-
7. Khanpur soils: Coarse loamy over sandy (Calcareous), Fluventic Haplustepts							
Ap	0-17	cs	10YR 4/4	sandy loam	m 1 sbk	nil	es
Bw1	17-43	cs	10YR 5/4	sandy loam	f 1 sbk	-	ev
Bw2	43-76	cs	10YR 5/4	sandy loam	f 1 sbk	-	ev
C1	76-103	cs	10YR 5/4	loamy sand	sg	-	ev
C2	103-132	cs	10YR 5/4	loamy sand	sg	-	ev
C3	132-155		10YR 5/4	loamy sand	sg	-	ev
8. Jagaus soils: Calcareous, Typic Ustipsamments							
Ap	0-15	cs	10YR 6/6	loamy sand	sg	nil	es
AC	15-34	cs	10YR 6/6	loamy sand	sg	-	es
C1	34-58	cs	10YR 6/4	sand	sg	-	es
C2	58-74	gw	10YR 6/3	sand	sg	-	es
C3	74-100	gw	10YR 6/3	sand	sg	-	es
C4	100-128	gs	10YR 6/3	sand	sg	-	es
C5	128-150		10YR 6/3	sand	sg	-	es

Boundary-cs= clear smooth; gs= gradual smooth; gw= gradual wavy; Texture- s= sand; sl= sandy loam; l= loam; cl= clay loam; Structure-sg= single grain; f 1 sbk = fine, weak, subangular blocky; m 1 sbk=medium, weak, subangular blocky; m 2 sbk= medium, moderate subangular blocky; m 3 sbk= medium strong subangular blocky; Lime concretions- vf-f f= very fine to fine, few; vf-f c= very fine to fine, common; Effervescence-e= slight effervescent; es= strong effervescent; ev= violent effervescent.
All the soils have hyperthermic temperature and mixed mineralogy

Soil Classification

Based on morphological and physico-chemical characteristics, the soils have been classified according to Soil Taxonomy (Soil Survey Staff, 1998). The study area fall in ustic moisture regime, hyperthermic temperature regime and have mixed mineralogy. *Hastinapur* and *Jagaus* soils are placed in order Entisols due to absence of any diagnostic subsurface horizon. They have sandy texture in the series control section (SCS) with single grain structure (exhibit A-C profile) and lacks post depositional inter horizon translocation of mobile constituents which suggest their recent origin and are non-calcareous and calcareous in nature and thus classified as Typic Ustipsamments and calcareous, Typic Ustipsamments respectively. The other soils are placed in Inceptisols order due to presence of cambic subsurface diagnostic horizon i.e. i) the presence of structural peds, which have sufficient aggregations and formed as a result of biological activity, ii) accumulation of clay enough meet the requirements of cambic horizon but not other diagnostic horizons (i.e. argillic or calcic / petrocalcic) and hence classified as Haplustepts at great group level and further placed in Typic Haplustepts at subgroup level since they qualify the central concept of Haplustepts as ochric epipedon is distinct by lighter hue and lower organic carbon content. Based on particle size distribution and morphological make up of the SCS and calcareousness, these soils are further classified at family level as Coarse loamy, Typic Haplustepts (*Mawana* soils); Fine loamy, Typic Haplustepts (*Icholi* and *Parichhatgarh* soils) and Fine loamy (calc.) Typic Haplustepts (*Masuri* and *Jiwana* soils) whereas due to irregular distribution of organic carbon in the SCS, *Khanpur* soils are therefore put under Fluventic subgroup (Soil Survey Staff, 1998) and classified as coarse loamy over sandy (calc.), Fluventic Haplustepts.

Constraints, management needs and land use

Hastinapur and *Jagaus* soils occurring along the rivers are marginally suitable for agriculturally important crops because of their light soil texture (sand to loamy sand), somewhat excessive drainage, structurlessness, high permeability, slumping of sand in furrowed fields, moderate to severe flooding, very low water and nutrients retentivity, loss of water and nutrients due to high percolation, low CEC and poor fertility. Though these soils are poor in all the qualities required for proper plant growth yet their productivity and crop suitability can be enhanced if proper management practices like addition of organic manures and crop residues, use of mulches, soil compaction to reduce permeability, use of inorganic fertilizers in splits, frequent and light irrigation and selecting crops that use moisture and nutrients from lower horizons and can sustain moisture deficit are adopted. Pressurized irrigation system must be followed to maximize the water use efficiency and minimize the leaching losses of nutrients. High drainability of these soils may poses nitrate pollution in groundwater. Therefore nitrogenous fertilizers in these soils must be applied in splits as the leaching losses of nitrate in sandy soils increases with increased use of mineral N fertilizers (Gasser et. al, 2002). Also applying irrigation frequently and at low rates in Psamments reduces the leaching losses of nitrate-N (Antil et. al, 2002). These soils must be put under short duration crops like barley, mustard, taramira, guar, moong, groundnut, til and vegetable / fruit crops like cucurbits, pea chillies, melon and watermelon with irrigation and fertilization. Tree plantation on field boundaries may be undertaken to protect the soils from erosion as well as for additional income.

I*choli*, *Masuri*, *Parichhatgarh* and *Jiwana* soils are quite productive, however, slight problems due to depletion of ground water, slow surface drainage owing to construction of roads, brick-kilns and nutrient deficiencies are encountered. These soils are ideal for growing all climatically adapted crops and may be intensively cultivated to sugarcane-wheat, rice-wheat under assured irrigation and balanced fertilization. However, transplanting paddy with the onset of monsoon and inclusion of legumes in the crop rotations must be adopted for sustaining productivity. *Mawana* and *Khanpur* soils suffer from somewhat high permeability, poor physical condition, leaching of nutrients, and depletion of groundwater and nutrient deficiencies. The sustainable cropping systems suitable for these soils are maize-wheat and potato-wheat. Rice cultivation in these soils must be avoided to check groundwater depletion. Field bunding, addition of organic manures, balanced fertilization, using N-fertilizers in splits and light irrigation must be adopted in these soils to sustain production.

It may be concluded that soils of the district varied widely in their characteristics (soil texture, drainage, structure, pH etc.) and suffers from inundation/overflow in active flood plain and salinity / sodicity particularly in old alluvial plain. In order to enhanced and sustain high productivity and also suggested agro-technologies must be adopted.

Table 3: Physico-chemical properties of soils

Horizon	Depth (cm)	Sand *(%)*	Silt *(%)*	Clay *(%)*	Clay/ Silt+ Clay	PH (1:2.5)	EC (1:2.5) (dSm^{-1})	OC (%)	$CaCO_3$ (%)	CEC [C mol (p+) kg^{-1}]
1. *Icholi* soils										
Ap	0-12	56.25	26.75	17.00	0.39	7.40	0.25	0.28	Nil	8.58
AB	12-30	51.25	28.75	20.00	0.41	7.20	0.19	0.23	-	8.64
Bw1	30-52	43.25	28.00	28.75	0.51	7.35	0.16	0.19	-	11.16
Bw2	52-82	39.29	29.46	31.25	0.51	7.50	0.14	0.17	-	15.96
Bw3	82-108	35.50	35.50	29.00	0.45	7.35	0.14	0.13	-	13.84
Bw4	108-132	32.44	34.25	33.31	0.49	7.35	0.12	0.11	-	15.88
Bw5	132-154	36.00	33.00	31.00	0.48	7.40	0.11	0.08	-	15.12
2. *Masuri* soils										
Ap	0-18	54.50	27.00	18.50	0.41	7.89	0.67	0.81	0.27	13.76
AB	18-45	43.50	31.50	25.00	0.44	8.73	0.17	0.30	0.38	12.90
Bw1	45-70	41.50	28.25	30.25	0.52	9.40	0.24	0.11	0.81	14.12
Bw2	70-92	40.00	28.00	32.00	0.53	9.68	0.44	0.11	0.62	15.48
Bw3	92-113	40.25	27.50	32.25	0.54	9.75	0.49	0.08	0.67	15.05
Bw4	113-136	43.50	25.75	30.75	0.54	9.74	0.45	0.06	0.81	14.19
Bw5	136-360	43.75	25.75	30.50	0.54	9.70	0.48	0.02	1.15	14.10
3. *Parichhatgarh* soils										
Ap	0-14	61.25	22.50	16.25	0.42	7.22	0.24	0.27	Nil	8.56
AB	14-34	55.55	26.00	18.45	0.41	7.21	0.24	0.23	-	9.10
Bw1	34-59	41.50	32.25	26.25	0.45	7.25	0.21	0.15	-	12.42
Bw2	59-82	35.75	30.25	34.00	0.53	7.35	0.20	0.11	-	15.28
Bw3	82-110	33.50	32.25	34.25	0.51	7.35	0.16	0.11	-	14.62
Bw4	110-128	36.88	29.25	33.87	0.54	7.40	0.15	0.06	-	15.30
Bw5	128-150	37.50	35.50	27.00	0.43	7.50	0.13	0.04	-	12.50
4. *Jiwana* soils										
Ap	0-15	69.00	14.25	16.75	0.54	8.40	5.10	0.74	0.95	10.65
AB	15-31	65.00	17.75	17.25	0.49	8.30	1.45	0.29	0.72	10.54
Bw1	31-57	45.63	34.25	20.12	0.37	8.40	0.90	0.23	0.72	11.12
Bw2	57-86	45.50	33.25	21.25	0.39	8.30	0.80	0.23	0.71	11.72
Bw3	86-118	42.32	35.93	21.75	0.38	8.40	0.80	0.22	0.67	12.10
Bw4	118-140	45.99	28.01	26.00	0.48	8.40	0.80	0.19	0.72	14.35
Bw5	140-158	46.01	28.24	25.75	0.48	8.50	0.65	0.15	0.81	14.25
5. *Mawana* soils										
Ap	0-16	73.00	16.50	10.50	0.39	8.05	0.12	0.36	Nil	6.12
AB	16-42	70.25	17.00	12.75	0.43	8.31	0.08	0.19	-	6.84
Bw1	42-75	69.75	15.00	15.25	0.50	8.33	0.07	0.19	-	7.56
Bw2	75-105	70.50	12.50	17.00	0.58	8.43	0.07	0.15	-	8.28
Bw3	105-130	71.50	14.25	14.25	0.50	8.45	0.07	0.10	-	7.92
Bw4	130-155	74.00	12.50	13.50	0.52	8.50	0.06	0.09	-	6.66
6. *Hastinapur* soils										
A	0-16	84.00	10.25	5.75	0.36	6.56	0.04	0.27	Nil	3.12
AC	16-40	86.50	8.50	5.00	0.37	6.66	0.03	0.21	-	2.65
C1	40-68	86.25	8.75	5.00	0.36	6.96	0.02	0.15	-	2.56
C2	68-95	89.50	7.00	3.50	0.33	7.00	0.02	0.13	-	1.80
C3	95-124	88.50	8.00	3.50	0.30	7.11	0.02	0.08	-	1.74
C4	124-155	89.50	7.75	2.75	0.26	7.20	0.02	0.04	-	1.41
7. *Khanpur* soils										
Ap	0-17	70-75	12.00	17.25	0.60	8.28	0.43	0.38	4.22	9.32
Bw1	17-43	69.34	14.25	16.41	0.54	8.94	0.21	0.13	4.84	8.03
Bw2	43-76	65.50	24.25	10.25	0.30	8.94	0.21	0.13	10.12	6.02
C1	76-103	89.99	1.76	8.25	0.82	8.96	0.18	0.06	6.96	4.82
C2	103-132	86.28	5.97	7.75	0.57	9.00	0.15	0.09	4.99	3.78
C3	132-155	91.75	2.50	5.75	0.70	8.97	0.16	0.06	4.12	3.44
8. *Jagaus* soils										
Ap	0-15	79.75	14.00	6.25	0.31	8.24	0.19	0.23	1.77	3.42
AC	15-34	85.75	9.75	4.50	0.32	8.94	0.12	0.06	3.60	2.30
C1	34-58	92.00	5.50	2.50	0.31	9.07	0.10	0.05	3.21	1.28
C2	58-74	92.25	5.00	2.75	0.35	9.16	0.07	0.04	2.59	1.37
C3	74-100	95.75	3.00	1.25	0.29	9.18	0.07	0.02	2.76	0.65
C4	100-128	97.00	2.50	0.50	0.17	9.20	0.06	0.01	2.71	0.32
C5	128-150	97.00	2.25	0.75	0.25	9.28	0.06	0.02	2.62	0.38

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