Agropedology 2005, 15 (1) 55-62

Characterization, classification and evaluation of soils in Chandragiri mandal of Chittoor district, Andhra Pradesh

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Abstract: Seven representative pedons representing hill slope, upland and plain landforms in Chandragiri mandal of Chittoor district in Andhra Pradesh were characterized, classified and assessed for their nutrients content. The soils were deep to very deep, light yellowish brown to dark red, excessive to poorly drained, slightly acidic to moderately alkaline, low to medium in organic carbon and low to medium in cation exchange capacity with wide textural variations. Soils were low in available nitrogen, medium in available phosphorus, high in available potassium but deficient in sulphur, zinc and iron. Pedon 1 and 4 occurring in plain and pedon 7 on hill-slope did not exhibit any diagnostic horizon and classified as Typic Ustipsamments, Typic Ustifluvents and Lithic Ustorthents, respectively. Pedon 2,3,5 and 6 occurring in plain are classified as Vertic Haplustepts, Typic Haplustepts, Typic Haplustalfs, Typic Rhodustalfs, respectively. On the basis of major soil constraints, suitable land use plan for the Chandragiri mandal was suggested for their sustainable management.

Additional key words : *Soil classification, land use plan, cambic horizon, argillic horizon*

Introduction

The most important basic natural resource that determines the ultimate sustainability of any agricultural system is the soil. The inherent ability of soils to supply nutrients for crop growth and maintenance of soil physical conditions to optimize crop yields is the most important component of soil fertility that virtually determines the productivity of agricultural system. A thorough and proper understanding of morphological, physical, and chemical characteristics of the soils gives greater insight of the dynamics of the soil. Though sporadic information is available on characterisation and classification of soils in Andhra Pradesh (Satyavathi and Reddy 2004), no information is available on these aspects for the soil of Chandragiri mandal, in particular and Chittoor district, in general. A necessity is always felt for more soil database on mandal-wise in Andhra Pradesh. Keeping these factors in mind, the present study has been undertaken to characterise and classify the soils of Chandragiri mandal and also to suggest land use plan to protect our finite soil resource to achieve sustainable crop production.

Materials and Methods

The study area lies in between 13° 31' and 13° 41' N latitude and 79° 14' and 79° 22' E longitude. It represents semi-arid monsoonic climate. The annual precipitation is 1221 mm of which 89 per cent is received during July to November. The mean annual soil temperature is 31.9°C with mean summer and winter soil temperatures of 32.1°C and 27.8°C, respectively. The area qualifies for *isohyperthermic* temperature regime. The soil moisture control section remains dry for more than 90 cumulative days or 45 consecutive days in four months following summer solstice and it qualifies for *ustic* soil moisture regime.

A reconnaissance soil survey was conducted in Chandragiri mandal as per procedure outlined by AIS &

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LUS (1970) on 1:50,000 scale. Four pedons in plains, two in uplands and one on hill slope were examined for their morphological (Soil Survey Staff 1951) and classified (Soil Survey Staff 1998). Pedon 1 located in plain was developed in alluvium. Pedons 2 and 7 situated in plains and hill-slope, respectively were originated from calcareous murrum and pedons 3 and 4 occurring in plains and pedons 5 and 6 located in uplands were developed from granite-gneiss parent material.

Horizon-wise samples were collected and characterised for important physical and chemical following standard procedures. Besides, eighty surface soil samples were also collected covering all the revenue villages of the mandal and these surface samples were analysed for available macronutrients (N, P, K, S) and micronutrients (Fe, Zn, Cu, Mn) by adopting standard procedures outlined by Jackson (1973) and Lindsay and Norvell (1978) respectively. The surface soil samples were rated as low, medium and high categories as per the limits suggested by Muhr *et al.* (1965) for available N, P and K. Nutrient indices (NI) for available N, P and K in surface soil samples were worked out as per the formula given by Parker *et al.* (1951). The available sulphur and micronutrients were rated as sufficient/deficient as per the limits suggested by Tandon (1991) and Lindsay and Norvell (1978), respectively. Considering potentials and limitations of the soils, land capability classification was also evaluated upto sub-class level (Klingebiel and Montgomery 1966) and based on that a suitable land use plan has also been suggested.

Results and Discussion

Morphology

The solum depth varied from deep to very deep. The soils of plain were deeper compared to the soils of upland and hill slope. The soils were poorly to excessively drained. The soils colour varied from 2.5 YR to 10 YR in plain, 2.5YR to 7.5YR in upland and 5YR to 10 YR on hill slope (Table 1). These variations in soil colour appear to be the function of chemical and mineralogical composition as well as textural make up of soils and conditioned by topographic position and moisture regime (Walia and Rao 1997).

The soils of Chandragiri mandal showed wide textural variations *i.e.,* from sand to clay (plain), sandy loam to clay loam (upland) and sandy clay loam to clay loam (hill slope). These wide variations in soil texture may be due to differences in parent material, physiography, *in situ* weathering and translocation of clay. Strong effervescence was noticed in all the horizons in pedons 2 and in A1 horizon of pedon 7. This strong effervescence was due to the presence of calcium carbonate in parent material of the respective pedons. The structure of the soils was single grain, crumb, subangular to angular blocky in plains; crumb, subangular blocky and angular blocky in uplands and subangular blocky and angular blocky on hill slope. Presence of thin patchy cutans in sub-surface horizons of pedons 5 and 6 indicated the development of argillic whereas pedons 2 and 3 exhibited cambic sub-surface diagnostic horizon. Pedons 1 and 7 did not have any diagnostic horizon. Pedon 2 exhibited vertic properties such as 3 to 5 mm wide cracks extended upto 35 cm depth and weak indistinct slickensides.

Physical characteristics

The data indicated that the clay content in soils varied from 1.00 to 42.51 per cent (plain), 12.50 to 28.82 per cent (upland) and 20.35 to 27.27 per cent (hill slope). The high clay content in soils of plain as compared to upland and hill slope soils was due to deposition of finer fractions in the plains from uplands and hill slope (Table 1). The increase in clay content in Bt horizons of pedons 5 and 6 located on upland could be attributed to vertical migration or translocation of clay (Sarkar *et al.* 2002) whereas the enrichment of clay in Bw horizon of pedons 2 and 3 situated on plain was primarily due to *in situ* weathering of parent material. Silt content of all the pedons except pedon 1 exhibited an irregular trend with depth. Sand constitutes the bulk of mechanical fractions, which could be attributed to the dominance of physical weathering.

The bulk density varied from 1.34 to 1.64 Mgm^{-3} in soils of different physiographic units (Table 1). The bulk density in soils, irrespective of landforms, increased with depth which might be due to finer particles in deeper layers caused by overhead weight of the surface soils (Jewitt *et al.*

Table 1. Some morpholog ical and physical properties of the pedons*

Horizon	Depth(m)	Boundary	Colour (Moist)	Sand	Silt	Clay	Bulk density (Mg m^{-3})	Particle density (Mg m^{-3})	Water holding capacity(%)	LOI (%)
				← (%) →						
				P_1 :Typic Ustipsamments (Plain)						
C1	0.17-0.50	cs	7.5 YR 8/4	94.44	4.34	1.22	1.54	2.49	17.20	1.36
C2	0.50-1.00	cs	7.5 YR 8/4	94.14	4.76	1.10	1.62	2.62	16.42	1.64
C3	1.00-1.20	cs	7.5 YR 7/4	94.02	4.88	1.10	1.64	2.61	16.00	1.23
C4	1.20-1.80	cs	7.5 YR 7/4	94.00	5.00	1.00	1.64	2.58	15.45	1.46
C5	1.80-2.00+		7.5 YR 7/4	96.24	2.76	1.00	1.64	2.56	15.43	1.39
				P_2: Vertic Haplustepts (Plain)						
Ap	0.00-0.20	cs	10 YR 3/1	33.99	31.98	34.03	1.34	2.48	45.51	8.32
Bw1	0.20-0.55	gs	10 YR 3/1	29.36	30.62	40.02	1.41	2.51	50.27	12.67
Bw2	0.55-1.00	gs	10 YR 3/1	30.00	27.49	42.51	1.46	2.52	52.34	11.63
Bw3	1.00-1.30	gs	10 YR 3/2	32.08	30.88	37.04	1.51	2.55	43.04	8.24
Ck	1.30 +			Parent material mixed with calcium carbonate						
				P_3: Typic Haplustepts (Plain)						
Ap	0.00-0.15	cs	7.5 YR 5/6	66.00	20.98	13.02	1.35	2.53	23.17	2.31
Bw1	0.15-0.55	gs	2.5 YR 3/4	46.07	30.69	23.24	1.42	2.47	35.10	4.93
Bw2	0.55-0.95	gs	2.5 YR 3/4	38.56	34.60	26.84	1.50	2.44	37.39	3.62
Bw3	0.95-1.20	cs	2.5 YR 3/4	43.68	28.63	27.69	1.52	2.45	37.53	7.64
Bw4	1.20-1.80+		5 YR 4/6	72.98	11.79	15.23	1.52	2.39	24.20	5.26
				P_4: Typic Ustifluvents (Plain)						
Ap	0.00-0.16	cs	10 YR 4/4	78.50	14.00	07.50	1.35	2.49	20.50	4.39
A1	0.16-0.42	gs	7.5 YR 2/4	42.77	35.17	22.06	1.38	2.44	34.03	6.26
A2	0.42-0.70	gs	5 YR 3/2	48.36	27.94	23.70	1.45	2.46	36.10	5.49
C	0.70			Weathered gneiss						
				P_5: Typic Haplustalfs (Upland)						
Ap	0.00-0.15	cs	7.5 YR 4/6	53.66	25.84	20.50	1.42	2.51	32.84	5.63
E	0.15-0.42	cs	7.5 YR 3/4	53.98	26.52	19.50	1.47	2.49	32.50	4.29
Bt1	0.42-0.85	gs	7.5 YR 4/8	29.99	42.28	27.73	1.48	2.52	37.20	6.71
Bt2	0.85-1.01	gs	7.5 YR 4/6	29.64	41.54	28.82	1.49	2.51	38.92	5.93
Bt3	1.01-1.50+		7.5 YR 4/8	27.14	44.20	28.66	1.51	2.57	38.89	6.24
				P_6: Typic Rhodustalfs (Upland)						
Ap	0.00-0.18	cs	5 YR 4/3	71.54	15.96	12.50	1.54	2.51	22.00	2.73
E	0.18-0.40	gs	2.5 YR 3/6	70.32	16.83	12.85	1.54	2.61	22.20	2.62
Bt1	0.40-0.65	cs	2.5 YR 3/6	61.14	16.36	22.50	1.54	2.59	34.72	3.79
Bt2	0.65-1.20	gs	2.5 YR 3/6	54.95	17.29	27.76	1.54	2.43	38.82	4.26
Bt3	1.20-1.50		2.5 YR 3/6	59.02	17.42	23.56	1.57	2.46	35.86	4.33
				P_7: Lithic Ustorthents (Hill slope)						
Ap	0.00-0.20	cs	5 YR 4/4	49.86	29.79	20.35	1.35	2.48	32.73	6.76
A1	0.20-0.45	as	10 YR 4/3	38.34	34.39	27.27	1.55	2.51	38.50	9.24
R	0.45			Parent rock with calcium carbonate						

* Symbols are according to soil survey manual (Soil Survey staff 1951)

1979). Water holding capacity of different pedons varied from 15.43 to 52.34 per cent in plains, 22.00 to 38.92 per cent in upland and 32.73 to 38.50 on hill slope. The loss on ignition varied from 1.23 to 12.67 per cent and this loss in weight on ignition was attributed to loss of organic matter, crystal lattice water and $CaCO_3$.

Chemical characteristics

The pH of the soils varied from 6.2 to 8.4 (plains), 6.1 to 7.6 (uplands) and 7.2 to 8.1 (hill slope). The higher pH in soils of plain may be due to more accumulation of bases removed from uplands and hill slope. The KCl-pH values of the soils were lower than aqueous pH values indicating the exisistance of net negative charge on colloidal particles. All the pedons, irrespective of landforms showed very low electrical conductivity.

The organic carbon content in soils varied form 0.6 to 6.3 g kg^{-1} (plains) 0.8 to 4.1 g kg^{-1} (uplands) and 3.7 to 6.6 g kg^{-1} (hill slope). Irrespective of landforms, the organic carbon decreased with depth in all the pedons. This could be attributed to the addition of plant residues and farmyard manure to surface horizons than in the lower horizons.

The CEC in soils ranged from 1.02 to 32.19 cmol (p+) kg^{-1}, which corresponds to clay content in the horizons. Exchangeable bases in all the pedons irrespective of landforms (Table 2) were in the order of $Ca^{2+}>Mg^{2+}>Na^{+}>K^{+}$ except in pedon 2. The base saturation was found to be varied from 63.81 to 94.75 per cent.

Macronutrients

The available nitrogen in surface soil samples varied from 35.73 to 212.37 kg ha^{-1} (Table 3) with an overall mean of 111.99 kg ha^{-1} in different revenue villages of the mandal. The overall nutrient index value of this mandal was 1.00 (Table 3), which indicate that the soils are low in available nitrogen. Low nitrogen status in the surface soils could be attributed to low amount of organic carbon in these soils (Prasuna Rani *et al.* 1992).

The available phosphorus in surface soil samples varied from 7.27 to 37.34 kg ha^{-1} in different revenue villages of the mandal. The overall nutrient index value of this mandal was 1.99 (Table 3), which indicates that the soils are medium in available phosphorus.

The available potassium in surface soil samples varied from 100.00-315.00 kg ha^{-1} in different revenue villages of the mandal with an overall nutrient index value of 2.45 (Table 3). This could be attributed to more intense weathering, release of K from organic residues, application of K fertilizers and upward translocation of potassium from lower depth along with capillary raise of ground water. Similar results were reported by Hirekurabar *et al.* (2000) in cotton based cropping system in Karnataka.

The available sulphur in soils varied from 2.00 to 10.78 mg kg^{-1} with an overall mean of 5.38 mg kg^{-1} in different revenue villages of the mandal indicating that soils of this mandal were deficient (Table 3) in available sulphur.

Micronutrients

Available zinc in surface soil samples was low with an overall mean of 0.56 mg kg^{-1} (Table 3). Considering 0.6 mg kg^{-1} soil as critical level (Lindsay and Norvell 1978) for available zinc, these soils were classified as deficient. Similar views were expressed by Venkatesu *et al.* (2002) in soils of Nellore district, Andhra Pradesh.

The DTPA-extractable Cu in soils ranged from 0.19 to 2.98 mg kg^{-1}. Considering 0.2 mg kg^{-1} soil (Lindsay and Norvell 1978) as the critical limit of DTPA-extractable copper for normal plant growth, it may be inferred that all the soils contain adequate amount of available copper.

The DTPA -Fe content ranged from of 0.93 to 7.00 mg kg^{-1} soil. Considering 4.5 mg kg^{-1} soil (Lindsay and Norvell 1978) as the critical limit for DTPA- extractable iron for normal plant growth, it may be inferred that the soils of this mandal were deficient in available iron. Similar observations were also made by Thangasamy (2002) in soils of Sivagiri micro-watershed in Chittoor district of Andhra Pradesh. The available manganese content ranged from 3.88 to 16.37 mg kg^{-1} soil with an overall mean of all the revenue villages was 8.50 mg kg^{-1} soil (Table 3). The available manganese content was sufficient to high because these values are well above the critical limit (1.0 mg kg^{-1}) of Lindsay and Norvell (1978).

Table 2. Physical and chemical properties of the soil

Pedon No & Horizon	Depth (m)	pH (1:2.5) H_2O	pH (1:2.5) 1*N* KCl	EC (dSm^{-1})	Organic carbon	$CaCO_3$	CEC (cmol (p+)kg^{-1})	Exchangable bases [cmol (p+) kg^{-1}] Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Base saturation (%)
					← g kg^{-1} →		←	1 *N* NH_4OAc pH 7.0			→	
					P_1 : Typic Ustipsamments (Plain)							
Ap	0.00-0.17	6.89	5..93	0.01	3.7	4.1	1.49	0.75	0.20	0.09	0.05	73.15
C1	0.17-0.50	7.49	6.69	0.02	1.8	8.3	1.18	0.45	0.31	0.02	0.03	68.64
C2	0.50-1.00	7.12	5.98	0.02	1.2	8.3	1.02	0.40	0.20	0.07	0.04	69.61
C3	1.00-1.20	7.15	6.13	0.11	1.1	4.1	1.50	0.70	0.32	0.02	0.06	73.33
C4	1.20-1.80	7.70	6.45	0.03	0.8	8.3	1.05	0.37	0.22	0.03	0.05	63.81
C5	1.80-2.00+	7.61	6.65	0.04	0.6	4.1	1.20	0.55	0.16	0.04	0.08	69.17
					P_2: Vertic Haplustepts (Plain)							
Ap	0.00-0.20	8.13	6.63	0.11	6.3	12.5	27.31	18.27	6.74	0.27	0.28	93.59
Bw1	0.20-0.55	8.35	7.53	0.13	3.5	33.3	29.84	19.71	7.83	0.17	0.35	94.03
Bw2	0.55-1.00	8.40	6.78	0.18	2.7	41.6	32.19	19.31	7.23	0.23	0.47	84.62
Bw3	1.00-1.30	8.41	6.93	0.21	2.4	54.1	25.83	16.51	5.37	0.21	0.22	86.37
					P_3:Typic Haplustepts (Plain)							
Ap	0.00-0.15	5.97	4.79	0.04	5.5	4.1	9.39	4.91	2.63	0.16	0.27	84.88
Bw1	0.15-0.55	6.62	5.53	0.02	3.0	8.3	12.96	6.32	2.61	1.27	0.36	81.48
Bw2	0.55-0.95	6.80	6.01	0.04	1.8	16.6	15.22	7.45	4.21	1.36	0.39	88.11
Bw3	0.95-1.20	7.00	5.99	0.05	1.8	20.8	18.27	10.31	5.36	1.23	0.41	94.75
Bw4	1.20-1.80+	7.25	6.07	0.03	0.9	20.8	7.83	3.31	2.01	1.31	0.21	87.36
					P_4: Typic Ustifluvents (Plain)							
Ap	0.00-0.16	6.73	6.03	0.02	0.63	0.83	5..39	2.79	1.86	0.12	0.19	92.02
A1	0.16-0.42	6.22	5.23	0.03	0.47	1.25	12.87	6.31	3.72	0.37	0.27	82.90
A2	0.42-0.70	6.21	5.23	0.04	0.22	1.66	13.92	7.42	3.01	0.52	0.25	80.46
					P_5: Typic Haplustalfs (Upland)							
Ap	0.00-0.15	7.27	6.03	0.03	2.2	4.2	13.57	7.26	3.11	0.59	0.32	83.12
E	0.15-0.42	7.57	6.73	0.08	1.5	8.3	12.26	6.21	3.01	1.23	0.27	87.44
Bt1	0.42-0.85	7.57	6.73	0.07	1.4	8.3	21.40	12.72	6.32	0.34	0.42	92.52
Bt2	0.85-1.01	7.55	6.81	0.09	0.8	4.1	24.88	12.67	7.23	0.73	0.36	84.36
Bt3	1.01-1.50+	7.21	5.98	0.09	0.8	8.3	23.92	12.63	7.07	0.68	0.39	86.83
					P_6: Typic Rhodustalfs (Upland)							
Ap	0.00-0.18	6.33	5.69	0.02	4.1	12.5	8.35	4.10	2.37	0.12	0.12	80.36
E	0.18-0.40	6.62	5.07	0.03	2.1	12.5	9.74	5.36	2.49	0.79	0.23	90.14
Bt1	0.40-0.65	6.06	5.16	0.03	1.4	4.1	11.83	6.51	2.79	0.23	0.27	82.84
Bt2	0.65-1.20	6.11	5.21	0.04	1.5	4.1	15.39	7.31	4.23	0.27	0.36	79.08
Bt3	1.20-1.50	6.17	5.12	0.19	1.5	8.3	12.87	6.54	2.81	1.12	0.29	83.60
					P_7 : Lithic Ustorthents (Hill slope)							
Ap	0.00-0.20	7.20	5.98	0.05	6.6	4.1	16.26	8.46	4.76	0.49	0.36	86.53
A1	0.20-0.45	8.13	7.39	0.15	3.7	16.6	17.83	10.32	4.12	0.39	0.38	85.31

Table 3. Range and mean of organic carbon and available nutrients in surface samples of different revenue villages of Chandragiri mandal

Sl. No.	Revenue Village	Range & Mean	Organic carbon (%)	N (kg ha^{-1})	NI	P (kg ha^{-1})	NI	K (kg ha^{-1})	NI	S	Zn	Cu	Mn	Fe (%)
										← (mg kg^{-1}) →				
1.	Panapakam	Range	0.24-0.63	96.10-210.31	1.00	8.34-25.34	1.88	130-270	2.38	2.00-10.00	0.19-0.94	0.63-1.73	4.37-12.36	0.97-3.93
		Mean	0.38	149.87		16.34		191.25	6.61	0.50		1.00	7.62	2.50
2.	Kalroad palli	Range	0.11-0.66	73.51-212.37	1.00	7.39-23.71	1.88	127-300	2.63	3.24-10.00	0.19-1.04	0.31-2.98	5.27-15.40	2.07-7.00
		Mean	0.29	118.80		15.08		207.25		5.53	0.57	0.95	8.06	3.84
3.	Mungilipattu	Range	0.08-0.37	40.38-143.61	1.00	12.63-31.37		2.38	135-295	2.50	4.10-9.70	01.3-0.96	0.34-0.93	4.29-12.39	1.87-5.84
		Mean	0.21	91.75		21.63		205.00			5.49	0.48	0.47	8.73	3.91
4.	Mamandur	Range	0.08-0.47	35.73-193.74	1.00	7.34-32.39	2.13	160-310	2.63	3.07-9.63	0.10-0.97	0.19-0.56	4.28-12.83	2.13-5.56
		Mean	0.24	100.09		18.92		227.50		5.66	0.52	0.43	8.91	3.61
5.	Chandragiri	Range	0.09-0.41	60.12-180.72	1.00	7.27-37.34	1.75	145-305	2.25	3.30-6.62	0.21-1.04	0.39-2.36	4.40-12.54	1.28-6.39
		Mean	0.26	111.56		18.62		196.25		4.69	0.64	1.05	8.21	3.53
6.	DhronakambalaRange		0.18-0.55	73.71-199.79	1.00	9.77-27.47	2.13	125-205	2.25	3.23-6.92	0.18-1.36	0.43-1.34	7.19-15.63	0.93-4.96
		Mean	0.31	124.18		17.08		158.13		4.79	0.65	0.80	9.14	2.29
7.	Thondawada	Range	0.17-0.27	74.36-99.32	1.00	10.37-23.70		2.00	175-305	2.75	3.67-10.00	0.10-1.04	0.37-0.76	4.28-13.34	1.56-4.42
		Mean	0.23	87.57		17.73		231.25			6.28	0.59	0.51	9.30	3.14
8.	Srinivasa Mangapuram	Range	0.11-0.41	62.81-170.63	1.00	7.27-19.31	1.88	130-280	2.38	3.16-6.45	0.21-1.29	0.37-1.26	3.88-16.37	1.02-4.46
		Mean	0.24	102.83		13.83		195.00		4.49	0.61	0.62	8.75	2.90
9.	Pullaiahgari Palle	Range	0.18-0.47	70.23-186.91	1.00	8.34-29.34	2.25	130-315	2.38	3.15-6.45	0.13-0.86	0.38-0.79	4.32-13.27	2.02-5.84
		Mean	0.32	128.16		18.98		200.63		4.74	0.44	0.46	7.47	3.47
10.	BheemavaramRange		0.11-0.66	59.37-209.79	1.00	7.41-19.31	1.66	135-260	2.38	3.80-8.12	0.26-1.36	0.39-1.23	5.34-14.39	1.36-5.84
		Mean	0.28	105.37		11.87		178.13		5.54	0.64	0.70	8.75	3.37
	Overall	Range	0.08-0.66	35.73-212.37	1.00	7.27-37.34	1.99	100-315	2.45	2.00-10.78	0.10-1.36	0.19-2.98	3.88-16.37	0.93-7.00
		Mean	0.28	111.99		17.01		199.04		5.38	0.56	0.65	8.50	3.32

NI: Nutrient Index

Land capability classification

Based on the criteria outlined by Klingebiel and Montgomery (1966) the soils of Chandragiri mandal have been classified into three land capability sub-classes for better management of lands (Table 4). The pedons were grouped in the capability sub-class IIs (P_3, P_5), IIIw (P2), IIIes (P4, P6), IIIse (P_7) and IVs (P_1). In case of pedons 3 & 5, the suggested land use was cultivating climatically adapted double cropping including legumes in rotation with the addition of optimum dose of fertilizers and manures. The crops like mango, pulses, oil seeds and vegetables were suggested in the pedons 4 and 6. Pedon 7 is suitable for growing horticultural crops like sapota, guava and pomegranate whereas addition of tank silt is recommended along with careful soil and water management practices to grow crops in soils of pedon 1. Double cropping including legumes in rotation with proper drainage facilities are required to get profitable yields in the soils of pedon 2. By adopting the above suggested land use not only sustainable yields but also soil health can be maintained without deterioration.

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Received November 2003; Accepted March 2005