



Characterization and classification of lowland soils of Chikkarsinkere Hobli, Maddur taluk, Mandya district of Karnataka

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Abstract: A detailed soil survey (at 1:8000 scale) was carried out in Chikkarsinkere Hobli covering an area of 16,873 ha. The survey area was divided into three major landforms, namely uplands, midlands and lowlands. Based on variation in physiography and landform, five soil series were identified in lowlands. Five typifying pedons representing the soil series were analysed for its physico-chemical properties and characterized for mapping. Soils of the lowlands are deep to very deep, well drained to somewhat poorly drained, dark colored, heavy textured and are developed over granite and gneissic parent materials. pH of the soils ranged from 7.4 to 9.4 with a mean value of 8.4, EC ranged between 0.09 to 0.62 dSm⁻¹ with a mean value of 0.27 dSm⁻¹, OC varied from 0.7 to 13.7 g kg⁻¹ with a mean value of 5.95 g kg⁻¹, CEC ranged from 0.57 to 38.7 cmol(p⁺)kg⁻¹ with a mean value of 15.88 cmol(p⁺)kg⁻¹ and CaCO₃ ranged between 0 to 50 g kg⁻¹ with a mean value of 20.62 g kg⁻¹.

Additional key words: Detailed soil survey, soil morphology, land resources, soil characteristics

Introduction

Modern agriculture requires precise information on bio-physical and climatic resources for sustainable land use planning. The properties of a soil are the basic attributes that directly influence the soil response to any specified use. The life supporting system of a country and socio-economic development of its people depends on natural resources. More than ever before, a renewed attention is being given to soils due to rapidly declining area for agriculture, declining soil fertility, increasing soil degradation, unsystematic land use policies and irrational and imbalanced use of inputs (Kanwar 2004). All above are the factors for a paradigm shift in research from

maximum crop production to sustainability of crop production without degradation of soil health. Agricultural intensification and massive infrastructure development in recent years without considering the variability of entire production system enhances the risk of soil erosion and fertility depletion (Singh *et al.* 2007). In order to adopt good management practices and remedial measures for various soils, a systematic study of the soils is highly essential. Sporadic information was available on the soils of Chikkarsinkere Hobli, Mandya district of Karnataka. Hence, the present investigation was taken up to characterize and classify the soils of Chikkarsinkere Hobli

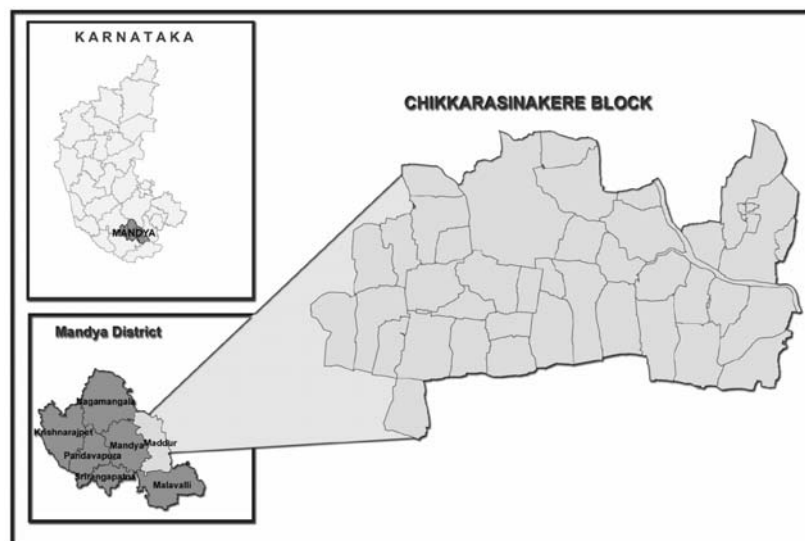


Fig.1. Location of Chikkarsinakere Hobli in Mandya district

Materials and Methods

Geographically, the Chikkarsinkere Hobli lies between 76°58' to 77°05' E longitude and 12°26' to 12°06' N latitude with an area of 16,873 hectare. Lowlands cover 4,935 ha (Fig.1) of the study area. The general elevation of the area ranges from 600 to 769 m above mean sea level (MSL). The drainage is sub-parallel and dendritic in the Hobli. Based on relief features, the area is divided into lowlands, midlands and uplands. Climate of the Hobli is hot moist and semi-arid with mean annual rainfall of 770 mm, mean annual temperature of 31°C and PET of 1794 mm. The relative humidity is high during monsoon season (77 to 89%) and low during rest of the season (23 to 35%). The area qualifies for 'Isohyperthermic' soil temperature regime. Geology of the study area is dominantly of granite. Major part of the Hobli is under Kaveri and Hemavathi canal irrigation command. The natural vegetation comprises of babul (*Acacia nilotica*), banyan (*Ficus bengalensis*), mango (*Mangifera indica*) tamarind (*Tamarindus indica*) and neem (*Azadirachta indica*) etc. Major crops are rice and sugarcane in the irrigated tracts and ragi, pulses and oilseeds in rainfed uplands.

Soil survey was carried out using base map on 1: 8000 scale. A detailed traverse of the Hobli was made

to identify the uplands, midlands and lowlands. Pedon sites were located in transects along the slope from the upper to lower slopes. In the lowland soils, five pedons were exposed and studied for morphological characteristics as per Soil Survey Manual (Soil Survey Division Staff 1999). The horizon-wise soil samples were collected, air dried and passed through 2 mm sieve and analysed for particle-size distribution following International Pipette method (Richards, 1954), pH and electrical conductivity (EC) in 1:2.5, soil : water suspension (Pipier 1966). Organic carbon was estimated by Walkley and Black (1934) method and calcium carbonate by rapid titration method (Piper 1966). The cation exchange capacity (CEC) and exchangeable cations were determined as described by Jackson (1958). The soils were classified as per Soil Taxonomy (Soil Survey Staff 2003).

Results and Discussion

Five soil series, namely, Chikkarsinkere (Cak), Doddarsinkere (Dak), Honnalagere (Hlr), Kyathaghatta (Kgt) and Madenahalli (Mnl) were identified and mapped in lowlands based on their morphological properties (Table 1) and physico-chemical properties (Table 2). The soil taxonomic information is given in Table 2.

Table 1. Morphological characteristics of pedons in lowland soils of Chikkarsinkere Hobli

Horizon	Depth (cm)	Colour (moist)	Texture	Structure	Concretions	Effervescence	Root distribution
Pedon 1 (Chikkarsinkere): Fine, mixed, calcareous isohyperthermic <i>Vertic Halaquepts</i>							
Ap	0-20	10YR 4/3	c	m2sbk	-	e	vf
Bw1	20-39	10YR 4/4	c	m2sbk	ff conc.	e	ff
Bw2	39-70	10YR 3/3	c	m2sbk	ff conc.	e	-
Bw3	70-95	10YR 3/2	c	m2sbk	-	e	-
Bw4	95-120	10YR 3/1	c	-	-	e	-
Bw5	120-150	10YR 3/1	c	-	-	e	-
Pedon 2 (Doddarasinkere): Fine, mixed, calcareous, isohyperthermic, <i>Typic Endoaquepts</i>							
Ap	0-15	10YR 3/3	Sl	m2sbk	-	-	Cf
A2	15-26	10YR 4/3	Scl	m2sbk	-	-	Ff
Bw1	26-52	10YR 3/1	Sc	m2sbk	-	-	Ff
Bw2	52-79	10YR 3/1	Sc	m2sbk	-	e	Ff
Bw3	79-110	10YR 3/1	C	m2sbk	-	e	Ff
Bw4	110-135	10YR 4/1	C	m2sbk	-	e	-
Bw5	135-160	10YR 4/1	C	m2sbk	-	e	-
Pedon 3 (Honnalagere): Fine-loamy, mixed, isohyperthermic <i>Typic Haplustepts</i>							
Ap	0-14	10YR 4/4	scl	m1sbk	-	-	Mf
Bw1	14-34	10YR 4/6	scl	m1sbk	-	-	Mf
Bw2	34-62	10YR 4/3	scl	m1sbk	-	-	Fm
Bw3	62-88	10YR 4/3	scl	m2sbk	-	-	Ff
Bw4	88-140	10YR 4/4	sl	m1sbk	-	-	Fm
Pedon 4 (Kyathaghatta): Fine-loamy, mixed, calcareous isohyperthermic, <i>Typic Haplustepts</i>							
Ap	0-13	10YR 3/2	sl	m1sbk	-	es	Ff
Bw1	13-35	10YR 6/6	sl	m1sbk	-	e	Ff
Bw2	35-69	10YR 5/6	scl	m2sbk	-	-	Ff
Bw3	69-104	10YR 6/6	scl	m2sbk	-	-	Ff
Bw4	104-131	10YR 6/6	sc	m2sbk	-	es	Ff
Pedon 5 (Madenahalli): Sandy over clayey, mixed, calcareous isohyperthermic <i>Typic Ustifluvents</i>							
Ap	0-14	10YR 3/1	scl	m2sbk	-	e	Ff
AC1	14-28	10YR 4/2	sl	m1sbk	-	e	Ff
AC2	28-40	10YR 4/2	ls	m1sbk	-	-	-
AC3	40-51	10YR 4/3	sl	m1sbk	-	-	-
AC4	51-73	10YR 4/4	sl	m1sbk	-	-	-
AC5	73-89	10YR 4/1	sc	m2sbk	-	-	-
AC6	89-113	10YR 4/1	C	m2sbk	-	-	-

Table 3. Physico-chemical properties of typifying pedons in lowlands of Chikkarsinkere Hbli

Horizons	Depth (cm)	Sand (%)	Silt (%)	Clay (%)	pH	EC (dSm ⁻¹)	OC (g kg ⁻¹)	CaCO ₃ (g kg ⁻¹)	CEC [cmol (p ⁺) kg ⁻¹]	Ca	Mg	Na	K	ESP	BS (%)
..... c mol (p ⁺) kg ⁻¹															
Exchangeable cations															
Pedon 1 (Chikkarsinkere): Fine, mixed, calcareous isohyperthermic <i>Vertic Halaquepts</i>															
Ap	0-20	38.8	12.6	48.6	8.0	0.29	8.4	30	24.8	14.6	12.3	3.10	0.59	12.9	100
Bw1	20-39	30.8	18.1	51.1	8.5	0.15	7.4	30	27.3	11.6	11.0	4.49	0.50	16.4	100
Bw2	39-70	31.0	14.7	54.3	8.7	0.10	4.8	30	30.8	13.4	12.0	7.77	0.51	25.2	100
Bw3	70-95	29.2	10.9	59.9	8.9	0.09	4.1	30	32.9	12.9	13.3	6.63	0.51	20.2	100
Bw4	95-120	27.6	20.7	51.7	8.9	0.09	3.7	30	35.7	13.5	14.5	8.67	0.56	24.3	100
Bw5	120-150	38.2	9.2	52.6	9.2	0.10	2.6	40	38.7	19.6	14.9	9.39	0.60	24.3	100
Pedon 2 (Doddarasinkere): Fine, mixed, calcareous, isohyperthermic <i>Typic Endoaquepts</i>															
Ap	0-15	76.0	6.8	17.2	8.2	traces	9.4	0	11.9	9.0	2.1	0.46	0.19	3.9	99
A2	15-26	75.0	3.3	21.7	8.1	traces	7.7	0	15.0	12.1	1.6	0.32	0.17	2.1	95
Bw1	26-52	58.2	6.4	35.4	8.2	traces	6.7	10	19.4	19.8	3.1	0.88	0.29	4.5	100
Bw2	52-79	53.9	10.8	35.3	8.9	traces	4.9	30	20.8	22.6	1.3	1.79	0.30	1.2	100
Bw3	79-110	40.7	17.3	42.0	9.2	traces	4.3	40	27.4	33.5	4.3	4.55	0.37	0.9	100
Bw4	110-135	26.4	20.9	52.7	9.1	traces	4.0	40	27.1	35.0	5.6	8.27	0.48	30.5	100
Bw5	135-160	25.5	21.6	52.9	9.2	traces	3.7	50	35.0	43.1	4.3	10.18	0.52	29.1	100
Pedon 3 (Honnalagere): Fine-loamy, mixed, isohyperthermic <i>Typic Haplustepts</i>															
Ap	0-14	74.5	5.4	20.1	7.4	0.21	10.6	0	13.7	5.8	6.6	0.26	0.43	96	1.9
Bw1	14-34	65.8	6.2	28.0	7.6	0.21	6.5	0	16.2	7.7	6.8	0.72	0.34	96	4.4
Bw2	34-62	65.2	5.4	29.4	7.7	0.20	4.1	0	16.9	7.9	6.7	0.62	0.31	92	3.7
Bw3	62-88	65.5	7.1	27.4	7.9	0.13	3.7	0	17.1	8.2	6.9	0.64	0.33	94	3.7
Bw4	88-140	71.4	10.7	17.9	7.7	0.13	2.6	0	14.0	8.7	7.0	0.59	0.29	100	4.2
Pedon 4 (Kyathaghatta): Fine-loamy, mixed, calcareous isohyperthermic <i>Typic Haplustepts</i>															
Ap	0-13	84.2	4.5	11.3	8.9	traces	8.8	40	9.6	7.9	6.6	0.58	0.21	6.0	100
Bw1	13-35	79.5	3.4	17.1	9.3	traces	3.5	40	7.1	6.3	5.0	0.50	0.17	7.0	100
Bw2	35-69	64.6	9.3	26.1	9.4	traces	3.5	50	6.0	2.7	4.1	0.40	0.10	6.7	100
Bw3	69-104	64.3	6.4	29.3	9.4	traces	2.5	50	5.3	4.7	3.5	0.55	0.14	10.4	100
Bw4	104-131	57.2	5.6	37.2	9.4	traces	0.7	30	10.9	5.9	4.1	0.72	0.20	6.6	100
Pedon 5 (Madenahalli): Sandy over clayey, mixed, calcareous isohyperthermic, <i>Typic Ustifluvents</i>															
Ap	0-14	73.3	4.7	22.0	7.8	0.62	13.7	10	12.1	7.9	2.7	1.18	0.13	2.9	98
AC1	14-28	78.0	5.3	16.7	8.3	0.34	13.3	20	8.6	5.8	2.0	0.83	0.10	2.9	100
AC2	28-40	89.7	3.2	8.1	7.6	0.19	6.8	10	4.3	3.0	0.8	0.40	0.16	3.7	100
AC3	40-51	78.0	10.4	11.6	7.6	0.17	6.8	0	6.2	3.9	1.7	0.49	0.09	2.2	100
AC4	51-73	69.5	12.0	18.5	7.6	0.56	6.5	0	9.4	6.1	2.1	0.77	0.11	2.9	97
AC5	73-89	51.2	13.0	35.8	7.8	0.60	5.7	0	17.7	12.5	3.4	1.14	0.15	3.6	97
AC6	89-113	46.9	12.6	40.5	7.4	0.59	5.3	0	21.8	12.4	8.9	1.08	0.16	1.3	100

Table 3. Range and mean values of physico-chemical properties of lowlands of Chikkarsinkere hobli

Ranges	Soil properties													
	Sand (%)	Silt (%)	Clay (%)	EC (dSm ⁻¹)	pH	OC g k ⁻¹	CaCO ₃ g k ⁻¹	CEC cmol (p+) kg ⁻¹	Exchangeable cations			ESP	BS (%)	
									Ca	Mg	Na	K		
									----- cmol (p+) kg ⁻¹ -----					
Minimum	25.5	3.2	8.1	0.09	7.4	0.7	0	0.57	2.7	0.8	0.26	0.09	0.9	1.9
Maximum	89.7	21.6	59.9	0.62	9.4	13.7	50	38.7	43.1	14.9	10.18	0.6	100	100
Mean	57.6	10.10	32.5	0.27	8.4	5.95	20.62	15.88	13.24	6.0	2.76	0.30	25.95	81.43

Table 2. Classification of the soils identified in lowlands of Chikkarsinkere Hobli

Soil Series	Family or Higher Taxonomic Class	Area (ha)	Total area of Hobli (%)
Chikkarasinakere	Fine, mixed, calcareous, isohyperthermic, <i>Vertic Halaquepts</i>	522	3.1
Doddarasinakere	Fine, mixed, calcareous, isohyperthermic, <i>Typic Endoaquepts</i>	1357	8.0
Honnalagere	Fine-loamy, mixed, isohyperthermic, <i>Typic Haplustepts</i>	213	1.3
Madenahalli	Sandy over Clayey, mixed, calcareous isohyperthermic, <i>Typic Ustifluvents</i>	356	2.1
Kyathaghatta	Fine-loamy, mixed, calcareous, isohyperthermic, <i>Typic Haplustepts</i>	2487	14.8

Soil morphology

Soils of Chikkarsinkere-1 (Cak) series occurring on lowlands were deep, moderately well to somewhat poorly drained with slow permeability, clay texture, moderate to very strongly alkaline pH (8.0 to 9.2), non-saline (ECe: 0.09-0.29), brown (10YR 4/3) to very dark gray (10YR 3/1) color and classified as fine, mixed, calcareous isohyperthermic *Vertic Halaquepts*. These soils occur on nearly level lowlands with <1 per cent slopes at an elevation of 610 m above MSL. The soils of Doddarsinkere-2 (Dak) series occurring on lowlands are very deep, moderately well drained with moderate permeability, sandy loam surface texture and sandy clay loam sub-surface texture, moderate to very strongly alkaline pH (8.1-9.2), dark brown (10YR 3/3) to dark gray (10YR 4/1) color, calcareous and classified as fine, mixed, calcareous, isohyperthermic, *Typic Endoaquepts* which are developed on weathered granite. The soils of Honnalagere-3 (Hlr) series were deep, moderately well drained with moderately rapid permeability, sandy clay loam surface texture, slightly alkaline pH (7.4-7.9), non-saline (ECe: 0.13-0.21), very dark grayish brown (10YR 3/2) to brownish yellow (10YR 6/6) in colour and classified as fine-loamy, mixed, isohyperthermic *Typic Haplustepts*. The soils of Kyathaghatta-4 (Kgt) series were deep, moderately well drained with moderately rapid permeability, sandy loam surface texture followed by

sandy clay loam sub-surface texture, very strongly alkaline pH (8.9-9.4), very dark grayish brown (10YR 3/2) and brownish yellow (10YR 6/6) in colour and classified as fine-loamy, mixed, calcareous isohyperthermic *Typic Haplustepts*. The Madenahalli-5 (Mnl) series occurring on lowlands are deep, moderately well to well drained with moderate permeability, slightly to moderately alkaline pH (7.4-8.3), non-saline (ECe: 0.17-0.62), sandy clay loam texture, very dark gray (10YR 3/1) to dark yellowish brown (10YR 4/4) in colour and classified as sandy over clayey, mixed, calcareous, isohyperthermic *Typic Ustifluvents*.

Physico-chemical characteristics

Physico-chemical characteristics of the soils are presented in Table 3. The sand content in lowland soils of Chikkarsinkere Hobli ranged from 25.5 to 89.7 per cent with a mean value of 57.6 per cent, silt content ranged from 3.2 to 21.6 per cent with a mean value of 10.1 per cent and clay content ranged from 8.1 to 59.9 per cent with a mean value of 32.5 per cent. The sand content was higher in surface horizons of lowlands, whereas higher clay content was found in the sub-surface horizons because of the illuviation of fine fractions from the surface layers. Sand content in soils of lowlands of higher altitude was higher and decreased with increasing depth. The silt content in all the pedons have irregular trend with the

depth. The pH of the soils ranged from 7.4 to 9.4 with a mean value of 8.4, electrical conductivity ranged between 0.09 to 0.62 dSm⁻¹ with an average value of 0.27 dSm⁻¹, OC varied from 0.7 to 13.7 g kg⁻¹ with a mean value of 5.95 g kg⁻¹, CaCO₃ ranged between 0 to 50 g kg⁻¹ with a mean value of 20.62 g kg⁻¹.

Exchangeable properties

Cation exchange capacity of typifying pedons ranged from 0.57 to 38.7 cmol (p⁺) kg⁻¹ with an average value of 15.18 cmol (p⁺) kg⁻¹. The CEC increased with increase in clay content of the pedons. Higher values of CEC in sub-surface horizon commensurate with the amount of clay ($r = 0.853^*$). The CEC increased with depth in the pedons of Chikkarsinkere and Doddarsinkere series due to increase in clay content of lower horizons. The CEC decreased with depth in the pedons Honnalagere, Kyathaghatta and Madenahalli series due to variation in clay and organic matter content (Mishra and Ghosh 1995).

The exchangeable bases had distinct pattern regarding their sequential dominance. In all the pedons, the order followed was Ca>Mg>Na>K. The Ca²⁺ in soils ranged from 2.7 to 43.1 cmol (p⁺) kg⁻¹, with a mean value of 13.24 cmol (p⁺) kg⁻¹, Mg²⁺ ranged from 0.8 to 14.9 cmol (p⁺) kg⁻¹ with a mean value of 6.0 cmol (p⁺) kg⁻¹, Na⁺ ranged from 0.26 to 10.18 cmol (p⁺) kg⁻¹, with a mean value of 2.76 cmol (p⁺) kg⁻¹ and K⁺ ranged from 0.09 to 0.6 cmol (p⁺) kg⁻¹ with a mean value of 0.30 cmol (p⁺) kg⁻¹ (Table 3). The variation observed in base saturation percentage (BSP) indicates the degree of leaching which was used as diagnostic character for classifying the soil orders. High base saturation was due to high Ca²⁺ followed by Mg²⁺, Na⁺ and K⁺ (Patil and Dasog 1997).

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