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Characterization and Classification of Soils of Harve-1 Microwatershed of Chamarajanagar District, Karnataka, India

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Authors' contributions

This work was carried out in collaboration among all authors. Author RH approved the study and sanctioned the fund. Author MBMK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author KVN corrected the manuscript and managed the analyses of the study. Author KVS prepared the maps in GIS environment. Author BAD managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The detailed survey of the microwatershed was carried out by using digitized cadastral map as a base. The objective of the investigation was undertaken to characterize and classify the soils of Harve-1 microwatershed of Chamarajanagar district, Karnataka.
Place and Duration of Study: soil survey was done and soil samples were collected from Harve-1 microwatershed of Chamarajanagar district in the year 2016. The laboratory characterization and soil classification work was done at National Bureau of soil survey and land use planning, Regional centre Hebbal, Bangalore, Karnataka.
Methodology: Using Cartosat-1 and LISS-IV merged satellite data at the scale of 1:7920 were used in conjunction with the cadastral map as a base. Soil profiles were exposed and location of soil profiles was recorded using GPS and studied from each landform for describing morphological

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characteristic as per the guidelines given in USDA soil survey manual (Soil Survey Staff 2014). Based on the soil-site characteristics, ten soil series were identified using the method employed by Reddy (2006). Horizon wise soil samples were collected, processed and analysed for various properties by adopting standard procedure.

Results: The study showed that, the soils were moderately shallow to moderately deep in depth. The colour of the soils varied from dark red to dark reddish brown. Texture of the soil varied from sandy loam to sandy clay loam in surface and sandy clay loam to sandy clay in subsurface. The structure was weak medium sub-angular blocky to moderate medium sub-angular blocky throughout the profile in all series. The consistency of majority of the soils were friable, slightly sticky and slightly plastic in surface and friable, moderately sticky and moderately plastic in subsurface. Soil reaction varied from slightly acidic to alkaline (5.70 to 8.18) in nature. Organic carbon content of the soils was low to high (0.20 to 1.24 per cent). Calcium and magnesium are dominant exchangeable cations followed by sodium and potassium. The CEC of the soils ranged from 3.17 to 25.76 cmol (p^+) kg^{-1}. Major proportion of soil series in the microwatershed belonged to the order of Alfisols (Paralitic Rhodustalfs, Typic Rhodustalfs, Typic Haplustalfs and Rhodic Paleustalfs) except Honnenahalli (HNH) series belong to the order of Inceptisols (Typic Haplustepts).

Conclusion: The soils of the microwatershed were comes under the order of alfisols and inceptisols. This generated information can help the researchers, farmers and planners to manage the natural resources for future planning and also to achieve sustainable productivity.

Keywords: Characterize; classify; microwatershed; series; alfisol; inceptisol.

1. INTRODUCTION

Land and water are the most vital natural resources of the country and these are under tremendous stress due to ever increasing biotic pressure. Characterization of soils is fundamental to all soil studies, as it is an important tool for soil classification, which is done based on soil properties. It also provides information for understanding of the physical, chemical and mineralogical properties of the soils and an insight into the potentials and limitations of the soils for management. The soil and land resource inventories made so far in Karnataka had limited utility because the surveys were of different types, scales and intensities at different times with specific objectives. Hence, there is need to generate detailed site-specific farm level database on different land resources for all the village/watersheds in a time bound manner that would help to protect the valuable land resources and also to stabilize the farm production [1]. An understanding of types of soils and their distribution, constraints and potentials are important for proper management to increase productivity and crop yield [2]. Study of soils within a watershed has increasingly been attempted as it offers diverse soils to form due to4 the topographic variation present in a watershed [3]. Soil Characterization provides the information for understanding of the physical, chemical, mineralogical and microbiological properties of the soils which are highly essential to grow crops, sustain forest and grasslands as well as to support homes and society structures [4].

In the recent past, concepts of watershed based holistic development has emerged as one of the potential approaches, which can lead to higher productivity and sustainability in agricultural production through conservation of soil and water resource [5]. Detailed soil survey is useful in deciding sustainable agricultural land use options. It also provides adequate information in terms of land form, slope, land use as well as characteristics of soils (viz., texture, depth, structure, stoniness, drainage, acidity, salinity etc.) which can be utilized for the planning and development. Detailed soil survey was undertaken to characterize and classify the soils of Harve-1 Microwatershed of Chamarajanagar district, Karnataka. System of farming in this area has changed gradually during last many years, hence, it was felt imperative to characterise these soils.

2. MATERIALS AND METHODS

The study area of Harve-1 microwatershed is located in the southern part of Karnataka in Chamarajnagar Taluk and District, Karnataka State (Fig. 1). It comprises parts of Mudanakodu, Harve, Kethahalli, Kethanapura and Maliyur villages. It lies between 76°47'8.05"

and 76°49'19.33" East longitudes and 11°55'29.62" and 11°57'48.90" North latitudes and covers an area of 514 ha. Geology of the study area is granite-gneiss of the Archaen age. They are essentially pink to gray granite gneisses and it is the major rock types in the watershed. The elevation ranges from 800 to 900 m above mean sea level (MSL). About 62 per cent of the area has very gently sloping (1-3% slope) lands and about 28 per cent area is nearly level (0-1% slope) lands. The climate is semiarid and categorized as drought- prone with an average annual rainfall of 769 mm, of which about 316 mm is received during south-west monsoon, 252 mm during north-east and the remaining 201 mm during the rest of the year. The mean maximum temperature of 32.6°C to 34°C. Length of growing period (LGP) ranges from 120 to 150 days.

The detailed survey of the land resources occurring in the microwatershed was carried out by using digitized cadastral map as a base. The cadastral map shows field boundaries with their survey numbers, location of tanks, streams and other permanent features of the area. Apart from the cadastral map, remote sensing data products from Cartosat-1 and LISS-IV merged at the scale of 1:7920 were used in conjunction with the cadastral map to identify the rock types, the landscapes, landforms and other surface features. The imagery helped in the identification and delineation of boundaries between hills, uplands and lowlands, water bodies, forest and vegetated areas, roads, habitations and other cultural features of the area. The cadastral map was overlaid on the satellite imagery that helps to identify the parcel boundaries and other permanent features. Apart

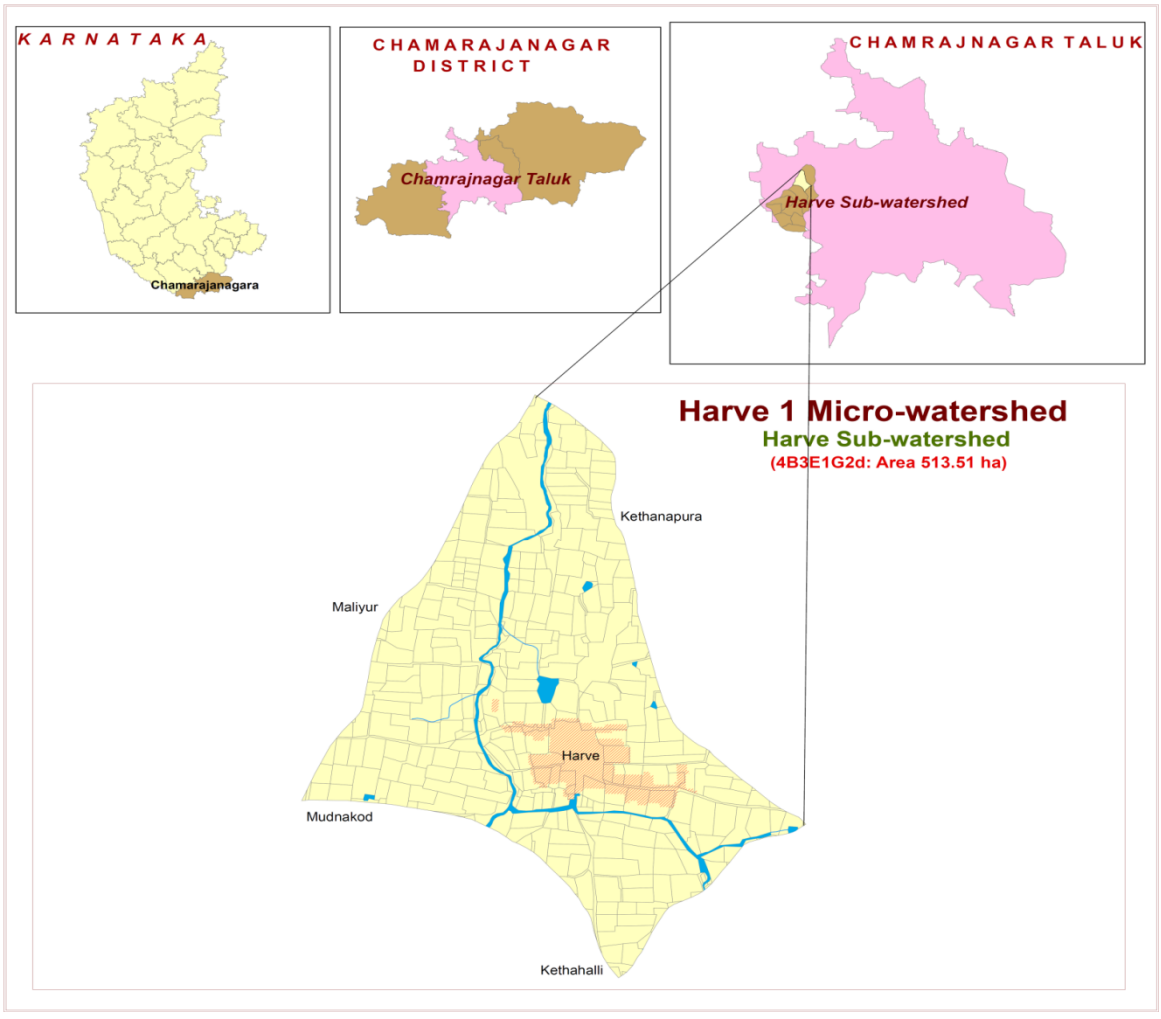

Fig. 1. Location map of Harve-1 microwatershed

from cadastral maps and images, toposheets of the area (1:50,000 scale) were used for initial traversing, identification of geology and landforms, drainage features, present land use and also for selection of transects in the microwatershed. In the selected sites, profiles (vertical cut showing the soil layers from surface to the rock) were opened up to 200 cm or to the depth limited by rock or hard substratum and studied in detail for all their morphological and physical characteristics. The soil and site characteristics were recorded for all profile sites on a standard proforma as per the guidelines given in USDA Soil Survey Manual [6]. Apart from the transect study, profiles were also studied at random, almost like in a grid pattern, outside the transect areas. Based on the soil-site characteristics, ten soil series (soil series is the most homogeneous unit having similar horizons and properties and behaves similarly for a given level of management) were identified using the method employed by Reddy [7]. The ten identified soil series such as Harve (HRV), Lakkur (LKR), Mukahadahalli (MKH), Thammadahalli (TDH), Honnenahalli (HNH), Kutegoudanahundi (KGH), Kethanapura (KTP), Gollarahatti (GHT), Hooradhahalli (HDH) and Balapur (BPR). Horizon wise soil samples were collected, processed and analysed for particle size distribution, pH, EC, organic carbon, exchangeable bases, cation exchange capacity and base saturation following the procedure outlined by Sarma et al. [8].

3. RESULTS AND DISCUSSION

In the study area its characterization and classification of soils with respect to morphological, physical and chemical characteristics and classification of series was assessed. The results obtained are presented and discussed below.

3.1 Morphological Characteristics

The morphological characteristics of the soil showed that most of the soils were moderately shallow to moderately deep in depth. The colour of the soils of identified series were dark red to dark reddish brown in colour with hue of 5 and 2.5 YR, value of 3 to 4 and chroma of 3 to 6. Dinesh et al. [9] reported that, the variation in the soil colour was a function of textural makeup, topographic position, mineralogy, chemical composition and moisture regimes of the soil. The texture of the soil is sandy clay loam in Harve (HRV), Honnenahalli (HNH), Kutegoudanahundi (KGH) and Gollarahatti (GHT) series whereas Lakkur (LKR), Mukahadahalli (MKH), Thammadahalli (TDH), Kethanapura (KTP), Hooradhahalli (HDH) and Balapur (BPR) series, the texture is dominantly sandy clay. Generally, heavy texture in subsurface horizon might be due to illuviation of clay and higher rate of weathering in subsurface horizon [10]. The structure of the soils were weak fine to weak medium subangular blocky in surface and moderate medium subangular blocky in subsurface soils of Mukahadahalli (MKH), Honnenahalli (HNH), Kutegoudanahundi (KGH), Kethanapura (KTP) and Hooradhahalli (HDH) series. The structure of the soils of Harve (HRV), Thammadahalli (TDH) and Gollarahatti (GHT) series were moderate medium subangular blocky in both surface and subsurface soils but in Lakkur (LKR) and Balapur (BPR) series were moderate medium subangular blocky in surface and weak medium subangular blocky in subsurface soils. The identified series were thin pachy cutans in subsurface soils except in Hooradhahalli (HDH) series (thick patchy cutans). The consistence of majority of the soils of identified series were friable, slightly sticky and slightly plastic in surface and friable, moderately sticky and moderately plastic in subsurface except in series of Thammadahalli (TDH), Kethanapura (KTP), Hooradhahalli (HDH) and Balapur (BPR) were friable, non sticky and non plastic in surface and friable, moderately sticky and moderately plastic in subsurface soils (Table 1).

3.2 Physical Characteristics

The distribution of particle size (Table 2) in surface to subsurface showed that the sand content varied from 43.09 to 85.71 per cent and it was higher at surface horizons as compared to subsurface horizon due to intermittent erosion and or clay translocation [11]. Silt content was varied from 5.63 to 27.63 per cent, the distribution was decrease with depth in Lakkur (LKR), Mukahadahalli (MKH), Kutegoudanahundi (KGH) and Hooradhahalli (HDH) series and irregular in most of the series, which might be due to variation in weathering of parent material or in-situ formation [12]. The variation of clay content from 5.84 to 48.31 per cent, the distribution was increase with depth in most of the series due to vertical migration of clay [13] and variability of weathering in different horizons and irregular with depth in Harve (HRV), Honnenahalli (HNH), Kethanapura (KTP) and Balapur (BPR) series.

3.3 Chemical Characteristics

The chemical characteristics of soils are presented in Table 2. The pH of the soils was slightly acidic to alkaline in reaction (5.70 to 8.18). This wide variation of pH in soils was attributed to the nature of the parent material, leaching, presence of calcium carbonate and exchangeable sodium. Increasing trend of pH (neutral to alkaline) with depth (Kutegoudanahundi (KGH), Kethanapura (KTP), Gollarahatti (GHT) and Balapur (BPR) series) might be due to the presence of exchangeable bases brought by runoff water in surface horizons and also prevalence of higher temperature during most part of the year resulting accumulation of soluble salts in surface to subsurface [14]. Majority of the soil series shows irregular in pH distribution and decrease with depth in Lakkur (LKR) and Thammadahalli (TDH) series. Thangasamy et al. [15] reported that the variation in soil pH is associated with parent material, rainfall and topography. The identified soil series were nonsaline in nature. This may be due to free drainage conditions, which removed the released bases by percolation or by drainage water. These results were in conformity with the findings of Kumar [16]. Organic carbon content of the soils was low to high and varied from 0.20 to 1.24 per cent. In surface soils, the distribution of organic carbon was high in Harve (HRV), Honnenahalli (HNH), Kutegoudanahundi (KGH) and Kethanapura (KTP) series due to low removal or depletion of organic carbon from the surface and continuously under cropping and seasonal addition of plant biomass will enhance high organic carbon in surface soil. Decrease OC with depth in majority of the soil series due to degradation of organic matter occurring at a faster rate coupled with low vegetative cover [17].

The exchangeable bases exhibited regular and irregular trends because of topographic position. Among exchangeable cations, calcium was dominant [1.5 to 19.71 cmol (p^+) kg^{-1}] in all the identified series followed by magnesium [0.60 to 6.59 cmol (p^+) kg^{-1}], sodium [0.02 to 1.32 cmol (p^+) kg^{-1}] and potassium [0.07 to 0.98 cmol (p^+) kg^{-1}]. Dinesh et al. [9] reported similar results in north-eastern Haryana. Exchangeable calcium had positive correlation with clay and pH. Presence of exchangeable Na and K in low amounts in soils might be due to preferential losses of monovalent cations over divalent cations in leaching under high rainfall condition [18]. Cation exchange capacity (CEC) showed variation in all the soils and ranged from 3.17 to 25.76 cmol (p^+) kg^{-1}. The CEC values largely influenced by the high clay content in black soils are attributed to their smectite clay mineralogy [19]. CEC increased with depth in all the identified series which may be related to the higher clay content down the profile. Similar results were obtained by Sharma and Anil Kumar [20]. Base saturation ranges from 63.48 to 100 per cent which was found to increase trend with depth. This may be attributed to the removal of bases by water. The influence of exchangeable Ca^{2+} and Mg^{2+} contributed for higher base saturation in these soils. Same results were also reported by Srinivasan et al. [21] and Meena et al. [22].

3.4 Soil Classification

Based on the morphological, physical and chemical characteristics of the identified series, the series were classified (Table 3) under order Alfisols due to presence of argillic endopedon and ochric epipedon. The base saturation was more than 35 per cent throughout the profile. At suborder level it was ustalfs due to presence of ustic moisture regime. Rhodustalfs, Haplustalfs and Paleustalfs were keyed out at the isohyperthermic temperature regime because of the reason that mean annual soil temperatures of >22°C and the difference between the mean summer and mean winter temperatures were <5°C and classified as super active. The Harve (HRV) series classified as loamy-skeletal, mixed and paralithic subgroup. Kutegoudanahundi (KGH) and Gollarahatti (GHT) series were classified as fine-loamy, mixed and Typic subgroup. Thammadahalli (TDH) and Kethanapura (KTP) series were classified under fine, mixed family with Rhodic subgroup. The Lakkur (LKR), Mukhadahalli (MKH), Hooradhahalli (HDH) and Balapur (BPR) series were classified under the family of clayey-skeletal, mixed with Typic and Rhodic subgroup. Honnenahalli (HNH) series were classified as Inceptisols at order level due to cambic endopedon and at sub order level keyed out as Ustepts because of ustic soil moisture regime. The base saturation was more than 60 per cent throughout the horizon. These characters indicated that, the identified series represent the central concept of ustepts. So, the Honnenahalli (HNH) series was grouped under Haplustepts at great group level and it comes under the family of fine-loamy, mixed with Typic subgroup.

Table 1. Morphological features of Harve-1 microwatershed of Chamarajanagar district, Karnataka, India

Depth cm	Horizon	Color (moist)	Structure	Texture	Consistence	Special features
Harve (HRV)						
0-15	Ap	2.5 YR 4/6	m2sbk	scl	fr, ms, mp	-
15-29	Bt1	2.5 YR 3/6	m2sbk	sc	fr, ms, mp	T tn p
29-47	Bt2	2.5 YR 3/4	m2sbk	scl	fr, ms, mp	T tn p
Lakkur (LKR)						
0-21	Ap	2.5 YR 3/6	m2sbk	sl	fr, ss, sp	-
21-35	Bt1	2.5 YR 2.5/3	m2sbk	sc	fr, ms, mp	-
35-56	Bc	2.5 YR 2.5/4	m1sbk	sc	fr, ms, mp	-
Mukahadahalli (MKH)						
0-19	Ap	5 YR 3/3	m1sbk	scl	vfr, ss, sp	-
19-32	Bt	5 YR 3/3	m2sbk	scl	fr, ms, mp	T tn p
32-58	Bt	5 YR 3/2	m2sbk	sc	fr, ms, mp	tn p
Thammadahalli (TDH)						
0-25	Ap	7.5 YR 4/6	m2sbk	ls	fr, s0, p0	-
25-65	Bt	2.5 YR 3/6	m2sbk	sc	fr, ss, sp	-
Honnenahalli (HNH)						
0-20	Ap	10 YR 4/3	m1sbk	scl	fr, ms, mp	-
20-35	Bw1	10 YR 4/3	m2sbk	sc	fr, ms, mp	-
35-50	Bw2	10 YR 3/1	m2sbk	scl	fr, ms, mp	-
50-70	Bw3	10 YR 3/2	m2sbk	scl	fr, ms, mp	-
Kutegoudanahundi (KGH)						
0-12	Ap	7.5 YR 3/4	m1sbk	sl	fr, ss, sp	-
12-35	Bt1	7.5 YR 3/4	m2sbk	scl	fr, ms, mp	T tn p
35-58	Bt2	7.5 YR 3/3	m2sbk	scl	fr, ms, mp	tn p
58-72	Bc	7.5 YR 4/4	m2sbk	scl	fr, ss, sp	-
Kethanapura (KTP)						
0-18	Ap	2.5 YR 3/1	fr1sbk	ls	fr, s0, p0	-
18-38	Bt1	2.5 YR 3/3	m1sbk	sc	fr, ms, mp	T tn p
38-73	Bt2	2.5 YR 3/4	m1sbk	sc	fr, ms, mp	tn p
Gollarahatti (GHT)						

Depth cm	Horizon	Color (moist)	Structure	Texture	Consistence	Special features
0-26	Ap	7.5 YR 4/4	m2sbk	ls	fr, ss, sp	-
26-63	Bt1	2.5 YR 3/6	m2sbk	scl	fr, ms, mp	T tn p
63-84	Bt2	2.5 YR 4/4	m2sbk	scl	fr, ms, mp	-
Hooradhahalli (HDH)						
0-18	Ap	7.5 YR 4/4	m1sbk	sl	fr, s0, p0	-
18-33	Bt1	2.5 YR 3/4	m2sbk	scl	fr, ms, mp	T tk p
33-58	Bt2	2.5 YR 5/4	m2sbk	sc	fr, ms, mp	T tk p
58-90	Bt3	2.5 YR 5/4	m2sbk	c	fr, ms, mp	T tk p
Balapur (BPR)						
0-12	Ap	5 YR 4/6	m2sbk	sl	fr, s0, p0	-
12-34	Bt1	2.5 YR 3/4	m2sbk	scl	fr, ss, sp	T tn p
34-60	Bt2	2.5 YR 3/4	m2sbk	sc	fr, ms, mp	T tn p
60-84	Bt3	2.5 YR 3/6	m1sbk	sc	fr, ms, mp	T tn p
84-112	Bt4	2.5 YR 3/4	m1sbk	sc	fr, ms, mp	T tn p
112-127	Bc	2.5 YR 3/4	m1sbk	scl	fr, ms, mp	T tn p

Table 2. Physico-chemical properties of the soils of Harve-1 microwatershed of Chamarajanagar district, Karnataka, India

Depth cm	Horizon	Particle size distribution			pH (1:2.5)	EC (1:2.5) dsm^{-1}	OC (%)	Exchangeable bases [Cmol (p^+) kg^{-1}]				CEC [Cmol (p^+) kg^{-1}]	Base saturation (%)
		Sand (2.0-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)				Ca	Mg	K	Na		
Harve (HRV)													
0-15	Ap	65.64	9.07	25.28	6.05	0.21	0.93	8.89	1.96	0.50	0.08	11.24	100
15-29	Bt1	56.13	7.75	36.12	5.99	0.15	0.29	9.72	2.75	0.51	0.09	12.71	100
29-47	Bt2	63.42	6.53	30.05	6.07	0.11	0.38	9.35	2.47	0.49	0.06	12.71	97.29
Lakkur (LKR)													
0-21	Ap	74.00	8.34	17.66	8.18	0.30	0.56	-	-	0.31	0.55	12.19	100
21-35	Bt1	54.37	10.48	35.14	8.17	0.30	0.52	-	-	0.19	0.84	22.18	100
35-56	Bc	48.37	13.46	38.17	7.95	0.46	0.48	-	-	0.24	0.58	22.94	100
Mukahadahalli (MKH)													
0-19	Ap	65.71	8.83	25.46	7.38	0.09	0.20	8.97	4.32	0.26	0.22	14.84	93
19-32	Bt	55.89	11.13	32.98	7.50	0.10	0.41	15.98	3.27	0.16	0.50	20.88	95
32-58	Bt	47.95	10.41	41.63	7.46	0.17	0.49	19.71	4.53	0.23	1.32	25.76	100
Thammadahalli (TDH)													
0-25	Ap	85.71	7.34	6.94	7.49	0.18	0.35	-	-	0.08	0.52	3.57	100
25-65	Bt	47.76	7.96	44.28	7.32	0.17	0.35	-	-	0.15	1.31	13.87	100
Honnenahalli (HNH)													
0-20	Ap	45.76	27.63	26.65	7.94	0.99	1.24	14.78	2.59	0.10	0.38	18.00	99.15
20-35	Bw1	53.87	20.02	26.11	7.68	0.09	0.81	15.03	3.02	0.10	0.32	18.40	100.34
35-50	Bw2	61.98	12.47	25.54	7.63	0.06	0.48	14.28	2.91	0.10	0.28	17.50	100.37
50-70	Bw3	62.35	10.44	27.21	7.67	0.06	0.48	13.78	2.29	0.13	0.36	18.20	90.99
Kutegoudanahundi (KGH)													
0-12	Ap	79.84	7.93	12.23	6.66	0.09	0.83	6.39	1.56	0.21	0.08	8.22	100
12-35	Bt1	64.49	9.69	25.82	7.39	0.06	0.73	-	-	0.25	0.07	14.95	100
35-58	Bt2	62.27	9.51	28.22	7.56	0.06	0.69	-	-	0.27	0.08	16.34	100
58-72	Bc	62.77	7.40	29.83	7.92	0.15	0.47	-	-	0.36	0.12	17.72	100
Kethanapura (KTP)													
0-18	Ap	83.64	10.52	5.84	6.42	0.07	1.24	2.95	0.93	0.57	0.02	4.41	100.00
18-38	Bt1	46.06	5.63	48.31	6.63	0.09	0.70	11.71	3.53	0.98	0.08	16.59	98.30

Depth cm	Horizon	Particle size distribution			pH (1:2.5)	EC (1:2.5) dsm^{-1}	OC (%)	Exchangeable bases [Cmol (p^+) kg^{-1}]				CEC [Cmol (p^+) kg^{-1}]	Base saturation (%)
		Sand (2.0-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)				Ca	Mg	K	Na		
38-73	Bt2	52.31	6.91	40.78	6.88	0.15	0.48	11.36	3.30	0.72	0.13	15.75	98.42
Gollarahatti (GHT)													
0-26	Ap	83.22	5.74	11.05	5.70	0.06	0.20	1.50	0.60	0.09	0.13	3.17	73.00
26-63	Bt1	55.91	13.36	30.73	6.26	0.04	0.24	7.35	1.55	0.09	0.17	9.89	93.00
63-84	Bt2	57.17	11.38	31.45	6.50	0.05	0.20	-	-	0.09	0.21	10.18	100.00
Hooradhahalli (HDH)													
0-18	Ap	72.56	15.17	12.27	6.54	0.07	0.60	2.68	1.38	0.44	0.42	5.84	84.07
18-33	Bt1	56.29	10.75	32.96	5.90	0.07	0.52	3.99	1.27	0.09	0.37	8.61	66.32
33-58	Bt2	46.66	10.79	42.55	6.16	0.07	0.44	4.92	1.67	0.08	0.55	10.00	72.23
58-90	Bt3	43.09	13.63	43.27	6.39	0.06	0.40	4.30	2.02	0.08	0.46	9.21	74.61
Balapur (BPR)													
0-12	Ap	65.66	18.66	15.68	6.64	0.03	0.56	1.90	1.32	0.21	0.03	5.45	63.48
12-34	Bt1	61.91	11.52	26.57	6.99	0.02	0.48	3.66	1.90	0.07	0.08	7.82	72.93
34-60	Bt2	51.81	11.24	36.94	7.29	0.02	0.40	5.13	2.08	0.11	0.20	11.19	67.18
60-84	Bt3	46.61	9.02	44.37	7.50	0.02	0.32	5.83	6.36	0.13	0.23	12.38	101.43
84-112	Bt4	48.75	12.92	38.33	7.54	0.02	0.24	6.02	6.59	0.11	0.25	12.77	101.49
112-127	Bc	50.98	24.74	24.28	7.90	0.02	0.20	8.04	3.62	0.07	0.32	12.47	96.56

Table 3. Classification of soils of Harve-1 microwatershed of Chamarajanagar district, Karnataka, India

Identified series	Classification				
	Order	Suborder	Great group	Subgroup	Family
Harve (HRV)	Alfisol	Ustalfs	Rhodustalfs	Paralitic	Loamy-skeletal, mixed, isohyperthermic
Lakkur (LKR)	Alfisol	Ustalfs	Rhodustalfs	Typic	clayey-skeletal, mixed, isohyperthermic
Mukahadahalli (MKH)	Alfisol	Ustalfs	Haplustalfs	Typic	clayey-skeletal, mixed, isohyperthermic
Thammadahalli (TDH)	Alfisol	Ustalfs	Paleustalfs	Rhodic	fine, mixed, isohyperthermic
Honnenahalli (HNH)	Inceptisol	Ustepts	Haplustepts	Typic	fine-loamy, mixed, isohyperthermic
Kutegoudanahundi (KGH)	Alfisol	Ustalfs	Haplustalfs	Typic	fine-loamy, mixed, isohyperthermic
Kethanapura (KTP)	Alfisol	Ustalfs	Paleustalfs	Rhodic	fine, mixed, isohyperthermic
Gollarahatti (GHT)	Alfisol	Ustalfs	Rhodustalfs	Typic	fine-loamy, mixed, isohyperthermic
Hooradhahalli (HDH)	Alfisol	Ustalfs	Paleustalfs	Rhodic	clayey-skeletal, mixed, isohyperthermic
Balapur (BPR)	Alfisol	Ustalfs	Rhodustalfs	Typic	clayey-skeletal, mixed, isohyperthermic

4. CONCLUSION

The study revealed that, the soils were slightly acidic to neutral in reaction, non-saline and low to high in OC content. The CEC were low and exchangeable bases was dominated by Ca^{2+} followed by Mg^{2+}, Na^{+} and K^{+} ions. The soils were comes under the order of Alfisols and Inceptisols. Based on base saturation, organic carbon and clay content of the soil, the soils were classified as Paralithic Rhodustalfs, Typic Rhodustalfs, Typic Haplustalfs, Rhodic Paleustalfs and Typic Haplustepts at sub-group level. The study showed the considerable variations in morphological, physical and chemical properties of soil as they were developed from different parent materials and landforms. The application of organic matter through green manuring or application of crop residues was highly essential not only to improve the soils properties but also to achieve sustainable productivity. This generated information can help the researchers, farmers and planners to manage the natural resources for future planning and also to achieve sustainable productivity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Vasundhara R, Chandrakala M, Dharumarajan S, Kalaiselvi B, Rajendra Hegde, Singh SK. Characterization and classification of soils of Madahalli Microwatershed of Karnataka. Agropedology. 2018;28(01):42-47.
2. Niranjana KV, Ramamurthy V, Hegde R, Srinivas S, Koyal Arti, Naidu LGK, Sarkar D. Characterization, Classification and suitability evaluation of banana growing soils of Pulivendla region, Andhra Pradesh. Journal of the Indian Society of Soil Science. 2011;59:1-5.
3. Prabhavati K, Dasog GS, Saharawat KL, Patil PL, Wani SP. Characterization and Classification of soils from three agroclimatic zones of Belgavi district, Karnataka. Journal of the Indian Society of Soil Science. 2017;65:1-9.
4. Devi P, AV Naidu, MVS, Ramakrishna Rao A. Characterization and classification of sugarcane growing soils in southern agro-climatic zone: A case study in eastern mandals of chittoor district in Andhra Pradesh.Journal of the Indian Society of Soil Science. 2015;63:245-258.
5. Patil PL, Kuligod VB, Gundlur SS, Jahnavi K, Nagaral IN, Shikrashetti P, Geetanjali HM, Dasog GS. Soil fertility mapping in Dindur subwatershed of Karnataka for site specific recommendations. Journal of the Indian Society of Soil Science. 2016;64:381-390.
6. Soil Survey Staff. Soil Survey Manual, Handbook No. 18, USDA, Washington DC, USA: 2012.
7. Reddy RS. Methodology for correlation of soil series in soil survey and mapping. Agropedology. 2006;16:1-11.
8. Sarma VAK, Krishnan P, Budihal SL. Laboratory Manual Technical Bulletin. NBSS Publ. Nagpur, India. 1987.
9. Dinesh Bhat MA, Grewal KS. Characterization and classifiation of soils on different geomorphic units of northeastern Haryana, India. Agropedology. 2017;27(2):103–106.
10. Dutta M. Land use planning of Tipukjan watershed of shivasagar district using GIS and remote sensing technique. Ph.D. Thesis, Assam Agricultural University. Jorhat. 2009.
11. Arunima Gogoi, Talukdar MC, Basumatary A, Baruah U. Characterization and classification of the soils of Dorika watershed of Assam using GIS and Remote sensing techniques. J. Indian Soc. Soil Sci. 2018;66(4):341-350.
12. Kumar YSS, Naidu MVS. Characteristics and classification of soils representing major landforms in Vadamalapeta mandal of Chittoor district, Andhra Pradesh. J. Indian Soc. Soil Sci. 2012;60:63-67.
13. Vedadri U, Naidu MVS. Characterization, classification and evaluation of soils in semi-arid ecosystem of Chillakur mandal in SPSR Nellore district of Andhra Pradesh. Journal of the Indian Society of Soil Science. 2018;66:9-19.
14. Ram RL, Sharma PK, Jha P, Das N, Ahmed N. Characterization and classification of Nagarjunasagar catchement in Shorapur taluk of Gulbarga district in Karnataka. Agropedology. 2010;20:112-123.
15. Thangasamy A, Naidu MVS, Ramavatharam N, Reddy RC. Characterization, classification and evaluation of soil resources in Sivagiri micro-watershed of Chittoor district in Andhra Pradesh for sustainable land use

planning. Journal of the Indian Society of Soil Science. 2005;53:11–21.
16. Kumar MD. Characterization and classification of soils of a microwatershed on basalt parent rock in Northern transition zone of Karnataka. M. Sc. (Agri.) Thesis, University of Agricultural Sciences., Dharwad, Karnataka; 2011.
17. Rao APVP, Naidu MVS, Ramavathram N, Rama Rao G. Characterization, classification and evaluation of soils on different landforms in Ramachandrapuram Mandal of Chittoor district in Andhra Pradesh for sustainable land use planning. Journal of the Indian Society of Soil Science. 2008;56:23-33.
18. Jenny H. Behaviour of potassium and sodium during the process of soil formation. University of Missouri Agricultural Experimental Station Research Bulletin. 1931;162.
19. Pal DK, Deshpande SB. Characteristics and genesis of minerals in some benchmark Vertisols of India. Pedology. 1987;37(3):259-275.
20. Sharma VK, Anil Kumar. Characterization and classification of the soil of upper Maul Khad catchment in wet temperate zone of Himachal Pradesh. Agropedology 2003;13:39-49.
21. Srinivasan R, Natarajan A, Anil Kumar KS, Kalaivanan. Characterization of major cashew-growing soils of Dakshina Kannada district of Karnataka. Agropedology. 2013;23:59-64.
22. Meena RS, Natarajan A, Thayalan S, Hegde R, Niranjana KV, Naidu LGK, Sarkar D. Characterization and classification of lowland soils of Chikkarsinkere Hobli, Maddur taluk, Mandya district of Karnataka. Agropedology. 2014;24:95-101.

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