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Soil resource characterization of Sigehadlu micro watershed, Kadur taluk of Chikmagalur district

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Abstract
A detailed soil survey was carried out in Sigehadlu micro watershed Kadur taluk, Chikkamagaluru district of Karnataka at 1:50,000 scale. The Sigehadlu micro-watershed was selected to study and understand the pedogenic characters of the soil in different physiographic regions for summit, undulating hills, side and foot slopes due to the variability in landform which affects the crop productivity. Ten soil series were identified in the study area based on the pedological investigations of typifying pedons and physico-chemical properties. The soils were characterized by shallow to deep, Colour of soil pedons varied from 2.5YR to 10 YR 5/6 (Munsell colour chart), soil structure of pedons varied from moderate to medium sub-angular blocky to moderate medium angular blocky. Textural variations in general, varied from sandy loam to clay. The clay content increased with the depth in the majority of the pedons, distribution of silt content did not follow the definite trend in the soils of pedons. The total sand content followed an irregular trend it decreased with increasing depth. The bulk density was increased with the depth. The field capacity, permanent wilting point and available water did not follow the definite trend in the soils of micro watershed. Soils of the micro-watershed were non-saline, low medium in organic carbon and available N, available P_2O_5, available K_2O and available sulphur content medium to high. The free calcium carbonate content increased with increasing depth.

Keywords: soil characterization, micro watershed, physico-chemical properties, munsell colour chart

Introduction
The natural resources of any country are the national treasure and need proper planning to make best use of them. Therefore, sustainable management practices are urgently needed all over the world to preserve the production potential of agricultural lands. Efficient management and maintenance of soil health is the key to accomplish sustained high productivity, food security and environment safety. Yadav (2003) reported that per capita arable land in India decreased from 0.34 ha in 1950-51 to 0.15 ha in 2000-01 and is expected to shrink to 0.08 ha in 2005. No possibility of further horizontal expansion in the cultivated area seems to exist. It has been also reported that 57 per cent of the total geographical area in India is suffering from various types of land degradation problems. Soil survey constitutes a valuable resource inventory linked with the survival of life on the earth. It provides an accurate and scientific inventory of different soils, their kind and nature, and extent of distribution so that one can make prediction about their character sand potentialities. 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. Keeping this in mind, the present investigation was undertaken characterize soil in respect to morphological physical and chemical properties of Sigehadlu micro watershed, Kadur taluk of Chikkamagalur district.

Materials and Methods
Sigehadlu micro-watershed is located in Chikkamagaluru district of Kadur taluk, Karnataka state. The climate is semi-arid with a mean annual average rainfall of 600 mm. Ferruginous schist is the parent rock in the study area. Area lies between 13° 43' 39" N latitude and 76° 3' 47" E longitude and 13° 42' 13" N and 76° 4' 41" E with a spatial extent of 823.18 ha. Visual interpretation of FCC of cartosat 2.5 mts + Resourcesat-2 LISS IV MX merged data on 1:7920 scale used in conjunction with survey of India (SOI) toposheet to identify the physiographic units in the watershed (Fig 1 and 2). Soil survey was carried out using base map on 1:50,000

scale. After intensive traversing, pedon sites were located in transects along the slope from the upper to lower slopes, 23 pedons were studied depending upon soil heterogeneity, Morphological characters like colour, structure, consistency and physico-chemical properties like bulk density, water holding capacity, pH, electrical conductivity, organic carbon, cation exchange capacity, etc., were studied for the profile samples. After correlating for the above referred properties of pedons, ten representative pedons were selected and presented in the paper.

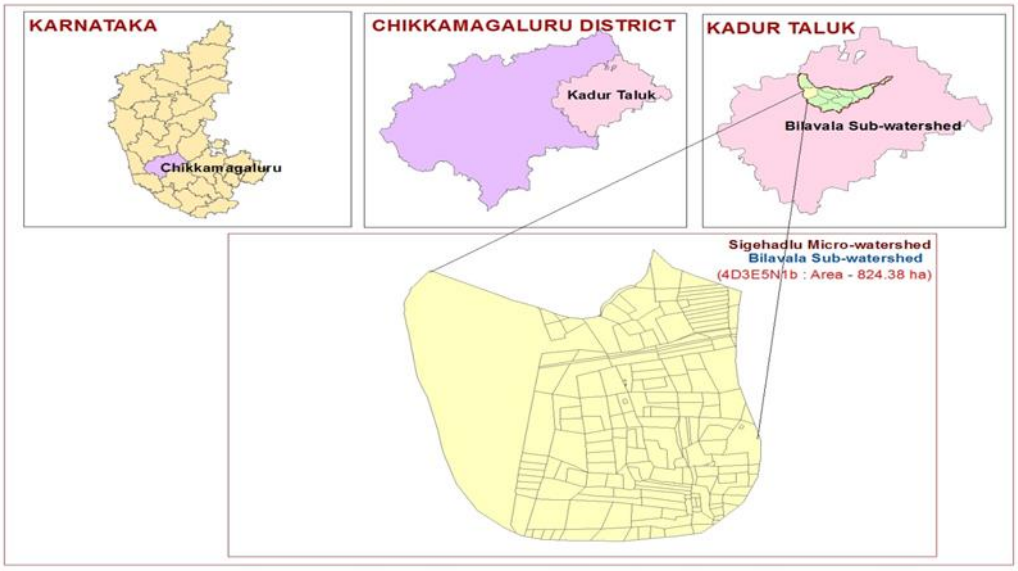

Fig 1: Location map of Sigehadlu micro-watershed

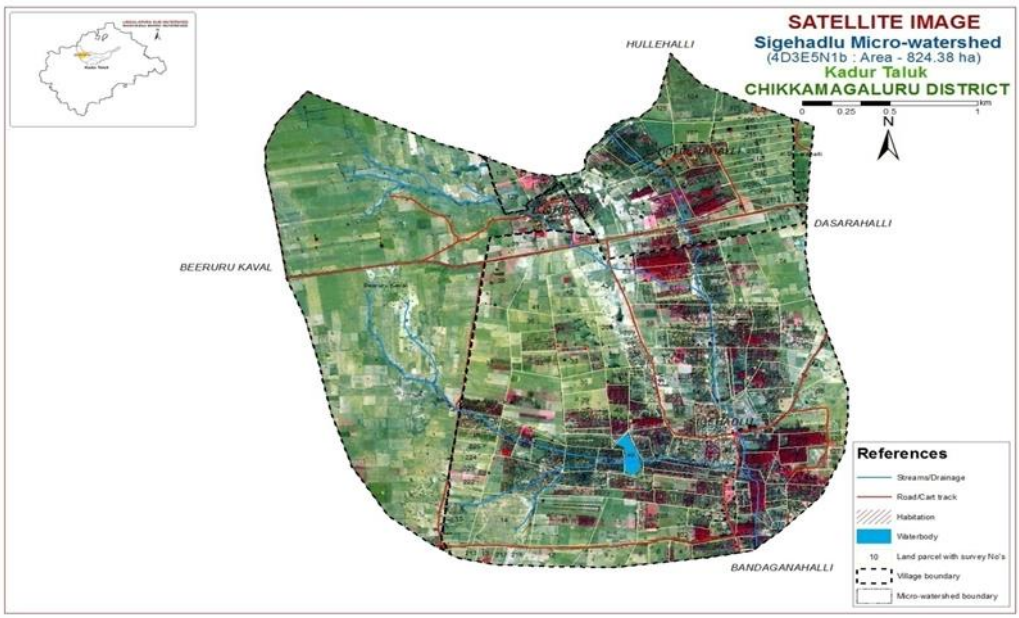

Fig 2: Cadastral map overlaid on IRS PAN+LISS IV merged imagery of Sigehadlu micro-watershed

Result and Discussion

Morphological characteristics of pedons

Soils of study area are derived from schist and ferrugenous quartzite parent rock. Based on land heterogeneity and slope ten soil pedons were identified in the micro-watershed. Selected soil pedons fall under nearly level (0-1 % slope) to gently undulating (1-3 %) slope and exhibit slight to moderate erosion with moderate to somewhat poor drainage condition.

The present investigations indicated that the pedon 4 was shallow in depth (25-50 cm), whereas pedon 1, 2, 5,7,8,9 and 10 was moderately depth (50-100 cm) and deep soil depth was (>100 cm) was observed in pedon 3 and 6. The variability in soil depth was due to the variation in topography and slope gradient. Similar observations were also made by Ram prakash and Seshagiri Rao (2002) [12]. Soil pedons, colour varied from 2.5 YR 3/4 (dark reddish brown) to 10 YR 5/6 (dark brown). The variations in soil colour might be due to the differences in content and hydration of iron oxide (Shyampura *et al.*, 1994) [16]. Whereas, the sub-surface horizons had comparatively brighter colour throughout the profile, which might be due to low organic matter content and higher iron oxide. Similar observation was made by Madhan Mohan (2008) [7] (Table 1).

The texture of Ap horizon in upland pedons was sandy loam whereas, lowland pedons was sandy clay loam to clay in texture. The finer soil texture of lowland horizon compared to uplands was mainly because of movement and deposition of finer fractions from surface similar findings were reported by Arun kumar *et al.* (2002) [1] (Table 1).

Structure was weak to moderate crumb in the surface horizons, moderate to strong sub-angular blocky in sub surface horizons. This might be due to tillage practices, organic matter addition and pressure from surface horizon resulted in development structure in surface and sub-surface layers. Similar observations were also made by Singh and Agarwal (2003) [17]. 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) [19] (Table 1).

Table 1: Morphological characteristics of the soil pedons of Sigehadlu micro watershed, Kadur taluk of Chikkamagaluru district, Karnataka

Horizon	Depth (cm)	Boundary	Color	Texture	Structure	Consistence			Roots	Special features
						Dry	Moist	Wet		
Pedon 1										
Ap	0-13	CS	5YR3/4	SCL	2msbk	sh	fr	ss&sp	fmp	-
Bt_1	13-34	CS	5YR4/4	SC	2msbk	h	fr	ms&mp	fmp	
Bt_2	34-47	CS	5YR3/4	SC	2msbk	sh	fr	ms&mp	-	
Bt_3	47-64	CS	5YR4/6	SC	1msbk	h	fr	ms&mp	-	
Cr	Weathered parent material									
Pedon 2										
Ap	0-14	CS	5YR3/4	SL	1msbk	sh	fr	ss&sp	cvf	-
Bt_1	14-31	GS	5YR3/4	SCL	1msbk	fr	fr	ss&sp	cvf	
Bt_2	31-43	GS	5YR3/4	SCL	1msbk	fr	fr	ss&sp	-	
Bt_3	43-52	GS	5YR3/4	SCL	1msbk	fr	fr	ss&sp	-	
Cr	Weathered parent material									
Pedon 3										
Ap	0-15	CS	10YR3/4	C	2abk	sh	fr	ms&mp	fcf	2cm wide cracks, more than30cm deep was observed on surface, well developed pressure face were observed
Bw_1	15-38	GS	10YR3/2	C	2abk	sh	fr	ss&sp	ff	
Bw_2	38-52	GS	10YR5/6	SC	1msbk	sh	fr	ss&sp	fc	
Bw_3	52-76	GS	10YR5/6	SCL	2msbk	sh	fr	ss&sp	-	
Bw_4	76-96	GS	10YR5/6	SL	1msbk	sh	fr	ss&sp	-	
Bw_5	96-109	GS	10YR5/6	SL	1msbk	sh	fr	fr&fr	-	
Bw_6	109-140	CS	10YR5/6	C	2abk	mh	fr	ms&mp	-	
Cr	Weathered parent material									
Pedon 4										
Ap	0-10	CS	5YR4/4	SL	1msbk	sh	fr	ms&mp	mf	-
Bt_1	10-23	CS	5YR4/4	SCL	2msbk	sh	fr	ms&mp	mf	
Bt_2	23-41	CW	5YR3/4	SC	1msbk	sh	fr	ms&mp	mf	
Cr	Weathered parent material									
Pedon 5										
Ap	0-12	CS	2.5YR3/4	SCL	1msbk	Sh	fr	ms&mp	ff	-
Bt_1	12-28	CS	2.5YR4/4	SC	2msbk	Sh	fr	ms&mp	ff	
Bt_2	28-45	CS	2.5YR4/3	SC	2msbk	Sh	Fr	ms&mp	ff	
Bt_3	45-64	CS	2.5YR3/3	SC	2msbk	H	Fr	ms&mp	ff	
Cr	Weathered parent material									

(**Note**: Structure: 0-structure less, 1-weak, 2- moderate, f- fine, m-medium, sbk-sub-angular blocky Consistence: l-loose, sh-slightly hard, h-hard fr-friable, ss- slightly sticky, sp- slightly plastic)

Continued

Horizon	Depth (cm)	Boundary	Color	Texture	Structure	Consistence			Roots	Special features
						Dry	Moist	Wet		
Pedon 6										
Ap	0-10	CS	5YR3/4	SL	1msbk	sh	fr	ss &sp		-
Bt_1	10-19	AS	5YR4/6	SCL	1msbk	sh	fr	Ss&sp		
Bw_2	19-37	CS	5YR3/4	SC	2msbk	sh	fr	ms&mp		
Bw_3	37-59	GS	5YR3/4	C	3msbk	h	fr	vs&vp		
Bw_4	59-80	GS	5YR4/4	C	3msbk	h	fr	vs&vp		
Bw_5	80-97	AS	5YR4/6	SC	2msbk	sh	fr	ms&mp		
Bw_6	97-118	CS	5YR5/6	SC	2msbk	sh	fr	ss&sp		
Cr	Weathered parent material									
Pedon 7										
Ap	0-13	CS	5YR4/4	SL	1msbk	fr	fr	ss&sp		-
Bt_1	13-32	CW	2.5YR3/6	SC	2msbk	sh	fr	ms&mp		
Bt_2	32-53	CS	2.5YR3/4	SC	2msbk	sh	fr	ms&mp		
Bt_3	53-65	CS	2.5YR3/4	SC	1msbk	sh	fr	ms&mp		
Bt_4	65-87	CS	2.5YR3/4	SC	2msbk	sh	fr	ms&mp		
Cr	Weathered parent material									
Pedon 8										

Ap	0-11	CS	5YR4/6	SL	1msbk	sh	fr	ss&sp		-
Bt_1	11-33	GS	5YR3/4	SCL	1msbk	sh	fr	ss&sp		
Bt_2	33-47	GW	5YR3/4	SCL	2msbk	sh	fr	ms&mp		
Bt_3	47-63	CS	5YR3/4	SCL	2msbk	sh	fr	ms&mp		
Bt_4	63-77	CS	5YR4/6	SCL	1msbk	sh	fr	ms&mp		
Cr	Weathered parent material									
Pedon 9										
Ap	0-13	CS	5YR4/6	SL	1msbk	fr	fr	ss&sp		-
Bt_1	13-31	CS	5YR4/6	SC	2msbk	fr	fr	ss&sp		
Bt_2	31-42	GW	5YR3/4	SC	2msbk	fr	fr	ms&mp		
Bt_3	42-56	CS	5YR3/4	SC	2msbk	fr	fr	ms&mp		
Cr	Weathered parent material									
Pedon 10										
Ap	0-13	CS	7.5YR3/4	SL	1msbk	fr	fr	ss&sp		-
Bt_1	13-26	CS	7.5YR3/4	SL	1msbk	sh	fr	ss&sp		
Bt_2	26-42	GS	7.5YR4/2	SC	1msbk	fr	fr	ms&mp		
Bt_3	42-71	GS	10 YR3/4	SC	1msbk	fr	fr	ms&mp		
Bt_4	71-94	GS	10 YR5/3	SCL	1msbk	fr	fr	ms&mp		
Cr	Weathered parent material									

(**Note**: Structure: 0-structure less, 1-weak, 2- moderate, f- fine, m-medium, sbk-sub-angular blocky Consistence: l-loose, sh-slightly hard, h-hard fr-friable, ss- slightly sticky, sp- slightly plastic)

Physical properties

The data on particle size distribution in different horizons of soil pedons revealed that the texture varied from sandy loam to clay in majority of the horizons. In almost all the pedons, surface horizons exhibited higher sand content than the sub surface horizons. This might be due to the removal of finer fractions from the upper layers by clay eluviations and surface runoff. Results were in accordance with Dasog and Patil (2011) [4]. The silt content did not fallow a regular trend in pedons of watershed area. Such irregular trend in silt content was reasoned to variation in the weathering of the parent material (Denis *et al.*, 2015) [5]. The clay content increased with the depth in the majority of the pedons. Increase in clay content with depth might be attributed to the illuviation process occurring during soil development, which also resulted in higher sand fractions in red soil pedons. Similar results were reported by Pulakeshi *et al*. (2014) [11]. The bulk density ranged from 1.18 to 1.79 mg m^{-3} in all the pedon samples followed a common pattern of increasing with increasing in depth. This might be due to lower total porosity and organic matter content in red soil pedons. The lower bulk density in the surface (AP) horizon was attributed to higher organic matter content, better and stable aggregation, and increase in the porosity of the soil. The increased bulk density with depth was attributed to increased compaction due to a load of overlying horizons (Nagendra and Patil 2015) [9]. The bulk density increased with depth due to rapid decomposition, mineralization and presence of low organic matter. The field capacity, permanent wilting point and available water did not follow a definite trend throughout the depth of all the pedons (Table 2).

Table 2: Physical properties of the soil pedons of Sigehadlu micro watershed, Kadur taluk of Chikkamagaluru district, Karnataka

Horizon	**Depth (cm)**	**Texture**	**Particle size distribution (%)**			**Moisture retention capacity (%)**			**BD ($mg\ m^{-3}$)**
			Sand	**Silt**	**Clay**	**FC**	**PWP**	**AW**	
Pedon 1									
Ap	0-13	Scl	60.75	11.75	27.50	19.94	9.02	10.92	1.25
Bt_1	13-34	Sc	49.25	13.25	37.50	19.87	4.14	15.73	1.31
Bt_2	34-47	Sc	53.50	10.45	36.05	23.53	9.09	14.44	1.34
Bt_3	47-64	Sc	51.25	12.50	36.25	16.57	5.26	11.31	1.38
Cr	**Weathered parent material**								
Pedon 2									
Ap	0-14	Sl	72.40	10.21	17.60	19.17	7.23	11.94	1.26
Bt_1	14-31	Scl	52.00	16.07	32.00	19.31	8.67	10.64	1.27
Bt_2	31-43	Scl	51.50	16.00	32.50	20.25	3.61	16.64	1.36
Bt_3	43-52	Scl	50.53	14.04	35.50	18.85	7.39	11.45	1.42
Cr	**Weathered parent material**								
Pedon 3									
Ap	0-15	C	48.03	22.31	29.66	38.49	5.00	33.49	1.37
Bw_1	15-38	C	40.36	28.00	31.64	34.02	6.67	27.35	1.31
Bw_2	38-52	Sc	38.36	29.60	32.04	20.44	5.88	14.56	1.32
Bw_3	52-76	Scl	37.59	30.01	32.44	15.51	3.45	12.06	1.34
Bw_4	76-96	Sl	36.39	30.26	33.35	15.41	5.56	10.86	1.35
Bw_5	96-109	Sl	33.02	31.29	35.69	17.86	5.26	12.60	1.34
Bw_6	109-140	C	30.38	31.60	38.02	16.49	4.13	10.49	1.28
Cr	**Weathered parent material**								
Pedon 4									
Ap	0-10	Sl	64.00	18.75	17.25	20.06	7.13	12.93	1.36
Bw_1	10-23	Scl	54.75	14.25	31.00	28.17	8.33	19.83	1.37

Bw_2	23-41	Sc	55.00	10.00	35.00	15.18	7.14	8.04	1.39
Cr	**Weathered parent material**								
Pedon 5									
Ap	0-12	Scl	55.10	14.34	31.23	23.14	1.66	22.49	1.42
Bt_1	12-28	Sc	54.24	13.23	33.29	23.08	3.07	20.01	1.33
Bt_2	28-45	Sc	49.32	15.14	34.57	20.00	6.25	23.75	1.36
Bt_3	45-64	Sc	35.18	12.27	36.14	12.16	2.66	22.49	1.29
Cr	**Weathered parent material**								

(**Note**: FC-Field capacity, PWP-Permanent wilting point, AW-Available water BD-Bulk density)

Continued

Horizon	Depth (cm)	Texture	Particle size distribution (%)			Moisture retention capacity (%)			BD (mg m^{-3})
			Sand	Silt	Clay	FC	PWP	AW	
Pedon 6									
Ap	0-10	Sl	54.50	16.00	29.50	20.38	8.34	12.04	1.28
Bw_1	10-19	Scl	51.00	15.00	34.00	21.72	9.45	12.27	1.28
Bw_2	19-37	Sc	42.00	17.00	41.00	22.82	6.67	16.15	1.29
Bw_3	37-59	C	31.00	26.60	42.40	32.37	11.40	20.97	1.32
Bw_4	59-80	C	30.00	23.00	47.00	33.26	11.11	22.14	1.33
Bw_5	80-97	Sc	35.00	20.00	45.00	23.66	8.33	15.33	1.35
Bw_6	97-118	Sc	42.00	21.00	37.00	24.19	8.22	14.25	1.38
Cr	**Weathered parent material**								
Pedon 7									
Ap	0-13	Sl	60.15	16.50	23.00	20.83	9.96	10.86	1.29
Bt_1	13-32	Sc	50.00	12.00	38.00	19.47	7.88	11.59	1.28
Bt_2	32-53	Sc	46.10	15.00	37.90	17.17	2.49	15.68	1.31
Bt_3	53-65	Sc	46.00	15.00	39.00	15.15	4.40	10.75	1.33
Bt_4	65-87	Sc	40.22	18.00	42.00	12.50	2.80	10.70	1.39
Cr	**Weathered parent material**								
Pedon 8									
Ap	0-11	Sl	70.00	10.00	18.00	19.67	8.46	11.20	1.31
Bt_1	11-33	Scl	60.00	12.00	31.00	20.92	4.48	16.44	1.33
Bt_2	33-47	Scl	52.00	13.00	35.00	22.08	5.79	16.29	1.53
Bt_3	47-63	Scl	50.00	12.00	38.00	22.30	5.31	16.99	1.59
Bt_4	63-77	Scl	54.00	16.00	30.00	20.20	5.26	14.93	1.75
Cr	**Weathered parent material**								
Pedon 9									
Ap	0-13	Sl	56.00	21.00	23.00	18.75	6.27	14.75	1.08
Bt_1	13-31	Sc	47.30	16.30	36.40	27.39	13.97	13.41	1.27
Bt_2	31-42	Sc	45.15	17.05	37.80	22.55	12.14	10.41	1.34
Bt_3	43-56	Sc	44.00	18.00	38.00	21.49	4.00	15.22	1.41
Cr	**Weathered parent material**								
Pedon 10									
Ap	0-13	Sl	52.00	27.00	21.00	17.04	2.06	14.98	1.18
Bt_1	13-26	Sl	51.00	20.00	29.00	16.63	3.69	12.94	1.23
Bt_2	26-42	Sc	45.60	17.50	36.90	20.88	5.88	15.00	1.25
Bt_3	42-71	Sc	44.50	14.60	40.90	20.38	6.67	13.72	1.37
Bt_4	71-94	Scl	65.00	13.00	30.00	17.12	5.77	11.35	1.41
Cr	**Weathered parent material**								

Chemical properties

In general, the pH (soil reaction) of soil pedons ranged from slightly acidic to moderately alkaline. Irrespective of pedons, the soil pH increased with depth pH of the soil pedons were varied from 5.83 to 7.98. This might be due leaching and accumulation of bases in the lower horizons. The electrical conductivity **(**EC) ranged from 0.10 to 0.87 dS m^{-1}, indicating that soils of the micro-watershed were non-saline. Pillai and Natarajan (2004) also reported similar low EC values indicating the non-saline nature of soils of Garakahalli watershed. The EC also increased with depth within a pedon. This was attributed to leaching of salts from surface horizon and subsequent accumulation in the lower horizons mediated by percolating rain-water (Table 3).

The soil organic carbon content was low to medium and it was ranged from 1.54 to 7.84 g kg^{-1}, throughout the profile soil organic carbon decreasing trends was observed with depth. The overall low organic carbon status of the soils of the micro-watershed was apparently due to the prevailing high temperature which caused rapid oxidation of organic matter coupled with low biomass production. These observations were in line with the findings of Basavaraju *et al.* (2005). In general, the surface soil horizon showed higher organic carbon content than underlying layers which decreased with increasing depth in all soil pedons. The higher organic carbon content of surface soil as compared to sub-surface soils in most of the pedons was obviously due to high amount of litter and crop residues left on the surface and also manures application. These results were in accordance with Vinay (2007) [20] (Table 3).

The available nitrogen content was low to medium and it was ranged from ranged from 30.26 to 338.69 kg ha^{-1}. However, available nitrogen was found high in surface horizon and decreased with soil depth which might be due to decreasing

trend of organic carbon with depth and the supplementation of depleted nitrogen by crops through the external addition of fertilizers to the surface horizons during crop cultivation (Rehman *et al*., 2017) [13]. The available phosphorus content was low to medium it was ranged from 11.05 to 59.54 kg ha^{-1}. The higher P in surface horizons was possibly due to the restriction of crop cultivation to the rhizosphere and supplementing the depleted phosphorous through fertilizers (Thangasamy *et al.*, 2005) [19]. The available phosphorus content decreased with the depth this might be attributed to its higher removal than replenishment in sub soils as well as due to higher phosphorous fixation capacity, as discussed by Sathisha and Badrinath, (1994 [14] (Table 3).

The available potassium content was low to high it was ranged from 340.84 to 101.39 kg ha^{-1}. The highest available K content was noticed in the surface horizons and showed more or less decreasing trend with depth. It could be attributed to more intense weathering, the release of labile K from organic residues, application of K fertilizers and upward translocation of K from lower depths along with the capillary rise of ground water (Thangasamy *et al*., 2005) [19]. The available sulphur content was low to high it was ranged from 7.45 to 24.63 kg ha^{-1}. It decreased with increasing depth. The high sulphur content in surface horizons may be due to higher organic matter and in lower layers attributed to the weathering intensity of sulphate minerals in soils (Rehman *et al*, 2017) [13]. The free calcium carbonate content of soils ranged from 1.15 to 9.84 per cent in general, the free calcium carbonate content increased with increasing depth. Similar results were reported by Barade and Gowaikar (1965) and Sehgal *et al*. (1968). Under semi-arid conditions, calcium and magnesium get precipitated as their carbonates and bicarbonates and move to lower layers with percolating water thus enriching lower horizons. This process was reported to cause an apparent enhancement in sodium concentration and subsequent sodification of soils (Kanwar and Kanwar, 1968) [6] (Table 3).

Table 3: Chemical properties of the soil pedons of Sigehadlu micro-watershed, Kadur taluk of Chikkamagaluru district, Karnataka

Horizon	Depth (cm)	pH	E.C (dS m^{-1})	O.C (g kg^{-1})	Available macro nutrients (kg ha^{-1})			Available S (mg kg^{-1})	Free $CaCO_3$ (%)
					N	P_2O_5	K_2O		
Pedon 1									
Ap	0-13	7.58	0.31	4.84	232.06	48.32	179.56	16.18	2.25
Bt_1	13-34	7.64	0.36	4.56	194.43	38.93	161.68	14.45	2.39
Bt_2	34-47	7.69	0.42	3.91	163.07	19.47	151.20	11.95	2.68
Bt_3	47-64	7.84	0.54	2.10	121.54	16.38	140.61	8.93	3.25
Cr	Weathered parent material								
Pedon 2									
Ap	0-14	6.32	0.10	6.51	150.53	59.54	300.52	23.83	1.55
Bt_1	14-31	6.35	0.13	6.28	137.98	50.38	251.19	15.63	2.35
Bt_2	31-43	6.56	0.18	6.24	137.98	18.32	237.75	16.18	2.68
Bt_3	43-52	6.69	0.21	5.44	131.08	13.74	193.00	15.05	2.93
Cr	Weathered parent material								
Pedon 3									
Ap	0-15	7.51	0.14	6.32	257.15	57.25	326.05	23.63	1.30
Bw_1	15-38	7.58	0.16	5.10	137.98	54.96	273.64	20.30	1.89
Bw_2	38-52	7.66	0.16	3.98	134.22	48.09	219.88	18.13	2.19
Bw_3	52-76	7.52	0.15	3.67	99.10	22.90	151.33	17.23	2.93
Bw_4	76-96	7.64	0.16	2.13	70.25	18.32	139.24	14.45	3.30
Bw_5	96-109	7.82	0.16	1.32	36.38	14.16	139.24	11.95	3.32
Bw_6	109-140	7.96	0.19	1.30	30.26	11.08	120.20	8.66	3.45
Cr	Weathered parent material								
Pedon 4									
Ap	0-10	7.53	0.13	5.46	288.51	50.38	231.84	16.88	4.14
Bt_1	10-23	7.56	0.18	5.43	228.93	43.51	141.93	13.70	5.19
Bt_2	23-41	7.59	0.24	3.47	198.07	38.32	128.92	11.95	8.93
Cr	Weathered parent material								
Pedon 5									
Ap	0-12	7.31	0.31	6.62	263.42	48.32	191.39	16.18	2.25
Bt_1	12-28	7.50	0.39	6.34	197.57	38.93	147.97	14.45	3.39
Bt_2	28-45	7.64	0.46	2.49	163.42	18.39	103.49	13.21	3.96
Bt_3	45-64	7.88	0.87	1.84	135.48	19.47	101.39	11.95	4.12
Cr	Weathered parent material								

Continued

Horizon	Depth (cm)	pH	E.C (dS m^{-1})	O.C (g kg^{-1})	Available macro nutrients (kg ha^{-1})			Available S (mg kg^{-1})	Free $CaCO_3$ (%)
					N	P_2O_5	K_2O		
Pedon 6									
Ap	0-10	7.12	0.11	7.50	338.69	44.96	340.84	24.63	3.98
Bw_1	10-19	7.14	0.13	5.75	313.60	27.48	300.52	22.40	4.69
Bw_2	19-37	7.26	0.16	5.43	133.59	25.19	260.20	18.95	5.90
Bw_3	37-59	7.34	0.17	3.97	125.44	22.90	128.49	17.23	5.93

Bw_4	59-80	7.52	0.16	3.08	99.10	19.16	122.57	14.45	4.75
Bw_5	80-97	7.86	0.18	1.58	73.38	17.87	115.05	10.30	4.96
Bw_6	97-118	7.91	0.21	1.54	55.62	12.05	110.06	8.65	6.39
Cr	Weathered parent material								
Pedon 7									
Ap	0-13	6.61	0.10	6.79	250.88	27.48	179.56	21.90	3.28
Bt_1	13-32	6.87	0.25	6.64	169.34	26.56	156.04	19.80	4.96
Bt_2	32-53	6.89	0.31	5.15	112.90	25.19	119.75	15.95	5.93
Bt_3	53-65	6.92	0.42	4.24	92.76	18.78	109.42	15.58	7.08
Bt_4	65-87	6.98	0.70	1.56	84.60	16.95	101.93	12.25	7.18
Cr	**Weathered parent material**								
Pedon 8									
Ap	0-11	5.83	0.09	6.30	319.87	42.00	313.96	16.43	1.15
Bt_1	11-33	5.99	0.11	6.09	131.71	32.15	260.20	11.40	1.29
Bt_2	33-47	6.66	0.15	5.45	131.71	21.83	245.28	9.73	1.94
Bt_3	47-63	6.85	0.19	5.43	74.01	17.86	166.12	7.80	2.19
Bt_4	63-77	7.12	0.24	3.61	50.18	17.48	139.24	7.45	2.25
Cr	**Weathered parent material**								
Pedon 9									
Ap	0-13	6.31	0.14	7.21	200.70	22.90	233.72	17.80	4.55
Bt_1	13-31	7.20	0.18	3.96	194.43	20.61	174.18	13.48	5.00
Bt_2	31-42	7.91	0.21	3.30	169.34	17.40	150.93	10.00	6.63
Bt_3	42-56	7.98	0.28	2.45	131.54	16.03	138.03	8.90	8.07
Cr	**Weathered parent material**								
Pedon 10									
Ap	0-13	7.26	0.13	7.84	296.70	52.67	263.29	15.75	5.94
Bt_1	13-26	7.48	0.26	7.28	214.43	43.51	191.25	15.85	6.14
Bt_2	26-42	7.52	0.27	7.29	189.34	32.06	146.23	10.93	7.35
Bt_3	42-71	7.56	0.31	5.70	152.17	22.90	111.42	10.28	9.84
Bt_4	71-94	7.77	0.34	4.55	110.03	18.03	104.40	9.45	4.71
Cr	**Weathered parent material**								

Conclusion

The study of morphological, physical and physico-chemical analysis of soil samples revealed that the soils of Sigehadlu micro watershed were shallow to deep. The colour of the soils in soil pedons varied from dark reddish brown to very dark gray. The texture of soils was found to vary from sandy loam to clay. The structure was moderate to medium sub-angular blocky to moderate medium angular blocky. The consistency of soil pedons varied from slightly hard to very hard when dry, friable to the firm when moist, slightly sticky to very sticky and slightly plastic to very plastic when wet. The soils of Sigehadlu micro watershed were acidic to moderately alkaline in soil reaction, non-saline and low in organic carbon content. The study shows the influence of topography in controlling the pedogenic processes and its physico-chemical characteristics of Sigehadlu soils that will certainly help in taking effective measures for sustainable management of the soil for suitable land use.

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References

1. Arun Kumar V, Natarajan S, Sivasamy R. Characterization and classification of soils of lower Palar-Manimuthar watershed of Tamil Nadu. Agropedology, 2002; 12:97-103.
2. Barade NK, Gowaikar AS. Studies on soils of semi-arid regions of North Gujarat. J Indian Soc. Soil Sci. 1965; 13:43-52.
3. Basava Raju D, Naidu MVS, Ramavatharam N, Venkaiah K, Rama Rao G, Reddy KS. Characterization, classification and evaluation of soils in Chandragiri mandal of Chittoor district, Andhra Pradesh. Agropedology. 2005; 15:55-62.
4. Dasog GS, Patil PL. Genesis and classification of black, red and lateritic soils of north Karnataka. In*: soil science research in North Karnataka*, Dharwad Chapter of ISSS (Ed.s), *76th* annual convention of ISSS, 2011, 1-10.
5. Denis MKA, Patil PL. Mapping of biophysical constraints of soils in semi-arid northern transition zone of India by GIS techniques. American-Eurasian J. Agric. Environ. Sci., 2015; 15(1):53-62.
6. Kanwar JS, Kanwar BS. Quality of irrigation water. Translations of 19th Int. Cong. Soil Sci. 1968; 1:391-404.
7. Madhan Mohan M. Characterization and classification of soils and land suitability of a micro-watershed in Hangal taluk. M. Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka (India), 2008.
8. Madhu BM. Characterization and evaluation of soil resources of Patapur micro-watershed for sustainable land use planning. M. Sc. (Agri.) Thesis, Univ. Agric. Sci., Raichur, Karnataka (India), 2012.
9. Nagendra BR, Patil PL. Characterization and classification of soil resources of Shirol West-1 micro-watershed. Karnataka J Agric. Sci. 2015; 28(4):504-509.
10. Pillai MY, Natarajan A. Characterization and classification of dominant soils of parts of Garakahalli watershed using remote sensing technique. Mysore J Agric. Sci. 2004; 38:193-200.
11. Pulakeshi HBP, Patil PL, Dasog GS. Characterization and classification of soil resources derived from chlorite schist in northern transition zone of Karnataka. Karnataka J Agric. Sci. 2014; 27(1):14-21.
12. Ram Prakash T, Seshagiri Rao M. Characterization and classification of some soils in a part of Krishna district, Andhra Pradesh. The Andhra Agric. J. 2002; 49:228-236.

13. Rehman NZ, Ram D, Wani JA, Maqbool M. Vertical spread of soil properties in different topo-sequenced arable lands of Pulwama, Kashmir. Res. J Agric. Sci., 2017; 8(2):445-449.
14. Sathisha C, Badrinath MS. Characterization of soils of Western Ghats in Dakshina Kannada district, Karnataka. Agropedology. 1994; 4:45-48.
15. Sehgal JL. *Pedology - Concepts and Application,* Kalyani Publishers, New Delhi, India, 1968.
16. Shyampura RL, Giri JD, Krishnendudas and Singh, S. K., 1994, Soil physiographic relationship on a transect in southern Rajasthan. J Indian Soc. Soil Sci. 1968; 42(4):622-625**.**
17. Singh IS, Agarwal HP. Characterization, genesis and classification of rice soils of eastern region of Varanasi, Uttar Pradesh. Agropedology. 2003; 15(1):29-38.
18. Sitanggang M, Rao YS, Ahmed N, Mahapatra SK. Characterization and classification of soils in watershed area of Shikohpur, Gurgaon district, Haryana. J Indian Soc. Soil Sci. 2006; 54:106-110.
19. Thangasamy A, Naidu MVS, Ramavatharam N, Raghava Reddy C. Characterization, classification and evaluation of soil resources in Sivagiri micro-watershed of Chittoor district in Andhra Pradesh for sustainable land use planning. J Indian Soc. Soil Sci. 2005; 53:11-21.
20. Vinay L. Characterization and classification of soil resource of Bhanapur micro-watershed (Koppal district) for land evaluation. *M.Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka (India), 2007.
21. Yadav JSP. Managing soil health for sustained high productivity. J Indian Soc. Soil Sci. 2003; 51:448-465.