J. Farm Sci., 31(2): (148-155) 2018

RESEARCH PAPER

Characterization and classification of soil resources of Dambal-II micro-watershed in Gadag district of Karnataka

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(Received: August, 2017 ; Accepted: June, 2018)

Abstract: A study was undertaken to characterize, and classify the soil resources of Dambal-II micro watershed in Gadag district of Karnataka. Eleven profiles were studied for the morphological, physical and chemical properties. Seven representative pedons covering all the soil types were selected and their properties and classification is discussed in this paper. The soils were very shallow to very deep in depth, colour varies from dark grayish brown to very dark grayish brown and dark brown to brown in all soils. Soils under the study were predominantly sub-angular blocky in structure, clay in texture, strongly alkaline reaction with non-saline soils and organic carbon content was low. Calcium and magnesium were the dominant exchangeable cations followed by sodium and potassium. Soils studied were classified up to family level according to revisions in Soil Taxonomy using morphological, physical and chemical properties. Major proportion of the soils in the micro-watershed belonged to the order Inceptisols and Entisols.

Keywords: Soil classification, Soil resources, Soil survey, Taxonomy

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. 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 characters and 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, a rapid reconnaissance soil survey of the area was carried to characterize and classify soils in Dambal-II micro-watershed in Gadag district of Karnataka for sustainable land use planning using geo-referred false colour composite image of IRS-P6, LISS-III and Survey of India (SOI) topomaps.

Material and methods

The selected Dambal-II (during 2016-17) micro-watershed lies 20 km away from Gadag district (Fig. 1). The micro-watershed is located between 15^0 16' 53.0" and 15^0 18' 6.0" N latitude and 75^0 46' 55.0" and 75^0 48' 28.0" E longitude, with an average elevation 572.90 m above Mean Sea Level (MSL). The climate is semi-arid type with mean annual maximum temperature of 32.8ºC and mean annual minimum temperature of 19.1ºC. The area receives a mean annual rainfall of 671 mm and having nearly level to undulating topography with frequent mound like features. Schist is the parent rock in the study area. The area is under Ustic moisture regime and isohyperthermic temperature regime. Soil survey was carried out during March, 2016 using IRS P6 LISS-III data, survey of India toposheet and cadastral map of the village. After intensive traversing, 11 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. The soils were classified at family level according to revisions in soil taxonomy (Anon., 2014). After correlating for the above referred properties of pedons, seven representative pedons were selected and presented in the paper.

Land capability classification in an interpretative grouping of soils mainly based on the inherent soil characteristics, external land features and environmental factors that limit the use of the land. The classification of soil units provide information on the nature of parent material, colour, texture, structure of soil, type of clay, mineral, consistence, permeability, depth of soil and soil reaction. Each of the above factor have definite role to play in behavior of soil and management. Fig. (3).

Results and discussion

Brief morphological features of the pedons are presented in Table 1. The soils were dark grayish brown (10 YR 4/1) to very dark gray (10 YR 3/2) in surface horizon and black (10 YR 2/1) to greyish brown (10 YR 5/2) in subsurface horizon of all the pedons, except pedons 8, 9 and 11 soils were dark brown (7.5 YR 3/3) to very dark brown (7.5 YR 2.5/3) in surface and subsurface horizons

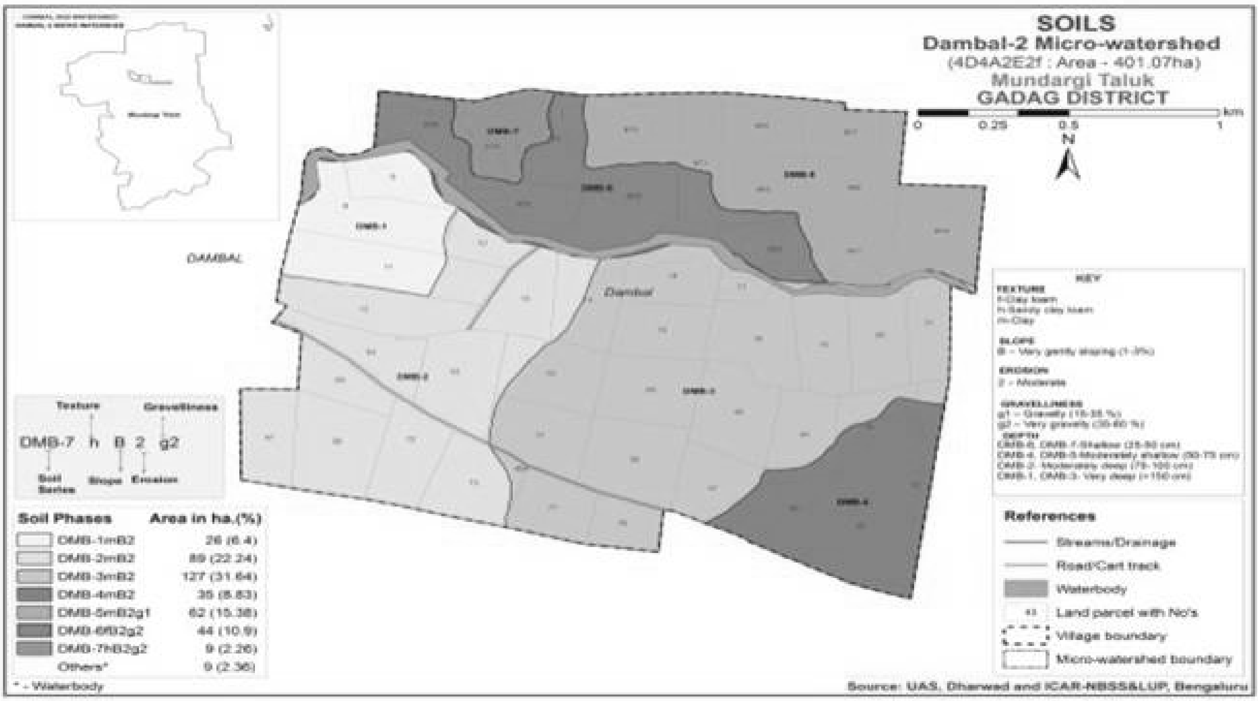

Fig. 2: Mapping units of Dambal-2 micro-watershed

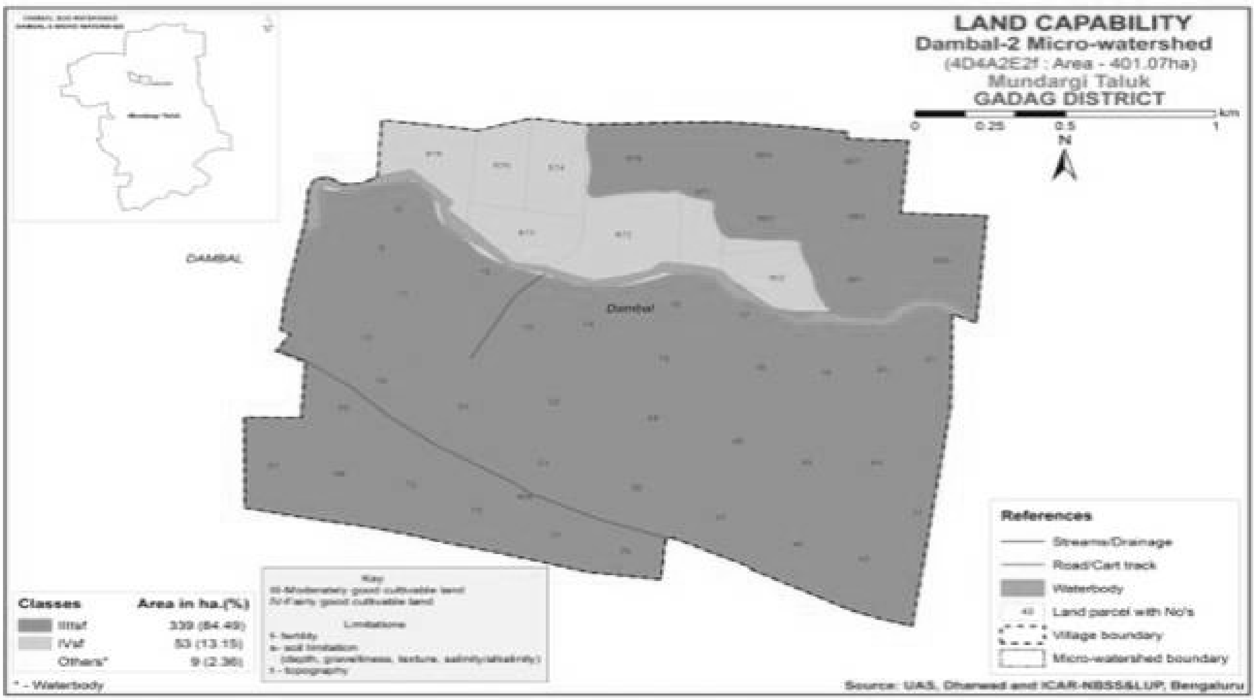

Fig. 3: Land capability classification of Dambal-2 micro-watershed

in colour. There was not much variation in the soil colour with depth in all the pedons. The entire soil pedons exhibited dominant colour was dark grayish brown to very dark grayish brown due to the clay-humus complex in the presence of lime. The dark matrix colour was due to presence of high organic matter content in the surface horizons (Tripathi *et al.,* 2006). The soils exhibited moderate medium sub-angular blocky structure in all the pedons in the surface and subsurface horizon, whereas in pedon 3 soils were weak medium crumb in structure. The structure designates the mode of arrangement of the particles and their aggregation,

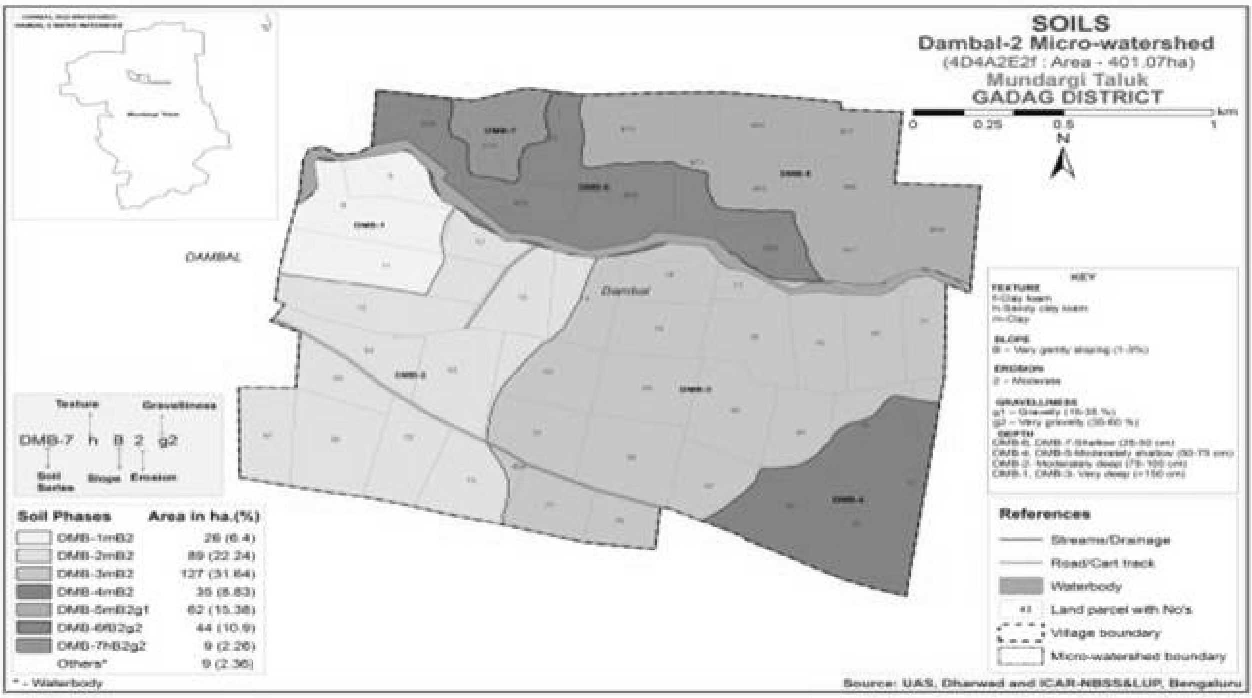

Fig. 2: Mapping units of Dambal-2 micro-watershed

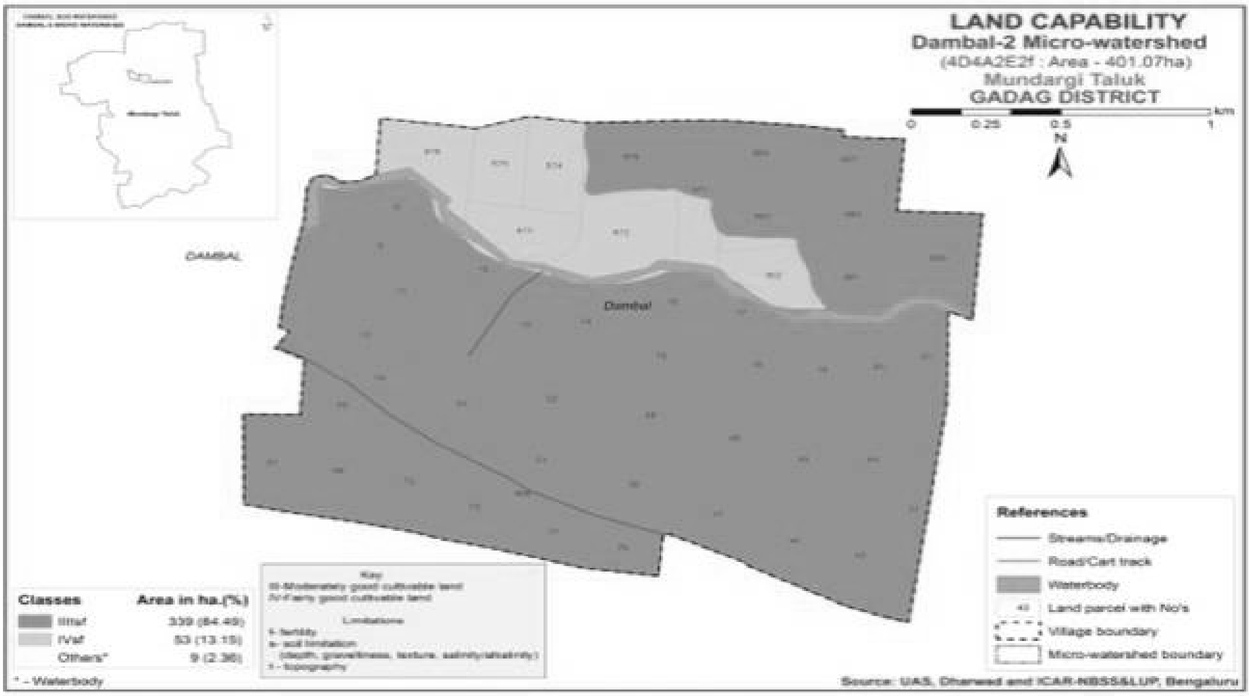

Fig. 3: Land capability classification of Dambal-2 micro-watershed

therefore the structural variation in soils was useful to differentiate the horizon.

The dry consistency of all pedon soils was slightly hard to hard in surface and subsurface horizon. Moist consistency of surface and subsurface horizon soils were friable to firm in almost all pedons. Very sticky and very plastic consistency was observed in almost all pedons horizon. All the horizons of pedon 3, 8 and 9 were found to be moderately sticky and moderately plastic in consistency (wet). Increase in stickiness and plasticity may be due to high clay content.

Table 1. Soil morphological characteristics of the pedons in Dambal-II micro-watershed

PedonNo.	Horizon	Depth (cm)	Colour Dry	Colour Moist	Texture	Structure	Consistency Dry	Consistency Moist	Consistency Wet	Root	Boun-dary	Special features
Pedon 1	Ap	0-10	10 YR 3/3	10 YR 3/3	c	2 m sbk	sh	fr	ms & mp	mmp	cs	Wide and deep cracks up to 48 cm violent effervescences with dilute HCl was observed.
	A_1	10-40	10 YR 3/2	10 YR 3/3	c	2 m sbk	h	fi	vs & vp	ffp	gs	
	AB	40-80	7.5YR2.5/3	7.5YR2.5/3	c	2 m sbk	h	fi	vs & vp	ffp	gd	
	Bw_1	80-130	7.5YR2.5/3	7.5YR2.5/3	c	2 m cr	h	fi	vs & vp	ffp	gd	
	Bw_2	130-152	7.5YR 4/4	7.5YR 4/3	c	2 m cr	h	fi	vs & vp	ffp	gd	
	C	152-175+	Weathered parent rock (schist).									
Pedon 3	A	0-10	10 YR 3/1	10 YR 2/1	cl	1 m cr	sh	fr	ms & mp	mfp	cs	Violent effervescences with dilute HCl was observed.
	AC	10-46	7.5 YR 3/1	7.5 YR 2/1	cl	1 m cr	sh	fr	ms & mp	ffp	Cs	
	C	46-80+	Paralithic contact with schist									
Pedon 4	Ap	0-23	10 YR4/1	10 YR3/1	c	2 m sbk	sh	fr	vs & vp	ffp	cs	Strong effervescences with dilute HCl, many and fine sized prominent $CaCO_3$ concretions were observed from 30-90 cm.
	Bw	23-60	10YR2/1	10YR2/1	c	2 m sbk	h	fi	vs & vp	-	cs	
	C	60-90+	Paralithic contact with schist									
Pedon 6	Ap	0-25	10 YR 4/2	10 YR 3/2	c	2 m sbk	sh	fr	vs & vp	cmt	cs	Strong effervescences with dilute HCl was observed.
	Bw_1	25-58	10 YR 2/1	10 YR 2/2	c	3 m sbk	h	fr	vs & vp	cmt	cs	
	Bw_2	58-99	10YR5/2	10YR2/2	c	3 m sbk	h	fi	vs & vp	ffp	cs	
	C	99-150+	Weathered parent rock (schist).									
Pedon 7	Ap	0-31	10 YR 4/2	10 YR 3/2	c	2 m sbk	sh	fr	vs & vp	cmt	cs	Deep cracks up to 30 cm depth and strong effervescences with dilute HCl was observed.
	Bw_1	31-78	10 YR 2/1	10 YR 2/2	c	2 m sbk	sh	fr	vs & vp	cmt	cs	
	Bw_2	78-125	7.5 YR 2.5/3	7.5 YR 2.5/2	c	3 m sbk	h	fi	vs & vp	fmt	cs	
	C	125-170+	Weathered parent rock (schist).									
Pedon 10	Ap	0-20	10 YR 4/2	10 YR 5/2	c	2 m sbk	sh	fr	vs & vp	mmp	cs	Strong to slight effervescences with dilute HCl, many and fine sized prominent $CaCO_3$ concretions were observed from 0-110 cm was observed.
	Bw	20-50	10 YR 2/1	10 YR 2/1	c	2 m sbk	h	fi	vs & vp	ffp	gs	
	BC	50-65	7.5YR3/3	7.5YR4/3	c	1 m sbk	h	fi	vs & vp	-	gs	
	C	65-110+	Weathered parent rock (schist).									
Pedon 11	Ap	0-28	7.5 YR 4/4	7.5 YR 5/4	c	2 m sbk	sh	fr	vs & vp	mfp	cs	Many fine roots between peds was conserved.
	C	28-80+	Paralithic contact with schist									

Many to few and fine sized roots were observed in all the pedons of surface and subsurface horizons, whereas in 3, 7, 8 and 9 pedon horizons were exhibit common medium throughout roots in size. Wide and deep cracks were observed up to 30 cm depth were noticed in subsurface horizons of pedons 1, 2 and 7. Accumulation of calcium carbonate concretions were observed in 2, 4 and 10 pedons. Physical characteristics of the soil are presented in Table 2. A perusal of the data on particle size distribution in soils revealed that, all the soil pedons are clay in texture according to the USDA textural triangle.

All the pedons were clay in texture except pedon 11 (sandy clay loam) both in surface and subsurface and the increase in clay content through the soil depth was observed. It could be attributed to processes like illuviation of the finer fraction to the lower depth. Similar results were quoted by Pulakeshi *et al.* (2014) for the soils of Mantagani village of Haveri district in Karnataka.The distribution of silt content did not follow definite trend in the pedons under study. Generally, fine sand per cent decreased with depth in all pedons, except in pedon 1 and 3 the fine sand per cent decreased upto AB horizon and increased thereafter. The distribution of coarse sand and total sand content did not follow definite trend in the pedons under study. High clay and silt content in some of the pedons of study area may be due to their formation on the transported parent material. Similarly, the illuvation process also affected the vertical distribution of silt and sand content. Similar observations were also made by Sharma *et al.* (2004).

Maximum water holding capacity of soils of pedons in the surface layer ranged from 45.40 to 61.68 per cent and in subsurface horizons varied between 54.33 to 65.40 per cent. MWHC increased from surface to the lower horizons and followed the trend in clay variation in pedons these results are in line with those of Thangasamy *et al.* (2005) in soils of Sivagiri village in Chittoor district of Andhra Pradesh. In all soil pedons, bulk density in surface layers (Ap) ranged from 1.28 to 1.46 Mg m^{-3} and in the subsurface horizons, the bulk density varied between 1.31 to 1.48 Mg m^{-3}. In general, the bulk density of the lower solum was more than the upper solum. This could be attributed to clogging of pores by dispersed clays in sub-soil layers and reduction of organic carbon with depth. Similar

Table 2. physical characteristics of the soils of pedons in Dambal-II micro-watershed

PedonNo.	Horizon	Depth (cm)	Coarse fragments (>2 mm)	Coarse sand (2- 0.25 mm)	Fine sand (0.25-0.05 mm)	Total sand (2.0-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	MWHC(%)	FC(%)	BD (mg m^{-3})
				(....................		......%......			....................)		
Pedon 1	Ap	0-10	7.20	7.10	16.30	23.40	24.60	52.00	58.12	29.06	1.28
	A_1	10-40	5.00	8.10	10.50	18.60	26.00	55.40	56.42	28.21	1.31
	AB	40-80	15.00	7.60	16.90	24.50	23.40	52.10	58.76	29.38	1.35
	Bw_1	80-130	18.90	5.30	19.40	24.70	24.10	51.20	59.11	29.55	1.39
	Bw_2	130-152	19.10	4.30	20.70	25.00	24.40	50.60	56.30	28.15	1.41
	C	152-175+		Weathered parent rock (schist).							
Pedon 3	Ap	0-10	32.80	20.30	12.80	33.10	20.60	46.30	58.20	29.10	1.38
	Ac	10-46	38.40	21.80	14.80	36.60	22.10	41.30	59.31	29.65	1.39
	C	46-80+		Paralithic contact with schist							
Pedon 4	Ap	0-23	25.50	7.80	9.90	17.70	28.10	54.20	53.69	26.84	1.36
	Bw	23-60	20.00	7.30	6.60	13.90	29.80	56.30	54.33	27.16	1.42
	C	60-90+		Paralithic contact with schist							
Pedon 6	Ap	0-25	12.80	8.40	13.60	22.00	19.40	58.60	57.61	28.80	1.36
	Bw_1	25-58	5.00	8.10	11.10	19.20	21.60	59.20	59.19	29.59	1.38
	Bw_2	58-99	4.00	7.60	9.00	16.60	22.10	61.30	60.11	30.05	1.40
	C	99-150+		Weathered parent rock (schist).							
Pedon 7	Ap	0-31	18.20	5.80	16.80	22.60	20.10	57.30	61.68	30.84	1.38
	Bw_1	31-78	17.00	4.90	14.20	19.10	18.80	62.10	63.69	31.84	1.41
	Bw_2	78-125	6.00	10.80	13.80	24.60	15.80	59.60	64.31	32.15	1.42
	C	125-170+		Weathered parent rock (schist).							
Pedon 10	Ap	0-20	25.80	7.80	15.00	22.80	22.60	54.60	59.30	29.65	1.31
	Bw	20-50	21.10	7.40	12.10	19.50	21.10	59.40	63.10	31.55	1.35
	BC	50-65	23.20	6.10	10.50	16.60	22.20	60.20	65.40	32.70	1.39
	C	65-110+		Weathered parent rock (schist).							
Pedon 11	Ap	0-28	40.20	37.90	16.40	54.40	11.30	34.40	45.40	22.70	1.38
	C	28-80+		Paralithic contact with schist							

results were quoted by Marathe *et al.* (2003) in mandarin orchards of Nagpur and Pulakeshi *et al.* (2014) for the soils of Mantagani village of Haveri district in Karnataka.

Field capacity of various pedons ranged from 22.70 to 32.70 per cent. These differences were due to the variation in clay and organic carbon content of the pedons. These results are in line with Thangasamy *et al.* (2005) observations in soils of Sivagiri micro-watershed in Chittor district of Andhra Pradesh and Amara *et al.* (2015) in Singhanhalli-Bogur microwatershed in northern transition zone of Karnataka.

In soil pedons, pH ranged from neutral to strongly alkaline. High pH in black soil pedons was due to their calcareous nature and the accumulation of bases in the solum as they were poorly leached. Increase in soil pH with depth was evident in some of the pedons, which may be ascribed to increasing content of exchangeable and soluble sodium and calcium. The pH was high at surface and then showed decreasing trend with depths in some other pedons. This may be attributed to high base status of these horizons resulting from the recycling of bases through the addition of crop residues. The increase in soil reaction down the slope could be due to leaching of bases from higher topography and getting deposited at lower elevations (Sitanggang *et al.,* 2006 and Pulakeshi *et al.,* 2014).

Electrical conductivity was more in subsurface than surface soil pedons, which indicate that subsurface soil pedons were less leached. In soils EC ranged from 0.13 to 0.69 dS m^{-1} and 0.11 to 0.54 dS m^{-1} in subsurface and surface horizon respectively, indicate non-saline nature of soils (Table 3). These soils did not show any specific relationship of EC with depth. This may be due to free drainage conditions, which removes the released bases by the percolating and drainage water. These results are in confirmation with the

Table 3. Chemical properties of the soils of pedons in Dambal-II micro-watershed

Pedon No.	Horizon	Depth (cm)	pH (1:2.5)		EC (dS m^{-1})	O.C. (g kg^{-1})	Free $CaCO_3$ (%)
			Water	KCl			
Pedon 1	Ap	0-10	8.88	6.21	0.21	4.8	8.12
	A_1	10-40	9.10	6.54	0.46	4.3	11.87
	AB	40-80	8.98	6.41	0.53	3.1	14.37
	Bw_1	80-130	9.21	6.58	0.69	2.0	14.87
	Bw_2	130-152	8.98	6.38	0.49	1.6	14.85
	C	152-175+	Weathered parent rock (schist).				
Pedon 3	Ap	0-10	8.32	6.21	0.16	2.2	14.0
	AC	10-46	8.39	6.23	0.13	1.2	14.75
	C	46-80+	Paralithic contact with schist				
Pedon 4	Ap	0-23	8.51	6.10	0.54	4.6	7.25
	Bw	23-60	8.56	6.10	0.59	3.1	8.12
	C	60-90+	Paralithic contact with schist				
Pedon 6	Ap	0-25	8.68	6.23	0.16	5.8	6.12
	Bw_1	25-58	8.87	6.30	0.58	4.1	6.87
	Bw_2	58-99	8.99	6.33	0.61	2.6	9.37
	C	99-150+	Weathered parent rock (schist).				
Pedon 7	Ap	0-31	8.84	6.42	0.13	6.2	10.50
	Bw_1	31-78	8.80	6.31	0.19	4.1	11.87
	Bw_2	78-125	8.91	6.44	0.17	3.0	14.37
	C	117-158+	Weathered parent rock (schist).				
Pedon 10	Ap	0-20	9.12	6.23	0.21	5.2	10.75
	Bw	20-50	9.20	6.41	0.28	4.1	12.25
	BC	50-65	9.24	6.43	0.32	3.0	14.87
	C	65-110+	Weathered parent rock (schist).				
Pedon 11	Ap	0-28	8.60	6.10	0.20	2.3	8.12
	C	28-80+	Paralithic contact with schist				

findings of Sumithra *et al.* (2013) in soils of Timanhal micro-watershed, Kushtagi taluk of Karnataka.

The free $CaCO_3$ is an accumulation of precipitated calcium carbonate in the solum. This generally happens due to negative precipitation-evapotranspiration (P-ET) balance and some geological properties (parent material). The calcium carbonate content in surface layers ranged from 3.87 to 10.75 per cent and in subsurface layers, it ranged from 5.62 to 14.87 per cent. Similar observations were also made by Pulakeshi *et al.* (2014) for the soils of Mantagani village of Haveri district in Karnataka.

The organic carbon content of surface soil was greater than subsurface soil in all the pedons and it decreased with depth. This was attributed to the addition of farmyard manure and plant residues to surface horizons which resulted in higher organic carbon content in surface horizons than that of lower horizons. These observations are in accordance with results of Basavaraju *et al.* (2005) in soils of Chandragiri Mandal of Chittor district of Andhra Pradesh.

The dominant cations on the clay complex were calcium followed by magnesium, sodium and potassium in soils pedons. The exchangeable calcium and magnesium in surface soils ranged from 23.11 to 38.90 cmol (p^+) per kg and 7.12 to 17.0 cmol (p^+) per kg, respectively (table. 4). In subsurface soils, Ca and Mg ranged from 27.94 to 41.70 cmol (p^+) per kg and 6.9 to 16.6 cmol (p^+) per kg, respectively. The exchangeable sodium content ranged from 1.82 to 4.95 cmol (p^+) per kg in surface horizons and 2.30 to 5.08 cmol (p^+) per kg in subsurface horizons and varied with profile depth and the soils under investigation contained exchangeable potassium in quantities less than 1 cmol (p^+) per kg and the values exhibited a decreasing trend with depth in few pedons and increased with depth. The exchangeable potassium content ranged from 0.27 to 0.83 cmol (p^+) per kg in surface horizons and 0.31 to 0.70 cmol (p^+) per kg in subsurface horizons. In all soil pedons, Ca^{2+} shows the strongest relationship with all the species, comparing these ions (Ca^{2+}, Mg^{2+}, K^+ and Na^+), it was clear that Mg^{2+} was present in low amount than Ca^{2+} because of its mobility. These results are in conformity with the findings of Manojkumar Dabi (2011) in Bastwad micro-watershed on basalt parent rock in northern transition zone of Karnataka. The low value of exchangeable monovalents compared to divalents due leaching of monovalents than divalent.

The values of cation exchange capacity increased with profile depths and followed the trend of clay. This is due to accumulation of clay and may be due to presence of smectic group of clay minerals (Das, 1999). Similarly the CEC values were higher in horizons containing high clay and or high organic carbon content. Low values of CEC may be ascribed to the predominance of low CEC minerals, especially illite, in outer Himalayas (Sanjeev *et al.,* 2005). The exchangeable sodium percentage ranged from 3.28 to 9.04 per cent in surface horizons and 4.12 to 9.35 per cent in subsurface horizon (table. 4). A lower ESP (<15) throughout the depth in soils clearly indicated that these soils are not sodic in nature. Exchangeable sodium percentage values did not follow definite trend throughout the

Table 4. Exchangeable cations of the soils of pedons in Dambal-II micro-watershed

Pedon No.	Horizon	Depth (cm)	Ca	Mg	Na	K	CEC	BS	ESP
			(……………………c mol (p^+) kg^{-1}…………….........................……)						(…….%.......)
Pedon 1	Ap	0-10	32.00	17.00	4.66	0.83	57.93	94.06	8.04
	A_1	10-40	34.20	14.00	4.56	0.70	58.59	91.24	7.78
	AB	40-80	30.80	12.40	4.72	0.39	56.55	85.42	8.34
	Bw_1	80-130	29.20	10.10	5.08	0.34	55.57	80.47	9.14
	Bw_2	130-152	28.60	9.80	4.78	0.31	54.25	80.16	8.81
	C	152-175+	Weathered parent rock (schist)						
Pedon 3	A	0-10	26.89	7.92	4.17	0.48	46.81	84.29	8.90
	AC	10-46	27.94	6.96	4.22	0.51	45.11	87.85	9.35
	C	46-80+	Paralithic contact with schist						
Pedon 4	Ap	0-23	36.80	12.10	3.57	0.32	57.64	91.58	6.19
	Bw	23-60	37.88	12.50	3.39	0.35	59.55	90.88	5.69
	C	60-90+	Paralithic contact with schist						
Pedon 6	Ap	0-25	37.60	14.40	4.80	0.37	62.88	90.09	7.63
	Bw_1	25-58	38.11	15.12	5.06	0.35	63.67	92.09	7.94
	Bw_2	58-99	37.80	16.60	4.65	0.34	64.86	91.56	7.16
	C	99-150+	Weathered parent rock (schist).						
Pedon 7	Ap	0-31	38.90	12.60	3.28	0.41	61.82	89.27	5.30
	Bw_1	31-78	37.20	13.00	3.50	0.44	63.89	84.74	5.47
	Bw_2	78-125	38.80	11.20	3.90	0.47	63.68	85.38	6.12
	C	125-170+	Weathered parent rock (schist).						
Pedon 10	Ap	0-20	35.50	12.40	4.17	0.46	59.54	88.22	7.00
	Bw	20-50	39.80	13.89	3.88	0.34	65.70	88.14	5.90
	BC	50-65	41.70	14.50	3.56	0.35	66.44	90.47	5.35
	C	65-110+	Weathered parent rock (schist).						
Pedon 11	Ap	0-28	23.11	7.12	2.80	0.37	37.40	89.30	7.48
	C	28-80+	Paralithic contact with schist						

depth in all pedons. A measure of relative amounts of exchangeable sodium in comparison with the total cations in the soil are dependent on factors such as type of minerals, concentration of electrolytes and status of soluble cations. The findings are in accordance with the works of Thangasamy *et al.* (2005).

Soils are classified according to the revision in US Soil Taxonomy. All pedons key out as Haplustepts and Ustorthents at great group level as they do not have salic, gypsic or calcic horizons. Pedons 1, 2, 4, 5, 6, 7, 8 and 10 were classified into Inceptisols owing to the absence of any other diagnostic horizon other than cambic horizon. As the moisture regime is Ustic and classified as Ustepts at sub-order level. Pedons 1, 2, 4, 5, 6, 7, 8 and 10 classified as Haplustepts and Typic Haplustepts at great group and subgroup level respectively. Pedons 3, 9 and 11 were classified as Entiosols, because there was no evidence of development of pedogenic horizons and followed none of the criteria established for sub-orders in the order Entisols. So it was classified as Orthents. At great group level these pedons classified as Ustorthents due to the prevailing soil moisture regime as "Ustic". All Pedons, under Entisols had a lithic contact within depth of 50 cm. Since they are classified as Ustorthents and Lithic Ustorthents at great group and subgroup level respectively.

Table 5. The overall classification of selected pedons are given below

Pedon No.	Soil classification
1, 2, 4, 5, 6,7, 8 and 10	Fine, mixed, super active, isohyperthermic, Typic Haplustepts.
3 and 9	Clayey, mixed, super active, isohyperthermic, Lithic Ustorthents.
11	Fine-loamy, mixed, super active, isohyperthermic, Lithic Ustorthents.

All the soils under study had isohyperthermic temperature regime, since, the mean summer and winter temperatures differ by less than 6^0C and mean annual temperature exceeds 22^0C. The cation exchange activity class of pedons under study was super active, where CEC to clay content ratio exceeds 0.60 and the particle size class of pedons under study were very fine (60 % clay content), fine (>35 to <60 % clay content) and if clayey more than 35 per cent clay content, fine-loamy (< 35 % clay) and lithic contact or shallow family (Soil Survey Staff, 2014). At family and series level, the pedons under study are classified and presented in Table 5.

Conclusion

Based on soil properties, the soils of Dambal-2 micro-watershed have been classified into two land capability classes *viz.,* III and IV. Mapping unit 6 and 7 classified into IVsf, which is fairly good cultivable lands with limitations of depth, coarse fragments and organic carbon content. Mapping units 1, 2, 3, 4 and 5 were classified as IIItsf owing to the limitations of texture, depth, erosion and organic carbon.

Acknowledgement

The study was part of the Sujala-III Project funded by world Bank through Governement of Karnataka. The authors duly acknowledge the support.

References

Amara, K., M., D. Massaquoi, A. D. S. and Patil, P. L., 2015, Characterization of soils in hot semi-arid agro-ecological region of India: A case study of Singhanhalli-Bogur microwatershed in northern transition zone of Karnataka. *Ash Ese J. Agric. Sci.,* 1 (6) : 54-70.

Anonymous, 2014, Soil taxonomy – A basic system of soil classification for making and interpreting soil surveys (Second edition). *Agricultural Handbook No. 436,* United States, Department of Agriculture, Washington DC, USA.

Basavaraju, D., Naidu, M. V. S., Ramavatharam, N., Venkaiah, K., Rama Rao, G. and Reddy, K. S., 2005, Characterization, classification and evaluation of soils in Chandragiri mandal of Chittoor district Andhra Pradesh. *Agropedology,* 15: 55–62.

Manojkumar Dabi, 2011, Characterization and classification of soils of a micro-watershed on basalt parent rock in northern transition zone of Karnataka. *M. Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, Karnataka, India.

Marathe, R. A., Mohanty, S. and Shyam Singh, 2003, Soil characterization in relation to growth and yield of Nagpur mandarin (*Citrus reticulate* Blanco). *J. Indian Soc. Soil Sci.,* 51: 70-73.

Pulakeshi, H. B., Patil, P. L. and Dasog, G. S., 2014, Characterization and classification of soil resources derived from chlorite schist in northern transition zone of Karnataka. *Karnataka J. Agric. Sci.,* 27 (1): 14-21.

Sanjeev, K. C., Karan Singh, Tripathi, D. and Bandari, A. R., 2005, Morphology, genesis and classification of soils from two important land uses in outer Himalayas. *J. Indian Soc. Soil Sci.,* 53: 394–398.

Sharma, V. K., Sharma, P. D., Sharma, S. P., Acharya, C. L. and Sood, R. K., 2004, Characterization of cultivated soils of Neogal watershed in North-West Himalayas and their suitability for major crops. *J. Indian Soc. Soil Sci.,* 52: 63-68.

Sitanggang, M., Rao, Y. S., Nayan Ahmed and Mahapatra, S. K., 2006, Characterization and classification of soils in watershed area of Shikohpur, Gurgaon district, Haryana. *J. Indian Soc. Soil Sci.,* 54: 106-110.

Sumithra, K. N., Budihal, S. L., Patil, S. G., Bellakki, M. A. and Desai, B. K., 2013, Productivity potentials of Timanhal micro-watershed soils. *Karnataka J. Agric. Sci.,* 26 (1): 40-45.

Thangasamy, A., Naidu, M. V. S., Ramavatharam, N. and Raghava Reddy, C., 2005, 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.,* 53: 11–21.

Tripathi, D., Verma, J. R., Patial, K. S. and Karan Singh, 2006, Characteristics, classification and suitability of soils for major crops of Kiar-Nagali micro-watershed in North-West Himalaya*s. J. Indian Soc. Soil Sci.,* 54: 131-136.

Yadav, J. S. P., 2003, Managing soil health for sustained high productivity. *J. Indian Soc. Soil Sci.,* 51: 448-465.