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Taxonomical Classification of soils of Asvaru Sub-watershed, Hunsur Taluk, Mysuru District

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Abstract: Soil characterization and classification is crucial to all soil studies, as it is an important tool for understanding the nature of soil along with successful transfer of research results from one study area to another. The proper understanding of the nature and properties of soil and their management based on their potential and problems is important for increasing crop production to the optimum level. For understanding the problems and potentials, detailed soil survey plays an important role which 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. The purpose of the study is to classify the soils of Asavru sub-watershed in Mysuru district to categorize the soils into different soil order upto family level of Soil taxonomy Classification and enhance the productivity and profitability of the area. The detailed soil survey was carried out in Asvaru sub-watershed. Seventy two profiles were studied for its different morphology, physical and chemical properties. The sub-watershed area was grouped into 75 mapping units consisting of 16 soil series. The soils were shallow to very deep with texture varying from sandy loam to sandy clay. The structure was sub-angular blocky in all profiles with friable consistency. Soil reaction varied from moderately acidic to moderately alkaline and non saline in nature. Exchangeable cations followed the pattern of Ca^{+2}>Mg^{+}>Na^{+}>K^{+}. The soil series identified in the sub-watershed area were classified under different soil orders (*Alfisols* and *Inceptisols*) upto family level according to revision of Soil Taxonomy. Major proportion of the soils of the sub-watershed belonged to *Alfisols* (Pedons1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12 and 15) and *Inceptisols* (Pedon5, 13 and 16).

Keywords: *Classification, land resource inventory, soil taxonomy classification.*

Introduction

Soil is the major factor that influences the food systems. To maintain healthy food production soil health is very important. In order to enhance production systems along with profitable and productive cropping systems healthy soil plays a vital role. But indiscriminate use and over exploitation of soils leads to serious impact on the ecology (Gorai *et al.* 2013). For sustainable utilization of this indispensable resource, it is imperative to know the nature, characteristics, distribution along with their quality of soils, productive potential and suitability for optimum land use (Mahapatra *et al.* 2005). To achieve this goal, detailed information about the finite soil resource is prerequisite. Watershed management plays a vital role in the agriculture practices as it facilitates

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the controlled use of water for irrigation as per crops requirement and it also provides water supply for a wide range of other uses. 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 (Pinki Seth *et al.* 2017).

The different soil forming factors which influence the soil profile characteristics have large impact on the soil fertility and productivity. In order to obtain optimum yield, profitability and also to suggest appropriate fertilizer schedule for crops a thorough understanding of morphological, physical and chemical properties is necessary. Soil characterization provides the information for our understanding of the mineralogical, physical, chemical and microbiological properties of the soils on which we depend on to grow crops, grasslands and sustain forests as well as support homes and social structures. 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. A soil characterization study is a major building block for understanding the soil, classifying it and getting the best understanding of the environment (Vasundhara *et al.* 2018). Keeping the importance of soil classification and characterization in view the present study of taxonomical classification of soils of Asvaru sub-watershed was carried out to know the nature and properties of soils which can be utilized for the planning and development of watershed area.

Material and Methods

The Mysuru district lies in Southern Transition Zone of Karnataka. This zone comprises an area of 1.218 Mha. The annual rainfall ranges from 611.7 to 1053.9 mm. More than 60 per cent of the rain is received in *kharif* season. Soils are red sandy loam in major areas and red loamy in the remaining areas. The study area Asvaru sub-watershed comprises of four micro-watersheds located in Hunsur taluk, Mysuru district of Karnataka (Fig. 1). The detailed soil survey of the land resource of the Asavru sub-watershed was carried out at 1:7,920 scale using the using satellite imagery (Worldview 2 imagery), cadastral map and toposheet to collect information on surface features/site characteristics like soil texture, slope, erosion and graveliness. The survey was carried out by the standard soil survey procedures as described in the soil survey manual (Soil Taxanomy 1971). Based on soil heterogeneity, 72 pedons were opened and studied for their morphological features.

Soil samples were collected from each pedon horizon wise and further physical and chemical parameters were analyzed. Based on morphological, physical and chemical properties, soils were classified as per 'Keysto Soil Taxonomy' (Soil Survey Staff 2014).

Result and Discussion

The morphological properties of the pedons are mentioned in Table 1. The soil colour varied from dark reddish brown (2.5YR3/4) to yellowish red (5YR4/6) in pedon 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12 and 15. Whereas in pedon 5, 13, 14 and 16 colour varied from dark brown (7.5YR 3/4) to brown (10YR4/3). No any major variation with respect to colour was noticed in subsurface horizons. This variation in colour is a function of chemical and mineralogical composition, topographic position, textural makeup and moisture regimes of the soils. The results of the present study are in accordance with the findings of (Pramod and Patil 2015). The soils exhibited weak to moderate subangular blocky structure at surface and subsurface horizons. The consistency of the pedon was slightly hard, friable, slightly to very sticky and slightly to very plastic when wet. This variation in consistency soils was not only due to the textural makeup but also due to the type of clay minerals present in the soils. Similar results were reported by (Pramod 2015) and (Harshita 2018).

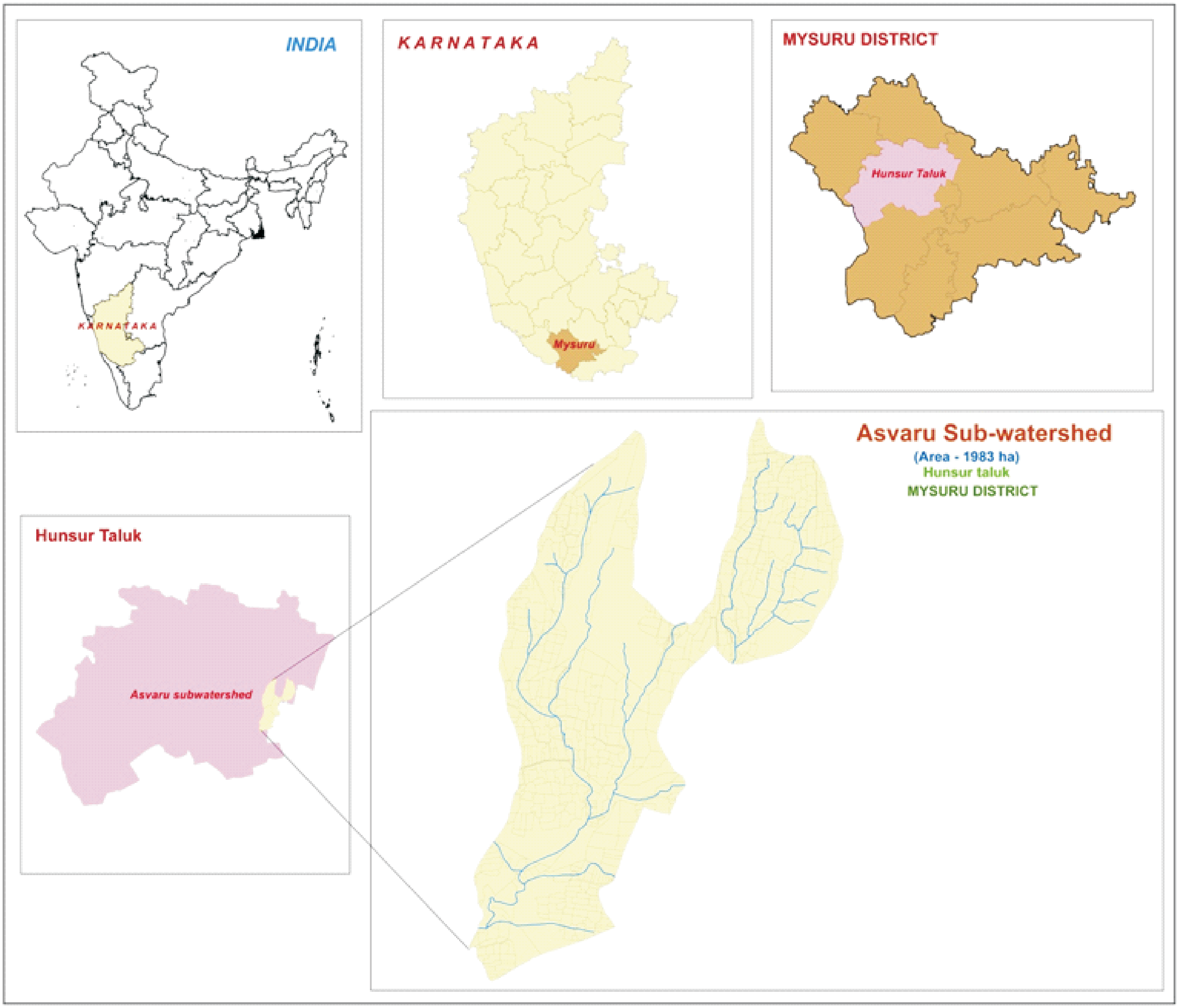

Fig .1. Location of Asvaru Sub-watershed.

The physical and chemical properties of the pedons are presented in Table 2. The soil texture in red soil pedons varied from sandy loam to sandy clay. The texture was clay loam because of lesser mobilization of finer practicals, whereas in black soil pedons it varied from sandy clay to clay. Similar results were quoted by (Pulakeshi *et al.* 2014) for the soils of Mantagani village of Haveri district in Karnataka.

The soil pH in red soils was strongly acidic to moderately alkaline and it varied from slightly acidic to strongly alkaline in black soils. In red soil pedons, higher H+ concentration from iron hydroxide species contributed to lower pH values as compared to black soil. In black soil pedons because of calcareous nature and the accumulation of the bases was the reason behind higher pH. Similar observation was made by (Devi *et al.* 2015). The electrical conductivity ranged from 0.05 to 0.45 dSm^{-1}. No any specific variation with depth was noticed.

Table 1. Morphological characteristics of the soil pedons

Horizon	Depth (cm)	Boundary	Colour	Texture	Structure	Consistency			Roots	Special features
						Dry	Moist	Wet		
Pedon 1										
Ap	0-18	as	5YR 3/4	scl	1msbk	sh	fr	ms&mp	fvft	-
Bt1	18-26	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	26-44	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	-	
Pedon 2										
Ap	0-12	cs	2.5YR 3/4	scl	1msbk	sh	fr	ms&mp	fvft	-
Bt1	12-32	cs	2.5YR 3/4	sc	1msbk	sh	fr	ms&mp	-	
Bt2	32-39	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	-	
Pedon 3										
Ap	0-22	cs	2.5YR 3/4	scl	2msbk	sh	fr	ms&mp	fvft	-
Bt1	22-39	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	39-51	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	fvft	
Bt3	51-73	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	fvft	
Pedon 4										
Ap	0-19	cs	2.5YR 2.5/4	sc	1msbk	sh	fr	ms&mp	fvft	-
Bt1	19-46	cs	2.5YR 2.5/4	sc	2msbk	sh	fr	ms&mp	fvft	
Bt2	46-70	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	-	
Pedon 5										
Ap	0-15	as	7.5YR 3/3	sc	2msbk	sh	fr	ms&mp	fvft	-
Bw1	15-32	cs	10YR 2/1	c	2msbk	sh	fr	ms&mp	-	
Bw2	32-55	cs	10YR 3/1	c	2msbk	sh	fr	ms&mp	-	
Bw3	55-72	cs	10YR 3/2	c	2msbk	sh	fr	ms&mp	-	
Pedon 6										
Ap	0-16	cs	2.5YR 3/4	sl	2msbk	sh	fr	ms&mp	fvft	-
Bt1	16-33	cs	5YR 3/3	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	33-67	cs	5YR 3/3	sc	2msbk	sh	fr	ms&mp	-	
Bt3	67-84	cs	5YR 3/4	sc	2msbk	sh	fr	ms&mp	-	
Pedon 7										
Ap	0-21	as	2.5YR 2.5/3	scl	1msbk	sh	fr	ss&sp	fvft	
Bt1	21-38	as	2.5YR 2.5/3	sc	1msbk	sh	fr	ms&mp	fvfc	
Bt2	38-59	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvft	
Bt3	59-78	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	-	

Pedon 8										
Ap	0-17	as	5YR 3/4	sl	2msbk	sh	fr	ms&mp	fvft	-
Bt1	17-39	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	39-65	cs	2.5YR 4/6	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt3	65-99	cs	5YR 4/6	sc	2msbk	sh	fr	ms&mp	-	
Pedon 9										
Ap	0-20	as	5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvft	-
Bt1	20-42	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	42-74	cs	2.5YR 2.5/4	sc	1msbk	sh	fr	vs &vp	fvfc	
Bt3	74-110	cs	2.5YR 2.5/4	sc	1msbk	sh	fr	vs &vp	-	
Pedon 10										
Ap	0-15	cs	7.5YR 3/4	scl	1msbk	sh	fr	so &po	fvft	-
Bt1	15-43	cs	5YR 3/4	sc	2msbk	sh	fr	ss&sp	fvfc	
Bt2	43-67	cs	5YR 3/4	sc	1msbk	sh	fr	ms&mp	fvft	
Bt3	67-109	cs	2.5YR 4/4	sc	1msbk	sh	fr	ms&mp	-	
Bt4	109-120	cs	2.5YR 4/4	sc	1msbk	sh	fr	ms&mp	-	
Bt5	120-139	cs	2.5YR 4/6	sc	1msbk	sh	fr	ms&mp	-	
Pedon 11										
Ap	0-25	as	5YR 3/4	scl	1msbk	sh	fr	ss&sp	fvft	Clay cutans were observed
Bt1	25-46	as	5YR 3/3	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	46-70	cs	5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvft	
Bt3	70-103	cs	5YR 3/4	sc	2msbk	sh	fr	vs &vp	fvft	
Bt4	103-135	cs	5YR 4/4	sc	2msbk	sh	fr	vs &vp	fvft	
Pedon 12										
Ap	0-18	as	7.5YR 4/4	scl	1msbk	sh	fr	ss&sp	fvft	Clay cutans were observed
Bt1	18-46	as	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	46-72	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvft	
Bt3	72-100	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	-	
Bt4	100-120	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp		
BC	120-145	-	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp		

Pedon 13										
Ap	0-10	as	7.5YR 3/4	scl	1msbk	sh	fr	ms&mp	fvft	-
Bw1	10-24	cs	7.5YR 3/3	sc	2msbk	sh	fr	ms&mp	fvfc	
Bw2	24-50	cs	7.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvft	
Bw3	50-84	gs	10YR 4/4	c	2msbk	sh	fr	vs &vp	fvft	
BC	84-120	cs	10YR 4/4	c	2msbk	sh	fr	vs &vp	-	
Pedon 14										
Ap	0-22	as	7.5YR 4/4	sc	2msbk	sh	fr	ss&sp	fvft	
Bt1	22-48	as	7.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	48-69	cs	7.5YR 3/4	sc	2msbk	sh	fr	ms&mp	-	
Bt3	69-105	cs	7.5YR 4/4	sc	2msbk	sh	fr	ms&mp	-	
Bt4	105-138	cs	7.5YR 4/6	sc	2msbk	sh	fr	ms&mp	-	
Bt5	138-180	cs	7.5YR 4/4	sc	2msbk	sh	fr	ms&mp	-	
Pedon 15										
Ap	0-20	as	2.5YR 4/4	sc	2msbk	sh	fr	ss&sp	fvft	
Bt1	20-45	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvfc	
Bt2	45-75	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvft	
Bt3	75-100	cs	2.5YR 3/4	sc	2msbk	sh	fr	ms&mp	fvft	
Bt4	100-122	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	-	
Bt5	122-156	cs	2.5YR 3/6	sc	2msbk	sh	fr	ms&mp	-	
Pedon 16										
Ap	0-19	as	10YR 3/3	sc	2msbk	sh	fr	ms&mp	fvft	-
Bw1	19-45	cs	10YR 3/3	sc	2msbk	sh	fr	ms&mp	fvfc	
Bw2	45-64	cs	10YR 3/4	sc	2msbk	sh	fr	ms&mp	-	
Bw3	64-78	cs	10YR 3/4	c	2msbk	sh	fr	vs &vp	-	
Bw4	78-100	cs	10YR 4/1	c	2msbk	sh	fr	vs &vp	-	
Bw5	100-129	cs	10YR 4/1	c	3msbk	sh	fr	vs &vp	-	
Bw6	129-156	cs	10YR 4/3	c	3msbk			vs &vp	-	

Table 2. Physical and Chemical properties of the soil pedons

Horizon	Depth (cm)	Texture	Partical size distribution			pH	EC (dSm^{-1})	OC ($g\ kg^{-1}$)	Exchangeable cations [$cmol(p^+)\ kg^{-1}$]				CEC [$cmol(p^+)\ kg^{-1}$]	BS (%)
			Sand	Silt	Clay				Ca	Mg	Na	K		
Pedon 1														
Ap	0-18	scl	68.47	5.60	25.28	6.05	0.05	0.30	2.00	1.00	0.25	0.15	6.35	53.49
Bt1	18-26	sc	58.26	5.77	35.58	6.11	0.06	0.18	2.50	1.50	0.28	0.08	7.12	61.28
Bt2	26-44	sc	56.58	6.13	36.95	6.21	0.07	0.15	3.00	1.50	0.23	0.09	7.44	64.80
Pedon 2														
Ap	0-12	scl	68.89	7.85	22.30	5.48	0.05	0.81	2.50	1.00	0.17	0.20	5.89	65.77
Bt1	12-32	sc	55.72	8.05	35.53	5.49	0.05	0.51	3.50	1.50	0.14	0.11	7.73	67.89
Bt2	32-39	sc	55.22	8.23	35.90	5.51	0.06	0.42	3.50	2.00	0.20	0.12	7.89	73.73
Pedon 3														
Ap	0-22	scl	72.59	5.38	21.03	6.31	0.06	0.90	3.50	2.00	0.24	0.10	8.61	67.80
Bt1	22-39	sc	54.68	6.70	38.03	6.46	0.07	0.42	4.50	2.50	0.34	0.10	10.89	68.41
Bt2	39-51	sc	53.98	6.55	38.98	6.75	0.07	0.30	5.00	2.50	0.34	0.10	11.64	68.29
Bt3	51-73	sc	53.68	7.50	38.30	7.94	0.08	0.18	5.50	2.50	0.33	0.08	12.09	69.53
Pedon 4														
Ap	0-19	scl	60.30	9.15	29.75	6.88	0.07	0.63	3.50	2.00	0.29	0.22	8.95	67.07
Bt1	19-46	sc	56.05	7.78	35.63	7.35	0.08	0.27	5.50	2.50	0.29	0.14	10.32	81.73
Bt2	46-70	sc	54.80	9.25	35.48	7.27	0.14	0.12	5.00	2.50	0.37	0.12	10.25	77.97

Pedon 5														
Ap	0-15	sc	43.26	16.88	39.48	8.21	0.32	0.30	21.00	10.50	0.44	0.26	33.74	95.42
Bw1	15-32	c	42.28	16.65	40.78	8.22	0.37	0.21	21.50	10.50	0.76	0.27	33.98	97.20
Bw2	32-55	c	41.60	16.18	41.95	8.26	0.43	0.15	21.50	11.00	0.66	0.24	34.21	97.65
Bw3	55-72	c	39.47	17.25	42.98	8.36	0.45	0.15	22.00	10.50	0.78	0.23	34.17	98.07
Pedon 6														
Ap	0-16	sl	73.95	8.15	17.10	5.73	0.04	0.81	2.50	1.00	0.16	0.24	7.54	51.77
Bt1	16-33	sc	59.10	4.18	35.90	5.90	0.05	0.78	4.50	2.50	0.17	0.20	8.83	83.55
Bt2	33-67	sc	56.75	5.50	36.80	6.04	0.05	0.60	5.00	2.50	0.18	0.15	10.71	73.05
Bt3	67-84	sc	57.90	4.69	36.60	6.08	0.05	0.39	7.00	3.00	0.27	0.14	12.13	85.86
Pedon 7														
Ap	0-21	scl	70.98	5.18	23.13	8.01	0.21	0.66	6.00	3.00	0.35	0.28	12.51	76.99
Bt1	21-38	sc	58.79	5.38	35.15	8.06	0.21	0.60	7.00	3.00	0.30	0.11	13.61	76.46
Bt2	38-59	sc	57.35	5.25	36.95	8.08	0.22	0.45	7.50	3.50	0.34	0.06	14.21	80.23
Bt3	59-78	sc	56.58	5.48	37.55	8.10	0.28	0.33	7.50	4.00	0.37	0.04	14.87	80.14
Bt4	78-85	sc	55.73	5.58	38.33	8.13	0.56	0.15	8.00	4.00	0.38	0.04	15.21	81.65
Pedon 8														
Ap	0-17	sl	75.41	6.20	17.53	6.53	0.09	0.84	3.50	1.50	0.24	0.20	8.39	64.76
Bt1	17-39	sc	55.93	7.78	35.53	6.62	0.10	0.60	5.00	2.50	0.27	0.22	10.21	78.23
Bt2	39-65	sc	55.31	7.50	36.40	6.74	0.11	0.57	5.50	2.50	0.33	0.24	10.77	79.55
Bt3	65-99	sc	54.54	7.60	37.23	6.82	0.12	0.45	5.50	3.00	0.32	0.15	11.34	79.09

Pedon 9														
Ap	0-20	sc	58.60	5.50	35.03	5.26	0.04	0.78	2.50	1.00	0.18	0.10	6.13	61.73
Bt1	20-42	sc	57.70	5.28	36.28	5.63	0.05	0.57	3.50	1.00	0.19	0.12	7.09	67.92
Bt2	42-74	sc	57.25	4.98	37.23	5.76	0.05	0.51	3.50	2.00	0.19	0.13	7.95	73.22
Bt3	74-110	sc	54.80	6.98	37.95	6.25	0.05	0.45	4.00	2.00	0.30	0.11	8.44	75.97
Pedon 10														
Ap	0-15	scl	67.15	11.48	20.83	7.79	0.16	0.33	5.50	2.50	0.25	0.13	12.59	66.58
Bt1	15-43	sc	54.35	9.15	35.58	8.33	0.17	0.30	8.50	4.00	0.28	0.13	15.32	84.23
Bt2	43-67	sc	52.10	9.95	37.18	8.34	0.18	0.27	9.00	4.00	0.26	0.13	16.14	82.96
Bt3	67-109	sc	49.90	10.90	38.40	8.41	0.20	0.21	9.50	4.00	0.29	0.11	16.95	82.01
Bt4	109-120	sc	47.85	11.93	39.73	8.42	0.21	0.12	9.50	4.50	0.26	0.11	17.19	83.61
Bt5	120-139	sc	46.65	14.85	38.28	8.43	0.21	0.12	9.50	4.00	0.30	0.11	17.05	81.58
Pedon 11														
Ap	0-25	scl	66.55	5.30	27.25	6.13	0.06	0.48	3.00	1.50	0.16	0.14	6.89	69.60
Bt1	25-46	sc	58.45	4.90	35.90	7.09	0.06	0.42	5.50	2.50	0.22	0.12	11.32	73.69
Bt2	46-70	sc	56.85	5.00	37.45	7.32	0.06	0.39	6.00	2.50	0.26	0.12	11.85	74.93
Bt3	70-103	sc	54.75	6.13	38.53	7.40	0.07	0.39	6.50	2.50	0.28	0.11	12.44	75.50
Bt4	103-135	sc	53.10	6.23	39.95	7.47	0.08	0.21	6.50	2.50	0.29	0.10	12.95	72.52

Pedon 12													
Ap	0-18	scl	63.45	7.58	28.00	6.28	0.15	0.78	3.50	3.00	0.33	0.33	10.33	69.29
Bt1	18-46	sc	56.55	4.83	37.80	6.41	0.18	0.63	6.50	3.00	0.39	0.26	13.54	74.99
Bt2	46-72	sc	53.85	6.90	38.40	6.62	0.20	0.57	7.00	3.00	0.51	0.26	14.33	75.13
Bt3	72-100	sc	51.85	7.43	39.95	6.91	0.22	0.33	7.00	3.00	0.52	0.20	14.84	72.28
Bt4	100-120	sc	51.25	7.63	40.70	7.01	0.24	0.27	7.50	3.00	0.55	0.20	15.01	74.95
BC	120-145	sc	50.40	8.18	41.18	7.07	0.25	0.15	7.50	3.50	0.59	0.19	15.67	75.22
Pedon 13														
Ap	0-10	scl	48.14	10.60	40.80	6.31	0.05	0.39	4.00	2.00	0.22	0.11	9.01	70.24
Bw1	10-24	sc	47.12	10.50	41.95	6.35	0.06	0.36	4.50	2.00	0.26	0.10	9.53	72.05
Bw2	24-50	sc	45.39	11.60	42.58	6.54	0.07	0.30	4.50	2.50	0.26	0.10	9.89	74.42
Bw3	50-84	sc	44.90	11.68	43.05	6.92	0.08	0.27	5.00	2.50	0.30	0.11	10.12	78.19
BC	84-120	sc	43.53	12.25	43.85	7.46	0.08	0.21	5.50	2.50	0.43	0.08	10.44	81.53
Pedon 14														
Ap	0-22	sc	52.24	11.63	35.15	7.88	0.26	0.87	4.50	2.50	0.54	0.22	10.44	74.32
Bt1	22-48	sc	49.66	11.35	38.38	8.32	0.31	0.54	6.50	3.00	0.63	0.20	12.97	79.60
Bt2	48-69	sc	48.54	11.15	39.73	8.48	0.46	0.42	6.50	3.50	0.67	0.15	13.41	80.68
Bt3	69-105	sc	47.57	11.40	40.53	8.61	0.47	0.36	7.00	3.50	0.46	0.11	13.69	80.85
Bt4	105-138	sc	46.19	11.60	41.85	8.87	0.97	0.30	7.00	4.00	0.50	0.13	14.22	81.78
Bt5	138-180	sc	45.70	11.75	42.23	8.89	1.12	0.27	7.50	4.00	0.50	0.12	14.56	83.22

Pedon 15													
Ap	0-20	scl	64.65	6.94	27.45	5.82	0.04	0.42	2.50	1.00	0.15	0.12	6.57	57.27
Bt1	20-45	sc	56.45	6.10	36.63	6.15	0.05	0.39	4.00	2.00	0.17	0.10	9.88	63.46
Bt2	45-75	sc	55.80	6.22	37.40	6.34	0.05	0.33	4.00	2.00	0.17	0.10	10.14	61.87
Bt3	75-100	sc	54.80	6.45	37.95	6.65	0.06	0.33	4.00	2.50	0.17	0.09	10.85	62.38
Bt4	100-122	sc	53.40	6.50	39.23	6.66	0.07	0.21	4.00	2.50	0.20	0.09	11.32	60.01
Bt5	122-156	sc	52.75	7.03	39.78	6.78	0.07	0.18	4.50	2.50	0.31	0.09	11.85	62.47
CB	156-175	sc	52.10	7.90	39.40	7.66	0.22	0.15	4.00	2.00	0.38	0.06	9.55	67.53
Pedon 16														
Ap	0-19	sc	46.69	15.98	36.95	7.58	0.29	0.48	9.50	5.00	0.47	0.12	18.84	80.10
Bw1	19-45	sc	46.08	16.18	37.40	7.98	0.31	0.30	10.00	5.00	1.33	0.13	19.33	85.13
Bw2	45-64	sc	45.75	15.93	38.03	8.15	0.36	0.27	10.00	5.50	0.29	0.12	19.75	80.57
Bw3	64-78	c	41.97	11.83	45.55	8.27	0.09	0.51	11.50	7.00	0.50	0.25	22.83	84.35
Bw4	78-100	c	41.07	12.28	46.08	8.51	0.13	0.27	12.00	7.00	0.77	0.23	23.61	84.71
Bw5	100-129	c	40.13	12.33	47.13	8.81	0.22	0.21	12.00	7.50	1.75	0.22	24.32	88.29
Bw6	129-156	c	39.38	12.63	47.60	8.86	0.31	0.15	12.50	7.50	2.31	0.23	25.27	89.17

The organic carbon content decreased with depth irrespective of soil pedon and it ranged from 0.12 to 0.90 per cent. The oxidation of organic matter due to high temperature leads to lower content of organic carbon (Vasundhara *et al*. 2018). The exchangeable bases in all the pedons were in the order of Ca^{+2}> Mg^{+2}> Na^{+}> K^{+} on the exchange complex. From the distribution of Ca^{+2} and Mg^{+2} , it is evident that Ca^{+2} showed the strongest relationship with all the species, comparing these ions (Ca^{+2}, Mg^{+2}, K^{+} and Na^{+}) it was clear that Mg^{+2} ions were present in low amount than Ca^{+2} ions. The low value of exchangeable monovalents, compared to divalents was due to preferential adsorption of divalents than monovalent. Similar findings were quoted by (Pinki Seth *et al.*2017). The CEC and BS varied depth and pedon wise and ranged from 5.89 to 23.61 cmol (p^{+}) kg^{-1} and 51.77 to 98.07 per cent, respectively. The increase in CEC was due to the illuviation of clay from the surface to sub-surface horizons, resulting in the accumulation of clay and hence, high CEC (Rajashekar 2018). The downward movement of bases with percolating water from the upper to the lower horizons is the main reason for the increase of base saturation with the depth. Similar results were found by Ram Prasad and (Govardhan 2011).

The soils of the sub-watershed were grouped into 16 soil series (Fig.2). After studying the morphological, physical and chemical properties each pedon was classified into different taxonomical classes.

Pedons 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12 and 15 have argillic sub-surface horizon and do not have plagganepipedon and spodic or oxic subsurface horizons above the argillic horizon. Further, the argillic horizon was developed due to clay illuvation and was identified by the presence of clay cutans and the thickness of the horizon was more than 7.5 cm and also more than one-tenth as thick as the sum of the thickness of all the overlying horizons. The base saturation was more than 35 per cent throughout the depth of the horizon. Hence, Pedons 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12 and 15 are keyed out as *Alfisol* at order level (Table 3). Pedon 5, 13 and 16 were classified into *Inceptisols* owing to the absence of any other diagnostic horizons other than cambic horizon. As the moisture regime is ustic, pedon 1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12 and 15 were classified as Ustalfs at sub-order level. Pedon 5, 13 and 16 were classified at sub-order level as Ustepts at sub-order level (Table 3).

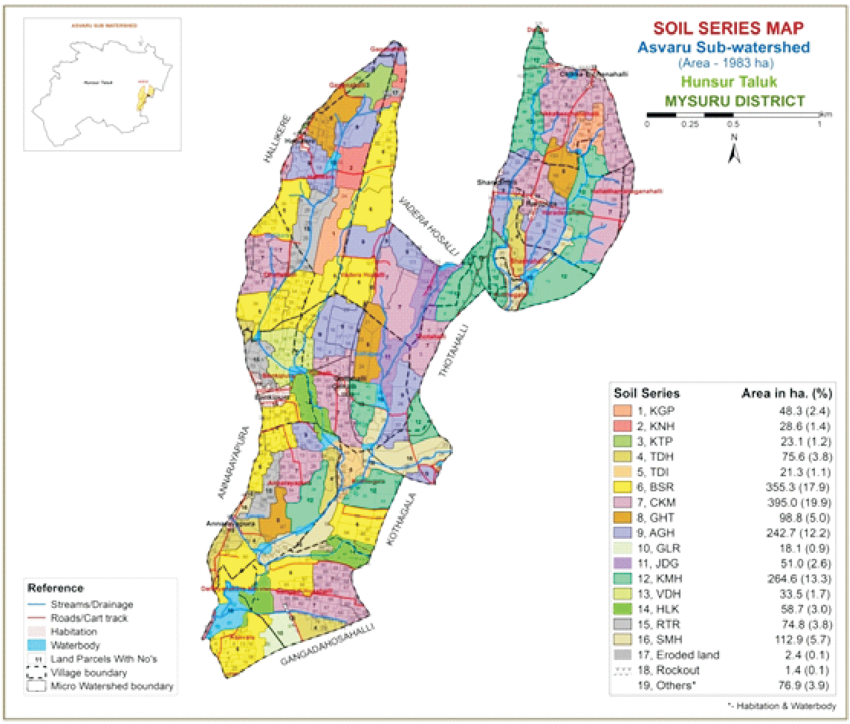

Fig .2. Soil Series map of Asvaru Sub-watershed.

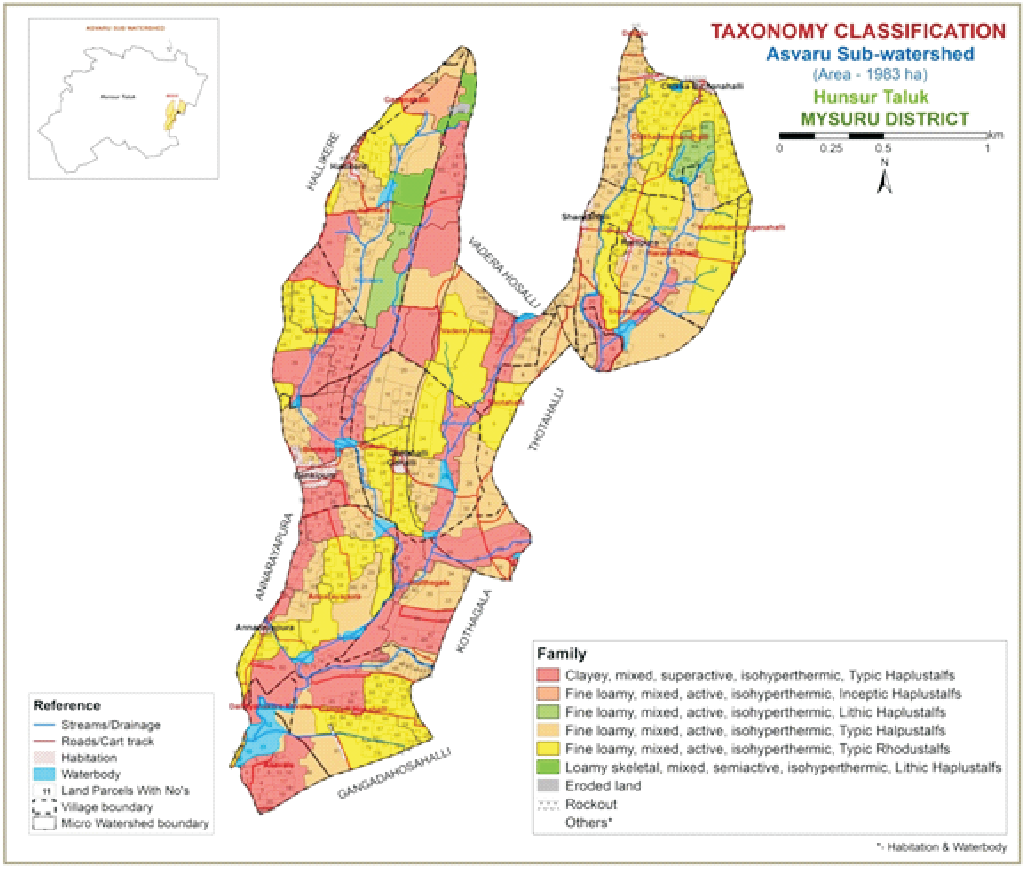

Fig .3. Soil Taxanomy Classification of Asvaru Sub-watershed.

At the sub-group level, pedons 2, 5, 6, 9, 10, 11, 12, 14 and 15 do not exhibit inter-gradation with other taxa or an extra-gradation from the central concept, hence keyed out as *Typic Haplustalfs*. Pedon 5, 13 and 16 keyed out as *Typic Haplustepts*. Similarly results were obtained by (Harshita 2018) in Hebbalagere micro- watershed. Whereas pedon 3 was classified as *Inceptic Haplustalf* due to an argillic horizon of less than 35 cm in thickness and no densic, lithic contact within 100 cm of mineral soil surface. Pedon 1 was classified under *Lithic Haplustalfs* due to lithic contact within 50 cm of the mineral soil surface and pedons 1 keyed out as *Lithic Rhodoustalfs* due to lithic contact within 50 cm of the mineral soil surface and Hue colour of 2.5YR or less and Value (moist) of 3 or less (Table 3). Similarly, pedons 4, 7 and 8 were classified under *Typic Rhodustalfs* due to Hue colour of 2.5YR or less and Value (moist) of 3 or less (Figure 3). Similar results were obtained by (Sireesha and Naidu 2013).

Classification of selected pedons at family level was made based on the particle size class, CEC class, mineralogy class and soil temperature regime class. Pedons 1, 3, 4, 7, 8, 9, 12, 14 and 15 contained 18 to 35 percent clay (weighted average) in the control section, which led the soils to be grouped under fine loamy particle size class. Pedon 2 contained less than 35 percent clay and is in lithic contact so they are classified under loamy skeletal particle size class. Pedons 5, 6, 11, 13 and 16 contained more than 35 percent and less than 35 per cent clay (weighted average) in the control section, hence keyed out as clayey (Table 3).

Pedon 2 was classified as semiactive at cation exchange activity classes because the ratio of CEC to percent clay (by weight) was less 0.40. Pedons 1, 3, 4, 7, 8, 9, 10, 12, 14 and 15 were classified as active at cation exchange activity classes because the ratio of CEC to percent clay (by weight) was between 0.40 to 0.60. Pedon 5, 6, 11, 13 and 16 were classified as superactive because the CEC to clay ratio was more than 0.60. Similar results were reported by (Madhu *et al.* 2012) in Patapur micro-watershed, (Kalaiselvi *et al*. 2018) in Bilalgodu micro-watershed, (Rajashekar 2018) in Sigehadlu micro-watershed.

MAST was computed from the MAAT (24^0C) by adding 3.5^0C, hence study area was classified under hyperthermic (MAST 27.5^0C) and the difference between mean summer and winter temperature was less than 60C. Therefore, the temperature regime of the study area.

The cation exchange activity class of pedons under study was super active for pedon where CEC to clay content ratio exceeds 0.60 (Soil Survey Staff 2014).

Table 3. Soil Classification of soils of Asvaru Sub-watershed of Hunsur Taluk, Mysuru District

Sl. No.	Soil Series	Family
1	KGP-Kaggalipura	Fine loamy,mixed, active, isohyperthermic, Lithic Haplustalfs
2	KNH-Kanchanahalli	Loamy skeletal, mixed, semiactive, isohyperthermic, TypicHaplustalfs
3	KTP-Kenthanapura	Fine loamy, mixed, active, isohyperthermic, IncepticHaplustalfs
4	TDH-Thammadahalli	Fine loamy, mixed, active, isohyperthermic, TypicRhodustalfs
5	TDI-Taadi	Clayey, mixed, superactive, isohyperthermic, TypicHaplustepts
6	BSR-Bisarahalli	Clayey, mixed, superactive, isohyperthermic, TypicHaplustalfs
7	CKM-Chikkamegheri	Fine loamy, mixed, active, isohyperthermic, TypicRhodustalfs
8	GHT-Gollarahalli	Fine loamy, mixed, active, isohyperthermic, TypicRhodustalfs
9	AGH-Aregujjanahalli	Fine loamy, mixed, active, isohyperthermic, TypicHalpustalfs
10	GLR-Gulur	Fine loamy, mixed, active, isohyperthermic, TypicHalpustalfs
11	JDG-Jedigere	Clayey, mixed, superactive, isohyperthermic, TypicHalpustalfs
12	KMH-Kumchahalli	Fine loamy, mixed, active, isohyperthermic, TypicHalpustalfs
13	VDH-Vaddarahalli	Clayey, mixed, superactive, isohyperthermic, TypicHaplustepts
14	HLK-Hallikere	Fine loamy, mixed, active, isohyperthermic, TypicHalpustalfs
15	RTR-Ranatur	Fine loamy, mixed, active, isohyperthermic, TypicHalpustalfs
16	SMH-Santhemarahalli	Clayey, mixed, superactive, isohyperthermic, TypicHaplustepts

Conclusion

The soils of the sub-watershed area were having shallow to very deep soils. The soil colour varied from dark reddish brown (2.5YR 3/4) to yellowish red (5YR 4/6) and dark brown (7.5YR 3/4) to brown (10YR 4/3) with friable consistency. Soil texture varied from sandy loam to sandy clay. The soil reaction was moderately acidic to moderately alkaline in majority of the soil profiles with non saline nature. Exchangeable cations followed the pattern of Ca^{+2}>Mg^{+}>Na^{+}>K^{+}. Based on the soil morphological, physical and chemical properties the soils of the Asvaru Sub-watershed were classified upto family level with majority of the soils coming under *Alfisols* (1734.6 ha) and *Inceptisols* (167.7 ha) soil order.

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