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Land Capability and Land Irrigability Classification in Garakahalli Micro- watershed of Karnataka

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Abstract: Land suitability for irrigation in semi-arid regions is important for agricultural development and to overcome water scarcity. The detailed soil survey of Garakahalli micro- watershed (447 ha) of Karnataka was carried out and mapped into 85 mapping units. The soil units were evaluated for surface irrigation. The suitability maps showed 74.06 per cent arable land, out of which 69.19 per cent of land is suitable for surface irrigation and remaining is unsuitable due to the limitation of the topography and stoniness. The detailed land resource data base in association with GIS and remote sensing was highly efficient in modeling and developing land suitability maps which can be used as a planning tool to optimize the agriculture in semi-arid regions of Karnataka.

Keywords: *Land evaluation, irrigability, capability, micro-watershed*

Introduction

The utilization of land and water resources are the major concern in arid and semi-arid regions covering more than 60 per cent of area in the country. Over 75 per cent of the cropped area falls in the semi-arid tropical region. Most of these drought prone districts are concentrated in Andhra Pradesh, Maharashtra, Tamil Nadu, Karnataka and Rajasthan, affecting 265 million people. Management of soil resources on scientific principles is essential to maintain the present level of soil productivity and to prevent its degradation. Therefore, in recent years increasing emphasis is laid on characterization of soils, accurate mapping of soils and developing rational and scientific criteria for land evaluation for its multifarious uses. This calls for a comprehensive knowledge on soil resources in terms of types of soils, their spatial extent, physical and chemical properties and limitations / capabilities. This kind of exercise using land capability and irrigability classification have been reported by researchers including Mani Bhushan and Roy (2018), but it is lacking in typical micro-watershed representing semi-arid tract of dry zone of Karnataka. Thus the present study was undertaken with the objective of generating soil resource information on 1:10000 scale for deriving land capability/ irrigability groupings for proper utilization of land resources, where irrigation potential is low.

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Materials and Methods

Study area

Garakahalli micro-watershed (527 ha) lies between 12°31'15" to 12°31'36" N latitude and 77°7'5" to 77°7'54" E longitude (Fig.1). Garakahalli micro-

watershed comes under agro-climatic zone 5 (eastern dry zone) of Karnataka. Garakahalli area receives a mean annual rainfall of 821.0 mm with bimodal distribution. May and September are the peak rainy months with length of the growing period of 120 to 150 days (August to November). The frequency of drought is 1 to 2 in a decade. The mean maximum temperature during July to November is 26.3 to 27.6°C and mean minimum temperature of 17.2 to 19.2C. The geology of study area is granite and granite-gneiss having very gently sloping to gently sloping lands at an elevation of 895 m to 900 m above MSL. The major area of the micro-watershed is under rainfed crops like groundnut (*Arachis hypogaea*), finger millet (*Eleusine coracana*), horse gram (*Macrotyloma uniflorum*) and sorghum (*Sorghum bicolur*). Irrigation from tubewells has enabled cultivation of irrigated mulberry (*Morus indica*), banana *(Musa acuminata colla)* and rice (*Oryza sativa*) in some patches of the watershed. The natural vegetation consists of *Ficus* spp., *Accacia arabica*, *Azadirachta indica*, *Eucalyptus globulus*, *Tamarindus indica,* and *Pongamia glabra.*

Field survey

A detailed soil survey of the Garakahalli micro-watershed was carried out using cadastral map to 1:4560 scale in conjunction with the False Colour Composite (FCC) of IRS - P6 -LISS IV satellite imagery Plus cartosat -1 merged data to identify landforms, land use and land cover following standard procedures. Eleven soil series were identified after field correlation and classified upto family level as per Soil Survey Staff (2014). The soil map was generated using Arc GIS 10.3 software. The land capability maps were prepared as per the guidelines of Klingebiel and Montgomery (1966). The land irrigability map was generated as per the guidelines proposed by Sehgal (1996). The step-wise methodology adopted in this study is given in figure 2. Horizon-wise soil samples were collected from representative pedon of each series, processed and analysed as per standard procedures (Jackson 1973).

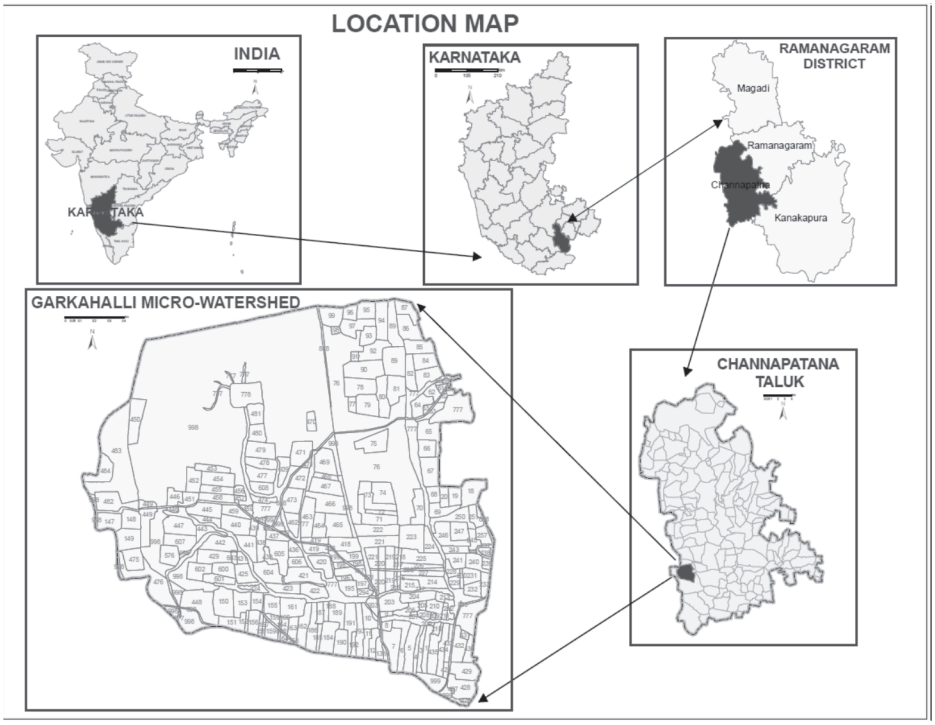

Fig. 1. Location map of study area

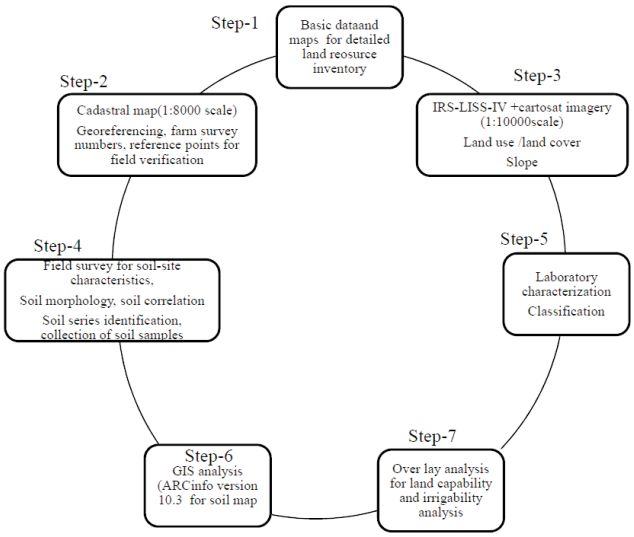

Fig.2. Step wise methodology used in Garakahalli microwatershed

Results and Discussion

Physical and chemical characteristics of soils

The soils (Lithic Ustorthent) are very shallow (<25 cm deep), well drained, dark brown to dark reddish brown, gravelly sandy loam (17.8 % clay) with more than 1 per cent of organic carbon and 60 to 70 per cent gravels and stones. These soils are slightly acid (pH 6.3) with cation exchange capacity of 7.0 cmol (p+) kg^{-1} and base saturation of 86 per cent (Table 1).

Typic Rhodustalfs covers an area of 30.68 per cent of TGA of watershed. These soils have A horizon with dark brown to dark reddish brown colour, sandy loam to sandy clay loam texture but gradually changed to dark reddish brown and gravelly sandy clay loam to sandy clay in argillic horizons (Table 1). These soils occur on very gently sloping to gently sloping (1-8% slope) uplands and are cultivated to *kharif* crops. The soils are slightly acid to neutral (pH 6.4-6.9). Clay content is 19.2 per cent in the surface soil and 24.5-31.6 per cent in the sub-soil. Cation exchange capacity is 6.0 cmol (p+) kg^{-1} to 17.1 cmol (p+) kg^{-1} with base saturation more than 60 per cent. Organic carbon content (0.24%) is low. The soil types that classified under this subgroup are B, C, D, F, G, I and L.

Under Typic Haplustalfs, three soil types namely E, J and M cover an area of 6.16 per cent of watershed. These soils are moderately deep with reddish brown to red and dark red, sandy clay loam with 15-35 per cent gravels mainly of quartz in the sub-soil. These soils occur on very gently sloping to gently sloping (1-8% slope) uplands and are slightly eroded. These soils are slightly acid (pH 6.4) to neutral (pH 6.4-7.1) with 23.2 per cent of clay in A horizons and 31.3 per cent clay in Bt horizons. The cation exchange capacity for surface horizons is 10.1 cmol (p+) kg^{-1} and increased up to 11.6 cmol (p+) kg^{-1} in the sub-soil horizons. The base saturation ranged from 51 to 61 per cent in the sub- soil. Organic carbon content (0.31%) is low.

Soil type K is classified as Rhodic Paleustalfs and cover an area of 27.76 per cent. These soils are very deep (>150 cm) and well drained. These soils have dark brown, sandy loam to sandy clay loam texture with low organic carbon in A horizons and dark red to dark reddish brown, sandy clay loam to gravelly sandy clay texture in Bt horizons. These soil soccur on very gently sloping to moderately sloping (1-15% slope) uplands and cultivated to rainfed *kharif* crops. These soils had pH ranging From (pH 5.9-6.9). Clay content is 13.5 per cent in A horizons but varied from 32.3-42.0 per cent in the sub-soils. The cation exchange capacity of Bt horizons ranged from is 13.5 to 18.0 cmol (p+) kg^{-1} with base saturation less than 60 per cent.

The soil type H is classified as Kandic Paleustalfs and covers 9.22 per cent area in the watershed. These soils are deep (100–150 cm) and well drained. The A horizons are dark brown to red with loamy sand texture but changed to dark red to dark reddish brown, gravelly sandy clay loam and gravelly sandy clay sub-soils with 15-60 per cent quartz gravel. They occur on very gently sloping to moderately sloping (1-15% slope) uplands and are cultivated to rainfed crops. The soils had pH ranging from pH 5.8 to 6.7. Clay content is 21.5 per cent in the surface but increased to 41.9 per cent in Bt horizons. The sub soils have cation exchange capacity of 8.3-16.6 cmol (p+) kg^{-1} and base saturation of 48 to 93 per cent. Organic carbon content (0.50%) is low.

Soil type N (Fluventic Haplustepts) is deep and well drained. The A horizons have reddish brown to dark reddish brown in colour with loamy sand to sandy loam textures but changed to yellowish red to dark reddish brown and dark red, gravelly sandy loam to sand and sandy clay loam indicating textural variations in sub-soils. These soils are alkaline (pH 7.5) with clay content of 25.6 per cent in A horizons but shows irregular distribution with depth. These soils had low cation exchange capacity, decreasing irregularly (2.0-5.9 cmol (p+) kg^{-1}) in the sub-soil with a base saturation of 50 to 60 per cent. Organic carbon content (0.43%) is low.

Soil map

The soil map is generated with 14 soil types and 85 management units based on surface texture, slope and erosion under ARC info environment (Fig. 3). The soil mapping units for soil A is defined as Ag2hD2St4 having gravelly sandy clay loam surface, moderately slopy and moderately eroded and very stony. This unit covers 0.39 per cent of total area of watershed. Among 85 units, the soil type K has 14 units (27.76%, 146.38 ha) and 15 units for soil type H and cover 48.59 ha (9.22 % of area). Likewise Soil G has 10 units cover 27.03 ha (5.13%) while soil C with 8 units covers 9.61 per cent of area. The Soil type B, L and M have 2 units each but cover an area less than 3 per cent of total area.

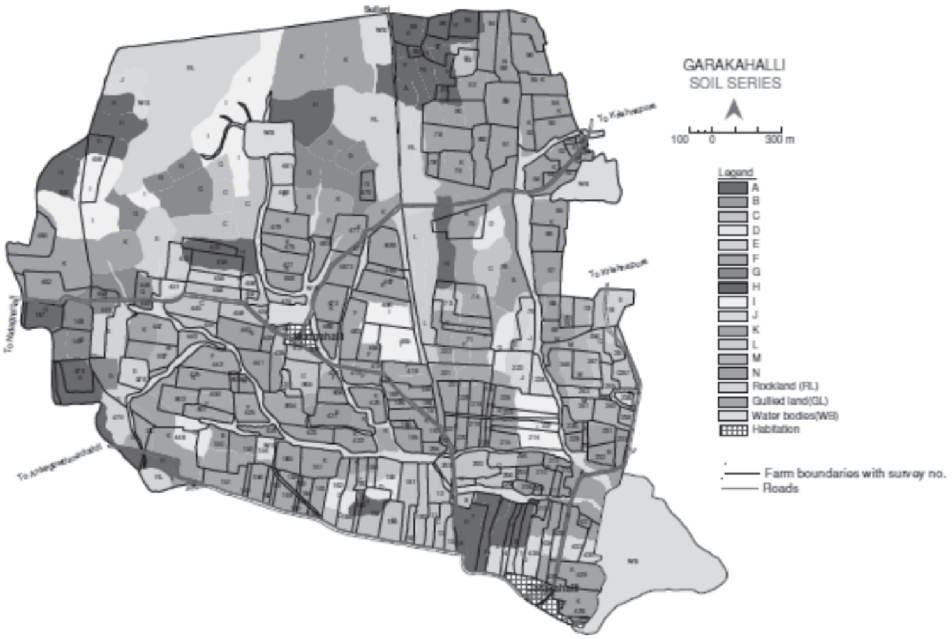

Fig. 3. Soils type map of Garakahalli microwatershed

Table 1. Physical and chemical properties of the soils of Garakahalli microwatershed

Horizon	Depth cm	Particle size distribution (% of <2 mm)			Organic Carbon (%)	pH	Exchangeable bases (cmol (p+) kg^{-1})				CEC	Base saturation (%)
		Sand	Silt	Clay			Ca	Mg	Na	K		
Soil type A. : Loamy-skeletal, mixed, isohyperthermic Lithic Ustorthents												
A	0–14	64.7	13.1	22.2	1.21	6.3	2.9	2.5	0.0	0.6	7.0	59
Soil type B : Fine, mixed, isohyperthermic, Typic Rhodustalfs												
Ap	0–18	65.1	7.9	27.0	0.37	6.8	5.1	1.8	0.0	0.2	9.9	72
Bt1	18–42	46.0	12.4	41.6	0.83	7.1	10.3	2.1	0.1	0.1	16.8	75
Bt2	42–75	61.6	12.3	26.1	0.21	7.5	7.8	1.3	0.1	0.1	12.2	76
Soil type C : Fine, mixed, isohyperthermic Typic Rhodustalfs												
Ap	0–13	70.3	13.1	16.6	0.19	6.8	6.5	1.7	0	0.1	10.3	81
Bt1	13–40	49.3	15.6	35.1	0.32	6.5	10.9	3.8	0.1	0.1	18.3	81
Bt2	40–58	40.3	19.7	40.0	0.42	6.6	10.8	4.4	0	0.1	19.0	81
Bt3	58–83	77.3	14.5	8.2	0.11	8.3						
Soil type D: Fine, mixed, isohyperthermic Typic Rhodustalfs												
Ap	0–14	56.9	10.6	32.5	0.45	7.3	6.4	1.8	0.5	0.2	13.2	67
Bt1	14–37	26.9	29.3	43.8	0.32	7.3	7.0	2.0	0.4	0.1	15.6	61
2Bt2	37–63	43.5	14.9	41.6	0.26	7.2	7.7	2.1	0.9	0.1	16.8	64
3Bt3	63–89	44.0	17.4	38.6	0.24	7.2	8.0	2.0	0.9	0.1	17.1	64
Soil type E: Fine-loamy, mixed, isohyperthermic Typic Haplustalfs												
Ap	0–7	60.6	16.2	23.2	0.31	6.4	4.8	4.4	0.1	0.1	10.1	53
Bt1	7–30	59.4	12.2	28.4	0.30	6.8	4.6	4.4	0.1	0.1	10.0	52
Bt2	30–51	55.8	12.9	31.3	0.31	6.8	6.3	4.4	0.3	0.1	11.6	61
Bt3	51–72	61	14.2	24.8	0.19	7.0	5.5	4.4	0.3	0.1	11.1	57
Bt4	72–96	67.2	13.7	19.1	0.24	7.1	4.3	0.3	0.2	0.1	9.6	51
Soil type F : Fine, mixed, isohyperthermic Typic Rhodustalfs												
Ap	0–15	47.3	18.5	34.2	0.28	6.3	2.0	0.4	0.4	0.1	3.6	81
Bt1	15–52	49.6	9.4	41.0	0.38	6.9	5.1	0.8	0.5	0.1	11.5	57
Bt2	52–75	47.4	10.5	42.1	0.39	6.7	5.6	0.9	0.4	0.1	12.1	58
2Bt3	75–106	45.5	7.9	46.6	0.25	6.4	6.0	0.9	0.6	0.1	12.9	59
2Bt4	106–130	56.5	11.7	31.8	0.18	6.5	5.6	0.7	0.5	0.1	10.9	63
Soil type G : Fine-loamy, mixed, isohyperthermic Typic Rhodustalfs												
A	0–16	79.3	10.5	10.2	0.76	6.2	2.7	1.7	0	0.4	7.0	69
Bt1	16–48	58.9	13.9	27.2	0.50	6.4	3.8	2.1	0	0.1	9.0	67
Bt2	48–84	64.9	15.5	19.6	0.28	6.6	4.7	2.7	0	0.1	7.5	100
Bt3	84–106	77.3	17.7	5.0	0.14	6.7	5.0	2.8	0	0.1	8.0	99
Soil type H : Clayey-skeletal, mixed, isohyperthermic Kandic Paleustalfs												
Ap	0–10	69.9	8.6	21.5	0.50	5.9	2.3	0.4	0.4	0.1	6.3	51
Bt1	10–29	60.1	8.9	31.0	0.43	5.8	3.3	0.4	0.5	0.1	8.3	52
2Bt2	29–45	50.7	9.0	40.3	0.48	6.3	4.0	0.5	0.5	0.1	10.1	50
2Bt3	45–84	48.3	9.8	41.9	0.33	6.7	3.2	5.3	0.2	0.1	9.5	93
2Bt4	84–122	45.9	14.5	39.6	0.28	6.3	5.0	0.5	0.2	0.1	12.2	48
2Bt5	122–144	49.2	16.1	34.7	0.25	6.6	8.5	1.1	0.3	0.1	16.6	60
Soil type I: Fine, mixed, isohyperthermic Typic Rhodustalfs												
Ap	0–10	73.1	7.7	19.2	0.24	6.5	2.3	1.7	0	0.3	6.0	72
Bt2	10–44	49.4	26.1	24.5	0.32	6.4	5.6	3.7	0.1	0.1	11.5	83
Bt1	44–77	51.6	16.8	31.6	0.37	6.0	3.8	2.9	0	0.2	9.6	72
Bt3	77–109	47.4	21.7	30.9	0.30	6.8	6.9	4.0	0.1	0.1	11.9	93
Bt4	109–130	50.4	39.8	9.8	0.36	6.9	5.5	3.2	0	0.1	10.7	82

Soil type J : Fine, mixed, isohyperthermic Typic Haplustalfs												
Bt1	0–12	67.6	15.5	16.9	0.46	8.2	5.9	3.4	0.2	0.2	10.5	92
Ap	12–33	64.9	13.4	21.7	0.53	8.3	5.3	2.9	0.2	0.2	9.4	91
Bt2	33–60	49.5	9.6	40.9	0.34	8.2	8.3	4.6	0.4	0.1	15.1	89
Bt3	60–94	48.5	11.6	39.9	0.38	8.2	9.2	4.6	0.4	0.1	16.8	85
Bt4	94–130	47.0	19.2	33.8	0.17	8.1	8.2	4.0	0.5	0.1	14.2	90
Soil type K: Fine, mixed, isohyperthermic Rhodic Paleustalfs												
Ap	0–10	79.1	7.4	13.5	0.41	5.9	2.2	0.3	0.1	0.1	5.5	49
Bt1	10–40	50.0	17.7	32.3	0.39	6.7	6.2	0.5	0.3	0.1	13.5	53
Bt2	40–69	45.6	12.4	42.0	0.50	6.8	6.1	0.5	0.3	0.1	13.4	52
Bt3	69–98	48.4	11.0	40.6	0.65	6.4	5.4	0.4	0.2	0.1	12.9	47
2Bt4	98–133	50.6	14.5	34.9	0.32	6.9	6.3	0.5	0.3	0.1	13.8	52
3Bt5	133–151	44.0	20.9	35.1	0.28	6.8	9.2	0.5	0.3	0.1	18.0	56
Soil type L : Loamy-skeletal, mixed, isohyperthermic Typic Rhodustalfs												
Ap	0–8	74.7	12.8	12.5	0.37	6	3.1	0.5	0.3	0.1	7.1	56
Bt1	8–25	55.5	15.4	29.1	0.49	6.2	7.5	1.2	0.4	0.1	13.9	66
Bt2	25–56	51.6	12.1	36.3	0.38	7.0	9.0	1.4	0.4	0.1	15.4	71
Bt3	56–79	45.1	9.0	45.9	0.44	7.6	9.6	1.2	0.5	0.1	16.5	69
Soil type M : Fine, mixed, isohyperthermic Typic Haplustalfs												
Ap	0–14	73.6	13.5	12.9	0.53	6.6	5.3	1.8	0.4	0.1	7.7	99
Bt1	14–28	74.1	14.6	7.3	0.43	7.2	5.9	1.4	0.3	0.1	7.1	100
Bt2	28–53	71.6	11.4	17.0	0.13	7.8	5.6	1.8	0.3	0.1	7.9	100
Soil type N : Coarse-loamy, mixed, isohyperthermic Fluventic Haplustepts												
Ap	0–11	61.2	13.2	25.6	0.43	7.5	5.5	0.6	0.4	0.5	12.3	57
Bw	11–30	73.6	10.4	16.0	0.37	7.5	3.5	0.5	0.3	0.2	9.0	50
C	30–52	94.5	2.4	3.1	0.10	7.8	0.9	0.2	0.1	0	2.0	60
2Bw	52–86	81.1	7.7	11.2	0.11	8.0	2.8	0.2	0.2	0.1	5.9	58

Land capability and land irrigability classification

The overlay analysis for capability and irrigability was performed as per the logical framework (Table 2).

The results showed that the watershed has 13 land capability units identified under five land capability classes (Fig. 4). Among arable classes, the capability class II lands occupy 338.79 ha *i.e.* 68.19 per cent TGA of watershed. It was further classified into three capability units such as IISt9 (minor problems of low fertility and heavy-textured surface soil); IIst9 cover 234.57 ha (44.49% of TGA), IIS2 (problem of coarse-textured surface soil (71.48 ha, 13.56%); IIs3: problem of heavy-textured surface soil (32.74 ha, 6.21%). They occur on very gently sloping to gently sloping (1-5% slope) uplands and require contour bunds with open ends or waste weirs, graded bunds and graded or contour border strips. These soils are grouped as suitable for irrigation but topographic limitations in 9 soil units covering 29.94 ha and thus categorized as 2st irrigability sub-class.

Land capability class III are moderately good cultivable lands with problems of surface stoniness (IIIs0, 10.38 ha). These soils are moderately deep or deep (75-150 cm), with sand to sandy clay and clayey sub-soils. The soil mapping units grouped under this capability units are Dg1bB1St3, Eg1cB1St3, Gg1hC1St3, HcB1St3 and HmC1St3.

The soils grouped under land capability class IIIs8 are slightly deep (50-75 cm), sandy loam or sandy clay loam surface soils occuring on very gently sloping (1-3% slope) uplands. This unit covers 7.35 ha (1.39 per cent) and has only two units, (BcB1 and BmB1). These soil units are very susceptible to sheet and rill erosion that needs contour bunds or contour border strips. Short duration crops can be grown.

The soils grouped under this land capability class (IIIes) are deep and very deep (100-150 cm) with loamy sand to sandy clay loam soils. These classes occupy an area of 20.22 ha (3.83%) and occur on gently sloping (3-5% slope) uplands and have problems of water erosion, gravelliness, and surface stoniness (3-15%) stones). The soil map units grouped under this unit are Gg2hC2St3, Ig2hC2St3 and Lg1bC2St3. These units need intensive soil and water conservation measures like terracing, stone pitched contour bunds and graded border strips.

The soils grouped under IIIes2 (GbB2 and KbC2) are deep to very deep (100-150^{+} cm), and have loamy sand, sandy loam and sandy clay loam texture. They occur on gently sloping (3-5% slope) uplands and cover 7.78 ha (1.48%) and suggested conservation measures are terracing, stone pitched contour bunds and graded border strips. These are non- irrigable and classified as 4s and 4st. These units are marginally suitable under irrigation due to soil and topography constraints. Limitations include stoniness/ gravelliness or coarse and heavy textures, permeability, available water capacity and slope.

Land capability class IV is fairly good for cultivation with moderate slope (5-10%) and water erosion. The soil unit grouped under capability unit of IVe1 is KhD2 (6.78 ha, 1.29%). These soils are very deep (>150 cm), sandy clay loam to gravelly sandy clay sub-soils. They occur on moderately sloping (5-10% slope) uplands and suggested for graded bunds and graded trenches. These marginal lands are suitable for occasional cultivation of short and medium duration crops and are better suited to silvipasture, agri-horti-silvipasture and agroforestry.

The soils grouped under capability unit of IVes are very shallow (<25 cm), moderately deep and deep (75-150 cm) with sandy loam to stony surface and clayey sub- soils. These soils occur on moderately sloping (5-10% slope) uplands and are very susceptible to water erosion. The soil map units grouped under this land capability unit are Ag2hD2St4, Eg2cC2St4, Hg1cD2St4, Hg1hD2St4, Hg2cD2St3, Hg2hD2St4, Jg1hD2St3, KhD2St3 and Lg1cD2St3. These unit covers 27.43 ha (5.2% of area) and needs soil and water conservation measures like graded bunds with grassed waterways and graded trenches. These units are well suited for agri-horti-silvipasture, pasture, silvipasture and agroforestry.

Non-arable land

The watershed has 70.77 ha (13.34% of area) land under non-arable class with severe erosion and surface stoniness. These soils are deep (100–150 cm), gravelly with stony surface soils and gravelly sandy clay loam sub-soils. These lands are suitable for forestry, agro-forestry, pasture and silvi-pasture. The soil mapping units grouped under this unit are Gg1cE3St4 and Gg1hE3St4. This class also includes miscellaneous lands with high grade export quality granite sheet rock.

Table 2. Mapping unit-wise land capability subclass and irrigability subclass

Land irrigability subclass	Land capability								Area	
	II				III		IV	V-VIII	ha	%
	S2	S3	S9	S0	e1	es2	So			
2s	CbB1, EbB1, FbB1, GbB1, HbB1, KbB1, NbB1	DmB1, EmB1, ImB1, KmB1	CcB1, , ChB1, FcB1, FiB1, GcB1, HcB1, HhB1, IcB1,IhB1, IiB1, JhB1, JiB1, KcB1, KhB1, McB1, MhB1, NcB1, NhB1, NiB1		ImB2	GbB2,			288.15	54.6
2st	IbC1		CiC1, IcC1, KcC1, KhC1, KiC1,		CcC2, IiC2,	KbC2			29.94	5.68
3s	Dg1bB1, Hg1bB1, Hg2bB1,		Cg1hB1, Cg2fB1, Eg1iB1, Hg1hB1, Hg1iB1, Kg1cB1, Kg1hB1						28.95	5.49
3st	Cg1bc1,	Hg1iC1,	Dg1cC1, Gg1iC1 Hg2iC1, Ig1hC1						12.95	2.42
4s				Dg1bB1st3, Eg1cB1st3, Gg1hC1st3, Gg2hC2st3, HcB1st3, HmC1st3,		Ig2hC2st3, Lg1bC2st3	Eg2cC2st4,		26.57	5.04
4st							Hg1cD2st4, Hg1hD2st4, Hg2cD2st3, Hg2hD2st4, Jg1hD2st3, KhD2, KhD2st3, Lg1cD2st3		30.09	5.71
4st-6st								Gbc2st3–R, Gg2cD2st4–R, Kg1hC2st4–R, Kg2hD2st4–R	13.39	2.53
6st								Ag2hD2st4, Gg1cE3st4, Gg1hE3st4,	47.33	8.98
Total area(ha)	71.48	32.74	234.57	10.38	6.08	7.78	27.49	70.77	447.43	84.77
Per cent	13.56	6.21	44.49	1.97	1.15	1.48	5.20	13.34		

Key to land-capability unit limitations

0	Stony or rocky	5	Coarse substrata
1	Erosion hazard/slope	6	Salinity/alkalinity
2	Coarse texture (surface)	7	Stagnation/overflow
3	Fine texture (surface)	8	Effective rooting depth
4	Slowly permeable subsoil	9	Fertility

Key to limitations in irrigability subclasses

2	Lands with moderate limitations	3	Lands with severe limitation
4	Lands with very severe limitation	6	Land not suitable for irrigation
R	Rockland	s	Soil limitation
t	Topographic limitation		

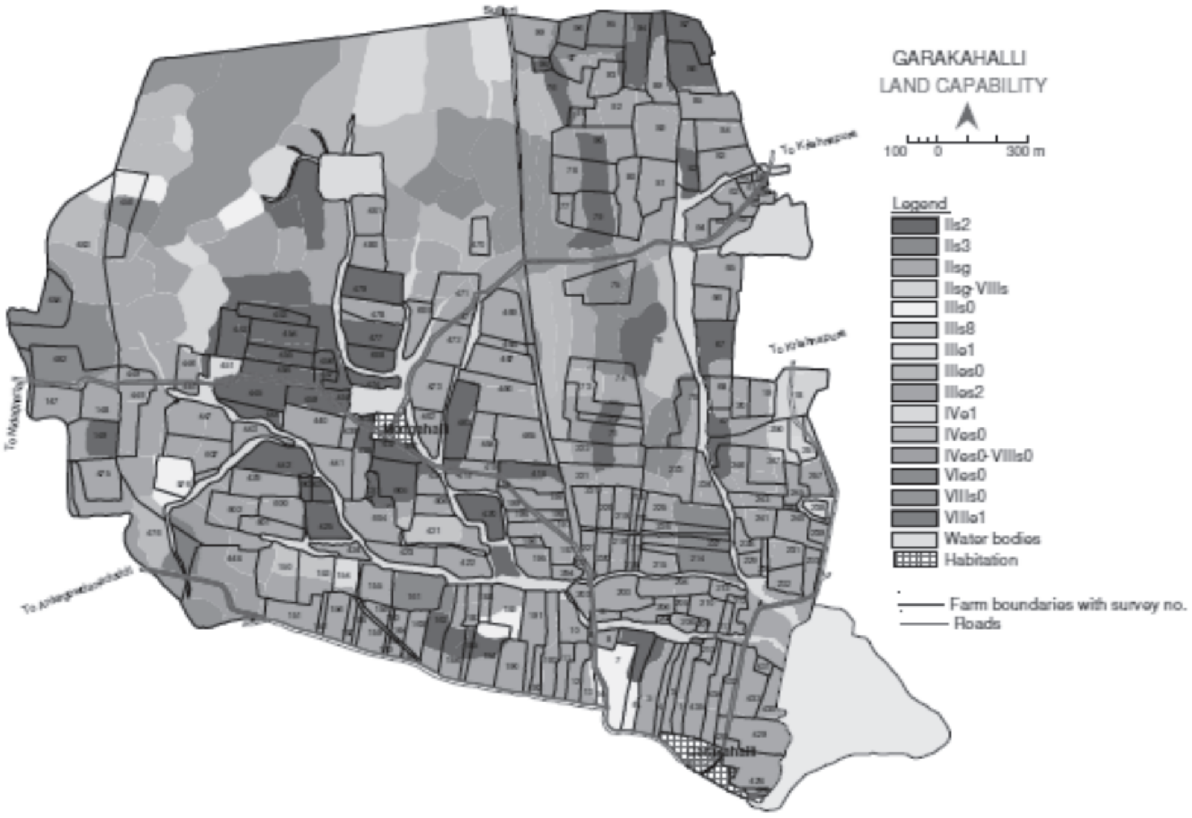

Fig. 4. Land capability subclass map of Garakahalli watershed

Suitability of land for irrigation

The land use and soil data were reclassified into four classes of land irrigability according to the FAO framework (FAO 1989). The land irrigability map (Fig. 5) shows that there is a possibility of irrigation in Garakahalli micro-watershed to an extent of 69.19 per cent of land as against the current irrigated land of 30 per cent. The clayey soils (>30 % in sub-soils) in soil units of class-II lands and grouped as suitable for surface irrigation. The data shows that about 54 per cent of area is manageable for irrigation with levelling. The study recommended that drip irrigation is a better choice for more than 14 per cent of irrigable area than surface irrigation in rugged topography areas. Climatic conditions in the watershed show that area receives a mean annual rainfall of 821.0 mm with bimodal distribution and PET of 1496 mm. The length of the main crop growing season is 120 to 150 days with probability of the growing season starts from the 33rd, 37th and 38th weeks. The end of the growing season is 46th to the 51st week with maximum probability of 18.52 per cent. The monthly rainfall and potential evapotranspiration indicates that rainfall is larger than potential evaporation during the rainy season. This suggests that there is no need of irrigation during the rainy season. However, supplementary irrigation may be necessary in case of unexpected dry spells and droughts. From the IMD data, it is estimated that reference crop evapotranspiration (ET) ranges between 5.44 and 4.32 mm day^{-1} for the growing season from June to September. The net irrigation requirement (NIR) over the growing period may vary from 600 to 1000mm year^{-1} depending upon the nature of crop grown.

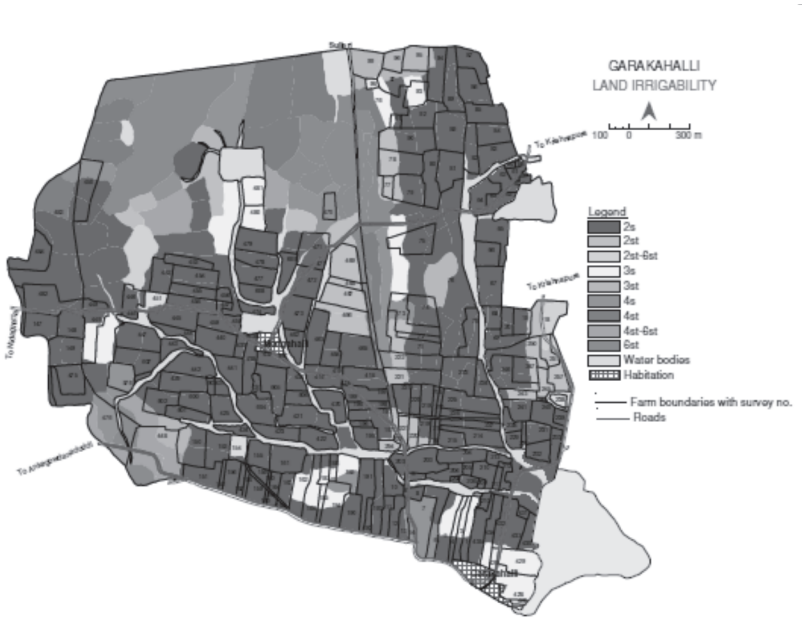

Fig. 5. Land irrigability subclasses map

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