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Land Suitability Evaluation for Different Crops of Channegowdarapalya Microwatershed, Kunigal Taluk, Tumkuru District

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ABSTRACT

An investigation was carried out to evaluate the land suitability of Channegowdarapalya Micro-watershed in Tumkur district for locally preferred crops. Among fifteen pedons studied by traversing, eight pedons were selected as master profiles. Soils were shallow to very deep, mostly non-gravelly horizons and gravelly to very gravelly soils in some profiles which is limitation for growing crops. Texture was varied from sandy clay to clay in subsurface soils. Nineteen soil phases including eight soil series were identified and there was increase in Clay, BD and CEC with depth but sand content decreased. Land suitability evaluation for different field and plantation crops was carried out. About 17.9 to 27.0 per cent of area was highly suitable for crops like redgram, mango, jamun and sapota and 4.4 to 13.3 per cent area was not suitable for plantation and fruit crops. Few areas of the microwatershed was found to be marginally to moderately suitable with major limitation of depth, texture and gravel. Soils of lower part of midland were highly suitable for most of the crops than the soils of upland.

Keywords : Land suitability, Microwatershed, Soil profiles

INCREASING demand on food as a result of population growth has created more pressure on land resources and there is a need to avoid degradation of resources and sustain the yield. The concept of using the land for sustaining the yield lies within the land use planning process. Since the availability of both water and plant nutrients is largely controlled by the physico-chemical and micro-environment of soils. This illustrate how soil depth, subsoil texture, subsurface gravels and climate are related to sustainability of yield. Land suitability studies provide information on the choice of crops to be grown on best suited soil unit for maximizing crop production per unit of land, labour and inputs.

Soil maps are the traditional source of information for land suitability analysis. The land suitability for defined use and the impact of the use on environment is determined by land condition and land qualities. These suitability models provide guidelines to decide the policy of growing most crops depending on the suitability of each soil unit and provide an insight into the potentialities and limitations of soil for its effective exploitation.

An appropriate land evaluation creates the awareness among land users, planners, research workers and administrators in order to ensure the proper and effective utilization of soil resources, as well as providing an accurate and scientific inventory of different soils, their kind and nature and extent of distribution so that one can make predictions about their characteristics and potentials.

Land evaluation study was conducted in Channegowdarapalya micro-watershed, Kunigal taluk, Tumkuru district of Karnataka, which is located at 13^0 3' 58.52" to 13^0 5' 59.79" N latitudes and 76^0 56' 51.44" to 76^0 58' 15.49" E longitudes covering an area of 461 ha (Fig. 1). It has tropical climate and average annual rainfall of the study area is 828 mm. South-West monsoon contributes most for the rainfall (435.9 mm). The average temperature is 25°C. Maximum temperature ranged from 30 to 36 °C and minimum temperature ranged from 14 to 20 °C.

The average temperature was highest in the month of April (28.3 °C) and least in December. Relative humidity ranged from 56 to 82 per cent with an average annual relative humidity of 73 per cent. Area was

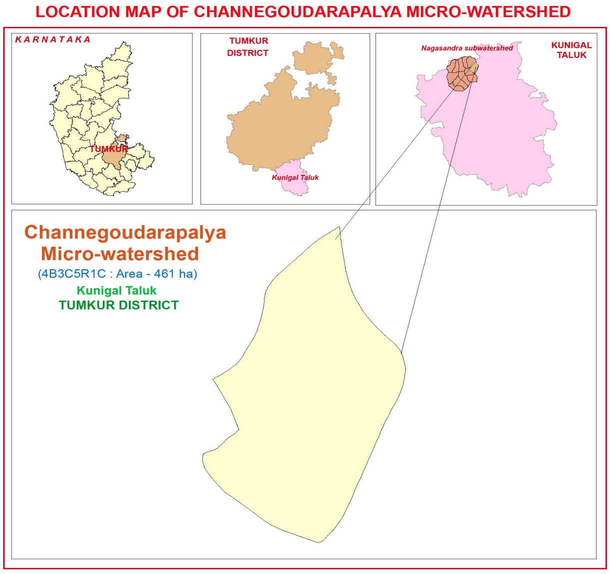

Fig. 1: Location map of Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

classified under ustic soil moisture regime and iso-hyperthermic soil temperature regime.

Material and Methods

Preliminary traverse of the micro-watershed was done using Cartosat-1 satellite imagery (Fig. 2) and cadastral

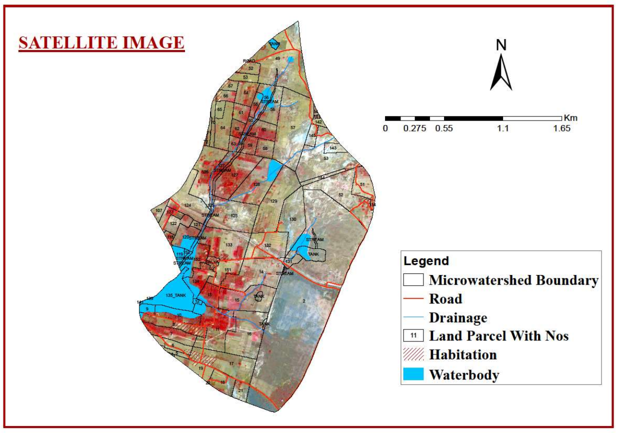

Fig. 2: Satellite imagery (Cartosat 1) of Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

map on 1:7920 scale (Fig. 3). Physiographic delineations were marked and traversing was done to confirm the delineations and to select representative sites for studying pedons. Transects were located across the slope at right angles to the contours and cover most of the variations observed in the landform.

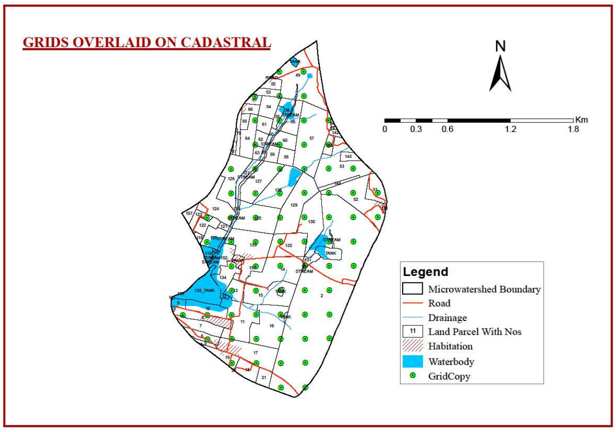

Fig. 3: Grids overlaid on cadastral map of Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

At closely spaced intervals of each transect, profiles were located considering any change in slope, gravels, erosion and stones. Wherever transects were not located, random soil profiles were studied to bring all the possible variability in soils of the study area and profiles were studied and horizon wise texture, gravel and pedon depth were recorded.

The characteristics of mapping units or soil phases which are used to determine the suitability of land for different crops are listed in Table 1. Eight soil series were identified and mapped into nineteen mapping units.

Land suitability for major crops like finger millet, redgram, arecanut, coconut, mango, custard apple, cashew, jamun, guava and sapota were evaluated following FAO (1979) guidelines as modified by Naidu (2006) was used. The soil properties from the study area were matched with soil-site suitability criteria of different crops (Table 2) and arrived at soil-site suitability sub-class.

Results and Discussion

Soil Characteristics

Shallow to very deep soils were found in study area in which maximum area was occupied by very deep (>150 cm) soils, in Hallikere series. There were no gravels in surface and subsurface soils in most of area except subsurface soils of Kambalahalli (KBH), Bidanagere (BDG) and Hooradhahalli (HDH) soil

TABLE 1

Characteristics of soil mapping units of Channegowdarapalya Microwatershed Kunigal taluk, Tumkuru district

Soil mapping units	Soil depth (cm)	Surface gravelliness (%)	Sub-surface gravelliness (%)	Surface texture	Sub-surface texture
KBHiB1g2	25-50	35-60	40-60	Sandy clay	Sandy clay
KGHbB1	50-75	<15	15-35	Loamy sand	Sandy clay
KGHcB1	50-75	<15	15-35	Sandy loam	Sandy clay
KGHhB1g1	50-75	15-35	15-35	Sandy clay loam	Sandy clay
KGHhB1g2	50-75	35-60	15-35	Sandy clay loam	Sandy clay
BDGbB1g1	75-100	15-35	35-60	Loamy sand	Sandy clay
BDGcB1	75-100	<15	35-60	Sandy loam	Sandy clay
CKMhB1g1	75-100	15-35	<15	Sandy clay loam	Clay
CKMiB1g1	75-100	15-35	<15	Sandy clay	Clay
HDHcB1	75-100	<15	>35	Sandy loam	Sandy clay
HDHmB1g2	75-100	35-60	>35	Clay	Sandy clay
JDGcB1g1	100-150	15-35	<15	Sandy loam	Clay
VDHcB1	100-150	<15	<15	Sandy loam	Clay
HLKhB1	>150	<15	<15	Sandy clay loam	Clay
HLKhB1g1	>150	15-35	<15	Sandy clay loam	Clay
HLKiB1	>150	<15	<15	Sandy clay	Clay
HLKmB1	>150	<15	<15	Clay	Clay
HLKhB1g2	>150	35-60	<15	Sandy clay loam	Clay
HLKmB1g2	>150	35-60	<15	Clay	Clay

series which were having very gravelly soils (>35%). Surface texture varied from loamy sand to clay and subsurface texture varied from sandy clay to clay and maximum area was found with clay textured subsurface soils.

Totally fifteen profiles were studied and eight profiles were selected as master profiles. In general, sand percentage was decreased as the depth of the soil increased in all the pedons while clay content was increased as the depth increased in all the pedons due to the eluviation of clay from surface layers and its accumulation in subsurface layers under the influence of rainfall. However, the distribution of silt content in the pedon did not follow any definite trend (Table 3).

The bulk density ranged from 1.22 to 1.47 Mg m^{-3} (Table 3) and increasing down the depth in almost all the pedons which was due to compaction of finer particles in deeper layers caused by the over-head weight of the surface layers and decreased organic matter content in the lower layers.

CEC generally followed increasing trend with depth in all the pedons (Table 3). This might be due to the illuviation of clay from surface to sub-surface horizon

TABLE 2

Criteria for assessment of land suitability for various crops

	Description		Maize	Finger millet	Redgram	Arecanut	Coconut	Mango	Sapota	Jamun	Guava	Cashew
Depth (cm)	V. shallow	<25	N	S3r	N	N	N	N	N	N	N	N
	Shallow	25-50	S3r	S2r	S3r	N	N	N	N	N	N	N
	Mod. Shallow	50-75	S2r	S2r	S2r	S3r	N	N	S3r	S3r	S3r	S3r
	Mod. deep	75-100	S1	S1	S1	S2r	S3r	S3r	S2r	S3r	S2r	S2r
	Deep	100-150	S1	S1	S1	S1	S2r	S2r	S1	S1	S1	S1
	V. deep	>150	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
Gravel(%)	g0	<15	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
	g1	15-35	S2g	S2g	S2g	S2g	S2g	S2g	S2g	S2g	S2g	S2g
	g2	35-60	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S3g	S2g
	g3	60-80	N	N	N	N	N	N	N	N	N	N
Slope(%)	A	0-1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
	B	1-3	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
	C	3-5	S2l	S2l	S2l	S2l	S2l	S2l	S2l	S2l	S2l	S2l
	D	5-10	S3l	S3l	S3l	S3l	S3l	S3l	S3l	S3l	S3l	S2l
	E	>10	N	N	N	N	N	N	N	N	N	S3l
Subsoil texture	Loamy sand	ls	S3t	S3t	S3t	S3t	S3t	N	N	N	N	S2t
	Sandy loam	sl	S3t	S1	S2t	S2t	S2t	S1	S2t	S2t	S2t	S1
	Sandy clay loam	scl	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1
	Clay loam	cl	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t
	Sandy clay	sc	S1	S1	S1	S1	S1	S1	S1	S1	S1	S2t
	Clay (red)	c	S2t	S1	S1	S2t	S2t	S1	S1	S1	S1	S2t
	Clay (black)	c	S3t	S3t	S2t	S3t	S3t	S3t	S3t	S2t	S3t	N

Suitability : S1- highly suitable, S2- moderately suitable, S3- marginally suitable, N- not suitable
Limitations: r-rooting depth, g- gravel, t- texture, l- slope

TABLE 3

Bulk density, particle size distribution, CEC of the typifying pedons of the Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

Horizon	Depth (cm)	Sand (2.0-0.05 mm) %	Silt (0.05-0.002 mm) %	Clay (<0.002 mm) %	Texture	B.D (Mg m^{-3})	CEC (meq 100g^{-1})
Pedon 1							
Ap	0-19	75.20	7.00	15.00	Sandy loam	1.24	12.75
Bt_1	19-37	34.50	13.00	50.50	Clay	1.34	23.20
Bt_2	37-65	37.60	12.50	48.50	Clay	1.36	22.10
Bt_3	65-83	39.80	11.50	46.00	Clay	1.38	20.00
Bt_4	83-111	38.90	12.00	47.50	Clay	1.43	21.40
BC	111-125	36.70	13.00	48.00	Clay	1.46	24.70
Pedon 2							
Ap	0-13	75.00	10.00	12.50	Loamy Sand	1.22	10.00
Bt_1	13-42	55.60	7.00	35.00	Sandy clay	1.24	19.80
Bt_2	42-66	54.50	7.50	35.50	Sandy clay	1.26	22.00
Bt_3	66-81	55.30	6.50	35.00	Sandy clay	1.32	21.70
Pedon 3							
Ap	0-17	74.50	7.50	15.00	Sandy loam	1.23	11.60
Bt_1	17-40	55.50	6.50	35.00	Sandy clay	1.26	20.50
Bt_2	40-58	56.50	6.00	35.00	Sandy clay	1.28	21.60
Bt_3	58-79	52.50	7.50	38.50	Sandy clay	1.32	20.50
Bt_4	79-96	51.40	7.00	39.00	Sandy clay	1.35	21.00
BC	96-117	54.50	7.50	35.00	Sandy clay	1.41	20.20
Pedon 4							
Ap	0-20	54.50	7.50	35.00	Sandy clay	1.35	20.30
Bt_1	20-38	48.00	13.00	36.50	Sandy clay	1.40	21.00
Bt_2	38-60	37.50	14.50	45.00	Clay	1.40	23.20
Bt_3	60-88	37.50	15.00	45.00	Clay	1.41	24.00
Bt_4	88-111	37.50	14.50	45.00	Clay	1.43	23.50
Bt_5	111-140	30.60	16.50	50.50	Clay	1.45	25.20
Bt_6	140-160	31.30	16.00	50.00	Clay	1.47	24.30
Pedon 5							
Ap	0-15	59.40	7.50	30.50	Sandy clay	1.23	19.50
Bt_1	15-40	44.10	13.00	40.00	Clay	1.25	21.70
Bt_2	40-59	38.50	14.50	45.50	Clay	1.28	23.50
Bt_3	59-78	38.80	13.50	45.00	Clay	1.30	24.00
BC	78-101	39.00	14.00	45.00	Clay	1.38	21.20
Pedon 6							
Ap	0-16	56.78	7.50	35.25	Sandy clay	1.25	8.77
Bt	16-34	38.26	10.25	46.25	Clay	1.27	21.04
BC	34-50	39.77	12.50	47.50	Clay	1.33	22.50

Horizon	Depth (cm)	Sand (2.0-0.05 mm)	Silt (0.05-0.002 mm)	Clay (<0.002 mm)	Texture	B.D (Mg m^{-3})	CEC (meq 100g^{-1})
			%				
			Pedon 7				
Ap	0-18	76.50	9.00	12.00	Loamy sand	1.25	10.00
Bt_1	18-40	74.50	7.50	16.00	Sandy loam	1.31	12.00
BC	40-65	52.50	7.00	38.00	Sandy clay	1.41	20.20
			Pedon 8				
Ap	0-15	75.63	8.50	15.00	Sandy loam	1.25	8.00
Bt_1	15-35	59.05	7.75	32.25	Sandy clay	1.26	20.20
Bt_2	35-59	62.95	6.25	30.50	Sandy clay	1.32	22.10
Bt_3	59-83	57.49	5.00	35.75	Sandy clay	1.42	21.10
BC	83-104	55.67	7.75	36.00	Sandy clay	1.45	19.80

resulting in accumulation of clay (Pillai and Natarajan, 2004).

Land suitability evaluation

The optimum requirements of a crop are always region specific. Climate and soil-site parameters play significant role in maximizing the crop yields. The kind and degree of limitations were evaluated and soil properties from the study area were matched with soil site suitability criteria.

Field crops

The 124.5 ha (27%) of study area comes under S2t class which is moderately suitable with limitation of texture followed by S2gr class (8.2%) which is moderately suitable with limitations of gravelliness and rooting depth (Fig. 4). Although subsurface texture

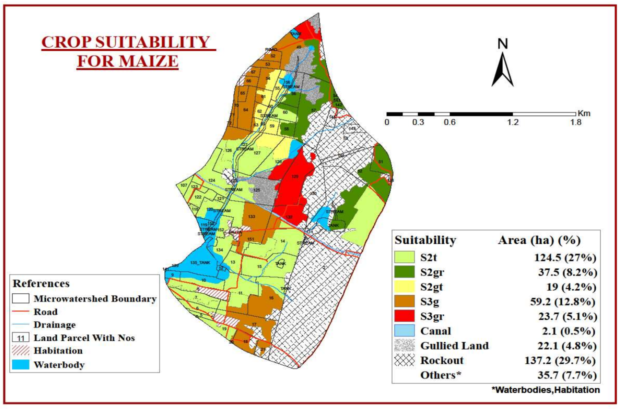

Fig. 4 : Land suitability for maize in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

and topography showed no limitations, land was marginally suitable for maize because of subsurface gravels and shallow soil depth which was also observed by Rajesh *et al.* (2018).

The land suitability study for finger millet revealed that land was moderately and marginally suitable for finger millet in which class S2t covered an area of 124.5 ha with limitation of texture (Fig. 5). The main constraint for growth of finger millet was gravelliness which was also found in the findings of Geetha *et al.* (2019) in Tumkuru district of Karnataka.

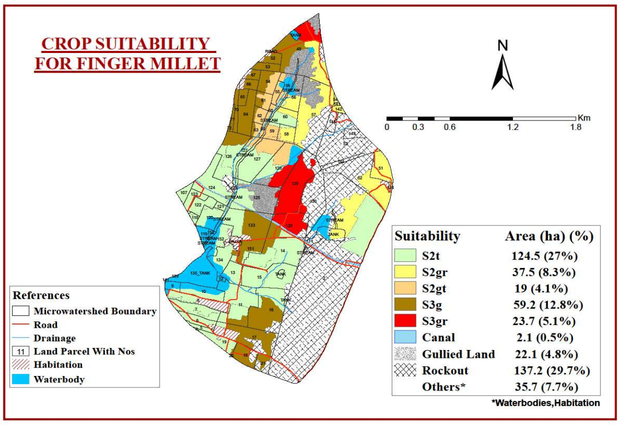

Fig. 5: Land suitability for finger millet in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

The highly suitable land for growing redgram without any limitations was observed in an area 124.2 ha, moderately suitable land with limitations of gravelliness and rooting depth in an area of 37.8 ha and marginally suitable land with limitation of gravelliness in an area of and 78.2 ha (Fig. 6), which were similar to the observations made by Geetha *et al.* (2019).

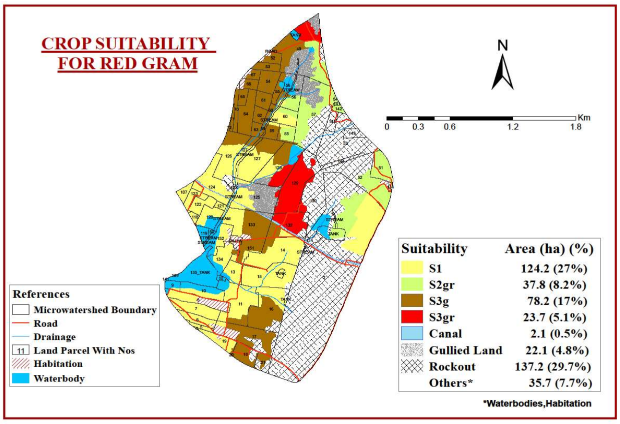

Fig. 6: Land suitability for redgram in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

Plantation crops

Arecanut and coconut are the two major plantation crops in the region. But land suitability study for arecanut reflected that only 4.4 per cent of study area was found to be not suitable and major areas were moderately to marginally suitable with higher limitation of gravelliness, texture and rooting depth (Fig. 7) as reported by Geetha *et al.* (2019).

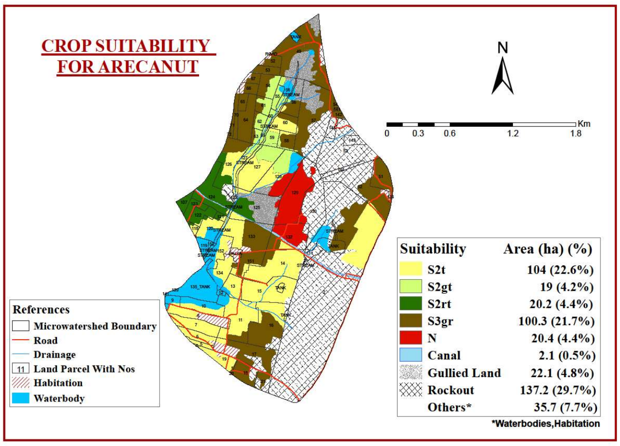

Fig. 7: Land suitability for arecanut in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

Land suitability study for coconut showed that out of total study area, about 61.5 ha area was found as not suitable for growing coconut due to the limitation of depth. Remaining area was found moderately to marginally suitable with rooting depth, textural and gravelliness limitations (Fig. 8) and these results are in confirmation with Savaliya *et al.* (2018).

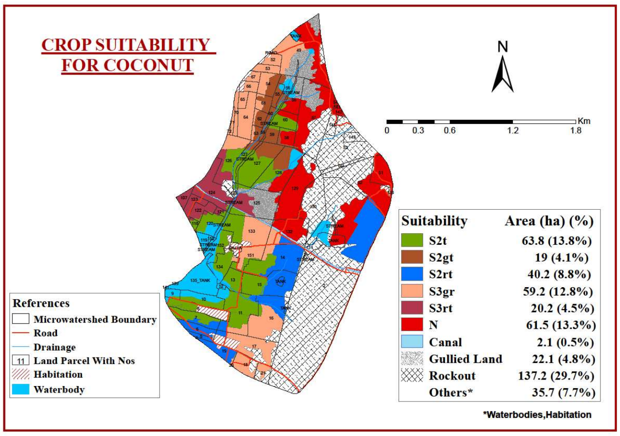

Fig. 8: Land suitability for coconut in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

Fruits crops

Suitability of study area for mango cultivation indicated about 82.5 ha (17.9%) was highly suitable land for mango with no limitations. About 61.5 ha (13.3%) of area was considered as not suitable for growing mango. Some soils also showed moderate and marginal suitability for mango (Fig. 9). Only soils with more than 150 cm depth are highly suitable for mango which was also found in the findings of Abdelrahman *et al.* (2016).

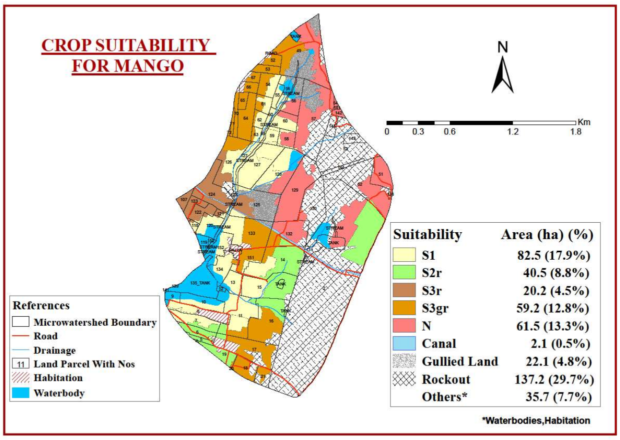

Fig. 9: Land suitability for mango in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

Suitability of land for sapota cultivation showed that 123 ha (26.7%) of study area was highly suitable for sapota without the limitations of depth, subsoil texture and subsoil gravel (Pushpanjali *et al.*, 2014). But about

20.4 ha (4.4%) of area was not suitable for growing sapota. While remaining areas of cultivable land was found to be moderately to marginally suitable for mango cultivation (Fig. 10).

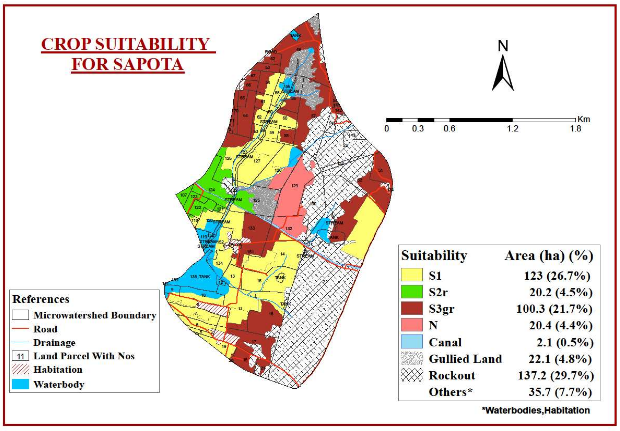

Fig.10: Land suitability for sapota in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

Land suitability of study area for Jamun showed that out of total study area, 123 ha (26.7%) was highly suitable land for jamun cultivation with no limitations. About 20.4 ha (4.4%) of area was not suitable for growing jamun (Fig. 11). Land also showed moderately to marginally suitability to jamun in some areas.

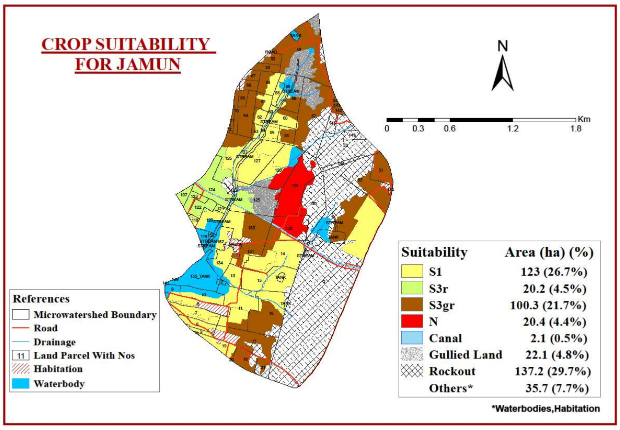

Fig.11: Land suitability for jamun in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

Study area showed moderately and marginally suitability to guava cultivation (Fig. 12) and about 20.4 ha (4.4%) of area was found as currently not suitable. Land was marginally suitable due to severe gravels and restricted rooting depth, though topography was favourable with moderate limitations of subsurface

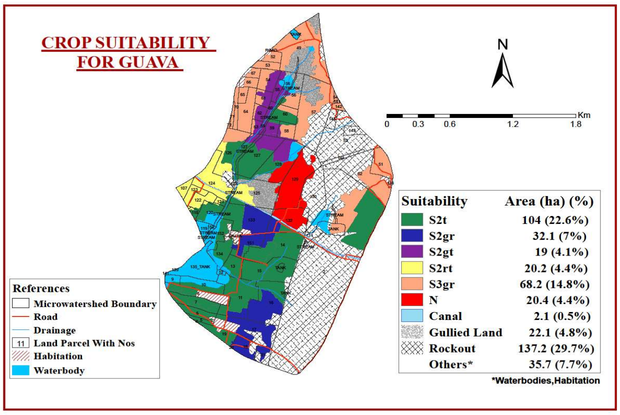

Fig. 12: Land suitability for guava in Channegowdarapalya microwatershed, Kunigal taluk, Tumkur district

texture. These findings are in conformity with findings of Anilkumar *et al.* (2017).

Land suitability of study area for cashew showed that majority of land was moderately to marginally suitable for cashew. About 20.4 ha (4.4%) of area was found as not suitable (Fig. 13).

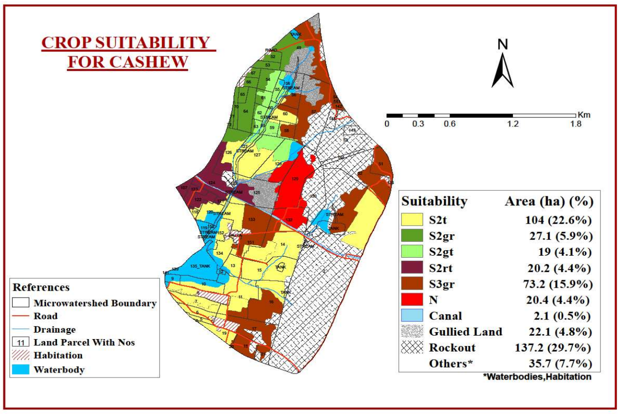

Fig. 13: Land suitability for cashew in Channegowdarapalya Microwatershed, Kunigal taluk, Tumkuru district

In Channegowdarapalya Microwatershed, eight soil series were identified and they were mapped into nineteen mapping units besides they were evaluated for their land suitability based on the inherent soil characteristics, external land features and environmental factors. Land suitability evaluation for some of the selected major field and horticultural crops was carried out. Out of total area, 17.9 to 27.0 per cent of area was highly suitable for crops like redgram, mango, jamun and sapota while 4.4 to 13.3 per cent area was not suitable for plantation and fruit crops.

Few areas of the microwatershed was found to be marginally to moderately suitable with major limitations of depth, texture and gravel. The mapping units on uplands and midlands were found under lower suitability class for majority of the crops because of limitations of gravelliness, texture and depth. Land was classified as unsuitable for crops because of the permanent limitation of soil depth in some of mapping units. The crop suitability maps give a better picture for selection of suitable crops for the area and suitability evaluation using remote sensing and GIS techniques helps to achieve the reliable results quickly with reasonable expenditure. Timely assessment of soil properties and timely availability of information will help in taking the measures in the right time.

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