



Suitability Evaluation for Cultivation of Cotton in Ganjigatti Sub-watershed of Karnataka using GIS, Remote Sensing and Detailed Survey

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10.18805/ag.D-5954

ABSTRACT

Background: The results of soil-crop suitability evaluation could serve as baseline information for identifying specific soil resource constraints to ensure the sustainable production of cotton in the study area.

Methods: A detailed soil resource inventory of the Ganjigatti sub-watershed was carried out and 21 series mapped into sixty-one (61) mapping units (phases) by using ArcGIS version 10.8, based on surface texture, depth, slope, erosion, gravelines and stoniness.

Result: The majority area of the sub-watershed was not suitable (N) for cotton cultivation due to very severe limitations in rooting depth, gravelines, CaCO₃ content and slope percentage, which occupies 3170 ha of the sub-watershed (73.31% of TGA). The area under moderate (S2) and marginally suitable (S3) for cotton crop was 242 ha (5.61% of TGA) and 539 ha (12.46% of TGA), respectively.

Key words: ArcGIS, Cotton, Ganjigatti sub-watershed, Mapping units, Suitability evaluation.

INTRODUCTION

Cotton holds significant economic value as a widely cultivated cash crop in tropical and sub-tropical regions globally. India leads the world in cotton acreage, covering 130.61 lakh ha, accounting for approximately 40% of the total global area of 324.16 lakh ha dedicated to cotton cultivation. About 67% of India's cotton is grown in rain-fed areas, while the remaining 33% is cultivated in irrigated lands. Despite being the top country in terms of acreage, India ranks 39th in productivity, yielding 447 kg/ha. This productivity lags considerably behind China (1993 kg/ha), Brazil (1830 kg/ha) and the USA (1065 kg/ha) (COCPC, 2022). The majority of India's cotton cultivation, around 65%, occurs in black soils (Vertisols and vertic intergrades) under rainfed conditions. Concerns have been raised about declining crop productivity in these soils, potentially exacerbated by the introduction of long staple Bt cotton designed for irrigated farming. This strain exhibits heightened sensitivity to moisture stress (Venugopalan *et al.*, 2009). The diminishing patterns in crop yield and frequent crop failures often compel farmers to embrace alternative crops and systems for their livelihood. The reduction in productivity and crop losses can be attributed to various factors, encompassing both biophysical and socioeconomic aspects, with biophysical constraints typically taking precedence. Biophysical elements constraining crop production encompass (i) adverse soil conditions, encompassing both physical and chemical aspects such as high levels of CaCO₃, the emergence of sodicity and poor soil structure (Vaidya and Pal, 2002; Kadu *et al.*, 2003), along with inadequate soil fertility status (Blaise and Ravindran, 2003); (ii) meteorological factors like unpredictable rainfall, variations in humidity during

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How to cite this article: Yadav, M.B.N., Patil, P.L., Prasad, V. and Vyas, R.D.V. (2024). Suitability Evaluation for Cultivation of Cotton in Ganjigatti Sub-watershed of Karnataka using GIS, Remote Sensing and Detailed Survey. Agricultural Science Digest. DOI: 10.18805/ag.D-5954.

Submitted: 30-01-2024 Accepted: 23-05-2024 Online: 28-06-2024

different phenological stages with implications for pests and diseases (Sawant, 2017), fluctuations in evapotranspiration affecting soil water balance (Zonta *et al.*, 2017), solar radiation and its interception (Sawant, 2017); and (iii) the nature of various soil management practices (Pal *et al.*, 2003).

Understanding soils, their characteristics and spatial distribution is crucial for enhancing crop productivity in any region, offering opportunities for more efficient land resource management (Van Ranst, 1994). An essential step in this process is conducting site-specific landform analysis to systematically study soils and create accurate soil maps. These soil survey data and maps have been extensively utilized for interpretative purposes, helping

define the relative suitability or limitations of different soil types for various land uses (Sabareeshwari *et al.*, 2018; Chandrakala *et al.*, 2019a). Land suitability evaluation involves assessing the degree of suitability of land for a specific type of use (Sehgal, 1995). It combines soil characteristics with climate and land use factors. The potential land suitability for crop production is determined by evaluating climate parameters, soil quality, water resources, topography and environmental components based on specified criteria (AbdelRahman *et al.*, 2016; Karthika *et al.*, 2022). Detailed soil information is crucial for deriving the crop suitability of a particular area and this is achieved through detailed soil survey data, resulting in the identification of soil mapping units. Assigning soil site suitability criteria to these mapping units enables the generation of soil suitability maps using the ArcGIS environment (Ramamurthy *et al.*, 2018; Chandrakala *et al.*, 2019b; Yadav *et al.*, 2023; Yadav and Patil, 2023). GIS (Geographic Information System) proves to be a flexible and powerful tool compared to conventional data processing systems, as it allows the integration of large volumes of diverse datasets into new datasets (Foote and Lynch, 1996). In this context, remote sensing data, combined with soil survey information, can be integrated into GIS to assess crop suitability for various soil and biophysical conditions. The focus of the current study is the evaluation of soils in the Ganjigatti sub-watershed for soil-site suitability concerning cotton cultivation.

MATERIALS AND METHODS

The study was conducted in 2021-2023, in the Ganjigatti sub-watershed (5B1A4F) of Dharwad district in Karnataka, situated between 15°10'10.114" to 15°17'1.147"N latitudes and 75°0'57.672" to 75°4'50.525"E longitudes. The total geographical area (TGA) of the sub-watershed is about 4323.84 ha. The annual temperature ranges from 24.68 to 26.67°C. The average rainfall in the sub-watershed was 917.00 mm (Fig 1). Relative humidity varies from 28% in summer to 70% in winter. The average potential evapotranspiration (PET) is 150 mm and varies from 115 to 232 mm. Generally, the length of crop growing period (LGP) is 150 days and starts from 3rd week of June to third week of November. After preliminary traversing of the entire sub-watershed using a 1:7,920 scale base map and satellite imagery, based on geology, drainage pattern, surface features, slope characteristics, land use, landforms and physiographic divisions, twenty-seven (27) soil profiles were selected and studied their morphometric characteristics. Physical and chemical properties were estimated using standard procedures. A detailed soil resource inventory of the Ganjigatti sub-watershed was carried out and 21 series mapped into sixty-one (61) mapping units based on surface soil properties. After a detailed soil survey, crop suitability maps for cotton in the Ganjigatti sub-watershed area at soil phase level were prepared by using the platform of ArcGIS (Fig 2). Their

suitability was assessed using the limitation method regarding the number and intensity of limitations (Naidu *et al.*, 2006). This evaluation procedure consists of three phases.

In phase I, the data was collected in terms of characteristics as shown in Table 1. The following landscape and soil characteristics were used to evaluate soil suitability: topography (% slope), wetness (flooding and drainage), physical soil characteristics (texture/structure, % coarse fragments by volume, soil depth in cm, CaCO₃ per cent), salinity (EC, dS m⁻¹) and alkalinity (ESP). Laboratory analysis of soil samples was done at the soil science laboratory of the University of Agricultural Sciences, Dharwad. The study locations were nearly level to moderately steep sloping and had never been flooded. The drainage conditions were moderately well to well and sandy loam to clay in texture, as per the guidelines given by FAO (1976). Weighted mean of each property was calculated and soil-site characteristics of different soil units were obtained as shown in Table 1. These weighted average data have been used to evaluate the soil site suitability (FAO, 1976). In phase II, the landscape and soil requirements for these five crops were taken from Naidu *et al.* (2006) as described by Sehgal (2005). In phase III, the land suitability under rainfed conditions has been assessed by comparing the landscape and soil characteristics with crop requirements at different limitations levels: no (0), slight (1), moderate (2), severe (3) and very severe (4). Limitations are deviations from the optimal conditions of a land characteristic, such as land quality, that adversely affect the kind of land use. If a land characteristic is optimal for plant growth, it has no limitation. On the other hand, when the same characteristic is unfavourable for plant growth, it has severe limitations for land evaluation types. Thus, the evaluation was done by comparing the land characteristics with the limitation levels of the crop requirement given by Naidu *et al.* (2006), as described by Sehgal (2005). The number and degrees of limitations suggested the suitability class of each soil series for a particular crop, as given by FAO (1976).

RESULTS AND DISCUSSION

Soil suitability for cotton in the Ganjigatti sub-watershed (Table 2 and Fig 3) reveals that mapping units AKTmB2R2, MVDfB2 and UGKmB2 (mapping unit numbers 1, 46 and 60) are moderately suitable (Class S2), constituting 5.61% of TGA. This moderate suitability is attributed to slight limitations in climate, topography, soil texture, gravelliness, drainage and erosion. Cotton cultivation requires specific conditions, such as an annual rainfall of 700–1000 mm, soil depth of 100-150 cm, a silt clay to clay texture, soils free of salinity and alkalinity and well-drained soils. The optimal temperature for germination and growth ranges from 20°C to 30°C and the growing period for optimum crop production is 180-240 days. However, in the mentioned mapping units, the depth varies from 65-170 cm, texture

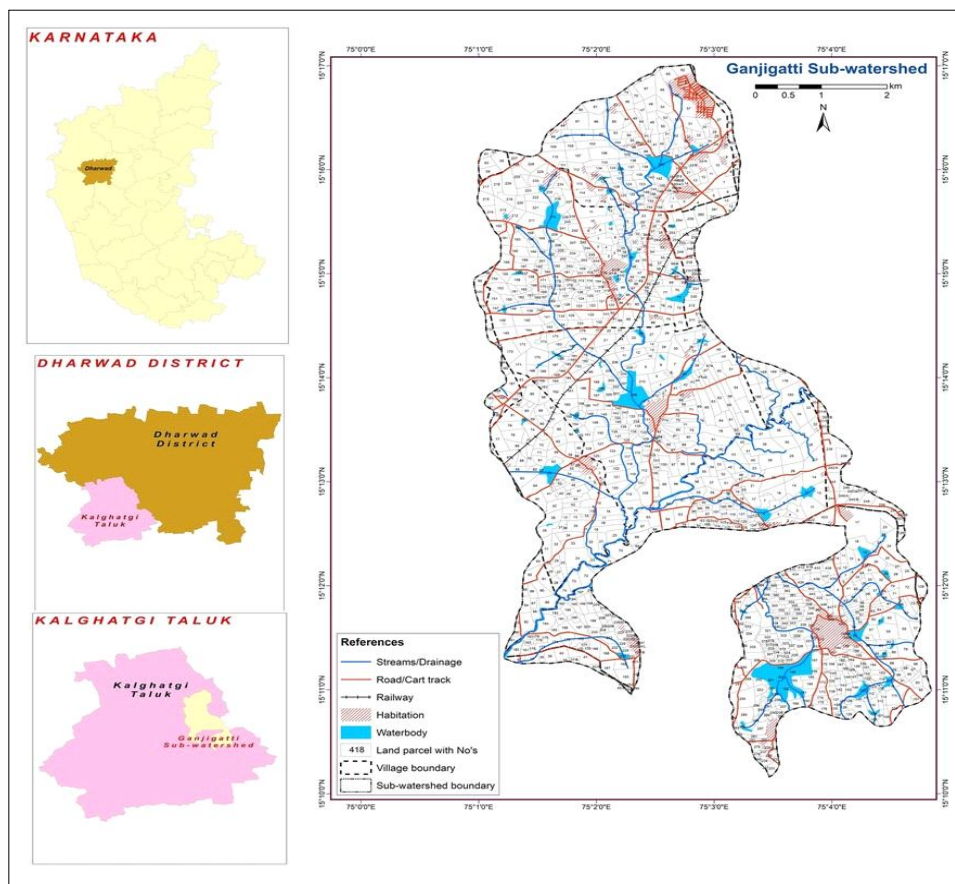


Fig 1: Location of the study area.

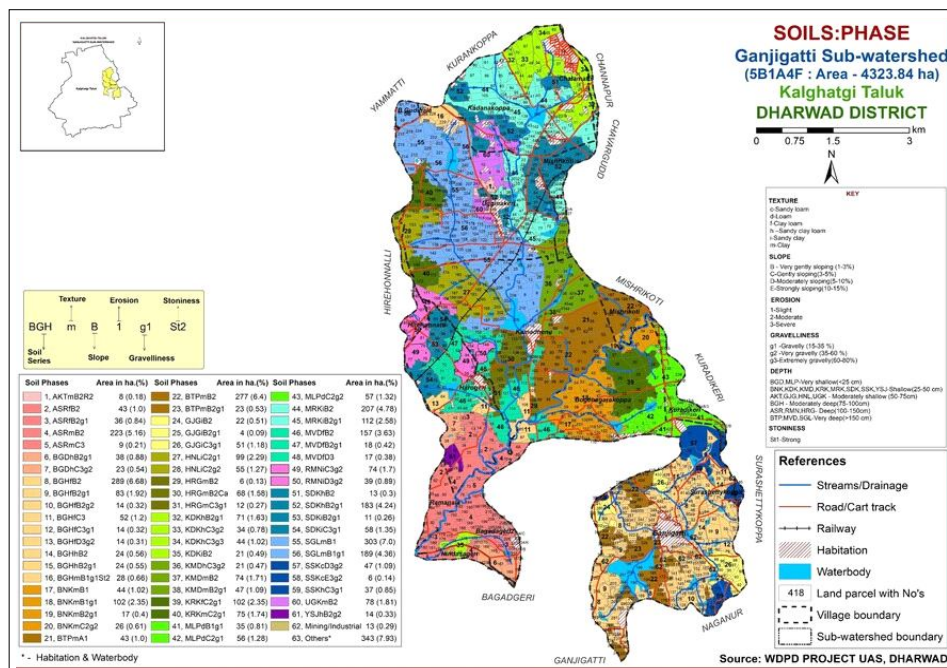


Fig 2: Soil phases map of Ganjigatti sub-watershed.

Table 1: Soil-site characteristics of soil mapping units of Ganjigatti sub-watershed.

Soil phases	Wetness (w)		Physical condition of Soil (s)				Fertility (f)			Salinity/alkalinity (n)		Erosion (e)	
	Drainage	Texture	Depth (cm)	Stoniness	Gravel %	CaCO ₃ %	pH	OC (%)	CEC	BS (%)	EC (dS m ⁻¹)	ESP (%)	Slope %
AKTmB2R2	Moderately well	Clay	79	Nil	<15	3.21	7.18	0.48	59.33	72.52	0.28	1.48	1-3
ASRfB2	Well drained	Clay loam	130	Nil	<15	15.96	8.68	0.33	48.70	87.46	0.36	1.00	1-3
ASRfB2g1	Well drained	Clay loam	130	Nil	15-35	15.96	8.68	0.33	48.70	87.46	0.36	1.00	1-3
ASRmB2	Well drained	Clay	130	Nil	<15	15.96	8.68	0.33	48.70	87.46	0.36	1.00	1-3
ASRmC3	Well drained	Clay	130	Nil	<15	15.96	8.68	0.33	48.70	87.46	0.36	1.00	3-5
BGDhB2g1	Well drained	Sandy clay loam	20	Nil	15-35	1.5	5.91	1.19	16.55	60.76	0.49	1.94	1-3
BGDhC3g2	Well drained	Sandy clay loam	20	Nil	35-60	1.5	5.91	1.19	16.55	60.76	0.49	1.94	3-5
BGHfB2	Moderately well	Clay loam	90	Nil	<15	7.35	7.33	0.6	23.64	85.7	0.3	2.19	1-3
BGHfB2g1	Moderately well	Clay loam	90	Nil	15-35	7.35	7.33	0.6	23.64	85.7	0.3	2.19	1-3
BGHfB2g2	Moderately well	Clay loam	90	Nil	35-60	7.35	7.33	0.6	23.64	85.7	0.3	2.19	1-3
BGHfC3	Moderately well	Clay loam	90	Nil	<15	7.35	7.33	0.6	23.64	85.7	0.3	2.19	3-5
BGHfC3g1	Moderately well	Clay loam	90	Nil	15-35	2.99	7.08	0.58	23.48	83.88	0.12	1.72	3-5
BGHfD3g2	Moderately well	Clay loam	90	Nil	35-60	2.99	7.08	0.58	23.48	83.88	0.12	1.72	5-10
BGHhB2	Moderately well	Sandy clay loam	90	Nil	<15	7.35	7.33	0.6	23.64	85.7	0.3	2.19	1-3
BGHhB2g1	Moderately well	Sandy clay loam	90	Nil	15-35	7.35	7.33	0.6	23.64	85.7	0.3	2.19	1-3
BGHmB1g1S1S2	Moderately well	Clay	80	1-3	15-35	3.5	6.83	0.83	43.84	77.7	0.18	0.53	1-3
BNKmB1	Well drained	Clay	35	Nil	<15	2.81	7.23	0.53	28.34	69.91	0.22	2.42	1-3
BNKmB1g1	Well drained	Clay	35	Nil	15-35	2.81	7.23	0.53	28.34	69.91	0.22	2.42	1-3
BNKmB2g1	Well drained	Clay	35	Nil	15-35	2.81	7.23	0.53	28.34	69.91	0.22	2.42	1-3
BNKmC2g2	Well drained	Clay	35	Nil	35-60	2.81	7.23	0.53	28.34	69.91	0.22	2.42	3-5
BTPmA1	Well drained	Clay	200	Nil	<15	12.02	8.3	0.75	58.22	90.28	0.16	2.67	0-1
BTPmB2	Well drained	Clay	200	Nil	<15	12.02	8.3	0.75	58.22	90.28	0.16	2.67	1-3
BTPmB2g1	Well drained	Clay	180	Nil	15-35	13.28	7.82	0.45	37.39	89.51	0.36	2.63	1-3
GJGiB2	Moderately well	Sandy clay	55	Nil	<15	3.76	7.22	0.66	22.68	71.53	0.22	1.48	1-3
GJGiB2g1	Moderately well	Sandy clay	55	Nil	15-35	3.76	7.22	0.66	22.68	71.53	0.22	1.48	1-3
GJGiC3g1	Moderately well	Sandy clay	55	Nil	15-35	3.76	7.22	0.66	22.68	71.53	0.22	1.48	3-5
HNLC2g1	Moderately well	Sandy clay	67	Nil	15-35	3.06	5.92	0.66	19.82	50.72	0.26	2.03	3-5
HNLC2g2	Moderately well	Sandy clay	67	Nil	35-60	3.06	5.92	0.66	19.82	50.72	0.26	2.03	3-5
HRGmB2	Moderately well	Clay	130	Nil	<15	15.9	8.1	0.49	49.58	90.85	0.34	0.86	1-3
HRGmB2Ca	Moderately well	Clay	130	Nil	<15	15.9	8.1	0.49	49.58	90.85	0.34	0.86	1-3
HRGmC3g1	Moderately well	Clay	130	Nil	15-35	15.9	8.1	0.49	49.58	90.85	0.34	0.86	3-5
KDKhB2g1	Moderately well	Sandy clay loam	49	Nil	15-35	2.89	6.42	0.53	59.33	72.52	0.16	0.84	1-3
KDKhC3g2	Moderately well	Sandy Clay loam	49	Nil	35-60	2.89	6.42	0.53	59.33	72.52	0.16	0.84	3-5
KDKhC3g3	Moderately well	Sandy Clay loam	49	Nil	60-80	2.89	6.42	0.53	59.33	72.52	0.16	0.84	3-5

Table 1: Continue...

Table 1: Continue...

KDKIB2	Well drained	Clay loam	35	Nil	<15	2.53	6.84	0.76	23.00	69.1	0.22	1.87	1-3
KMDhC3g2	Well drained	Sandy Clay loam	35	Nil	35-60	0.91	5.36	0.73	11.15	49.67	0.1	1.82	3-5
KMDmB2	Well drained	Clay	35	Nil	<15	0.91	5.36	0.73	11.15	49.67	0.1	1.82	1-3
KDKIB2	Well drained	Clay loam	35	Nil	<15	2.53	6.84	0.76	23	69.1	0.22	1.87	1-3
KMDhC3g2	Well drained	Sandy Clay loam	35	Nil	35-60	0.91	5.36	0.73	11.15	49.67	0.1	1.82	3-5
KMDmB2	Well drained	Clay	35	Nil	<15	0.91	5.36	0.73	11.15	49.67	0.1	1.82	1-3
KMDmB2g1	Well drained	Clay	35	Nil	15-35	0.91	5.36	0.73	11.15	49.67	0.1	1.82	1-3
KRKIC2g1	Well drained	Clay loam	30	Nil	15-35	2.65	5.61	0.58	20.03	68.16	0.09	2.07	3-5
KRKmC2g1	Well drained	Clay	40	Nil	15-35	3.33	6.02	1.02	21.16	70.31	0.06	0.79	3-5
MLPdB1g1	Moderately well	loam	20	Nil	15-35	1.35	5.83	0.58	23.62	49.72	0.11	2.22	1-3
MLPdC2g1	Moderately well	loam	20	Nil	15-35	1.35	5.83	0.58	23.62	49.72	0.11	2.22	3-5
MLPdC2g2	Moderately well	loam	20	Nil	35-60	1.35	5.83	0.58	23.62	49.72	0.11	2.22	3-5
MRKIB2	Moderately well	Sandy Clay	28	Nil	<15	3.21	7.18	0.48	26.49	64.29	0.28	1.48	1-3
MRKIB2g1	Moderately well	Sandy Clay	28	Nil	15-35	3.21	7.18	0.48	26.49	64.29	0.28	1.48	1-3
MVDfB2	Well drained	Clay loam	170	Nil	<15	4.66	6.62	0.52	23.96	84.18	0.2	2.07	1-3
MVDfB2g1	Well drained	Clay loam	170	Nil	15-35	4.66	6.62	0.52	23.96	84.18	0.2	2.07	1-3
MVDfD3	Well drained	Clay loam	170	Nil	<15	4.66	6.62	0.52	23.96	84.18	0.2	2.07	5-10
RMNID3g2	Well drained	Sandy Clay	120	Nil	35-60	3.2	8.28	0.64	17.35	90.34	0.18	4.65	3-5
RMNID3g2	Well drained	Sandy Clay	120	Nil	35-60	3.2	8.28	0.64	17.35	90.34	0.18	4.65	5-10
SDKhB2	Moderately well	Sandy clay loam	39	Nil	<15	3.81	6.45	0.56	27.41	69.55	0.16	0.81	1-3
SDKhB2g1	Moderately well	Sandy clay loam	39	Nil	15-35	3.81	6.45	0.56	27.41	69.55	0.16	0.81	1-3
SDKIB2g1	Moderately well	Sandy Clay	46	Nil	15-35	3.85	6.68	0.72	19.92	87.4	0.14	2.61	1-3
SDKIC3g1	Moderately well	Sandy Clay	46	Nil	15-35	3.85	6.68	0.72	19.92	87.4	0.14	2.61	3-5
SGLmB1	Moderately well	Clay	180	Nil	<15	15.05	8.13	0.45	53.97	92.99	0.21	1.36	1-3
SGLmB1g1	Moderately well	Clay	180	Nil	15-35	15.05	8.13	0.45	53.97	92.99	0.21	1.36	1-3
SSKcD3g2	Moderately well	Sandy loam	30	Nil	35-60	1.25	5.49	0.47	6.18	69.69	0.28	2.56	5-10
SSKcE3g2	Moderately well	Sandy loam	30	Nil	35-60	1.25	5.49	0.47	6.18	69.69	0.28	2.56	10-15
SSKhC3g1	Moderately well	Sandy clay loam	30	Nil	15-35	1.25	5.49	0.47	6.18	69.69	0.28	2.56	3-5
UGKmB2	Moderately well	Clay	65	Nil	<15	3.05	7.13	0.64	29.03	58.28	0.24	1.81	1-3
YSJhB2g2	Moderately well	Sandy clay loam	30	Nil	35-60	0.45	5.55	0.64	14.54	40.22	0.12	1.86	1-3

ranges from clay loam to clay, slope is 1 to 3% (very gently), with slight to moderate erosion and moderately well to well drainage. Thus, these units are deemed moderately suitable for cotton production (NBSS and LUP, 1994; Naidu *et al.*, 2006). Mapping units BGHfB2, BGHfC3, BGHhB2, BNKmB1, GJGiB2, KDKiB2, KMDmB2 and SDKhB2 (mapping unit numbers 8, 11, 14, 17, 24, 35, 37 and 51) constitute the largest area at 12.46% of TGA and are marginally suitable (Class S3). This classification is due to severe limitations in soil physical factors such as soil texture, depth, gravelliness, CaCO_3 content and slope percentage. These mapping units commonly have slopes B (1-3%) and C (3-5%), with textures including sandy clay, sandy clay loam, clay loam and clay. Gravelliness is <15%,

CaCO_3 content varies from 0.91 to 7.35% and soil depth ranges from 35 to 90 cm. Studies by Walke *et al.* (2012) and Karthikeyan *et al.* (2019) in Central India also examined the suitability of cotton. In some mapping units, even if one factor is highly suitable, another factor may not be favorable, making the soils marginally suitable. For example, in mapping unit BGHfB2, the slope is 1-3%, which is favorable and the texture is clay loam, which is also favorable, but the CaCO_3 content is not suitable, rendering the soils marginally suitable. Similarly, mapping units ASRfB2, ASRfB2g1, ASRmB2, ASRmC3, BGDhB2g1, BGDhC3g2, BGHfB2g1, BGHfB2g2, BGHfC3g1, BGHfD3g2, BGHhB2g1, BGHmB1g1St2, BNKmB1g1, BNKmB2g1, BNKmC2g2, BTPmA1, BTPmB2, BTPmB2g1, GJGiB2g1,

Table 2: Soil-site suitability classification of mapping units for cotton crop.

Soil phases	Suitability class	Area (ha)	TGA (%)
AKTmB2R2, MVDfB2, UGKmB2	S2cse	242.00	5.61
BGHfB2, BGHhB2, BNKmB1, GJGiB2, KDKiB2, KMDmB2, SDKhB2	S3s	487.00	11.26
BGHfC3	S3se	52.00	1.20
MVDfD3	Ne	17.00	0.38
ASRfB2, ASRfB2g1, ASRmB2, ASRmC3, BGDhB2g1, BGDhC3g2, BGHfB2g1, BGHfB2g2, BGHfC3g1, BGHhB2g1, BGHmB1g1St2, BNKmB1g1, BNKmB2g1, BNKmC2g2, BTPmA1, BTPmB2, BTPmB2g1, GJGiB2g1, GJGiC3g1, HNLiC2g1, HNLiC2g2, HRGmB2, HRGmB2Ca, HRGmC3g1, KDKhB2g1, KDKhC3g2, KDKhC3g3, KMDhC3g2, KMDmB2g1, KRKfC2g1, KRKmC2g1, MLPdB1g1, MLPdC2g1, MLPdC2g2, MRKiB2, MRKiB2g1, MVDfB2g1, RMNiC3g2, SDKhB2g1, SDKiB2g1, SDKiC3g1, SGLmB1, SGLmB1g1, SSKhC3g1, YSJhB2g2, BGHfD3g2, RMNiD3g2, SSKcD3g2, SSKcE3g2	Ns	3065.00	70.88
	Nse	105.00	2.43

Note: 356 ha (8.22%) area of the sub-watershed is under habitation and water body *etc.*

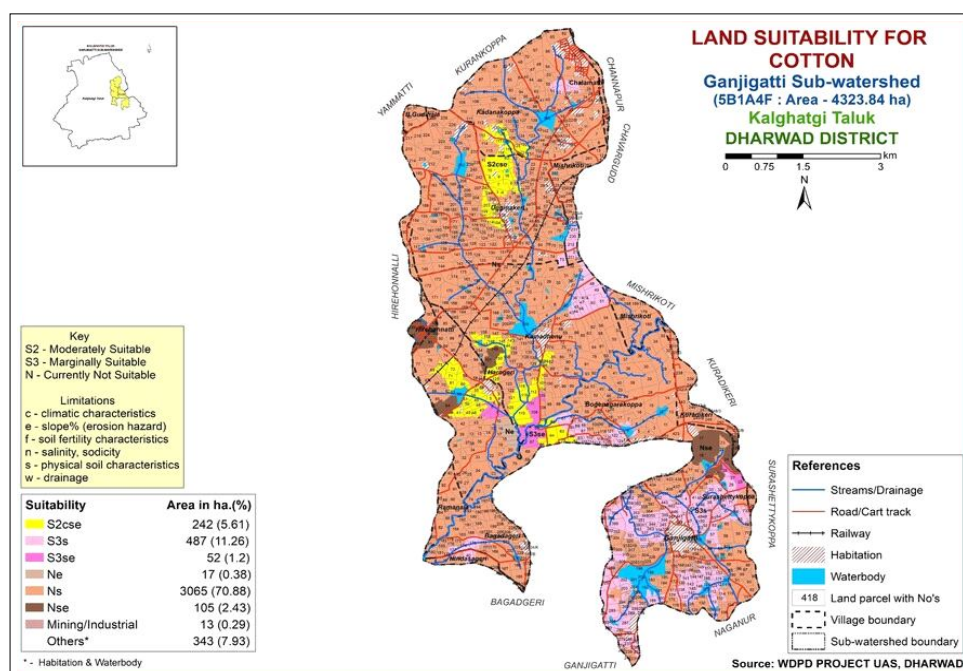


Fig 3: Soil site suitability map for cotton crop in Ganjigatti sub-watershed.

GJGiC3g1, HNLiC2g1, HNLiC2g2, HRGmB2, HRGmB2Ca, HRGmC3g1, KDKhB2g1, KDKhC3g2, KDKhC3g3, KMDhC3g2, KMDmB2g1, KRKfC2g1, KRKmC2g1, MLPdB1g1, MLPdC2g1, MLPdC2g2, MRKiB2, MRKiB2g1, MVDfB2g1, MVDfD3, RMNiC3g2, RMNiD3g2, SDKhB2g1, SDKiB2g1, SDKiC3g1, SGLmB1, SGLmB1g1, SSKcD3g2, SSKcE3g2, SSKhC3g1 and YSJhB2g2 are unsuitable (73.69% of TGA) for cotton cultivation due to limitations in soil depth, CaCO_3 content and gravelliness. Depth is the most important criterion (<30 cm) for cotton crop growth in mapping units BGDhB2g1, BGDhC3g2, KRKfC2g1, KRKmC2g1, MLPdB1g1, MLPdC2g1, MLPdC2g2, MRKiB2, MRKiB2g1, SSKcD3g2, SSKcE3g2, SSKhC3g1 and YSJhB2g2.

Nasre *et al.* (2013) have highlighted that the soils in Wathoda, Niljai, Jalka and Singledeep-3 are categorized as marginally suitable (S3) due to constraints such as calcareousness, organic carbon content and limited soil depth. Soil depth limitations in Vai, Singledeep-2 and Sakhi designate them as presently unsuitable but potentially suitable (N1). In accordance with the cotton soil suitability criteria, Obi Reddy (2018) classified the soils of Bonderkhed, Dhotardi, Warudi, Apoti Khurd, Kumbhari-1, Kumbhari-2, Shamabad and Sanglud Buzurg as moderately suitable (S2) due to moderate constraints related to texture, calcium carbonate and low organic carbon content. Sivani and Washimba have marginally suitable soils (S3) with severe depth limitations. On the other hand, Gorva, Vizora, Borgaon Manju-1 and Borgaon Manju-2 have unsuitable soils (N) with very severe depth and erosion limitations. At the soil series association level, the distribution of areas under S2, S2-S3, S3-N and N categories is 47.3%, 10.9%, 11.5% and 24.0%, respectively. The GIS-based model, when integrated, provides not only site-specific but also spatially explicit maps depicting the suitability of sites for cotton cultivation in the study area. Beyond land and soil characteristics, socio-economic, market and infrastructure factors play crucial roles in influencing crop selection. This study holds significant implications for expanding cotton cultivation in the region by addressing the identified limitations and rectifying specific issues to improve cotton production and productivity in the small and marginal lands of the hilly region of Karnataka. This, in turn, has the potential to enhance the livelihood conditions of farmers in semi-arid lands.

CONCLUSION

Soil site suitability is a complex process of decision making, which requires a greater understanding of many factors and processes involved in the growth and development of the specific crops along with the soil processes in SAT regions. The present study showed that majority of the mapping units (73.69%) were unsuitable for cotton cultivation. However 3 mapping units (5.61%) are moderately suitable (Class S2) and 8 mapping units (12.46%) are marginally suitable (Class

S3) for cotton cultivation in the Ganjigatti sub-watershed. The main limitations in all the soil mapping units found to be shallow soil depth, slope, texture, CaCO_3 content and climatic factors. However, the degree of these limitations in all these soil series varies from slight to very severe. In order to map specific soil resource limits for sustainable production of these crops in the study area, the results of this research could serve as a foundational data set. In order to improve lucrative land use planning decision support for sustainable crop production in the research area, the combination of remote sensing and GIS techniques might be envisioned as a commendable resource sustainable way to modelling the growth of these crops.

ACKNOWLEDGEMENT

The study is part of the WDPD project funded by Government of Karnataka. The authors duly acknowledge the financial support.

Conflict of interest

All authors declare that the contents and data published in the manuscript do not have a conflict of interest for any party. If this is discovered in the future, it will be the author's full responsibility.

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