AN AJSS An Asian Journal of Soil Science
Volume 12 | Issue 2 | December, 2017 | 323-327 | e ISSN–0976–7231 ■ Visit us : www.researchjournal.co.in

Research Article

DOI : 10.15740/HAS/AJSS/12.2/323-327

Soil-site suitability evaluation for chickpea in micro-watershed of Wardha district, Maharashtra

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Received : 15.09.2017; **Revised :** 17.11.2017; **Accepted :** 26.11.2017

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Summary

In the present study, soil-site suitability evaluation was made for the Nagalvadi micro-watershed of Wardha district for chickpea (*Cicer arietinum* L.). Five soil series representing major land forms of Nagalvadi micro-watershed were evaluated for their suitability to chickpea cultivation using limitation method regarding number and intensity of limitations. The study suggests that chickpea is moderately suitable in soils of NG-2 and NG-5 but soils of NG-1, NG-3 and NG-4 are not suitable for chickpea cultivation. Soil depth, wetness (drainage), texture, coarse fragments, soil pH and organic carbon are the major limitations for crop growth in the most of soils of Nagalvadi micro-watershed. The suitability classes can be improved if the correctable limitations (soil fertility characteristics) are altered through application of farm yard manure, green manuring and inclusion of legumes rotation.

Key words : Evaluation, Micro-watershed, Chickpea

How to cite this article : Sadanshiv, Nilima S., Metkari, Prajakta M. and Gore, Yogita D. (2017). Soil-site suitability evaluation for chickpea in micro-watershed of Wardha district, Maharashtra. *Asian J. Soil Sci.*, **12** (2) : 323-327 : **DOI : 10.15740/HAS/AJSS/12.2/323-327.**

Introduction

Relatively scarcity of land resources for agriculture and insufficient food security of world's population require that land be used in optimum way. Soil is recognized as one of the most valuable natural resources on whose proper use depend the life supporting systems and social and economic development. Indiscriminate use of land resources, in general, leads to their degradation and in-turn decline in productivity. They need to be used according to their capacity to satisfy the needs of its inhabitants. This can be achieved through proper investigations of land resources and their scientific evaluation. Land suitability evaluation is the process of determining the potential of land for land use planning (Sys *et al.*, 1991). In the different parts of India, land suitability was evaluated for various crops such as cotton (Sehgal, 1991; Kharche and Gaikawad, 1993 and Mandal *et al.*,2002) mustard (Bera *et al*., 2005 and Gandhi and Savalia, 2014) wheat (Sharma and Sharma,1991; Bhaskar *et al.,* 1996 and Sharma, 1999), maize (Leelavati and Naidu,2010), chickpea (Satyavati and Suryanarayan Reddy, 2004; Meena *et al.,* 2012), sorghum (Pakhan *et al*., 2010) and rubber (Kharche *et al.*,1995). However, such information on soils of Nagalvadi micro-watershed of Wardha district is very scanty hence, In view of this, the present study was undertaken to evaluate soil-site suitability for chickpea.

Resource and Research Methods

Geographically, the study area Nagalvadi micro-

watershed is located in Karanja tehsil of Wardha district, Maharashtra and lies between 78°26' to 78°27'E longitudes and 21°8' to 21°10'N latitudes in part of survey of India (SOI) toposheet (55 K/8) with an area of 572.3 ha. The geology of the area is basalt. The elevation ranges from 460 to 500 m above mean sea level (MSL). The climate is sub-tropical dry sub-humid with mean annual maximum and minimum temperature is 32.6°C and 19.4°C, respectively. The mean annual rainfall is 1134.40 mm. The area qualifies for ustic soil moisture regime and hyperthermic soil temperature regime.

Five soil series representing major landforms of the area *viz.*, very gently sloping plateau, very gently sloping pedimentand level to nearly level valley were studied for their morphological characteristics following the procedure outlined in survey manual (Anonymous, 1995). Horizon-wise soil samples were collected from the typifying pedons and analysed for their physical and chemical properties following standard procedures. The soils were classified according to key to soil taxonomy (Anonymous, 1998) and these soils were evaluated for their suitability using limitation method regarding number and intensity of limitations (Sys *et al.*,1991). The landscape and soil requirements for these crops were matched with generated data at different limitation level: no (0), slight (1), moderate (2), severe (3), very severe (4). The number and degrees of limitations suggested the suitability class of pedon for a particular crop (Sys *et al.*,1991). The potential land suitability (Table 4) sub-classes were determined after considering the improvement measures to correct these limitations (Sys *et al.*,1991).

Research Findings and Discussion

The relevant morphological, physical and chemical soil characteristics are given in Table 1 and 2 and soil–site characteristics are given in Table 3. These soils are developed from basalt parent material. The kind and degree of limitations of the soils for the chickpea crop are presented in Table 4. The soils with no or only slight limitations were grouped under highly suitable class (S1); the soils with more than four slight limitations and/or with more than three moderate limitations under moderately suitability class (S2); the soil with more than three moderate limitations and/or one or more severe limitations (s) under marginally suitable class (S3); the soils with very severe limitations which can be corrected under N1 (currently not suitable); the soil with very severe limitations which cannot be corrected were grouped under unsuitable class N2 (Sys *et al.*, 1991). This method also identifies the dominant limitations that restrict the crop growth in the sub-class symbol such as climatic (c), topographic (t), wetness (w), physical soil characteristics (s), soil fertility (f) and soil salinity/alkalinity (n). The suitability classes and sub-classes were decided by the most limiting soil characteristics (Table 4).

The studied soils vary in their suitability for chickpea according to the criteria for the determination of the land suitability classes. The soil series NG-1, which is grouped under Lithic Ustorthents is not suitable for chickpea cultivation. The major limitations are wetness (drainage), physical soil characteristics *viz.*, coarse fragments, texture and soil depth and soil fertility characteristics like pH and organic carbon.The soil series NG-2, which is grouped under Vertic Haplustepts is moderately suitable for chickpea cultivation. These soils showed limitations of wetness (drainage), physical soil characteristics coarse fragments, soil depth and texture and soil fertility characteristics like organic carbon.The major limitation of chickpea cultivation in Vertic Haplustepts is organic carbon, which can be upgraded by applying organic manures.The soil series NG-3 and NG-4 which is grouped under Lithic Ustorthents is not suitable for chickpea. The major limitations are wetness (drainage), physical soil characteristics *viz.*, coarse fragments, texture and soil depth and soil fertility characteristics like pH and organic carbon. Shallow depth and low organic carbon are the major limitations. The improvement measures such as application of organic manures, green manuring are necessary to enrich and maintain organic matter content in these soils.

The soil series NG-5 which is grouped under Calcic Haplusterts is moderately suitable for chickpea cultivation. These soils showed limitations of wetness (drainage), physical soil characteristics coarse fragments, soil depth and texture and soil fertility characteristics like organic carbon.The major limitation of chickpea cultivation in Calcic Haplusterts is wetness (drainage) and organic carbon and so, the organic carbon status in soils can be improved by the application of farmyard manure, green manuring and inclusion of legumes in rotation. Therefore, these soils can be upgraded in highly suitable class by management of soil fertility.The soils of NG-2 and NG-5 are moderately suitable for chickpea whereas the soils of NG-1, NG-3 and NG-4 are not suitable for chickpea cultivation. Satyavathi and

Table 1 : Morphological characteristics of soils

Hori-zon	Depth (cm)	Boundary D	Boundary T	Colour (moist)	Texture	Structure	Consistence D	Consistence M	Consistence W	Porosity S	Porosity Q	Roots S	Roots Q	Effervescence	Other features
NG-1Series (Very gently sloping plateau): Clayey, smectitic, hyperthermic Lithic Ustorthents															
Ap	0-18	c	s	10YR3/2	c	m2sbk	vh	fr	vs,vp	f	c	vf	f	-	
Cr	18-25	----------weathered basalt----------													
R	25+	----------hard basalt----------													
NG-2Series (Very gently sloping plateau): Fine, smectitic, hyperthermic, Vertic Haplustepts															
Ap	0-15	c	s	10YR3/2	c	m3sbk	vh	fr	vs,vp	f	c	vf	c		Cracks 3-4 cm
Bw1	15-40	g	s	10YR3/2	c	c3abk	vh	fi	vs,vp	vf	c	m	f		upto 30 cm,
Bw2	40-73	g	s	10YR3/2	c	c3abk	vh	fi	vs,vp	vf	c	m	f		Pressure faces
Cr	73-82	----------weathered basalt----------													
R	82+	----------hard basalt----------													
NG-3Series (Very gently sloping pediment): Clayey-skeletal, smectitic, hyperthermic Lithic Ustorthents															
Ap	0-20	c	s	10YR4/2	c	m1sbk	sh	fr	s,p	m	c	vf	f	-	Coarse
Cr	20-40	----------weathered basalt----------													fragments,
R	40+	----------hard basalt----------													35-40%
NG-4 Series(Very gently sloping pediment): Clayey, smectitic, hyperthermicTypic Ustorthents															
Ap	0-19	c	s	10YR3/3	c	m2sbk	vh	fr	vs,vp	m	c	vf	f	-	
Cr	19-58	----------weathered basalt----------													
R	58+	----------hard basalt----------													
NG-5 Series (Level to nearly level valley):Very-fine, smectitic, hyperthermic Calcic Haplusterts															
Ap	0-19	c	s	10YR3/1	c	m3sbk	vh	fi	vs,vp	f	c	vf	c	ev	Cracks 3-4 cm
Bw1k	19-45	g	s	10YR2/1	c	c3abk	vh	fi	vs,vp	vf	c	vf	c	ev	upto 30 cm,
Bss1k	45-78	g	s	10YR2/1	c	c3abk	vh	fi	vs,vp	vf	c	vf	c	ev	pressure
Bss2k	78-106	g	s	10YR2/1	c	c3abk	vh	fi	vs,vp	vf	c	vf	c	ev	faces,
Bss3k	106-150	g	s	10YR2/1	c	c3abk	vh	fi	vs,vp	vf	c	vf	c	ev	intersecting slickensides

Boundary: c- clear, d- diffuse s- smooth, Texture: c- clay, l- loam, g- gravelly, Structure: m- medium, f- fine, 2- moderate, sbk- subangular blocky, Consistence: h- hard, fr- friable, fi- firm, s- sticky, p- plastic, Roots: mc- medium common, ff- fine few, cc- coarse common, fc- fine common

Table 2 : Chemico-physical characteristics of soils

Horizon	Depth (cm)	pH (1:2.5)	EC (dSm^{-1})	OC (%)	CEC [Cmol (p+) kg^{-1}] (%)	$CaCO_3$ (%)	Sand (%)	Silt (%)	Clay (%)	Bulk density ($Mg\ m^{-3}$)
NG-1 Series (Very gently sloping plateau): Clayey, smectitic, hyperthermic Lithic Ustorthents										
Ap	0-18	7.4	0.06	0.38	53.0	3.3	15.4	39.4	45.2	1.75
NG-2Series (Very gently sloping plateau): Fine, smectitic, hyperthermic, VerticHaplustepts										
Ap	0-15	7.8	0.20	0.91	51.9	4.5	10.2	39.3	50.5	1.78
Bw1	15-40	8.2	0.17	0.52	52.0	4.9	9.6	38.2	52.2	1.81
Bw2	40-73	8.3	0.14	0.44	63.5	4.9	7.3	35.9	56.8	1.69
NG-3 Series (Very gently sloping plateau): Clayey-skeletal, smectitic, hyperthermic Lithic Ustorthents										
Ap	0-20	7.3	0.13	0.32	48.3	3.8	21.0	35.0	44.0	1.56
NG-4 Series (Very gently sloping pediment): Clayey, smectitic, hyperthermic Lithic Ustorthents										
Ap	0-19	7.3	0.21	0.38	55.2	5.6	24.7	29.3	46.0	1.48
NG-5 Series (Level to nearly level valley): Very-fine, smectitic, hyperthermic Calcic Haplusterts										
Ap	0-19	8.4	0.26	0.73	55.7	19.8	8.1	33.5	58.4	1.68
Bw1	19-45	8.5	0.19	0.48	61.5	19.6	8.8	27.9	63.3	1.81
Bss1	45-78	8.5	0.23	0.44	60.9	14.2	5.9	27.8	66.3	1.74
Bss2k	78-106	8.6	0.27	0.45	62.6	13.0	4.8	4.8	26.9	68.3
Bss3k	106-150	8.6	0.24	0.41	65.2	12.6	6.7	6.7	27.0	66.3

Table 3 : Soil-site characteristics of typical pedons of different soil series

Soil series	Land form	Geology/ parent material	Soil depth (cm)	Soil texture	Surface stoniness (%)	Coarse fragments (%)	Slope (%)	Erosion	Drainage	Present land use
NG-1	Very gently sloping plateau	Basalt	18	clay	<3	3-5	1-3	Severe	Well	Single crop
NG-2	Very gently sloping plateau	Basalt	73	clay	<3	1-3	1-3	Severe	Moderately well	Double crop
NG-3	Very gently sloping pediment	Basalt	20	clay	3-15	35-40	1-3	Severe	Well	Single crop
NG-4	Very gently sloping pediment	Basalt	19	clay	<3	15-20	1-3	Severe	Well	Double crop
NG-5	Level to nearly level valley	Basalt	150	clay	<3	1-3	0-1	Slight	Moderately well	Double crop

Table 4 : Degree of limitation and suitability of soil series for growing chickpea

Characteristics	NG-1	NG-2	NG-3	NG-4	NG-5
Rainfall during growing season(mm)	1	1	1	1	1
Length of growing season (days)	1	1	1	1	1
Mean temperature growing season (^{0}C)	1	1	1	1	1
Mean max.temp. growing season (^{0}C)	1	1	1	1	1
Mean min. temp. (^{0}C)	1	1	1	1	1
Mean R.H. in growing season (%)	1	1	1	1	1
Slope (%)	1	1	1	1	1
Drainage	1	2	1	2	2
Texture (clay %)	2	2	2	2	2
Coarse fragment within 50 cm	2	1	3	2	1
Depth (cm)	4	2	4	4	1
ECe (dSm^{-1})	1	1	1	1	1
pH (1:2.5)	1	2	1	1	2
Soil suitability	N1s,f,w	S2s,f	N1s,f,w	N1s,f,w	S2 s,f

Limitations: 0-no slight; 1- slight; 2- moderate; 3- severe; 4- very severe, Soil suitability class: Moderately suitable (S2), Not suitable (N1)
Suitability subclass:f- soil fertility limitations; s- physical soil limitations; w- wetness limitations; n- salinity (and/or alkalinity) limitations

Suryanarayan Reddy (2004) also reported that the soils of Telangana region of Andhra Pradesh are marginally to moderately suitable or not suitable for chickpea crop. Shallow depth in Lithic Ustorthents (NG-1, NG-3 and NG-4) and low organic matter in all the soils are the important limitations. These finding are corroborated with finding of Satyavathi and Suryanarayan Reddy (2004) who indicated that the shallow soil depth, coarse fragment, wetness (drainage) and organic carbon are the major limitation for chickpea in the Telangana region of Andhra Pradesh. The improvement measures such as application of organic manures, green manuring and crop rotation are necessary to enrich and maintain organic matter content in these soils.

Conclusion:

The study reveals that the data collected during the soil resource surveys are useful to workout suitability of different soil units for specific crops or specific land use by comparing the requirements of the desired land use with the existing land qualities. The basic information in this study can effectively be used as input for soil, fertilizer and land use management that help in suggesting suitable soil and crop management and land use decision option to the farmers.

Literature Cited

Anonymous (1995). *Soil survey manual*, Agric. Handb., U.S. Dept. Agric. 18. Indian Print, Scientific Publishers, Jodhpur. 437P.

Anonymous (1998). *Key to soil taxonomy*, 8th Ed., USDA National Resource Conservation Service.328 P.

Bera, R., Seal, A., Mukherjee, K. and Dolui, A.K. (2005). Characterization of tropical soils in the fringe of Chhotanagpur Plateau in Eastern India for land use planning. *Nig. J. Soil Res.*, **6** : 50 - 57.

Bhaskar, K.S., Gaikawad, S.T. and Anantha Rao, D. (1996).

Soil site suitability evaluation for wheat : A case study. *Agropedology*, **6** (1) : 89 - 94.

Gandhi, Gopal and Savalia, S. G. (2014). Soil-site suitability evaluation for mustard in calcareous soils of Girnartopo sequence in Southern Saurashtra region of Gujarat. *J. Oilseed Brassica*,**5** (2) : 128-133.

Kharche, V.K. and Gaikawad, S.T. (1993).An appraisal of production potential of soils of Saongi watershed near Nagpur, Maharashtra. *Agropedology*, **3**: 69 - 78.

Kharche, V.K., Sehgal, J.L. and Challa,O. (1995). Evaluation of soil-site conditions for suitability of rubber. *Agropedology,* **5** : 69 - 78.

Leelavathi, G.P. and Naidu, M.V.S. (2010). Soil-site suitability evaluation for commonly growing crops in Yerpedumandal of Chittoor district, Andhra Pradesh. *Agropedology*, **2**: 133 - 138.

Mandal, D.K., Kandare, N.C., Mandal, C. and Challa, O. (2002). Assessment of quantitative land evaluation methods and suitability mapping for cotton growing soils of Nagpur district. *J. Indian Soc. Soil Sci.*, **50**(1): 74 - 80.

Meena, R.H.,Giri, J.D. and Sharma, S.K. (2012). Soil-site suitability evaluation for chickpea in Malwa Plateau of Banswara district, Rajasthan. *Internat.J. Scient. & Res. Public.*, **2** (9) : 1-6.

Pakhan, Atul D., Chatterji, S., Sen, T.K., Venugopalan, M.V., Patil, S. and Challa, O. (2010) Use of different techniques in evaluation of suitability of shrink- swell soils of Nagpur district, Maharashtra for rainfed sorghum. *J. Indian Soc. Soil Sci.,* **58** (1) : 117 - 124.

Satyavathi, P.L.A. and Suryanarayan Reddy, M. (2004) Soil-site suitability for six major crops in Telangana region of Andhra Pradesh. *J. Indian Soc. Soil Sci.,***52** (3): 220 - 225.

Sehgal, J.L. (1991). Soil-site suitability evaluation for cotton. *Agropedology*, **1** : 49 - 63.

Sharma, K.R. and Sharma, P.K. (1991) Soil-site suitability for wheat in different Agro- climatic regions of Punjab. *Agropedology*, **1**: 65 - 73.

Sharma, R.C. (1999). Soil suitability of reclaimed salt affected soils for wheat. *Agropedology*, **9** : 59 - 62.

Sys, I.C., Vanranst, B. and Debaveye, J. (1991). Land evaluation part II, Methods in land evaluation Agric. Pub. General administration for development co-operation, place, du, camp de Mars, 5bte. 57 - 1050, Brussels, Belgium.