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Soil Suitability Evaluation for Rice (*Oryza sativa*) in the Chikkarasinakere Hobli, Mandya district of Karnataka

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ABSTRACT: The study aimed at assessing the suitability of rice (*Oryza sativa)* in the soils of Chikkarsinkere Hobli using land resource inventory database on 1:12,500 scale. Thirteen typical pedons were studied for their suitability to grow rice. Dominant soil physico-chemical properties such as texture, depth, drainage, pH, EC etc., were correlated with crop suitability criteria. The soil of the Chikkarsinkere series found to be highly suitable (S1) for rice cultivation whereas, severity of soil limitations such as soil texture, gravel and pH render the soils less suitable to not suitable. The study will be of great helps to various stakeholders such as land user farmers, policy planners and administrators for selecting crops and cropping systems in a particular area.

Keywords: Rice; Soil suitability evaluation.

INTRODUCTION

The land resources are facing serious degradation (Hammad and Tumeizi, 2012), which affects 23.5% area globally (Lal, 2010; Guo *et al*., 2019). Thus, land suitability evaluation is considered as most authentic tool because of its usefulness to predict the land potential for land use planning (Sys *et al.* 1991). The crop choices required to be made based on the soil suitability evaluation to yield maximum profit and ecological sustainability (Khan and Khan, 2014). Soil and site characteristics related information is necessary for crop planning and effective utilization of soil resources. Every crop has its specific soil-site conditions requirements for its optimum growth and production. Thus, soil site suitability for different crops needs to be determined for rationalizing the land use. The soil suitability acts as guiding tool for policy planning to grow the most suitable crops on every parcel of soil. India occupies about 43-million-hectare area under rice which is staple food for about 65% of Indian population (Pathak *et al.,* 2018). Rice is consumed by majority of the peoples in the study area even then very little attention was paid for assessing the suitability of soil resources for this crop. Thus, in view of the above facts, the study was carried out in the Chikkarsinkere Hobli of Maddur taluk, Mandya district of Karnataka to evaluate the soil-site suitability for rice crop in order to achieve optimum production.

MATERIAL AND METHODS

A. Location and extent

Chikarsinekere Hobli is situated in the Maddur taluk of Mandya district in Karnataka State. The study site with a total geographical area of 16,873 ha comes under southern dry zone. It is located between 12° 26′ and 12° 34′North latitudes to 76°58′ and 77°05′ East longitudes. The area is characterized by 13 soil series, which are Torebomnhalli (P1), Manigere (P2), Honnanayakanahalli (P3), Bidarahalli (P4), Kadakothanahahalli (P5), Yadaganahalli (P6), Aravanhalli (P7), Kalugere (P8), Kyathaghatta (P9), Chikkarsinkere (P10), Doddarasinkere (P11), Honnalagere (P12) and Madenahalli (P13).

B. Climate and Geology

Climate of the study area is sub-tropical monsoon type. The mean minimum and maximum temperature of the area is 18.7°C and 30.6°C while, rainfall is about 765 mm. Granite and gneiss is the major rock types of the Hobli and is the oldest rock formations in the world belong to the Archean period. The Chikkarsinkere Hobli forms part of the Bangalore plateau.

C. Landforms and land use

The major landforms identified in the area are uplands, lowlands, and valleys. More than 75 per cent of the total area is under cultivation. Major parts of the cultivable lands (7478 ha) are under canal irrigation. The canal-irrigated land is under rice, sugarcane, coconut, mulberry, etc., whereas, rainfed areas cultivated for ragi, pulses and oilseeds.

D. Soil analysis

Soil samples were processed for important physico-chemical properties such as soil pH (1:2.5 soil water suspension) using a glass electrode pH meter. Electrical conductivity was measured using a conductivity bridge (Jackson 1973). Organic carbon was determined following rapid titration method (Walkley and Black 1934) and $CaCO_3$ by rapid titration method (Puri, 1930). The available micronutrients were extracted using DTPA method (Lindsay and Norvell, 1978), and the concentration of Zn, Fe, Cu, and Mn was determined using atomic absorption spectrophotometer.

E. Soil-site suitability evaluation

The landscape and soil site characteristic for soil suitability evaluation of rice was carried out as per Sys *et al.* (1991) and Naidu et al. (2006). Soil suitability has been assessed by comparing the landscape and soil characteristics with crop requirements tables (Sys *et al.* 1993). The number and degrees of limitations suggest the suitability class of each soil for a particular crop. The potential land suitability subclasses were determined after considering the improvement measures to correct the limitations.

RESULTS AND DISCUSSION

The soils on uplands were shallow to moderately deep and deep to very deep, moderately drained to well drained, whereas the soils of the midlands and lowlands were deep to very deep and moderately drained. The texture of uplands was sandy loam to sandy clay loam to clay. The texture of lowland physiographic units was finer than uplands because of lateral movement of finer fractions from uplands to lowlands, difference in parent material, physiography, in-situ weathering, and translocation of clay (Basavaraju *et al.*, 2005).

Landform and physico-chemical characteristics (weighted average) of the soils of the study area are presented in Table 1. The soil pH varied from 5.6 to 8.7 (uplands), 8.9 to 9.4 (midlands), and 7.4 to 9.4 (lowlands). This increase in pH could be due to leaching of bases from higher topography and getting deposited at lower portion. Kumar *et al.* (2020) also reported lower pH at higher elevation due to leaching of bases. The electrical conductivity ranged from 0.03 to 0.62 dS m^{-1}, indicating moderate salt content. The lowlands had slightly higher EC than the uplands and midlands, which could be attributed to salt deposition in the lowlands. The study findings are in close agreement to Sitanggang *et al.* (2006). The lowland pedons had higher organic carbon content mainly due to physiography and land use. Our findings are in conformity with Isitekhale *et al.* (2014). The CEC ranged from 0.57 to 62.7 cmol (p^+) kg^{-1}, which corresponds to clay content in the horizons. The higher CEC (62.7 cmol (p^+) kg^{-1}) was observed in the lowland horizons than in the uplands and midlands.

Table 1: Soil-site characteristics of Chikkarsinkere Hobli.

Pedon No.		**Landform characteristics**			**Physical and physico-chemical characteristics (weighted averages)**							
	Gravel (%)	**Slope (%)**	**Flooding**	**Drainage**	**Depth**	**Texture**	**pH**	**EC dSm^{-1}**	**OC $g\ k^{-1}$**	**$CaCO_3$ $g\ k^{-1}$**	**ESP**	**BS (%)**
Upland												
Pedon 1	35-70	1-5	Nill	Well	87	scl,	7.6	0.34	8.9	0	1.9	78
Pedon 2	35-60	0-5	Nill	well	74	scl,	8.7	0.37	11.1	0	5.8	100
Pedon 3	10-30	0-5	Nill	well	79	sc,	7.9	0.25	10.5	-	3.8	87
Pedon 4	10-30	0-3	Nill	well	90	gsl,	8.0	0.06	7.1	0	0.85	100
Pedon 5	-	0-3	Nill	Mod. well	103	c	8.1	trace	13.0	20	0.8	>100
Pedon 6	35-60	1-5	Nill	Well	126	sl,	5.6	0.09	12.5	0	3.3	78
Pedon 7	<10	0-3	Nill	Well	157	sl,	6.3	0.03	5.2	0	0.20	69
Pedon 8	-	0-3	Nill	Well	140	gsl,	8.6	0.15	7.7	0	3.6	100
Midland												
Pedon 9	-	0-1	Slight	Mod. well	131	sl,	8.9	trace	8.8	40	6.0	100
Lowland												
Pedon 10	-	0-1	Mod.	Mod. well	150	c	8.5	0.15	8.4	30	12.9	100
Pedon 11	-	0-1	Mod.	Mod. well	160	sl,	8.2	trace	9.4	0	3.9	99
Pedon 12	-	0-1	Mod.	Mod. well	140	scl,	7.4	0.21	10.6	0	1.9	96
Pedon 13		0-1	Mod.	Mod. well	51	scl,	7.8	0.62	13.7	10	2.9	98

Soils were classified according to the keys of soil taxonomy (Soil Survey Staff 2006). The limitation levels of the land characteristics and land suitability are presented in Table 2. The soil suitability assessment for rice revealed that about 1879 ha (11%) area in the block found to be highly suitable (S1) for rice cultivation followed by moderately suitable (S2) area (5290 ha), whereas about 3645 ha (22%) is found to be not suitable. On either side of the Kadamba River, highly suitable (S1) areas can be found in the panchayaths of Kulagere, Honnalagere, Torebommanahalli, Kyathaghatta, and Doddarasinakere (Fig. 1). Moderately suitable areas distributed predominantly in Kulagere, Honnalagere, Kyathaghatta, Chikkarasinakere, Doddarasinakere, Annur, and Madarahalli panchayaths while, S3 areas primarily found in the panchayaths of Doddaarasinakere, K. Shettihalli, Chikkarasinakere, and Kulagere. The current study findings are in the close agreement with the previous studies (Savalia and Gundalia, 2008; Savalia *et al.*, 2010). Results revealed that Pedon 10 was highly suitable for rice cultivation while, pedon 7, 11, and 12 were moderately suitable, and pedon 1 and 2 were not suitable. Our findings are in close agreement with Karthikeyan *et al.* (2013). The major constraints for rice cultivation in Chikkarasinakere hobli was topography, gravelliness, texture, depth and drainage. The potential suitability of these pedons can be improved by correcting these limiting factors. Kumar *et al.* (2020) also reported improvement in suitability class with the rectification of such limitations under best management practices. Further, Kumar et al. (2021) reported that bio-physical and socio-economic resources need to be evaluated for effective management and utilization of natural resources such as land and soils to ensure sustainable agricultural land use planning of an area.

Table 2: Soil suitability of rice in Chikkarsinkere Hobli.

Pedon	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13
Suitability classes	**N**	**N**	**S3**	**S3**	**S3**	**S3**	**S2**	**S3**	**S3**	**S1**	**S2**	**S2**	**S3**

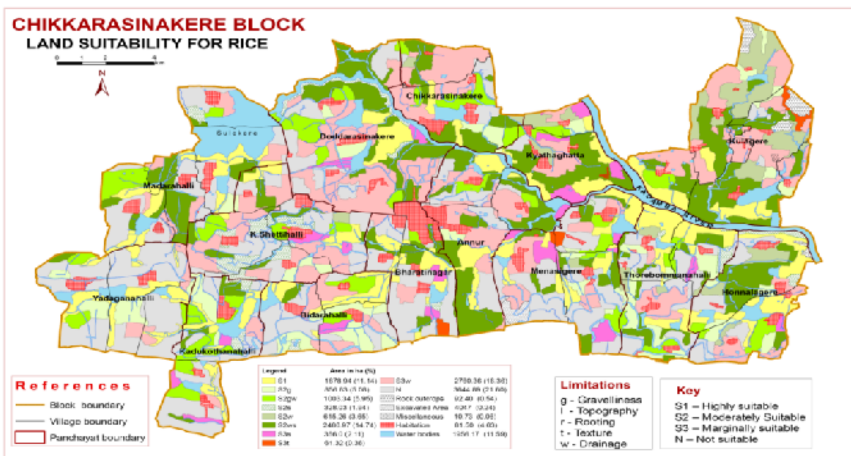

Fig. 1. Soil suitability map for rice.

CONCLUSION

The soils suitability of rice (*Oryza sativa)* revealed that the Chikkarsinkere (P10) series found to be highly suitable whereas, Aravanhalli (P7), Doddarasinkere (P11) and Honnalagere (P12) evaluated to be moderately suitable. Soil texture, gravel, and pH are the limiting factors for suitability of the rice cultivation in the area. Thus, best management practices that improve these limitations need to be adopted for bringing more areas under rice cultivation (potential soil suitability).

FUTURE SCOPE

The study will be of great helps to various stakeholders such as land users, farmers, policy planners and administrators for selecting crops and cropping systems in a particular area. Based on soil characteristics the farmers will be able to make the future plan to increase crop production.

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