

## Soils of Haldi Ghati region of Rajasthan and their suitability for different land uses

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### Abstract

Six pedons each representing summit, moderately sloping side slope, gentle foot slope and alluvial plain (nearly level, gently sloping and dissected) have been characterized. The soil-site characteristics were matched with maize and wheat requirements. The soils associated with nearly level and gently sloping plains are highly suitable and that of dissected alluvial plain and foot slope are moderately suitable for both maize and wheat. The soils on side slope are marginally suitable and summit soils are not suitable for these crops. Afforestation with appropriate forest species and proper agrotechniques have been suggested for non-suitable summit soils and crops to suitable soils.

**Additional keywords :** Landforms, soil characterization, soil suitability, forest trees, maize, wheat

### Introduction

The Haldi Ghati region of Rajasthan is characterized by a variety of landforms, soil and natural vegetation. Soils being an important natural resource, it is essential to have knowledge about their potentialities and limitations for various uses, including agriculture. Such studies in Rajasthan are few (Giri *et al.* 1994; Singh *et al.* 1998). For the Haldi Ghati region, virtually none have evaluated the site and soil characteristics for commonly grown crops. Hence, through this study an attempt has been made to match the soil and site characteristics of the area with the requirements for maize and wheat for suitability rating. The constraints to sustained productivity have been identified and possible alternative land uses are also suggested.

### Materials and methods

**Study area :** The study area lies between 24°45' to 25°51' N latitudes and 73°29' to 74°19' E longitudes. The geological formation bears proximity to the Aravalli system and is composed of argillaceous deposits metamorphosed from shales through slates and phyllites to mica schists (Anonymous 1979). The climate is semi-arid with mean annual

rainfall of 660 mm. The MAAT is 24.2°C with May being the hottest month. The MSST is 29.4°C and the MWST is 18°C. The temperature regime is *Hyperthermic* and the moisture regime is *Ustic*. The drainage pattern is dendritic and the streams and tributaries are mostly ephemeral with major drainage through the Banas river. The natural vegetation is made up of variety of trees, shrubs and grasses. The land use of the area is mostly made up of forest trees on the hills and steeper slopes whereas the foothill plains, alluvial plains and flood plains are cultivated to maize in *kharif* and wheat and mustard in *rabi*. Gram, paddy and sugarcane are also grown in patches.

*Field studies* : Six profiles each representing the six landforms viz. summit, side slopes, foot slope, gently sloping, nearly level and dissected alluvial plains were exposed and studied for their morphological properties. The soils were analyzed for their physical and chemical characteristics following the standard procedures. Soils were also classified upto family level (Soil Survey Staff 1998).

*Suitability rating* : The soils were evaluated for their suitability for the crops grown (rainfed maize and irrigated wheat) in the area using the method suggested by FAO (1976) and Sys *et al.* (1993). Alternate land use has been suggested for the soils which are not under crops.

## Results and discussion

The relevant morphological, physical and chemical characteristics of soils occurring on different landforms are shown in table 1.

The summits are mostly barren and the exposed rocks are fractured. The summits have scattered vegetation namely Khakra (*Butea monosperma*), Babul (*Acacia arabica*), Khair (*Acacia leucopholea*) and afforestation with these plant species is needed to prevent further erosion. The side slopes are covered moderately by shrubs and grasses and tree species like Babul, Neem, Khakra, Dhak and Pipal.

The moderately sloping side slopes are associated with very shallow to shallow, loamy-skeletal soils. They are nearly neutral with low organic carbon and nutrient retention capacity. They have moderate water holding capacity and are of low to medium fertility. The soils occurring on gently sloping foot slopes are slightly deep, well drained, and loamy-skeletal (Table 1). The presence of gravel and stones on the surface may be due to the colluvial-alluvial action of the moving soil and water causing severe erosion, thus limiting the soil depth. The soil development might have also been affected by sparse

Soils on gently to moderately sloping and nearly level alluvial plains are moderately shallow to moderately deep, well drained, slightly calcareous and loamy in nature. The soils are nearly neutral to slightly alkaline, with low nutrient retention capacity and low organic carbon content. The presence of calcium carbonate throughout the depth, and the change in colour from 10 YR to 7.5 YR hue indicate the profile development on this relatively stable landform.

**Table 1. Some important morphological, physical and chemical properties of soils**

[illegible]

**5 Nearly level alluvial plain (1-3%) : Fine - loamy Typic Haplustepts**

0-10	Ap	7.5 YR 3/4	12.1	41.0	49.2	9.8	20.3	7.4	3.6	1.12	5.8	8.5
10-37	Bw1	7.5 YR 3/4	12.9	38.5	48.1	13.0	24.1	7.7	3.7	0.70	7.3	8.7
37-63	Bw2	7.5 YR 3/4	13.4	42.1	44.1	13.8	25.0	7.9	3.8	0.61	7.9	8.7
63-89	Bw3	7.5 YR 3/4	18.2	49.1	33.7	17.2	30.3	8.0	3.2	0.55	12.2	6.3
89-110	Bw4	7.5 YR 3/4	20.5	46.4	30.6	23.0	31.9	8.3	3.1	0.36	16.6	6.4
110-150*	BC	7.5 YR 3/4	21.4	52.7	24.0	23.0	37.3	7.9	2.8	0.33	17.3	5.1

**6 Dissected alluvial plain (3-8%) : Coarse-loamy Typic Ustifluvents**

0-18	Ap	2.5 YR 3/4	9.2	81.9	11.8	6.3	17.2	7.7	2.1	0.51	3.5	8.7
18-37	A <sub>1</sub>	2.5 YR 3/4	8.0	69.9	22.4	7.7	19.1	8.3	3.4	0.55	3.5	8.4
37-57	2c <sub>1</sub>	2.5 YR 3/4	10.8	79.0	13.5	7.5	19.0	8.4	3.4	0.27	3.5	11.8
57-75	2c <sub>2</sub>	2.5 YR 3/4	19.1	70.4	22.5	7.1	18.5	8.2	4.1	0.36	3.0	9.7
75-90	2c <sub>3</sub>	2.5 YR 4/2	22.1	76.9	14.0	9.1	17.9	8.0	4.3	0.31	4.5	7.8
90*	R	Hard Rock										

Dissected alluvial plain is associated with moderately deep dark reddish brown soils. Variable texture throughout the depth and the irregular increase in organic carbon confirms the variation due to fluvial action (Table 1). The redder hue indicates its origin from ferruginous material. The calcareous nature of the soils indicates mixed lithology. The soils are slightly alkaline, slightly calcareous and have low organic carbon content and nutrient retention capacity. Their water holding capacity is moderate. The soils are of low to medium fertility.

**Soil suitability for maize and wheat**

According to Sys *et al.* (1993), maize and wheat require a depth greater than 100 cm, medium to fine textured soils, nearly level to moderately sloping land (<8 per cent) that are free from waterlogging or flooding hazard. The soils should have moderate fertility and water holding capacity. Based on this information, the suitability of soils over various landforms have been rated and placed into different suitability classes.

**Hills and sideslope :** Soils over the steep slopes are best utilized when put under grasses, shrubs and tree species native to the region. Such use will keep these slopes covered through the year and reduce the soil loss due to accelerated erosion during the monsoon. Though, efficient management practices to conserve soil and water can make growing of maize feasible, yet the costs involved would be too high for the local farmers of the region to bear. Thus the best use of these soils would be forestry. Singh *et al.* (1998) have also recommended forestry for steeply sloping hill sides and hill tops in Jharol region of Rajasthan.

*Soils of the gently sloping footslope* : The adequate depth, good drainage of these soils is, however, hampered by gravelliness which cause the soils to be rated as moderately suitable for both the crops. To sustain production of these crops and also to retain the productivity of the soils, addition of organic matter and chemical fertilizers, need to be adopted vigorously (Giri *et al.* 1994; Singh *et al.* 1998).

*Soils of gently sloping and nearly level alluvial plains* : The soils occurring on gently sloping alluvial plain have been found to be highly suitable for wheat and maize with a moderate limitation of gravelliness. The soils over nearly level alluvial plain on the other hand have very few limitations and are also highly suitable. Since the farmers are having small holdings, growing of these crops mainly as subsistence farming by animal drawn tillage equipment is possible and the gravelliness does not become a serious limitation.

**Table 2. Soil suitability for maize and wheat of the study area**

Pedon	Crop	Suitability class	Major limitations	Alternate Land use/management Practices
1	Maize Wheat	Not Suitable (N2)	Steep Slope (35%)	Babul, Khair, Dhok, shrubs and grasses
2	Maize Wheat	Marginally Suitable (S3)	Slope (8-15%) shallow depth (40-cm), erosion	Babul, Khair, Dhok, shrubs and grasses
3	Maize Wheat	Moderately Suitable (S2)	Gravelliness (>50%), slope (upto 8%), erosion	Management practices like field bunding, sowing across slope, frequent but light irrigation, balanced fertilizer application and high dose of FYM
4	Maize Wheat	Highly Suitable (S1)	Slight limitations like gravelliness (35-50%)	Minimum tillage plus above mentioned practices
5	Maize Wheat	Highly Suitable (S1)	Slight limitations	Minimum tillage plus above mentioned practices.
6	Maize Wheat	Moderately Suitable (S2)	Slope (3-8%), erosion, flooding, abrupt textural change	Field bunding with vegetative barriers to lessen the drainage due to flash floods plus above mentioned practices.

*Soils of the dissected alluvial plain* : The soils of the dissected alluvial plain are moderately suitable for both maize and wheat. The limitations identified are gentle slopes, risk of erosion and coarse texture (Table 2). Management practices like bunding of fields, cultivation across the slope, light and frequent irrigation, vegetative barriers on field bunds to protect the crop from flash floods from ephemeral streams and channels, balanced fertilizers application and large addition of FYM are suggested. Soils occurring on steeper slopes should be put under appropriate forest species, shrubs and grasses. Soils occurring on gentle slopes are suitable for growing agricultural crops under definite set of management practices.

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