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Assessing the suitability of soils under Narmada command in Gujarat state for irrigation using soil resource information

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Abstract

The information generated during the soil resource mapping of Gujarat state has been utilized to assess the extent of feasibility of using this information to delineate in potential risk areas for productivity of soils under irrigation. The risks identified were waterlogging, rise in watertable, secondary salinization and erosion. It is observed that most of the soils in the command are prone to various intensities of the above mentioned risks. The soils in the area can prove to be sustainable for irrigated land use only if subjected to high technological and management skills. Beneficiary farmers need to be trained, to prevent the potential risks. The information generated is qualitative in absence of certain properties which are necessary to quantify the risks.

Additional keywords : Irrigation suitability, risk potential, use of soil survey data.

Introduction

Creating irrigation facilities has been one among the important factors for the increase in agricultural productivity. However, it is now being observed, that after a lapse of time, irrigated areas have become prone to waterlogging, secondary salinization, and associated problems. These problems have negative effects on yield and restricted the choice of crops. These experiences emphasize the need for a comprehensive study of these vital issues and have effective solutions at hand when the irrigation project is implemented. Since soil is the main receptacle of the irrigation water it needs to be studied thoroughly to know about its suitability for irrigation. In the present study, an attempt is made to use the soil resource map information for the area under the Narmada command to arrive at a conclusion regarding the suitability of the soils for irrigation. Also, the data gaps that need to be filled in to make the map more meaningful, will be identified.

Materials and methods

Brief description of the Narmada Project : The Sardar Sarovar Project on the river Narmada is a multi-dimensional project set up to meet the irrigation and power needs of Madhya Pradesh, Maharashtra, Gujarat and Rajasthan. The major beneficiary as far as irrigation is concerned will be Gujarat. The 1.8 million ha land being irrigated will cover 12 districts, 64 talukas and 3393 villages (Fig. 1, Anonymous, 1999). The irrigated area thus consists of a variety of agro-ecological subregions, soils and crops and cropping patterns.

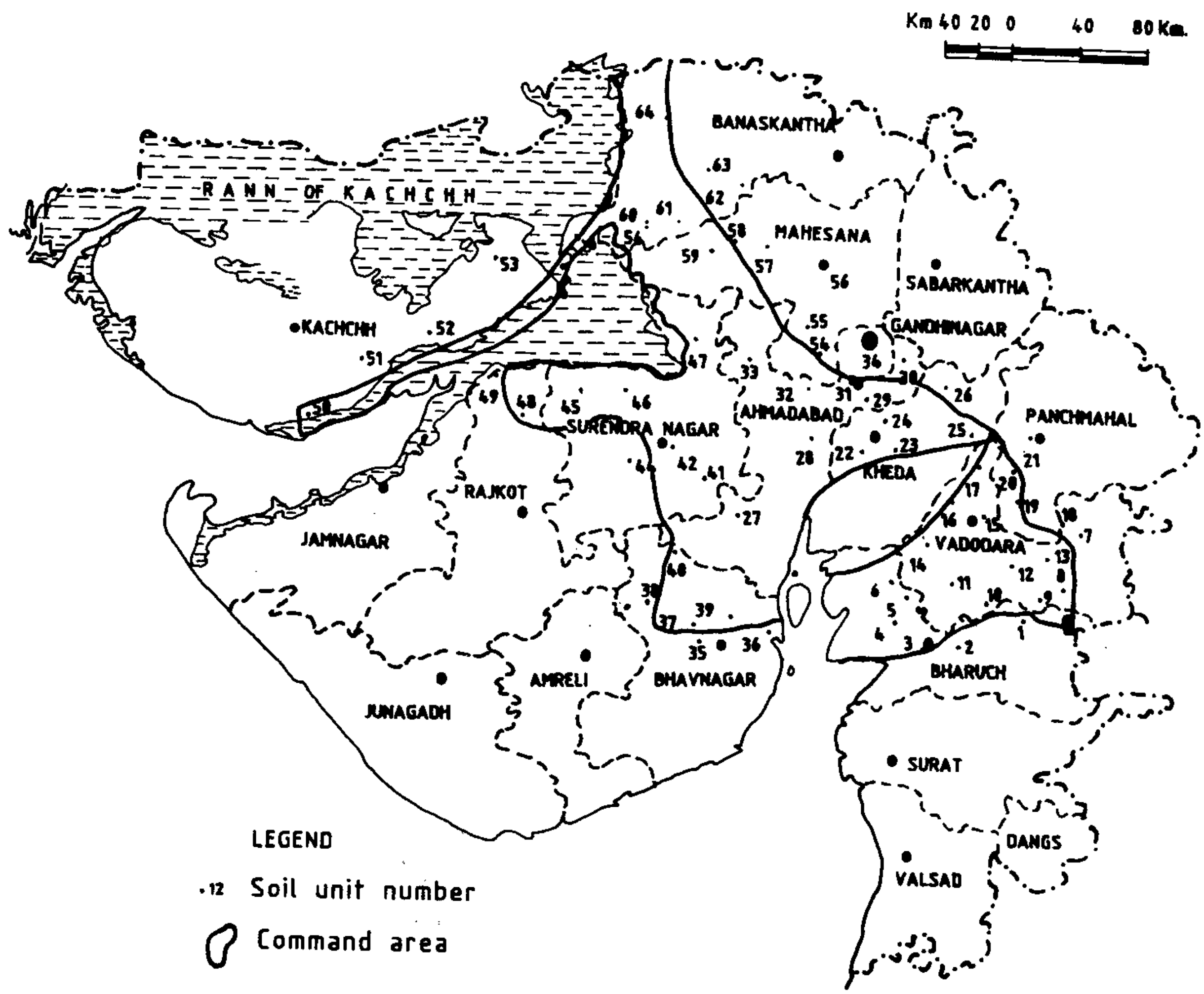

Fig. 1 : State of Gujarat and its districts

The FAO (1979) guidelines for irrigated agriculture have laid out various criteria (for the different soil properties) to be followed while judging the irrigation suitability. Depending on the extent of satisfaction of the limits placed in these criteria, the irrigation suitability and the risk potential of the soils for problems like waterlogging, rise in watertable, secondary salinization and erosion have been assessed. The intensity of the constraints determines the risk potential, and also helps in classifying it as (1) slight, (2) medium and (3) high. The characteristics of the soils that have a risk potential to the above mentioned risks are considered (FAO 1979). The soil resource map legend describes each soil unit using some of the characteristics. Some more properties are determined during laboratory characterization and in the field. In the present study, the characteristics selected to derive inferences about the suitability of the soil units for irrigation were soil depth, drainage, texture, slope, erosion, salinity/sodicity and available water capacity (AWC).

Table 1. Susceptibility of soil units in Narmada command in different types of high level of risk potential and the causative soil properties

Soil Unit No.	Type of risk	Causative soil property	Suitability class*
38,60	WL	Depth, erosiveness, AWC	S3
77	E	Erosiveness	S3
78,162,135,138,139,165,166, 169,174,27,4,275,306,368	WL,SS	Drainage, Sal/Alk, texture	S3
137,327	WL, E	Texture, drainage, slope	S3
143,151,307,367	SS	Sal/Alk	S3
164	RWT, SS	Sal/Alk	S3
167,168,328	SS, E	Sal/Alk	S3
187,189,332,335,360	WL, RWT, SS	Depth, drainage, texture, slope, erosiveness, AWC, Sal/Alk	S3
289,292,293,294,370	WL, RWT, SS	Depth, erosiveness	S3
315,317	RWT; E	AWC	S3

WL = Waterlogging; E = Erosiveness; SS = Secondary salinization; RWT = Rise in watertable; * Based on FAO (1979).

Results and discussion

The soils in the Narmada command fall in 4 orders, viz. Inceptisols, Aridisols, Entisols and Vertisols. Most of the soil units in the command area belong to the Typic and Vertic subgroups of the Ustochrepts followed by soils of the subgroups Typic Chromusterts (Sharma *et al.* 1994). The criteria adopted and their ranges are as per FAO (1979, 1985). Based on the selected soil properties and the limits that rate the suitability of the soils for irrigation, the risk potential of the soils in the Narmada command has been inferred. The results are presented in tables 1-3. The results show that majority of the soil units have the potential for the risks of waterlogging, rise in watertable, secondary salinization and erosion, either for a single risk or a combination of these. Thus it is imperative that high level of technological and management skills are applied to sustain the agricultural productivity of these irrigated soils. Irrigation scheduling should invariably take into account the soil properties, the climatic demand (PET) and the crop water requirements, and beneficiary farmers be trained accordingly.

Table 2. Susceptibility of soil units to different types of potential risks of medium intensity and the causative soil properties

Soil Unit No.**	Type of risk	Causative soil property	Suitability class*
58,114,116,146,152,156,160,161, 163,21,4,218,220,254,260,2,61, 270,339,340,342,343	SS	Sal/Alk	S2–S3
62,63,249	E	Erosiveness	S2–S3
65	WL, RWT	Depth, drainage, texture	S2–S3
80,87,115,265,122,131,176,345	WL, SS	Drainage, Sal/Alk, texture,depth	S2–S3
88	WL	Drainage	S3–S3
89,127,155,197,348,349	WL, E	Drainage, erosiveness, texture, AWC, slope, depth	S2–S3
212,213,236,253,271,216,224,264	SS, E	Erosiveness, Sal/Alk, texture, depth, AWC	S2–S3
217,252	RWT, SS	Depth, texture, Sal/Alk	S2–S3
266	WL, SS, E	Drainage, texture, erosiveness, Sal/Alk	S2–S3

* Based on FAO (1979, 1985); ** Sharma *et al.* (1994). Sal/Alk = Salinity/alkalinity.

Table 3. Susceptibility of soil units to different types of potential risk of slight intensity and the causative soil properties

Soil Unit No.	Type of risk	Causative soil property	Suitability class*
79,150	SS	Drainage, Sal/Alk	S2
112,153,219,259,351	E	Drainage, texture, erosiveness, AWC	S2
130	WL, E	Drainage, texture	S2
92,96,106, Irrigable	NIL	–	S1
97,98,100,105,118,128,I**	WL, E	Erosiveness, Sal/Alk, texture, drainage	S1–S2
42,199,200,332,333	–	Exposed rock/extremely shallow	NI

I** = Risk may aggravate in the long run if management aspect is continuously neglected; NI = Non-irrigable; * Based on FAO (1979, 1985); Sharma *et al.* (1994)

From the study it is observed that the soil resource information, will help in inferring the type and potential of the risk prediction which is of qualitative in nature. This is because data on aspects like rate and extent of ground water fluctuations, the rate of upward flux of water, critical watertable depth, rates of infiltration, permeability, hydraulic conductivity are missing which are crucial for quantitative information. Such information as and when available will help in finding solutions to check these risks and sustain agricultural productivity. In spite of the inability of the information contained in the soil resource map to quantitatively define the risks yet, it definitely helps in getting a quick idea about areas of probable risks, where greater detailed inventory is needed.

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