Qualitative Evaluation of Land Suitability for Principal Crops in the Evan Region, Khuzestan Province, Southwest Iran

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ABSTRACT:Today's excessive use of croplands and the resulting damages along with the ever-increasing demand for further crop productions have necessitated the best land management practices more than ever. Due to the current lack of any proper land management practices for Evan region in Khuzestan Province, southwest Iran, a land suitability evaluation study for key productions of the region, including wheat, alfalfa, maize, and barley, covering an area of 18300 ha was carried out in the region. Using the findings of the semi-detailed soil studies for this area, 4 soil families and 16 soil series in 3 physiographic units were identified. Physiologic requirements of each crop were also determined and rated based upon the proposed method of Sys et al. (1991) and the tables provided by the Iranian Soil and Water Research Institute (Givi. J., 1997). Qualitative evaluation was carried out by means of simple limitation and parametric methods (Storie and Root Square Method) and comparing land and climate characteristics with crop needs. The index obtained for barley, wheat and alfalfa was higher in comparison to that developed for maize. Limiting factors in different crop yield in the region along with climatic variables included soil physical properties, especially its carbonate contents, soil texture and soil depth. From the two methods used i. e, simple limitation and parametric methods (Storie and Square Root Methods), the latter(Square Root Methods)produced more realistic results in respect to the existing conditions of the region.

Introduction

Considering the rapid growth of the world populations, which is in its turn a limiting factor to the arable lands around the world, the dire need for effective and efficient application of the croplands have been felt more than ever. Sustainable agriculture would be achieved if lands be categorized and utilized based upon their different uses (FAO.1983). Qualitative evaluation of the land suitability consists of determination of the land use for particular applications regardless of yield fulfillment and socio-economic issues (FAO.1976 and 1983). In this view, FAO (Food and Agriculture Organization) took a stride in its Soils Bulletins No. 32, 42, 48, 52 and 55 by introducing various methodologies based upon the above framework.

In their research in the Province of Ben Slimane, Morocco, Briza *et al.* (2001) carried out the qualitative land evaluation for crop production and fruit-bearing trees under rainfed and irrigated conditions. By the use of the parametric method, they showed that much of the croplands of the region were in critical conditions the most limiting factors of which including lime content ,soil texture and soil depth. The main crops of the area were wheat, barely, pea, bean and onion.

Azzat *et al.* (2007) evaluated the land suitability for key agricultural crops in Essaouira Province, Morocco. The principal crops cultivated in the study area were barley, maize, onion and wheat which are the main source of subsistence for the families in *Essaouira*. Olive is the main perennial crop. The aim of this evaluation was to find out which parcels of land may best support the different crops commonly grown by the local farmer based on the physical and chemical properties of the soils in the study area and recommend these results to the local stakeholder for an increase in yield. Suitability maps were produced for each specific crop. In general, the evaluation class for the crops suitability ranges from “moderately suitable” to “permanently not suitable”. This is due to the different condition that the crops require for their developments in the

local area in question. Barley and wheat are the most important crops for the economy and subsistence of the families in the region since most families earn their livelihoods from the cultivation of these crops. Livestock farming constitutes a significant financial reserve for the majority of the farmers. The animals also take advantage of the leftovers of cropfields after the harvest. These areas have limitations due to the presence of coarse fragments and rock outcrops, poor drainage, steep slope, high C_aCO_3 content and texture which are considered to be important factors since they determine the capacity for the penetration of the roots and the capacity to retain water and nutrients.The main objective of this research is to evaluate and compare land suitability for principal crops based on the simple limitation and parametric evaluation systems for Evan Plain, Khuzestan Province, Iran.

Materials and Methods

The study area was Evan Plain with an area of 18300 ha. in the Khuzestan Province at a distance of 20 km of southwest Andimeshk between 32º 13´ and 32º 25´ N and 47º 59´ and 48º 12´ E. This area has an arid climate with a mean annual rainfall of 295 mm and minimum and maximum relative humidity of 31% and 63%, respectively. The mean annual temperature is 22.5 Cº.

According to the particular semi-detailed studies of the region, samples were taken from each soil series profiles and laboratory analysis were carried out based upon the conventional methods of the Iranian soil and water research institute methodologies.

In the present study almost totally 16 soil series were categorized and climatic, topography and soil properties were prepared and ranked based upon Sys *et al* .(1991) tables and proposed tables of the Iranian soil and water research institute (Givi. J., 1997) and the Manual of land classification for irrigation (Mahler, P.J., 1979), Climate data and those related to different stages of plant growth were taken from Khuzestan soil and water research institute and physiological requirements of each plant were extracted from tables prepared specifically for Iran (Givi. J., 1997). In evaluating of the qualitative land suitability, land properties were compared with the corresponding plant requirements. In this stage, in order to classify the lands the simple limitation and parametric methods (i. e, Story and Square Root Methods) were used.

Simple limitation method compares the plant requirements with its corresponding qualitative land and climatic characteristics and the most limiting characteristics defines land suitability class while in parametric method land and climate characteristics are defined using different ratings. The measurement of theses characteristics can be done using the followings:

1. Storie Method:

$$I = A \times \frac{B}{100} \times \frac{C}{100} \times \frac{D}{100} \times \frac{E}{100} \times \frac{F}{100}$$

where I is the specified index and A, B, C, …., are different ratings given for each property.

2 Square Root Method:

$$I = R\min \sqrt{\frac{A}{100} \times \frac{B}{100} \times ...}$$

in which R_{min} is the minimum rank.

By determining the specific land index and using the guidelines given by Sys *et al*. (1991), the qualitative land suitability classes and the limiting factors of the plant growth in different soil series for each plant were determined

Results and Discussion

Sixteen soil series and thirty nine series phases were derived from the semi-detailed soil study of the area.. The soils of the area are of Aridisols, Inceptisols and Entisols orders. Also, the soil moisture regimes are Aridic, Aquic and Ustic while the soil temperature regime is Hyperthermic (KWPA, 2006).

The results of the physical evaluation showed a close correlation between the simple limitation method and parametric method; however, due to the interaction of many-sided impacts of the land properties, using Storie method in determining of the land index will lead to underestimation of the land classes obtained compared to what gained through simple limitation and square root methods. Regarding the accuracy and several advantages of the parametric method (square root method) the

results obtained by this method in the present study will be reviewed briefly.

The comparison of the land indexes for wheat, barley, alfalfa and maize , Table (1) and (2) indicated that in land series 1,7,9,10,11 and 12 with an area of 10475 ha (57.24%) growing wheat, barley and alfalfa was the most suitable than maize. In land series coded 2,3,4,13 and 15 with an area of 3700 ha (20.22%) growing wheat and barley was the most suitable than alfalfa and maize, and in land series 5,6 and 16 with an area of 1250 ha (6.83%) growing alfalfa was the most suitable compared with wheat, barley and maize. Also, In land series coded 14 with an area of 1200 ha (6.56%) growing barley and alfalfa was the most suitable compared with other productions, And, Finally in land series 8 with an area of 700 ha (3.85%) growing barley was the most suitable than other crops. Figure 1 shows the most suitable map for Principal Crops in the Evan Region, by notation to land index (Li). As seen from this map, the largest part of this plain was suitable for barley, wheat and alfalfa respectively. Also, there was not founded area that was suitable for maize.

Generally, the most important limiting factors in wheat and barley productions in the region under study included physical properties of the soil especially lime content and partly soil texture. Briza *et al.* (2001) also suggested that the most limiting factors of the land suitability in the Province of Ben Slimane, Morocco, in wheat and barley productions included physical characteristics such as lime content, soil texture and soil depth.

The major limiting factors in maize production are low relative humidity and high n/N ratio during the plant growth, soil texture and lime content among the soil physical properties. Limiting factors in producing alfalfa also include soil depth and lime content among the soil physical properties.

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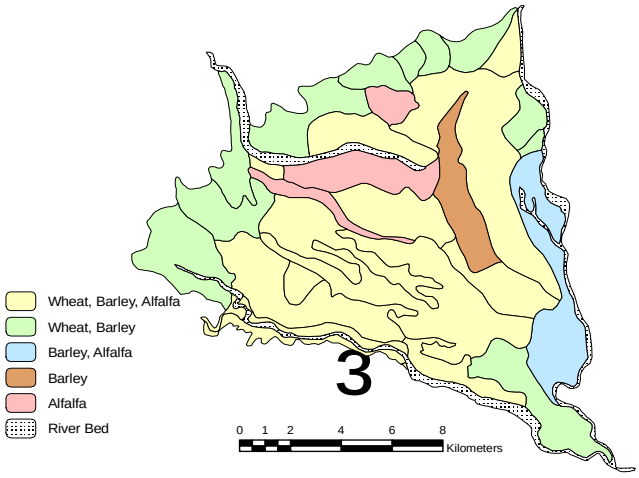

Fig 1: The most suitable map for Principal Crops.

Table (1): Results of the Qualitative Suitability Evaluation of Different Land Series for Crops under Study Using Parametric Method (Square Root)

Land series	Wheat		Maize		Barley		Alfalfa	
	Land index	Suitability Classes	Land index	Suitability Classes	Land index	Suitability Classes	Land index	Suitability Classes
1	81.49	S_1	43.61	S_3sc	82.62	S_1	75.92	S_1
2	76.53	S_1	44.12	S_3sc	80.46	S_1	63.90	S_2s
3	75.09	S_1	48.64	S_3sc	78.96	S_1	62.52	S_2s
4	67.77	S_2s	37.96	S_3sc	65.85	S_2s	22.60	N_1 s
5	61.30	S_2s	43.52	S_3sc	63.32	S_2s	79.02	S_1
6	60.87	S_2s	43.95	S_3sc	64.03	S_2s	80.84	S_1
7	75.53	S_1	41.87	S_3sc	77.66	S_1	76.35	S_1
8	66.08	S_2s	21.28	N_1sc	76.22	S_1	51.02	S_2sn
9	75.94	S_1	42.70	S_3sc	78.53	S_1	77.95	S_1
10	76.35	S_1	42.35	S_3sc	77.59	S_1	78.67	S_1
11	75.42	S_1	46.37	S_3sc	79.35	S_1	82.20	S_1
12	78.10	S_1	46.65	S_3sc	80.87	S_1	80.53	S_1
13	75.91	S_1	44.99	S_3sc	76.79	S_1	55.95	S_2s
14	72.94	S_2s	41.02	S_3sc	76.72	S_1	75.19	S_1
15	63.90	S_2s	34.69	S_3sc	66.69	S_2s	22.38	N_1 s
16	61.60	S_2s	43.01	S_3sc	63.98	S_2s	80.15	S_1

Table (2): Results of the Qualitative Suitability Evaluation of Different Land Series for Crops under Study Using Parametric Method (Storie)

Land series	Wheat		Maize		Barley		Alfalfa	
	Land index	Suitability Classes	Land index	Suitability Classes	Land index	Suitability Classes	Land index	Suitability Classes
1	73.98	S_2s	26.34	S_3sc	74.08	S_2s	66.06	S_2s
2	65.47	S_2s	26.95	S_3sc	71.94	S_2s	54.02	S_2s
3	63.65	S_2s	26.86	S_3sc	70.42	S_2s	51.72	S_2s
4	54.47	S_2s	19.95	N_1sc	56.60	S_2s	19.01	N_1 s
5	51.85	S_2s	26.24	S_3sc	55.30	S_2s	70.61	S_2s
6	51.16	S_2s	26.70	S_3sc	56.61	S_2s	73	S_2s
7	68.46	S_2s	24.25	N_1sc	72.39	S_2s	69.33	S_2s
8	52.82	S_2s	6.26	N_2sc	68.31	S_2s	37.26	S_3sn
9	65.19	S_2s	25.26	S_3sc	71.53	S_2s	69.92	S_2s
10	68.36	S_2s	24.81	N_1sc	70.27	S_2s	71.61	S_2s
11	64.46	S_2s	29.76	S_3sc	71.32	S_2s	75.90	S_1
12	68.10	S_2s	30.11	S_3sc	73.02	S_2s	71.78	S_2s
13	64.86	S_2s	28	S_3sc	66.38	S_2s	47.76	S_3s
14	65.31	S_2s	23.26	N_1sc	72.20	S_2s	68.76	S_2s
15	53.34	S_2s	16.67	N_1sc	58.10	S_2s	18.65	N_1 s
16	52.37	S_2s	25.59	S_3sc	56.51	S_2s	72.26	S_2s