Int. J. Forest, Soil and Erosion, 2019 9 (1)
ISSN 2251-6387

Research Paper

Qualitative land suitability evaluation for citrus in Pol-e-dokhtar area, Western Iran

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Abstract

A land suitability evaluation study for citrus was carried out in Pol-e-Dokhtar area, Western Iran based upon Simple Limitation method (SLM), Limitation Method regarding Number and Intensity (LMNI) and parametric (PM) such as square root and storie methods. Results showed that the accuracy of obtained results by the square root method is high and more realistic when compared with the limitation methods results. Therefore according to the results of square root method cultivation of citrus is not suitability for citrus.

Key words: Citrus, Land evaluation, Lorestan

Introduction

The process of assessing the performance of land for a specific purpose is called land evaluation that can be done for a specific kind of use such as maize and potato (Land suitability) or for a more general utilization such as agriculture and grazing (Land capability evaluation). Land evaluation may be performed as qualitative or quantitative (Verheye, 2009). Qualitative assessments are depending on experience and intuitive judgement; they are real empirical systems and no quantitative expressions of either inputs or outputs are normally given. (De la Rosa and van Diepen, 2002). Qualitative assessment can be done by several methods such as Simple Limitation method (SLM), Limitation Method regarding Number and Intensity (LMNI) and parametric (PM) such as square root and storie methods. Many researchers have evaluated lands using qualitative assessment. Albaji *et al.* (2009) have evaluated the land suitability of West Shoush plain in Khuzestan Province, southwest Iran for principal crops including wheat, alfalfa, maize, and barley using simple limitation and parametric methods. They concluded that parametric methods produce more realistic results in respect to the existing conditions of the region. Briza *et al.* (2001) carried out the qualitative land evaluation using parametric method for crop production and fruit bearing trees under rainfed and irrigated conditions. Their results showed that much of the croplands of the region were in critical conditions the most limiting factors of which including soil texture , soil depth and slope. Sabeti Amirhendeh *et al.* (2013) have done suitability assessment in Talesh site for tobacco in Guilan province, northern Iran. In their study results of simple limitation method and the limitation method regarding number and intensity showed similar marginally suitability classes (S3). Due to the lack of any appropriate study of land evaluation for citrus in Pol-e-dokhtar area, Western Iran, this research was conducted to perform this purpose in the region.

Material and methods

Study area

The study area is located in Pol-e-dokhtar, one of the cities of Lorestan province, in the west of Iran (Fig. 1). The 3900 km^2 watershed lies between 33°44′51″–33°51′47″ N and 48°12′30″–48°28′45″ E. The annual precipitation is 360 mm which most of it falls during the months of December to March in the form of rain. The average temperature is 18 °C, with the Min. and Max. of 4 and 42 °C.

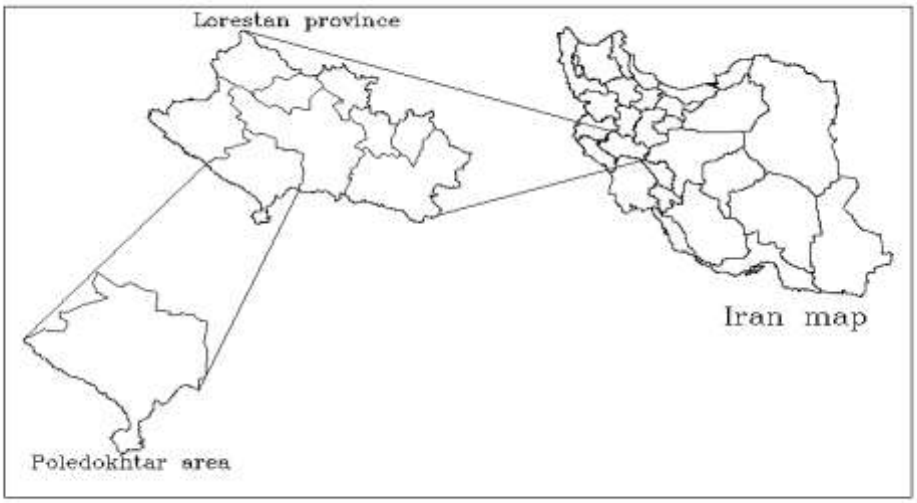

Figure 1: Location of study area

land suitability evaluation implies that requirement tables have to be produced for each land utilization type. We compared the land characteristics with the plant requirements tables introduced by Sys *et al*., (1993). For determination, the limits of land classes we used pattern introduced by Sys *et al*., (1991).
Land units of the study area are shown in figure 2.

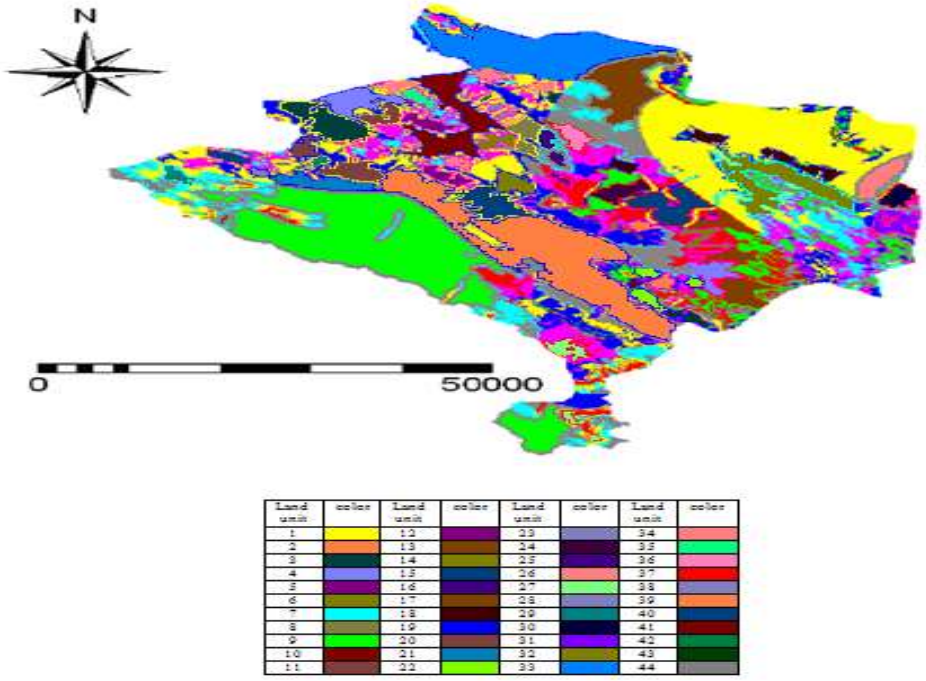

Figure 2: Land units of the study area

The climatic data was collected from Khoramabad synoptic climatology station and then have been processed absolute minimum temperature belonged to January and February . Absolute maximum temperature was reported on July.
According to the results, temperature regime is thermic and moisture regime is dry Xeric. Detailed Soil survey was carried out and results were used as the base information in the research.
Physiographic land forms of study area plateau and piedmont alluvial plain. The soil of area was classified in two Orders. Entisols and Inceptisols. Two Families for Entisols and five Families for land suitability classification, using the guidelines of FAO (1996) is divided into Order, Class, Sub Class , and Unit. In this system ,orders are divided in to Suitable (s) and Not Suitable (N). Suitable order includes three classes of highly Suitable (S_1), moderately Suitable (S_2) and marginally Suitable (S_3).

Table 1 Physiographic land forms and soil classification of study area

		Soil classification		
Land form	Soil No	Family	Subgroup	Order
Plateau	1	Fine loamy, mixed, thermic	Typic Xerocherepts	Inceptisolis
	2	Fine loamy, mixed, thermic	Typic Calcixerepts	Inceptisolis
	3	Loamy skeletal, mixed, thermic	Typic Calcixerepts	Inceptisolis
Piedmont	4	Fine, mixed, thermic	Typic Calcixerepts	Inceptisolis
Plain	5	Fine loamy, mixed, thermic	Typic Xerocherepts	Inceptisolis
	6	Loamy skeletal, mixed, thermic	Typic Xerorthents	Entisols
	7	Sandy skeletal, mixed, thermic	Typic Xerorthents	Entisols

Not Suitable order consists of two Class of Currently not Suitable (N_1) and permanently not Suitable (N_2). The subclasses are a more detailed division of classes based on land quality and characteristics. Sub classes show kind of limitation. In study present some of limitation is shown with following lower-case letters.
C: Climatic limitations, t: Topographic limitation, S: Soil physical properties limitations (consist of texture and structure , soil depth and coarse fragment problems), f: Soil fertility , n: Soil salinity & alkalinity limitations. Land suitability unit is reflecting minor differences in required management within Subclasses. Land use requirements including soil, topography and climatic characteristics were got from Sys et al (1991) and Givi (1998) and then were modified with regard to the regional conditions and the cultivars of crops.
Four methods including limitation methods (Simple limitation & Number and intensity of limitation) and parametric methods (Storie &Square root) were used to evaluate the land suitability for these crops. Simple limitation method: land use requirements compare with climate or land characteristics and suitability classes determined for those. Lowest suitability class for characteristics is known as the final climatic or land suitability class. Number and intensity of limitation method: Up on the number of climatic limitations , intensity of climatic limitations is determined. It is put together with land limitations and finally land suitability class is determined.
Parametric methods: Parametric methods carried out following two procedures include Storie and Square root methods. After compare between climatic and land characteristic with land use requirements, one rating between 0 and 100 is given to every climatic for land characteristic. According to the selected method (storie or square root method), at first stage with use of equation2 , Climate index (C1) is calculated . Afterwards Climate Rating (CR) is estimated on the basis of equation 3. At second stage with using of Climate Rating (CR) and land characteristics rating. Land Index (L1) is calculated for selected method (equational or equation 2).

Storie method:

$$I = A \times \frac{B}{100} \times \frac{C}{100} \times \ldots$$

I: Land Index (L1) or Climatic Index (C1)
A,B,C,… : Rating of characteristic

Square root method:

$$I = R_{\min} \times \sqrt{\frac{A \times B \times C \times \ldots}{100}}$$

I: Land Index (L1) or Climatic Index (C1)
R_{min}: Minimum rating
A,B,C,… : Rating of characteristic

$\Rightarrow$

If C1<25 CR = 16.67 +0.9 C1

$\Rightarrow$

If 25<C1<92.5 CR = 1.6 C1

On the basis of amount of L1, land suitability class is determined. For parametric methods, suitability classes defined according to table 2.

Table 2: Suitability class in parametric methods

Suitability classes	Land Index (L1)
Highly suitable(S1)	75-100
Moderately suitable(S2)	50-75
Marginally suitable(S3)	25-50
Not suitable(N)	0-25

Results and discussion

Suitability is largely a matter of producing yield with relatively low inputs (Vink, 1960) and there are two stages in finding land that is suited to a specific crop. Firstly, the requirements for the crop need to be known, or alternatively which soil and site attributes adversely influence the crop. The second stage is to identify and to delineate land with the desirable attributes but without the undesirable ones. In the present study reported specified requirements for citrus by Syset al. (1993a) were used. Soil attributes data such as pH, lime, OM, and texture & structure had influence on the land suitability for citrus and resulted: 1) into mainly moderately to non-suitable (N1) land classes by using the limitations and storie methods and 2) into moderately to marginally suitable classes by using the parametric square method (Tab. 3).

Climate for citrus are the main limiting factors (Table 3). Simple limitation method, limitation method regarding number and intensity and parametric methods (Storie and Square root) were employed and land suitability classes were determined. The simple limitation method results are similar to those of the limitation method regarding number and intensity. The accuracy of obtained results by the square root method is high and more realistic when compared with the limitation methods results. Therefore according to the results of square root method cultivation of citrus is not suitability for citrus (N2).

Conclusion

An area suitability assessment for crop production requires a considerable effort, which can provide necessary information for optimum land use. Agricultural land use has benefited significantly from the use of suitability systems in recent years. These systems have jointly showed their capabilities in the evaluation and assessment of suitable sites for a variety of crops. Our results showed that the accuracy of obtained results by the square root method is high and more realistic when compared with the limitation methods results. Therefore according to the results of square root method cultivation of citrus is not suitability for citrus.

Table 3. Land suitability classes for 44 land units of the study area for citrus based on different methods

Land unit	SL	NIL	Storie	Square root	Area(ha)
1	S2c	S2c	S2c	S2c	72612.5
2	S2tc	S2tc	S2tc	S2tc	34162.5
3	S3t	S3t	S3t	S3t	16656.25
4	N2t	N1t	Nt	Nt	2000
5	S2sc	S2sc	S2sc	S1sc	1493.75
6	S2tsc	S2tsc	S2tsc	S2tsc	1993.75
7	S3t	S3t	S3t	S2t	5306.25
8	N2t	N2t	Nt	Nt	950
9	S3c	S3c	S3c	S2c	77168.75
10	S3c	S3c	S3c	S2c	16681.25
11	S3ct	S3ct	S3ct	S2ct	6012.5
12	N2t	N1t	Nt	Nt	3606.25
13	S3c	S3c	S3c	S2c	23537.5
14	S3c	S3c	S3c	S2c	18306.25
15	S3ct	S3ct	S3ct	S3ct	9337.5
16	N2t	N2t	Nt	Nt	3493.75
17	S3sc	S3sc	S3sc	S3sc	6356.25
18	S3sc	S3sc	S3sc	S2sc	3831.25
19	S3tsc	S3tsc	S3tsc	S3tsc	2575
20	N2t	N2t	Nt	Nt	1356.25
21	S3s	S3s	S3s	S2s	906.25
22	S3s	S3s	S3s	S2s	856.25
23	S3ts	S3ts	S3ts	S3ts	643.75
24	N2t	N1t	Nt	Nt	356.25
25	N2c	N2c	Nc	Nc	3768.75
26	N2c	N2c	Nc	Nc	3762.5
27	N2c	N2c	Nc	Nc	2700
28	N2tc	N2tc	Ntc	Ntc	1093.75
29	N2c	N2c	Nc	Nc	4443.75
30	N2c	N2c	Nc	Nc	4631.25
31	N2c	N2c	Nc	Nc	4962.5
32	N2tc	N2tc	Nt	Ntc	262.5
33	N2c	N2c	Nc	Nc	32593.75
34	N2c	N2c	Nc	Nc	5025
35	N2c	N2c	Nc	Nc	1150
36	N2tc	N2tc	Ntc	Ntc	562.5
37	N2st	N2st	Nst	Nst	843.75
38	N2st	N1st	Nst	Nst	2081.25
39	N2st	N2st	Nst	Nst	2781.25
40	N2tsc	N2tsc	Ntsc	Ntsc	1112.5
41	N2s	N1s	Ns	Ns	100
42	N2s	N2s	Ns	Ns	356.25
43	N2s	N2s	Ns	Ns	1112.5
44	N2st	N2st	Nst	Nst	487.5

S* = soil limitation, f** = fertility limitation, CS*** = climate and soil limitations

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