DOI: 10.17707/AgricultForest.64.4.26

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QUALITATIVE LAND SUITABILITY ASSESSMENT AND ESTIMATING LAND PRODUCTION POTENTIAL FOR MAIN IRRIGATED CROPS IN NORTHERN OF FARS PROVINCE

SUMMARY

The aim of this research is land suitability evaluation (qualitative) and estimation of biomass net production (Bn) and yield potential (Y) for wheat and sugar beet in a 15000-hectare area in Fars province in southern Iran. Climate data for last 25 consecutive years were collected from the nearest synoptic meteorological Station. These soils were classified based on semi details studies with 5 physiographic units and were classified in four orders of Alfisols, Vertisols, Inseptisols and Entisols consisted of eleven soil families based on soil data and Keys to Soil Taxonomy. Qualitative evaluation was carried out using the square root of parametric (SRP) method and yield potential was calculated for the area based on FAO method. The results showed that the climatic class of the surveyed area is moderately suitable (S_2) for wheat and very suitable (S_1) for sugar beet due to limitations imposed by the relative humidity of the growing cycle. According to the parametric method, the studied area can be classified from (S2) to (N1) for the mentioned products. For different soil units, the parametric method (square root method) is better than limitation method. Finally, yield potential was calculated for sugar beet and wheat in the Aspas as 9307.49 and 7206.13kg DM per hectare, respectively. Regarding the parametric multi-criteria evaluation, the soil qualities characteristics including soil physical properties (s), topography (t), water table limitations (w) and soil fertility(F) are the most limiting factors for studied crops.

Keywords: land suitability, qualitative land evaluation, wheat, sugar beet, FAO method

INTRODUCTION

The ability of the world's natural resources to provide the needs of its growing population is a fundamental issue for the international community. Productive capacity of land resources are limited by climate, soil and landform conditions as well as land use and management. Land is the ultimate source of wealth and the foundation upon which many civilizations were constructed. Land evaluation may be defined as ‘process of assessment of land performance when

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Notes: The author declare that they have no conflicts of interest. Authorship Form signed online.

used for specified purposes' (FAO 1985). Sustainability of ecosystem productivity and biodiversity imply the quality and quantity of natural resources and their suitability for a range of land-use planning processes in future rural, urban and industrial activities (Kilic et al. 2005). Land evaluation plays a major role in comparing various types of land for different uses, and provides information for subsequent activities such as optimum land-use planning or increasing the area per unit with respect to land-suitability evaluation (FAO 1976). Determination of land suitability for various productivity is not only a way to prevent the destruction of agricultural lands, but is also one of the most important and basic methods to combat this issue. Agro ecological land evaluation predicts land behavior for each particular use; soil quality evaluation predicts the natural ability of each soil to function. However, land evaluation is not the same as soil quality assessment, because biological parameters of the soil are not considered in land evaluation (Braimoh and Vlek 2008). In agricultural context, finding optimal locations for crops can increase the economic benefits, as well as reducing the negative environmental consequences (Ashraf et al., 2010). Numerous studies have addressed various aspects of land suitability for crop cultivation on the basis of FAO framework in different countries (Chinene and Situmbanauma 1988; Embrechts et al. 1988; Oise 1993; Habrurema and Steiner 1997). Zang et al. (2004) introduced a system for the quantitative evaluation of soil productivity developed and deployed in Gaoyou County, China. The objective of their study was to develop a new quantitative method within the framework of a GIS. Results of this study showed that the soils with a bleached layer in their profile located in sloping areas were not suitable for rice and wheat, but they were however suitable for tea plantations, fruit trees or other kinds of cash crops. In several parts of Iran, land suitability evaluation has been done for some of the crops by Movahhedi Naenui (1993) Ghasemi Dehkordi (1994), Givi (1996 ,1997) Sarvari and Mahmoudi (2001), Seyed Jalali (2001), Shahbazi and Jafarzadeh (2004), Shahabi (2005), Akef (2005), Jafarzadeh and Abbasi (2006), Jafarzadeh et al. (2008), Rahimi Lake et al. (2009), Behzad et al. (2009).

The calculation of radiation-thermal potential by FAO model allows estimating net biomass production based on climate and crop data. The predicted production is obtained by taking the impacts of soil and water management and the radiation-thermal potential into account (Givi, 2000). The method is based on some simple assumptions which allow estimating the biomass and economical yield of most annual plants provided that they are protected against pests and diseases and enjoy optimum moisture and nutritional conditions (Sys et al., 1991a). For this purpose, enormous efforts have been devoted in Iran for a variety of products. For instance, Farajnia (2002) computed production potential of irrigated wheat as 6700 $kg.ha^{-1}$ in Tabriz Plain, Iran. Also, Farajnia (2002) assessed 100000 hectares of Yekanat plain of Marand, Iran and calculated the production potential of sugar beet as 77127 $kg.ha^{-1}$. Sohrabi et al. (2003) calculated production potential of sugar beet in Silakhoor Plain of Lorestan, Iran as 68628 kg.ha^{-1}. Seiedjalali (2000) studied the production potential and land suitability in 36205 hectares of Mian-ab lands of Shushtar, Iran for rain fed and irrigated wheat cultivation and estimated wheat biomass yield as 13284 kg.ha^{-1}.

The main objective of this research is then evaluation and comparison of land suitability (qualitative) for principal crops based on the simple limitation and parametric evaluation systems and estimation the biomass net production and yield potential for main irrigated crops in Aspas region, northern of Fars Province, as wheat and sugar beet crops are among the important and commercial products in the most parts of Fars province.

MATERIALS AND METHODS

Study site

This study was carried out in Fars province, southern Iran. The study area is about 15000 ha located in Aspas, northern of Shiraz city (30 27´ 02´-´ N, 52 42´29´E, Fars Province, Iran) (Figure. 1).

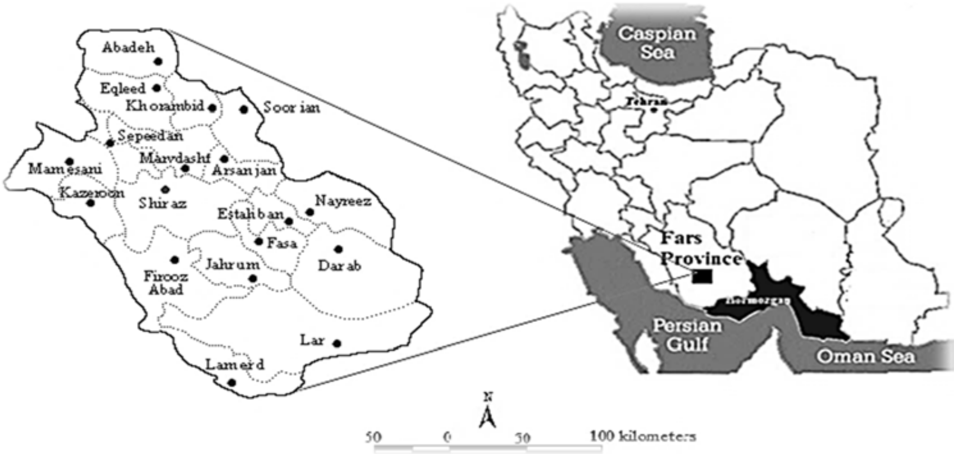

Figure 1. Study area in South of Iran (Fars province)

The study area is 2300 m above sea level with mean annual temperature of 10.2°C. According to Banaei (5), the soil moisture and temperature regime of the study area are “xeric" and "mesic", respectively. Climatic data indicate mean annual rainfall of about 177 mm, the precipitation mostly occurred from December to April with minimum rainfall in summer. Annual mean temperature is 10.2°C with temperature range of -1.04-3.33°C during winter and 9.12-21.28°C during the summer. Mean annual potential evapotranspiration (thornthwaite method) is about 1746 mm. The native vegetation in the region is thinly scattered consisting of *Gunddelia sp. Astraglus sp. Akgagu camalar sp. Gundelia tourenf.* and annual grasses. The soil survey reports were identified from the profiles inspected and 5 physiographic units consisted of 5 physiographic units, namely gravelly colluvial fans, Piedmont plains, low lands, mountains and hills. Then several profiles were dug and 8 of them were selected as representative profiles for different experiments within different land units where mostly parent materials in pedons were calcareous. A brief morphological characteristic of horizons for the selected profiles (Schoeneberger et al. 2002) is presented in Table 1.

Table 1: Results of chemical and physical analysis of some soil parameters in the studied area**.**

Profile no	Depth (cm)	pH	EC (dSm^{-1})	OM	CCE	Gypsum	Sand	Silt	Clay
				%					
					Typic Xerorthents				
1	0-15	7.74	0.39	1.21	4.62	0.045	22.92	39.44	37.64
1	15-50	7.81	0.34	0.32	24.98	0.046	28	38.72	33.28
					Aquic Haploxerepts				
2	0-12	7.86	0.73	0.61	24.24	0.042	33.28	41.08	25.64
2	12-50	8.2	0.61	0.32	21.93	0.361	16	68.72	15.28
					Typic Calcixererts				
3	0-25	7.54	0.54	2.24	30.93	0.078	16	40.72	43.28
3	25-45	7.67	0.4	0.65	30.01	0.109	14	44.72	41.28
3	45-65	7.84	0.5	0.002	25.39	0.085	15.28	43.08	41.64
3	65-115	7.96	0.27	0.32	34.62	0.166	14.92	53.44	31.64
					Petrocalcic Calcixerepts				
4	0-20	7.47	0.45	0.42	4.62	0.031	8	34.72	57.28
4	20-70	7.97	0.22	0.29	13.85	0.066	24.92	43.44	31.64
4	70-120	7.87	0.25	1.62	60.01	0.062	36.92	47.44	15.64
					Typic Xerorthents				
5	0-20	7.78	1.05	0.9	25.38	0.032	24	45.3	30.7
5	20-55	7.81	0.98	0.33	31.2	0.028	25	45.5	29.5
					Typic Xerorthents				
6	0-15	7.71	0.52	2.28	25.39	0.047	23.28	29.08	47.64
6	15-45	7.63	0.49	0.94	24.33	0.037	20.61	33.44	45.95
					Calcic Haploxeralfs				
7	0-15	7.72	0.42	0.002	13.85	0.041	32.92	23.44	43.64
7	15-50	7.87	0.21	0.58	27.35	0.066	26.92	37.44	35.64
7	50-95	8.01	0.2	0.002	21.93	0.059	20.92	43.44	35.64
					Typic Fluvaquents				
8	0-20	7.62	1.2	1.4	53	0.028	33	37	30
8	20-45	7.93	1.51	1.1	52	0.09	24	32	44
8	45-70	7.86	1.36	0.7	55	0.078	41	33	26

Soil sampling and chemical analyses

Based on topographic maps, satellite images and field visits were used for several pedons studies in the area. For further studies, eight representative pedons on different landscapes were selected and sampled (Schoene berger et al. 1998); then. air-dried soil samples were meshed through a 2-mm sieve for routine physicochemical soil properties. In this way particle size distribution was analyzed using hydrometer method described by Bouyoucos (1962), organic matter content was assessed by wet combustion (Nelson 1996), cation exchange capacity (CEC) was measured using sodium acetate 1 N at pH 8.2 (Sumner et al, 1996), percentage of gypsum was determined by acetone precipitation (Soil Conservation Service, 1972) and calcium carbonate equivalent (CCE) was tested by titration (Loppert et al. 1996), electrical conductivity (EC), and pH in saturated paste were also extracted according to methods of analysis for soils in arid and semi-arid regions handbook (Bashour and Sayegh, 2007). Soils with cambic, calcic, argillic horizons and ochric epipedon were classified as Entisols, Inceptisols, Vertisols and Alfisols, respectively (Soil survey staff, 2014).

Land evaluation studies

A wide range of limiting physical, economic and social factors can restrict suitability of the land for different applications (FAO 2007). For qualitative land suitability investigation, simple limitation and parametric methods (Storie and square root) were employed. Simple limitation method compares the plant requirements with its corresponding qualitative land and climatic characteristics and the most limiting characteristics define land suitability class. The parametric land evaluation involves numerical rating of different limitation levels of land characteristics according to a numerical scale ranging between climatic index, as well as the land index which can be calculated from these individual ratings. The calculation of these indices can be carried out by two procedures (Eq. 1 and Eq. 2);

1. Storie method (Storie 1976): $\boldsymbol{I = A \times \frac{B}{100} \times \frac{C}{100}} \times ...$ (Eq. 1)

Where: I = index (%) A, B, C etc. = ratings (%)

2. Square root method (Khiddir 1986): $\boldsymbol{I = R_{min}\sqrt{\frac{A}{100} \times \frac{B}{100}} \times ...}$ (Eq. 2)

where: I = index (%) R_{min} = minimum rating (%) A, B, C etc. = remaining ratings (%)

Application of these methods necessitates providing the requirement tables 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). The land suitability classes are defined as follows:

-S1 (very suitable) class: Lands having indexes >75.

-S2 (moderately suitable) class: Lands having indexes ranging in 50-75.

-S3 (marginally suitable) class: Lands having indexes ranging in 25-50.

-N (non-suitable) class: Lands having indexes < 25.

Fall growth of irrigated wheat and irrigated sugar beet are among the common agricultures in the studied region. The agriculture in the area uses traditional to semi-mechanized techniques and equipment. According to the available data, the growth periods and development stages for the wheat and sugar beet crops in the studied region including growth period, type of plant, data of planting according to information in connection with plant wheat planting stage, germination, vegetative into the anatomy, pollen and deal were determined (Table 2).

Table 2. Study of wheat and sugar beet growth cycle in the region

Plant	Planting stability	Vegetative stage	Flowering stage	Ripening stage	Harvest	Growing cycle
Wheat	17-30 Oct	5-20 Nov	15 May-5 June	1-25 July	25July - 1Aug	197 days
Sugar beet	20 Apr-15 May	15 June-15July	30July-5Sep	5 Sep-15 Oct	15Oct-16 Nov	211 days

The Method of Estimating Biomass Net Production Rate (Bn) and Yield Potential (Y)

Irrigated wheat and sugar beet production potential were determined for Aspas region by radiation-thermal production potential (RPP) method. This model estimates net production of a living crop and its yield for the best cultivar under the optimum conditions in terms of water and nutrients availability and pests and diseases control. For calculating biomass net production, we used Eq. 3 (Sys et al., 1991):

$$Bn=(0.36*bgm*KLAI)/((1/L)+0.25*ct) \quad \text{(Eq. 3)}$$

Where, Bn is the net production rate of biomass (kg/ha), ct denotes the respiratory rate calculated from:

$$ct=C30(0.044+0.0019t+0.001t2) \quad \text{(Eq. 4)}$$

In which Bgm is the maximum net production of biomass (Kilogram CH_2O in hectare per hour), KLAI shows the correction factor for LAI <5 and L represents the number of days required for crop maturity. C30 represents the respiratory rate for plants except the legume which equals 0.0108, T stands for the average temperature (°C);

Crop production can be computed by:

$$Y=Bn*Hi \quad \text{(Eq. 5)}$$

where, Y is crop production ($kg.ha^{-1}$) and HI is harvest index

RESULTS AND DISCUSSION

Climatic data were derived based on nearest synoptic station (Eghlid). General information such as main crops, alternation condition and yield as well as socioeconomic information was collected from farmers and existing services centers. Two land utilization types including irrigated wheat and sugar beet were selected for qualifying and evaluation.

Regarding the results obtained from climatic properties and climatic data and climatic suitability evaluation given by Sys et al. (1991), the climatic characteristics of region are Suitable (S_2) for wheat and very suitable (S_1) for sugar beet plantation (Table 4).

Table 3: Rating of climatic factors for wheat crop in studied region

Climatic factors	Properties	Parametric Rating	Climatic Suitability Class
Mean temp of growth (°c)	11.61	80	S_2
Mean temp of vegetative stage (°c)	5.42	65	S_2
Mean temp of flowering stage (°c)	15.24	96	S_1
Mean temp of ripening stage (°c)	21.26	98	S_1
Mean daily min temp coldest month (°c)	-6.8	100	S_1
Mean daily max temp coldest month (°c)	4.72	100	S_1
Climatic index	Storie/ Square root	65 65	S_2 S_2
Climatic rating	Storie/Square root Climatic rating= 16.67+0.9Cl	75.1	S_2
Climatic classes		S_2	S_2

Table 4: Rating of climatic factors for sugar beet crop in studied region

Climatic factors	Properties	Parametric Rating	Climatic Suitability Class
Growth period in terms of thermal suitability (day)	211	100	S_1
Minimum absolute temperature at early growth period(°c)	-6	95	S_1
Average maximum temperature at the coldest month during sugar beet growth cycle(°c)	19.5	90	S_1
Average minimum temperature at the coldest month during sugar beet growth cycle(°c)	6.1	85	S_1
Climatic index	Storie Square root	85 85	S_1 S_1
Climatic rating	Storie/Square root Climatic rating= 16.67+0.9Cl	93.2	S_1
Climatic classes		S_1	S_1

The results also showed that on the basis of soil taxonomy system, the soils can be classified as *Typic Xerorthents, Aquic Haploxerepts, Typic Calcixererts, Lithic Xerorthents , Petrocalcic Calcixerepts, , Haploxeralfs* (Soil Survey Staff 2014) and Calcisols, Luvisols, Leptosols and Regosols in WRB system (IUSS Working Group WRB 2014). Calcite content was higher in profiles with calcareous parent mater. The most important feature was the clay illuviation process shown as Bt horizon in profiles. The calculation results (Table 3 and 4) revealed that climatic suitability classes in study area and all land units had moderate limitation levels (S_2) for wheat and very suitable (S_1) limitation levels for sugar beet. According to simple limitation method, 3.1 land unit had moderate suitability (S_2) for wheat and marginal suitability (S_3) for sugar beet, the most important limiting factors in whole land units were topography and physical soil characteristics limitations. Furthermore, 8.1 land units had pH-induced fertility limitations. Also, 1.1, 2.1, 4.1, 5.1 and 6.1 land units had physical soil characteristics limitation due to coarse fragments (high gravel percentage). High gravel percentage limitations comprised physical, chemical and fertility limitations which decreased organic matter retention, number and intensity of microorganism activity, cations and anions in soil.

Results obtained by parametric methods (Storie) for irrigated wheat showed unsuitable condition for this cultivation (N_2) for 1.1, 2.1, 4.1and 6.1 land units; 5.1 land unit had non-suitable but correctable (N_1) land classes. 7.1 and 8.1 land units had marginally suitable (S_3) land classes. Only 3.1 land unit possessed moderate limitation levels (S_2). Results of square root method showed non-suitable but correctable (N_1) condition for 1.1, 2.1, 4.1 and 6.1 land units. For 5.1 and 8.1 land units, marginally suitable (S_3) land classes were obtained. Only 3.1 land unit had moderate limitation levels (S_2) (Table 5). Results obtained by parametric methods (Storie) for irrigated sugar beet (Table 6) showed unsuitable condition for this cultivation (N_2) for 4.1 and 6.1 land units; 1.1, 2.1 and 5.1 land unit had non-suitable but correctable (N_1) land classes; while 3.1, 7.1 and 8.1 land units had marginally suitable (S_3) land classes. Based on square root method, 4.1 and 5.1 land units had non-suitable but correctable (N_1) condition. For 1.1, 2.1 and 8.1 land units, marginally suitable (S_3) land classes were observed. Only 3.1 and 7.1 land unit had moderate limitation levels (S_2) (Table 6). Comparing climate information and product requirements, the results of this study showed that climatic suitability classes (based on three methods) were S2 and S1 for irrigated wheat and sugar beet, respectively.

Regarding high annual rainfall in this region (>508 mm), at the first look, it seems that it is enough to fulfill wheat water requirement and no irrigation is needed. However, a detailed study of the rainfall showed its uneven distribution throughout the year with higher occurrence during non-cultivation months of the year (winter) when wheat is in hibernation period. Considering that most percent of wheat production occurs in summer, water balance in this season is negative and the cultivation of wheat and sugar beet in summer requires supplementary irrigation. As the severe topography problem affects feasibility of effective irrigation system, reaching to a high yield is restricted.

Table 5. Qualitative land suitability and climatic suitability classes for irrigated wheat

		Qualitative suitability class				
		Parametric (Storie)		Parametric (Root square)		
Land unit	Simple Limitation	Land Index	Land Class	Land Index	Land Class	Climatic Suitability Class
1.1	N_S	11.64	N_2	22.88	N_1	S_2
2.1	N_{SW}	11.87	N_2	24.36	N_1	S_2
3.1	S_2	51.13	S_2	61.97	S_2	S_2
4.1	N_{TS}	8.04	N_2	19.02	N_1	S_2
5.1	S_{3TS}	19.72	N_1	32.93	S_3	S_2
6.1	N_{TS}	5.76	N_2	15. 18	N_1	S_2
7.1	S_{3T}	31.53	S_3	62.48	S_2	S_2
8.1	S_{3F}	31.85	S_3	43.7	S_3	S_2

Table 6. Qualitative land suitability and climatic suitability classes for sugar beet

		Qualitative suitability class				
		Parametric (Storie)		Parametric (Root square)		
Land unit	Simple Limitation	Land Index	Land Class	Land Index	Land Class	Climatic Suitability Class
1.1	N_S	12.86	N_1	25.87	S_3	S_1
2.1	N_{SW}	13.22	N_1	25.16	S_3	S_1
3.1	S_3	44.10	S_3	52.07	S_2	S_1
4.1	N_{TS}	9.64	N_2	19.69	N_1	S_1
5.1	N_{TS}	15.27	N_1	22.97	N_1	S_1
6.1	N_{TS}	7.36	N_2	12. 12	N_2	S_1
7.1	S_{3T}	25.53	S_3	57.58	S_2	S_1
8.1	S_{3F}	33.15	S_3	46.12	S_3	S_1

F: fertility limitations, t: Topography limitations, s: Physical soil characteristics limitations, W: water table limitations

The results showed close correlation the employed methods (simple limitation and parametric methods (Storie and Square root methods) but square root method had better outcomes. The big part of the studied area was classified as non-suitable for sugar beet and wheat crop due to physical and chemical soil parameters(Tables 5 and 6). Furthermore, the most limiting chemical factors considered in this area were soil alkalinity (pH). The qualitative land suitability evaluation assists decision makers to ensure land use according to their capacities to satisfy human needs for present and future generations thus, sustaining ecological and economic productivity of natural resources. One way to increase the production rate and optimized usage of the lands is to determine their production capacity and choosing appropriate applications for them. In this method, the yield is computed regardless of limitation type such as soil, water and management. One important and applicable method to optimize the usage of soil resources is determination of land capacity and potential.

One of these methods involves estimation of the potential of the product yield in ideal and optimized conditions. In this research the net production of biomass (Bn) and yield potential (y) of the irrigated wheat and sugar beet were estimated in Aspas region of Eghlid, Fars province based on weather reports of synoptic station of Eghlid. The results showed that regardless of soil, water and management limitations, the yield of wheat and sugar beet equals 7206 and 9307 kg in dry matter hectare, and 7981and 62049 kg in humid matter hectare, respectively (Tables 7 and 8).

Table 7-The estimated coefficients of yield potential for **sugar beet** , in Aspas region, based on FAO method

Quantity	**Calculating the maximum net production Amount of Biomass(bgm)**
25	Maximum leaf photo synthesis (Kilogram CH_2O in hectare /hour): Pm
411.7150	Maximum gross biomass production ($kg.ha^{-1}.d^{-1}$): bc
222.9975	Maximum gross biomass production in cloudy day ($kg.ha^{-1}.d^{-1}$) :bo
0.3211	f : The ratio of days with unclear weather (1-n/N)
0.6790	1-f : The ratio of days that the weather is clear(n/N)
389.6678	The maximum net production of Biomass (kg CH_2O/hectare/day time): bgm
Calculating the net production rate of Biomass(Bn)	
0.0108	Respiratory rate for all accept legume:C30
0.0051	Respiratory rate: Ct
211	The number of day to harvest: L
1	correction factor: KLAI
23268.74	Biomass net production rate: Bn
0.4	Harvest index: HI
9307.49	Sugar beet production potential (kg/hectare/dry matter)
85	Moisture percentage
62049.98	Sugar beet Yield: (kg fresh weight per ha)

Table 8-The estimated coefficients of yield potential for **wheat** , in Aspas region, based on FAO method

Quantity	**Calculating the maximum net production Amount of Biomass(bgm)**
20	Maximum leaf photo synthesis (Kilogram CH_2O in hectare /hour): Pm
408.2275	Maximum gross biomass production ($kg.ha^{-1}.d^{-1}$): bc
220.9300	Maximum gross biomass production in cloudy day ($kg.ha^{-1}.d^{-1}$):bo
0.3115	f : The ratio of days that the weather is not clear(1-n/N)
0.6885	1-f : The ratio of days that the weather is clear (n/N)
349.8908	Maximum net production of Biomass (kg CH_2O/hectare/day time) bgm
Calculating the net production rate of Biomass(Bn)	
0.0108	Respiratory rate for all accept legume:C30
0.0048	Respiratory rate: Ct
197	The number of days to harvest: L
0.9	correction factor: KLAI
18015.33	Biomass net production rate: Bn
0.4	Harvest index: HI
7206.13	wheat production potential (kg/hectare/dry matter)
12	Moisture percentage
7981.19	wheat Yield: (kg fresh weight per ha)

Considering that the observed yield of sugar beet in this area (39 ton per hectare), we can increase it to 62049 kg fresh weight per hectare by applying proper management and eliminating the reparable limitations. Also, the qualitative assessment of the land proportion for wheat and sugar beet was done in Aspas region based on the simple and parametric methods.

The results of parametric method (Storie and square root) showed that for producing wheat and sugar beet in this area proportion class ranged from S2 to N2 and S2 to N1, respectively and the most limiting factors were slope, wetting, percentage of calcium carbonate, salinity and alkalinity. The results of this study indicated that most parts of sugar beet and some parts of wheat growth stages occur after May, as the growth period of this product is outside the growth period of the area (19 November to 30 April).

Therefore, moisture content was not sufficient for sugar beet and wheat growth and supplementary irrigation was required. These results are in agreement with those reported by Masihabadi et al. (2001) and Sohrabi (2003) who stated that there were no thermal limitations for sugar beet growth in Qazvin Plain, Iran, but supplementary irrigation was required.

CONCLUSION

To evaluate the land suitability for irrigation, the parametric evaluation system was applied using soil and land characteristics. Results of climatic suitability classification based on different methods showed that climatic class of the studied area was moderately suitable (S2) for irrigated wheat and very suitable (S1) for sugar beet. The main limiting climate factor for irrigated wheat was the mean temperature during the growth cycle. Therefore, a modification of climatic suitability classes is suggested. Therefore, it was more suitable for sugar beet cultivation. Considering the existing limitations, the studied area was classified from moderately suitable (S2) to not suitable (N) for the selected crops based on the parametric method. However determination of the final class of this area depends on soil limitations such as surface and subsurface stone and gravel percentage, land slope and the amount of lime. Consequently, the most important limiting physical, fertility and topographical factors were soil parameters like texture, pH, coarse fragments, and land slope, $CaCO_3$ content and micro relief. Their effects can be evaluated alone or in combinations for different soil units. The parametric methods (square root method) performed better than limitation method. Finally, production potential was calculated for sugar beet and wheat in Aspas as 9307.49 and 7206.13kg DM per hectare for the studied area, respectively. Of course, reaching to such production is impossible due to soil and management limiting factors in irrigated farming. In the other words, the difference between the actual and potential yield can be attributed to these limitations. The results of this study indicated that most parts of sugar beet and some parts of wheat growth stages occur after May, as the growth period of these product falls outside the growth period of the area (19 November to 30 April). Therefore, moisture content was not sufficient for growth of sugar beet and wheat and supplementary irrigation was necessary. Therefore, farmers can enhance the productivity by removing the modifiable limitations and improving management.

ACKNOWLEDGEMENTS

The authors would like to appreciate Shiraz University for providing research facilities.

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