Suitability of peach in Souma area (Iran), using Almagra model

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Abstract
One of the promising areas for the horizontal expansion in west Azerbaijan (Iran) is the Souma area. Peach suitability calculated on the basis of the proposed computer program "MicroLEIS DSS" and presented as a soil suitability map has been integrated with GIS tools. Nine benchmark soil series constituents comprising 35 soil profiles have been selected to represent the variation in soils of the studied area. According to the morphological description, physical and chemical properties and USDA Soil Taxonomy, the soils can be classified as Entisols and Inceptisols. Useful depth, texture, drainage, carbonate, salinity, sodium saturation and profile development were selected as limitation factors for peach development. For perennial crops (peach), soil reference sections are between 0 and 100 cm in depth, or between 0 cm and the limit of useful depth when the latter is between 0 and 100 cm. Following a semi-quantitative procedure and according to the generalization level set up for each soil diagnostic criterion, the area under investigation has been divided into four relative suitability classes. Results showed that texture and drainage are the most important limitation factors in 2266 ha and 66 ha respectively of the study area. Peach garden development can be recommended for 1824 ha of the studied area with special reference to sustainable agriculture achievement.

Key Words
Almagra model, MicroLEIS DSS, suitability, Souma, GIS.

Introduction
The Almagra model constituent of new MicroLEIS DSS frame work has been established for the Mediterranean area (De la Rosa *et al*. 2004). Since the last decade, it has been widely used to evaluate many different areas. The Almagra –Tuxpan developement based on the specific conditions of Nayarit (Lopez Garcia *et al*. 2006) was carried out based on a semi-detailed soil survey, Using the Almagra-Tuxpan model, a software routine was written to evaluate the agricultural aptitude of twelve traditional crops (bean, sorghum, maize, tobacco, Virginia, Barley, chili, tomato, melon, watermelon, jícama, peanut, and cotton), after that, the relative agricultural aptitude was determined for every one of the mapped soils units.
Suitability evaluation for specific crops is the first step in land use planning. For this purpose, soil survey and climate are two main factors which impact on land use type. MicroLEIS DSS as a new method in land suitability evaluation was used in Iran for the semi-arid region (Shahbazi 2008 a). The research dealt with sustainable land suitability evaluation of the Ahar soils, located in East Azerbaijan, Iran, based on the multifunctional evaluation of soil quality, using input data collected in standard soil surveys, and with particular reference to the peculiarities of the Mediterranean region and recalibration and validation tests were applied for the new semi-arid condition. Land use planning in Ahar area using MicroLEIS DSS (Shahbazi *et al*. 2008 b) showed peach gardens were recommended only for 30% of the total area heavy texture being the major limitation factor in this case.
Bioclimatic deficiency and land capability evaluation must be carried out to separate agricultural lands from the marginal land. Some special phenomenon such as climate change can be considered in land capability and bioclimatic deficiency evaluation (Shahbazi *et al*. 2008 c; 2009 b). The evaluation results showed that with climate change, only wheat will be converted from moderate to good land use capability in the study area of Ahar, while none of the crops will change its land capability in the Seville area for future scenarios. Also, it is revealed that climate perturbation effects on rainfed conditions are higher than for irrigated conditions in the area. According to previous research work in the studied area (Shahbazi *et al*. 2009 a; Jafarzadeh *et al*. 2009), 80.49% of the total area was capable of agricultural use and 19.51% must be reforested and not dedicated to agriculture. Soils are Typic Xerofluvents, Typic Calcixerepts with high carbonate percentage and Fluventic Endaquepts with 812ha extension not suitable for agricultural use and which must be reforested, while Typic Calcixerepts, Fluventic Haploxerepts with 3344 ha are mainly high suitable and in some cases excellent or moderately suitable.

Another novel model of land suitability evaluation was built based on computational intelligence (Jiao and Yaolin 2007). A fuzzy neural network (FNN) was constructed by the integration of a fuzzy logic and an artificial neural network (ANN). Genetic algorithm (GA) was employed as the learning algorithm to train the network, and makes the training of the model efficient. This model is a self-learning and self-adaptive system with a rule set revised by training.

Methods

Site and soil information

This study was performed in the Souma area between 44°35' to 44°40' east longitude and 37°50' to 37°55' north latitude, in the North-West of Iran (West Azerbaijan) which is close to Urmieh with different physiographical units of plain, alluvial plain, plateau and hill side. In the area with an approximately 4100 ha extension, slopes and elevation range from 2–10%, and 1200–1400 m above sea level, respectively. Graphical representation using a climate database package (De la Rosa *et al*. 1986) according to climate characteristics of the study area is shown in Figure 1.

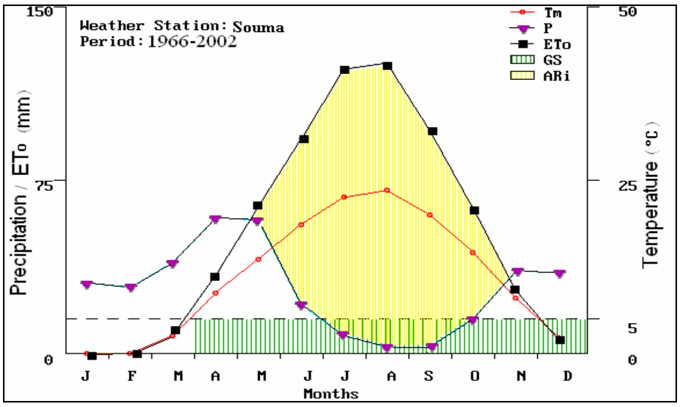


Figure1. Graphical representation of climate information for the Souma area, (Tm) mean temperature (P) mean annual precipitation (ETo) potential evapotranspiration calculated by the Torenthwaite method (GS) Growing season aridity index (ARi).

According to the morphological description, physical and chemical properties and USDA Soil Taxonomy (USDA 2006), the soils can be classified as: Typic Xerofluvents, Typic Calcixerepts, Fluventic Haploxerepts and Fluventic Endaquepts (Figure 2).

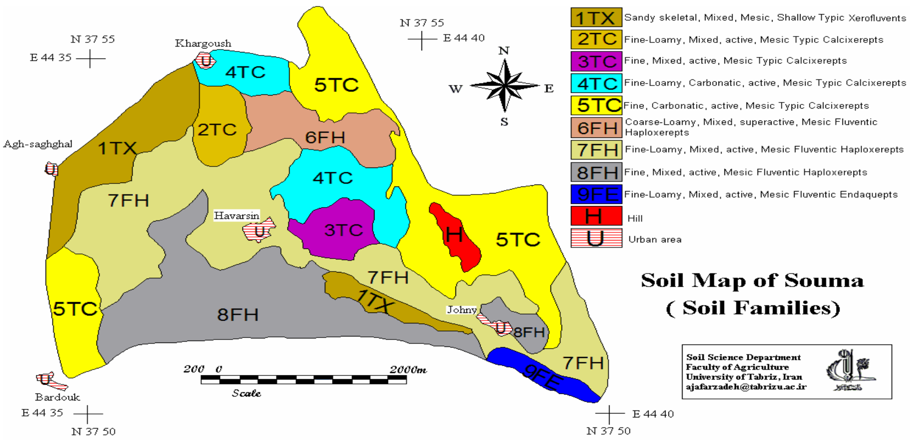


Figure 2. Soil Family Map of the study area

Useful depth, texture, drainage, carbonate, salinity, sodium saturation and profile development were selected as limitation factors for peach development. For perennial crops (peach), the soil section considered is between 0 and 100 cm in depth, or between 0.0 cm and the limit of useful depth when the latter is between 0.0 and 100 cm.

Almagra model

Within the new framework of MicroLEIS, the Almagra model fits the suitability of specific crops of which peach is one. The control or vertical section of soil for measuring texture, carbonates, salinity and sodium character was established by adapting the criteria developed for the differentiation of families and series in the Soil Taxonomy. It refers to between 0.0 and 100 cm in depth, or between 25 cm. and the limit of useful depth when the latter is between 0.0 and 100 cm, or in some part of the soil is within the useful depth for perennial crops e.g. peach (*Prunus Persica*). Five suitability classes optimum, highly, moderately, marginally and no suitability are represented an S1, S2, S3, S4 and S5 respectively. Once the land unit data have been entered, Almagra gives an on-screen evaluation based on the criterion of the maximum limitation and verification of the degree of a single variable is sufficient to classify the soil in the corresponding category. Suitability classes will be identified with attention to the land characteristics.

GIS spatialization the results

The soil survey maps, in a geographical database format correspond to polygon multi-factor maps, they represent the main source of basic data to expand land evaluation results in geographic areas. Also, additional basic information can be extracted from other soil survey related maps, such as the land use maps. The conversion of the different basic maps to the same geographical projection is a prerequisite to continue the spatial analysis procedure. Previously, several semi-automatic spatial studies were developed using several basic information maps (Bonneau 2002). To extract information from original maps to be used in the evaluation models, the original polygon maps (multi-factor covers) were converted into grid maps (single factor covers). This task was done automatically by ArcView which takes into account the needed input variables to apply to the particular evaluation using the Almagra model.

Results

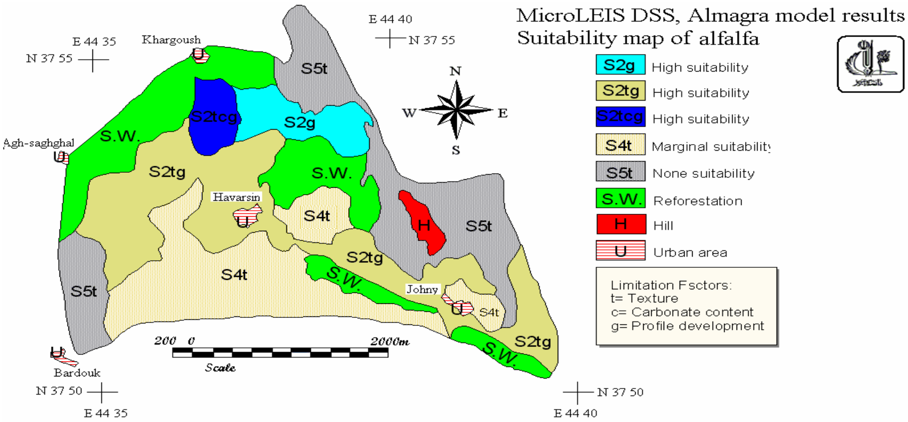
According to soil analysis data and applying the Almagra model (Table 1), soil texture, carbonate calcium, profile development and drainage are recognized as limitation factors for peach garden development. Limitation for the nine benchmark soil profiles are sand or gravel and permeable lime for 1319 ha and 2834 ha, respectively. The results showed that only 35.66% of the total area is classified as highly suitable land (S2) for peach trees with soil texture, profile development and calcium carbonate limitation factors. Only 22.1% of the total area was distinguished as a not suitable because of soil texture limitations (Figure 3)

Table 1. Summary of soil analysis data (0 – 100 cm) and suitability classification

Soil units	Ext. area (ha)	Lowest section of soil	depth (cm)	Stoniness (%)	Texture	Drainage	calcium Carbonate (%)	EC (dS/m)	ESP	Suitability classes
1	403	S/G*	100	55	SL	Well	1	0.27	1	##
2	126	P.L.**	130	18	L	Well	18	0.32	0.96	S2tcg
3	125	P.L.**	100	14	C	Moderate	27	0.25	1.2	S4t
4	343	P.L.**	120	10	CL	Well	45	0.28	1	##
5	916	S/G*	120	35	C	Well	35	0.26	0.94	S5t
6	223	P.L.**	100	2	L	Well	3	0.39	1	S2g
7	1132	P.L.**	120	5	CL	Well	3	0.4	1.11	S2tg
8	822	P.L.**	100	2	C	Moderate	6	0.27	1	S4t#
9	66	P.L.**	100	4	L	poor	5	0.38	0.91	##

Conclusion

The area covered with the "Fine, carbonatic, active, mesic, Typic Calcixerepts" soil family comprising total of 916 ha is the most unsuitable land for peach development which mainly occurs in the north-east of the study area. Besides 812 ha on marginal agricultural land, 947 ha of the total area, because of soil limitation factors is classified as marginally suitabile. Soils in the north of the Havarsin and Johny natural region are classified as highly suitable for peach development. To favour sustainable agricultural development of peach gardens it is recommended they be located in the highly suitable area which is revealed in the suitability map (Figure 3).



Figurer 3. Suitability map for peach garden in the Souma area

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