Identification Criteria For and Rank the Factors Affecting Climate and the Impact of Saffron in Ardebil

Seyed Mohammad Mahdi Torabi[1*] and Mohsen Azizi[2]

[1] PhD. Student of Agronomy, lslamic Azad University, Tabriz
[2] Masters Geography, Payam Noor University, Tehran, Iran

Abstract
This paper aims to identify the Criteria for affecting climate and to identify the rank of saffron and its impact assessment was conducted in Ardabil province. Methods - descriptive analysis based on data collected from weather stations and area of saffron in the region, in a period of ten years, using the deviation from optimal conditions, the gradient. Methods - descriptive analysis based on data collected from weather stations and area of saffron in the region, in a period of ten years, using the deviation from optimal conditions, the gradient. The results indicated that the temperature threshold phenological calendar saffron climate in the region Registration crops harvested in late September and mid-October and early November. Based on the analysis of deviations from optimal conditions in the study area between the station Ardabil Khalkhal station Deviation less than optimal conditions for planting have been better. Another parameter that plays an important role in phonological stages saffron rainfall amounts during growth That, in Ardabil province due to high rainfall and rainfall duration in line with the growth of saffron, saffron cultivation can be done in terms of rainfall in all its parts, But since the saffron water is needed during the growing season to 300 mm can be seen that the north of the The south and southeast move more robust in terms of rainfall for planting this plant there. saffron has its best and most growth in altitudes from 1300 to 2300 meter, and the basis for ranking the altitude factor is . Data show that That regions is very suitable for planting saffron height parts of the Central, East and South. In this part, to summarize the contents, only the map related to altitude classification has been presented based upon saffron requirement.
Key words: modeling, product performance, saffron, climate, Ardebil

Introduction

It is impossible to achieve economic growth and sustainable development without paying attention to the agricultural sector. This not only brings about self-sufficiency in producing foods and exporting them, but also reduces the migration of villagers to cities. To this end, application of principles and scientific methods to identify environmental capabilities and potentials of each region is essential. It means that depending on climatic and environmental conditions the crops to be cultivated are those which spurn economical development. Thus, agricultural researchers and experts of natural resources pay considerable attention to spatial planning and to do so, they identify and assess the ecological resources and their potentials using appropriate methods. Saffron (Crocus sativus L.) is a small, bulbous perennial crop with a growing period from fall to early spring, which makes it a popular crop in areas with limited water supply (Azizi-Zohan et al., 2004; Azizi-Zohan et al., 2008). Saffron is widely used in cooking to give natural color and flavor to food. It is also used for medical treatments in cases such as controlling fevers, melancholia enlargement of liver and catarrhal infections of children (Katayal, 1987; Heravi et al., 2010; Beygi et al., 2010). Saffron has also been used for dying textiles. The appreciation for saffron as a food additive continues today and it has become the world's highest priced spice (Winterhalter and Straubinger, 2000; de Juan et al., 2009, Athanasios et al., 2006). There is also a long tradition of saffron use in the traditional medicine of many cultures (Abdullaev, 1993; Ma et al., 2001; Giuliano et al., 2007; Molina et al., 2004). More recently, there has been increasing interest in the biological effects of the components of saffron and their potential medical applications, particularly those based on their cytotoxic, anti-carcinogenic and anti-tumor properties (Abdullaev and Frenkel, 1999; Ferna´ndez Pe´rez and Escribano Martı´nez,

(DOI: dx.doi.org/14.9831/1444-8939.2014/2-3/MAGNT.32)

2000; Molina et al., 2005). Due to its high economic value, saffron has a significant role in non-petroleum export of Iran and as an agricultural product which goes back to thousand years ago it is one of the most important products in which there is too much interest due to its being exportable and accordingly its being very profitable. This fact has made many researchers to try to recognize different aspects of cultivation, growth, and harvest of saffron agricultural product and pay attention to specialties of this invaluable plant from different points of view. So many people in the markets all over the world are interested in this product which is mostly produced in Razavi and South Khorasan provinces so that Iran is now considered to be the major exporter of good quality saffron in the world. According to the statistics presented by the ministry of agricultural jihad of Iran, from the 173.5 tons of saffron product produced in Iran in 1999, which is equal to 85% of the world product, 88 tons equal to 50% has been offered to the world's markets. Cultivation of saffron as the most expensive agricultural product in Iran which is the first producer of this product in the world, calls for the more attention to environmental factors and natural conditions. Ardabil province, due to its considerable area and its enjoying surface and underground water resources as well as varying natural conditions, has high potentials for agriculture and producing agricultural products. Therefore, recognition of natural potentials especially the climatic ones in Ardabil province are necessary for the purpose of developing the agricultural section. Since saffron is an economical product and it is a very important product in the world's markets, and also taking into account some potentials of Ardabil province in this regard, this research aims at: Studying the climatic and circumferential conditions of saffron cultivation in Ardabil province, determining the areas susceptible of saffron cultivation in Ardabil province with regard to climatic and circumferential potentials and conditions, using Geographical Information System (GIS) for determining the ecological power for development of saffron cultivation and contributing to stable development of the zone in the field of agriculture.

Materials and Methods

First, the climatic specifications of Ardabil Province were studied. Climatic conditions include daily temperature, rainfall, solar radiation data. Favorable saffron cultivation conditions were scrutinized. For this purpose, measures were taken for collecting basic data including the daily data of synoptic and climatological stations of Ardabil province, and using Excel software related possibilities were calculated. Due to unequal dates on which stations were established, the meteorological data used in this study has been obtained within an 10 year period (2003 to 2012) from the Iran meteorological organization.

Method of thermal coefficient or total degrees of active days.

Most biological changes such as the growth of plants and some hydrological phenomena are a function of the ambient temperature. For this purpose, the index of degree - days will be used as thermal need. Each process is activated from a certain temperature threshold, and the growth value depends on the number of degree - days more than this threshold. If the number of degree – days is zero or a negative value, that day would have no effect on growth. In order to grow in a specific area, each plant requires a certain number of degree-days that the area must be able to supply throughout the growth period. Otherwise, even if water is available in the area, the plant should not be recommended for planting in agricultural projects. Therefore, growth season in each area is defined as the longest continual period in which the number of degrees - days required to supply the plant is provided. To determine the thermal need of plants, method of the sum of effective temperatures is implemented. The principle of this method is to calculate the total summation of effective temperatures, i.e. temperatures above the base zero biological zero of a plant. This temperature depends on the type of the plant. 5C° for Saffron is calculated by the following equation.

$$H_U = \sum_{i}^{n} \left[\frac{T_M + T_m}{2} - T_t \right] \quad \text{Equation (1)}$$

(DOI: dx.doi.org/14.9831/1444-8939.2014/2-3/MAGNT.32)

H_U : Thermal unit (degree-days) accumulated in N days.

T_M : Maximum daily temperature

T_m : Minimum daily temperature

T_t : Base temperature

N: n= number of the days. According to the day temperature conditions and the five degree threshold in Ardabil.

Thermal Gradient Method

In order to study the relationship of temperature of study area with deviation from optimal condition in different altitudes or time optimal conditions, it was necessary to use the thermal gradient to obtain the temperature of altitude points where there was no station. To obtain the temperatures, the linear regression method was used. Using linear regression, coefficients of variation of temperature with altitude, were calculated for the months of the year and the whole year. Following equation was used to calculate the curve equation: (b+ ax= y)

In this equation, (y) the expected value (dependent variable), (x) the most important variable which predictions will be based on that (the independent variable), (a) constant coefficient known as intercept and (b) line slope or thermal gradient slope showing the thermal decrease with altitude.

Following equations are used to calculate a and b:

Eq (1)

$$a= \frac{\sum(y) \sum (X^2) - \sum(x) \sum (xy)}{N\sum X^2 - (\sum X)}$$

Eq (2)

$$b= \frac{N\sum XY - (\sum X) (\sum Y)}{N\sum X^2 - (\sum X^2)}$$

To achieve results and calculate the above equations, first, table of correlation elements for selected stations and time intervals was formed; that will be mentioned as the monthly and annual correlation elements of selected stations.

Case Saudy

The province of Ardabil covers an area of 17,881 km2 and lies in the northwestern parts of Iran. It is surrounded by the Republic of Azerbaijan on the north, and the provinces of Zanjan on the south, Eastern Azerbaijan on the west and Gilan on the east. The capital of this province is the city of Ardebil and its other major cities are Bileh Savar, Geirmi, Khalkhal, Meshginshahr and Pars Abad. Ardabil province is one of the colder provinces of Iran. There are highlands in most parts of the province which reduce the temperature, especially in autumn and winter. Ardebil has a moderate climate in summer. Moghan plain lies in the northern parts of this province and is low in altitude. So, it has warm summers but is moderate during the other seasons. The average annual rainfall in this region is about 500 mm. Khalkhal being mountainous, the temperature in this area is low and it has cold winters. The annual rainfall in Khalkhal is 400-450 mm. Meshginshahr in the central parts of the province has cold and long winters, and its average annual rainfall is 300 mm. Because of high altitudes and severe cold, the temperature in most parts of this province is below 0°C during six months of the year. The temperature at higher altitudes falls at times to -30°C.

Figure 1

Results and Discussion

Assessment of environmental conditions and climatic parameters affective saffron cultivation in Ardabil.

Altitude

Altitude is one of the most significant factors in agriculture for crop cultivation. This factor affects amount and type of rainfall, temperature, rate and quality of soil. saffron has its best and most growth in altitudes from 1300 to 2300 meter, and the basis for ranking the altitude factor is as presented in Table 1. Data show that That regions is very suitable for planting saffron height parts of the Central, East and South. In this part, to summarize the contents, only the map related to altitude classification has been presented based upon saffron requirement (Figure 2).

Table 1

(DOI: dx.doi.org/14.9831/1444-8939.2014/2-3/MAGNT.32)

Figure 2

Rainfall component

Saffron is another parameter that plays an important role in phonological stages during the growing season rainfall amounts that, in Ardebil Due to the high rainfall and rainfall duration in line with the growth of saffron, saffron cultivation in the rain It was all over, but since the saffron water needs during the growing season to 300 mm can be seen And as we move from north to south and southeast of the more favorable conditions for the cultivation of the plant there will be rain. According to latitude and topography of Ardabil province, the amount of rainfall differs in different parts of the province. In this province, the maximum annual rainfall is related to Khalkhal and Meshkin Shahr stations. According to these specifications, the rate of rainfall in these stations is higher than other stations due to their high altitude. The least rainfall in Ardabil province is related to Pars Abad station. This station has been located in the northern part of the Ardabil province province. Due to its low latitude as well as semi-low altitude, the amount of rainfall is the least in comparison to other stations In the next step, classification of rain in regard to saffron product has been offered in Table 2. Figure 3 presents the classification of rainfall in Ardabil province based upon saffron requirement.

Figure 3
Table 2

Degree- day factor in Ardabil Province

One of the significant and basic factors in growth and cultivation of products in different zones is the degree- day factor. This issue is so important that even if there is enough water in the place but it can not provide the degree-day required for the plant growth, the considered plant is not recommended to be cultivated in that place.In every region, growth season is the one with the longest duration in which the number of degree-day required by the plant is provided (Shakoor, et al., 2010; Canavar et al., 2010; Balta1 et al., 2010). To determine the heating need of the crops the total effective temperature degree method may be used, the basis of which is to sum up the effective temperature degrees which means the temperature degrees above the physiologic zero or the basic zero, and this temperature depends on the plant type (Jamshidi, 2009). the level of energy required for saffron plant is provided in this province, and there is no limitation in the province in this regard. In fact, according to the basic temperature for saffron which is five degree centigrade, the dates of four hundred and sixteen degree-day in stations of Ardabil province are presented in Table 3.

Table 3

Areas suitable for cultivation Saffron thermal gradient method

Based on the analysis of climatic factors for the cultivation of Saffron, and agro-climatic conditions according to mentioned methods, favorable and unfavorable areas for a variety of Saffron cultivation in different months of study area are as follows. Early September is the best time for sowing of Saffron in Ardabil province. According to figure (2), suitable areas for Saffron cultivation in this province regions is very suitable for planting saffron height parts of the Central, East and South.

Results

Crops for growth and phenological development requires appropriate environmental conditions, air, water and soil are. Favorable conditions for the development of a variety of different plant species in the world. Agriculture climate classification model is applied to study the wide range of possibilities is required. In this method, according to the statistics of long-term climatic parameters affecting the growth and development of products in terms of minimum and maximum temperatures, rainfall and relative humidity And then classified with regard to product requirements such as thermal thresholds, During growth and water requirement zone and appropriate culture conditions specific product specified. Results indicated that the temperature threshold phenological calendar saffron climatic history of the region to harvest crops in late September and mid-October and November respectively. saffron has its best and most growth in altitudes from 1300 to 2300 meter, and the basis for

(DOI: dx.doi.org/14.9831/1444-8939.2014/2-3/MAGNT.32)

ranking the altitude factor is . Data show that That regions is very suitable for planting saffron height parts of the Central, East and South.

References

1- Abdullaev FI, 1993. Biological effects of saffron. Biofactors. 4: 83-86.
2- Abdullaev FI, Frenkel GD, 1999. Saffron in biological and medical research. In: Negbi, M. (Ed.), Saffron:Crocus sativus L.. Harwood Academic Publishers, Australia. pp. 103-114.
3- Antonio F, 2006. Anticancer properties of saffron, Crocus sativus Linn. Adv. Phytomed. 2: 313-330.
4- Athanasios S, Tsaftaris A, Polidoros N, Konstantinos P, Apostolos K, 2006.Tepal formation and expression pattern of B-class paleoAP3-like MADS-box genes in crocus (Crocus sativus L.). Plant Sci. 170(2): 238-246.
5- Azizi-Zohan AA, Kamgar-Haghighi AA, Sepaskhah AR, 2004. Investigation on water requirement, irrigation method and frequency of saffron (Crocus sativus L.). Proceedings, Sept. Leuven, Belgium, 2004, pp. 12-16.
6- Azizi-Zohan AA, Kamgar-Haghighi AR, Sepaskhah, 2008. Crop and pan coefficients for saffron in a semiarid region of Iran. J Arid Environ. 72(3): 270-278.
7- Balta I, Ha_met Ca_ırgan F, 2010. Oxytetracycline residues in cultured gilthead sea bream(Sparus aurata L. 1758) tissues. Afr. J. Biotechnol. 9(42): 7192-7196.
8- Canavar O, Ali Kaynak MA, 2010. Growing degree day and sunshine radiation effects on peanut pod yield and growth. Afri. J. Biotechnol. 9(15): 2234-2241.
9- Deng H, 1999. Multicriteria analysis with fuzzy pairwise comparisons. Int. J. Approximate Reasoning. 21: 215-231.
10- Erensal YC, Kebeck S, Lorenzo S, 2006. Determining key capabilities in technology management using fuzzy analytic hierarchy process: a case study of Turkey. Information Sciences. 176(18): 2755-2770.
11- Ferna´ndez Pe´rez JA, Escribano Martı´nez J, 2000. Biotecnologı´a del azafra´n. Ediciones de la Universidad de 12- Castilla-La Mancha, Cuenca. Geographical Information Science, August, 2005. Stockholm, Sweden, p 75-87.
13- Giuliano F, Michele M, Claudio P, Fernando T, 2007. Allozyme differentiation in four species of the Crocus cartwrightianus group and in cultivated saffron (Crocus sativus) Biochemical Systematics and Ecology. 35(12): 859-868.
14- Hansen H.S, 2005. GIS-Based Multi-Criteria Analysis of Wind Farm Development. In: Hauska, H. &Tveite, H. (Eds.): ScanGIS'2005. 10th Scandinavian Research Conference on geographical information technology environment in Giroft. Iranian J. Environ. Health Sci. Eng. 3(3): 177-184.
15- Javaheri H, Nasrabadi T, Jafarian MH, Rowshan GR, Khoshnam H, 2006. Site selection of municipal solid waste landfills using analytical hierarchy process method in Giroft. Iranian J. Environ. Health Sci. Eng. 3(3): 177-184.
16- Kahraman C, Cebeci U, Ulukan Z, Tamin AR, 2003. Multi-criteria supplier selection using fuzzy AHP. Logistics Information Management. 16(6): 382-394.
17- Katayal SL, 1987. Saffron cultivates well in hill areas. Indian Horticult. 11(3): 24-27.
18- Mikhailov L, Tsvetinov P, 2004. Evaluation of services using a fuzzy analytic hierarchy process. Applied Soft Computing 5: 23-33.
19- Molina M, Valero Y, Navarro I, Guardiola JL, Garcı´a-Lui A, 2005. Temperature effects on flower formation in saffron(Crocus sativus L.). R.V. Sci. Horticult. 103: 361-379.
20- Molina RV, Valero M, Navarro Y, Garcia-Luis A, Guardiola JL, 2004. The effect of time of corm lifting and duration of incubation at inductive temperature on flowering in the saffron plant (Crocus sativus L.). Sci. Horticult. 103(1): 79-91.
21- Molina RV, Valero M, Navarro Y, Guardiola JL, Garcia-Luis A, 2005. Temperature effects on flower formation in saffron (Crocus sativus L.). Sci. Horticult. 103(3): 361-379.
22- Ørjan T, Matthews I, 1998. Determinants of pollinator activity and flower preference in the early spring blooming Crocus vernus Acta Oecologica. 19(2): 155-165.
23- Shakoor A, Roshan GhR, Najafi Kani A, 2010. Evaluating climatic potential for palm cultivation in Iran with emphasis on degree-day index. African J. Agric. Res. 5(13): 1616-1626.
24- Winterhalter P, Straubinger M, 2000. Saffron: Renewed interest in an ancient spice. Food Rev. Int. 16: 39-59.

(DOI: dx.doi.org/14.9831/1444-8939.2014/2-3/MAGNT.32)

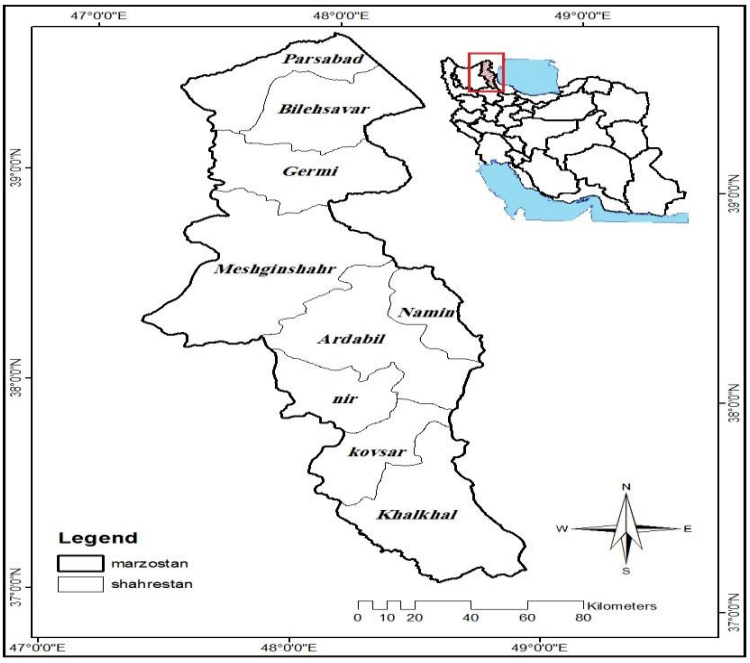

Figure 1, Study area

Table 1. Classification of altitude factor based on saffron requirement.

Classification	Altitude
Inappropriate	Over 2300
Totally appropriate	1300 to 2300
Appropriate	Below 1300

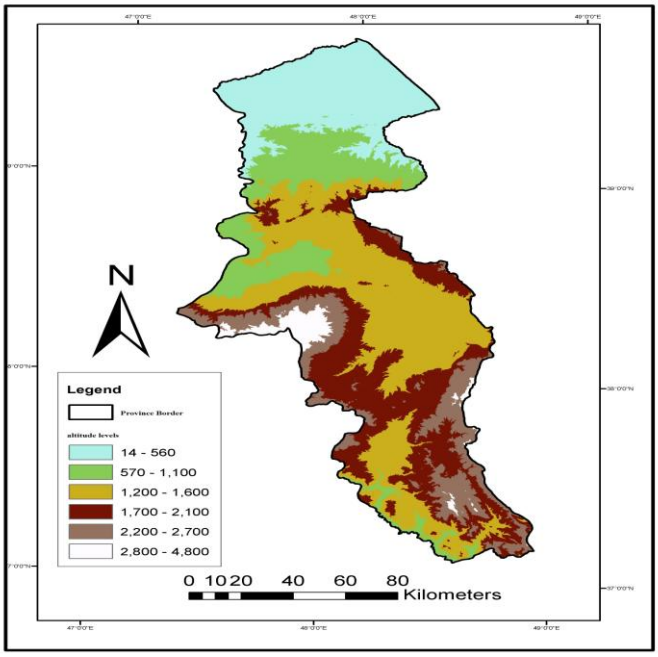

Figure 2. Classification of altitude levels of Ardabil province based on saffron requirement

(DOI: dx.doi.org/14.9831/1444-8939.2014/2-3/MAGNT.32)

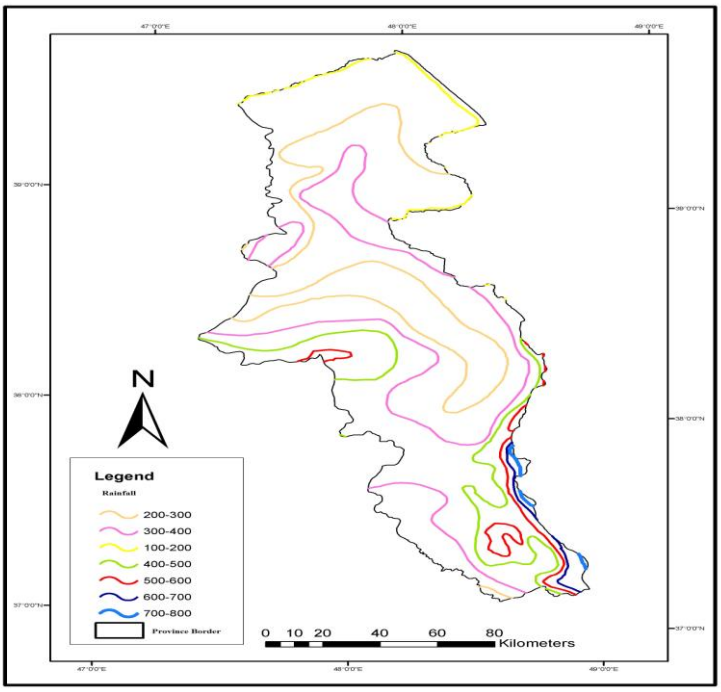

Figure 3 presents the classification of rainfall in Ardabil province based upon saffron requirement

Table 2. Classification of rainfall based upon saffron requirement**.**

Classification	**Amount of rainfall (mm)**
Good	**Over 300**
Intermediate	**250 to 300**
Low	**Below 250**

Table (3) the date of completion of the phenological stages of saffron

Perfect achieve	Minimum threshold	Height	**Station**
22 October	14 September	1485	Meshkinshahr
20 October	8 September	1365	Ardebil
11 October	15 September	75	Pars Abad
10 October	10 September	1806	Khalkhal

(DOI: dx.doi.org/14.9831/1444-8939.2014/2-3/MAGNT.32)