



## **Feasibility of Olive Cultivation based on Climatic Parameters by GIS in Buyerahmad town**

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### **ABSTRACT**

*As production of better and more food is one of the important issues of the current world and as production of products and agriculture capability in each region depends upon the weather and climatic features, the study of climatic elements and factors on agriculture is of great importance. This study applied climatic parameters for good locating of olive tree cultivation including the following elements: the total annual raining, olive growth day degree (GDD), relative humidity, sunny hours, annual temperature, minimum cold temperature. By using growing needs and influence and expert investigations (climatic conditions) of olive cultivation, information layers, classification and weight value of each of zones is defined. The final results of the study showed that the role of each of effective factors on olive cultivation was different and five climatic elements of annual raining, growth day-degree, annual temperature and minimum temperature of the coldest month of year (January) and relative humidity based on the expert weighting and scientific resources in olive tree cultivation are more effective and show more capabilities.*

**Keywords:** Locating, Climatic parameters, Buyer Ahmad, Olive cultivation, GIS

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### **INTRODUCTION**

Although climate is referred to the general and stable condition of the weather of a region and it has relative stability, this stability is true in short-term processes and it is not valid in long-term [1]. The nature of climate is varied observed in various regions of world [2]. Among the climatic elements, temperature and raining have high fluctuations. In low latitude with strong radiation, the temperature fluctuation is low and in mild and high latitude, there are high annual temperature fluctuations. Also, raining in various regions of world has high fluctuations [3].

As climate is effective on distribution of agriculture regions and climatic fluctuations have short fluctuations, the climatic elements duration (temperature and raining) is in a short-term period. Thus, these fluctuations can be effective on nature, namely agriculture fields and their distribution method [4]. The growth and development of agriculture fields and the quality of products are related with these elements [5]. Totally, agriculture fields and quality of products are analyzed in close relation with climate [6]. The maps of agriculture communities' distribution are consistent with the main climatic lines of region [7]. In Iran, the changes of fields and agriculture products are under the influence of tangible climatic fluctuations. It should be said Iran is varied land from climatic issues. According to the studies in Iran, for example in southern regions of the country, the high raining fluctuations is observed and these fluctuations are effective on quality of agriculture products and the dispersion of the fields of various regions [8]. As there are changes in quantitative parameters as frequency, combination and structure and distribution of fields and agriculture products based on Abiotic factors (e.g. raining and other climatic elements), the determination of climatic parameters and identification of relevant regions is important in decision making in agriculture [2].

The topography conditions on town caused that it is divided into two regions from climatic issues (cold area with humid and cold weather and hot area with hot and dry weather). This town is located in dryness belt and is encountered with drought continually [9]. olive is one of the products adapting with mild and mountainous climates. Also it is used in food and industry industries [10]. Olive with scientific

name *Olea europaea* belongs to *Oleaceae* family. Due to its high adaptation with environmental conditions, olive tree can growth in various types of soils and it is highly tolerant to salinity and drought and it can product acceptable product in climates consistent with the cultivation of this product. Also, olive can be cultivated under specific conditions of topography (steep and mountainous areas) not suitable to cultivate other oil seeds. All these unique features caused that live cultivation is considered as a strategic product. Thus, the locating and feasibility of cultivation to recognize and separate suitable cultivation areas of unsuitable regions is unavoidable issue [11].

Boyer Ahmad town is considered as agriculture and husbandry region from economic aspects. Thus, any planning in agriculture industry can help the regional economy of town. The present study attempted to evaluate the feasibility of olive cultivation by GIS in Boyerahmad town in Kohkiloye and Boyer Ahmad.

## STUDY HYPOTHESES

It seems Boyerahmad town is suitable for cultivation of olive from climatic issues.

## STUDY METHOD

This study is fundamental-development, causal and ex post facto and it is an applied study with combination of document and descriptive (analytic) method. In descriptive method, at first we collect data, then by the data and quantitative methods and GIS tool, we can evaluate the feasibility of olive cultivation in Boyer Ahmad town one of the regions of Kohkiluye and Boyerahmad province. These data of this study are including as: a) Spatial data, b) Descriptive data, c) Topography maps, d) Applied software Arc GIS-SPSS-Excel

### The geography location of the studied region

In this study, Boyerahmad town is used as study area. Boyerahmad town is one of the towns of Kohkiluye and Boyer Ahmad province in the east of this province. This town is bounded from north to Isfahan, from east to Fars province, from west to Kohkiloye and Dehdasht town and from south to Norabad town from Fars province. The center of this town is Yasuj and is located in longitude 51°, 36' eastern and latitude 30°, 28' northern.

## RESULT

In this study, by regression method, the data are reconstructed and the data normalization is evaluated by Anderson-Darling, Rayan and Joiner test and their homogeneity is investigated by Chi-square test.

### The zoning and weighting layer growth days-degree

Temperature is one of the important factors in cultivation plants geography. A definite area is defined for any plant. Temperature is of great importance in each of growth stages but there are some stages that are of great importance due to the sensitivity of plant to climate changes. To achieve the date of full ripening of olive tree, growth day-degree (GDD) is used. Generally, the sum of positive temperature is from the beginning of spring to olive product harvest as 5300 degree-day [12]. It can be said this growth days-degree based on biological zero (-7°C) as evaluated in the above issue from the early spring to the harvest of olive product as 5300 degree-day growth. Based on images 1, 2, the results show the suitable temperatures in southern, southeast, southwest with the area more than 49.67% equal to 152335 hectare. The region less important are in northern section of town covering about 0.45% (14058 hectare) and is ignorable in this regard (Table 1).

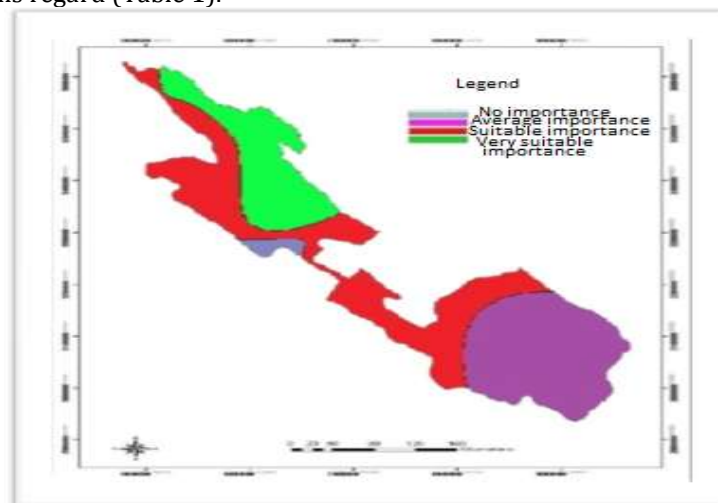


Figure 1- The zoning of density degree in Boyerahmad town, Source: Author

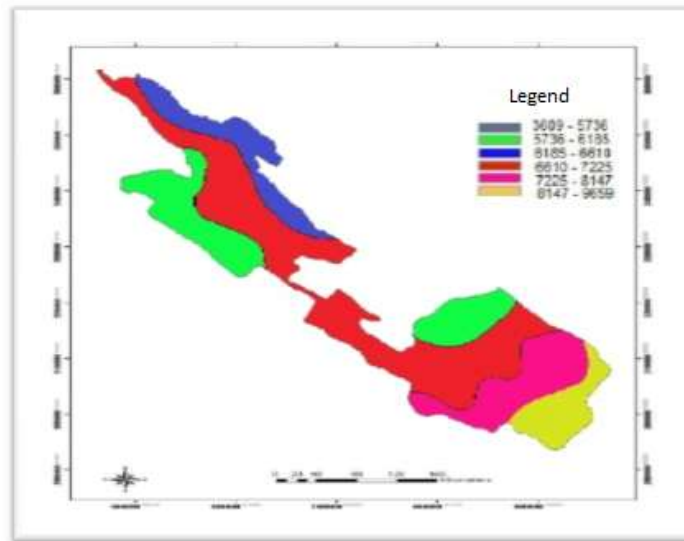


Figure 2- Weighting of density degree in Buyer Ahmad town, source: Author

Table 1- Group features of density temperature (degree-day) and their weights

| Growth day-degree | Weight value | Capability description | Hectare | Area (%) |
|-------------------|--------------|------------------------|---------|----------|
| <4000             | 1            | Unsuitable             | 14058   | 0.45     |
| 4000-5000         | 3            | Average                | 239316  | 7.80     |
| 5500-6000         | 5            | Suitable               | 1289664 | 42.051   |
| 6500>             | 7            | Very suitable          | 152335  | 49.67    |

**Zoning layer and weighting of annual temperature**

Temperature is one of the effective factors in olive product cultivation. The most suitable temperature is the annual temperature ranging 16 to 22°C[13]. Based on 16-22 °C in geographical information system, weighting is started and temperatures above 22 are considered as weight value 7(very suitable). By a review of images 3, 4, layers of annual temperature, we can say the southern sections have very suitable conditions in terms of olive cultivation.

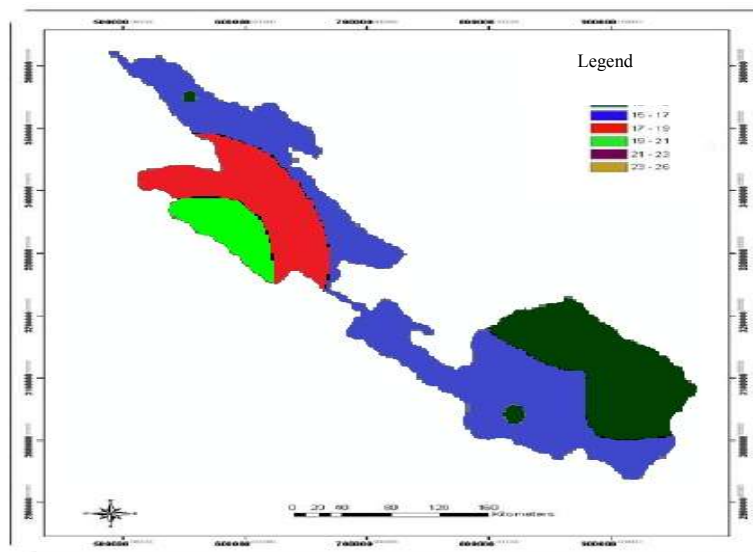


Figure 3- Weighting of annual temperature in Buyer Ahmad town, source: author

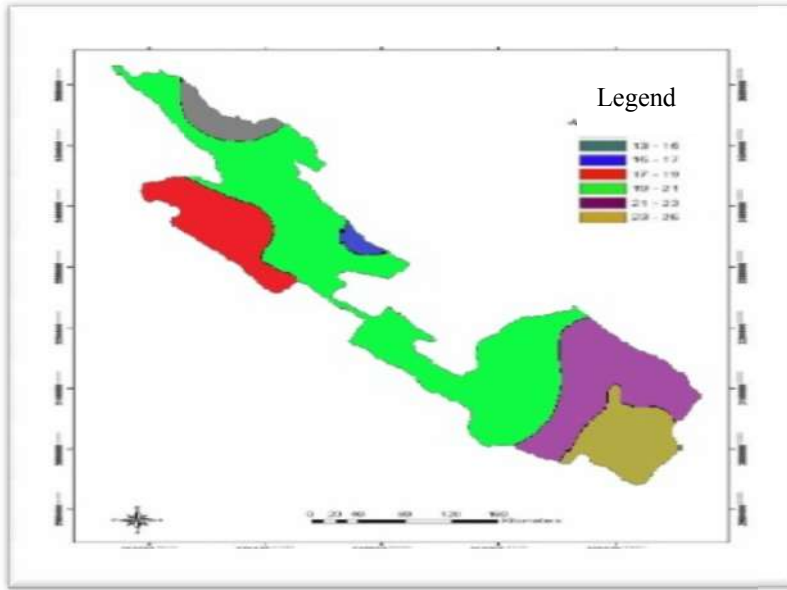


Figure 4- Zoning of annual temperature in Buyerhamad town, Source: Author  
 Table 2- The group features of annual temperature and their weights

| Annual temperature | Weight value | Capability description | Hectare | Area (%) |
|--------------------|--------------|------------------------|---------|----------|
| <16                | 1            | Unsuitable             | 315221  | 10.27    |
| 16-18              | 3            | Average                | 178866  | 5.83     |
| 18-20              | 5            | Suitable               | 552464  | 18.01    |
| 20>                | 7            | Very suitable          | 2019897 | 65.87    |

**Zoning layer and weighting of minimum annual temperature (Jan)**

As olive tree is sensitive to the temperature below -7°C, it leads to freezing and destruction of tree. Thus, the coldest month of year temperature shouldn't be less than -7°C, [12]. (Figures 5. 6). Based on the maps extracted from minimum temperature, western parts and some parts of south have very suitable condition as dispersed in Buyerahmad.

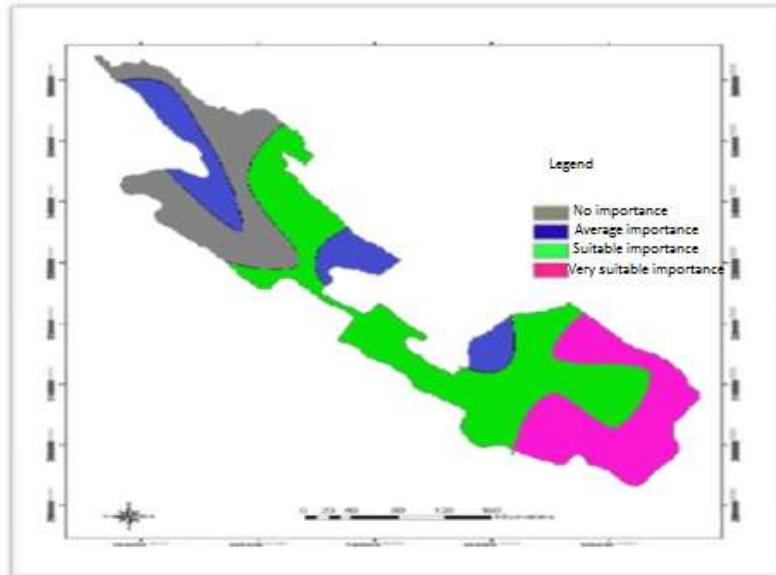


Figure 5- Weighting of minimum temperature (Jan) in Buyer Ahmad town, source: Author

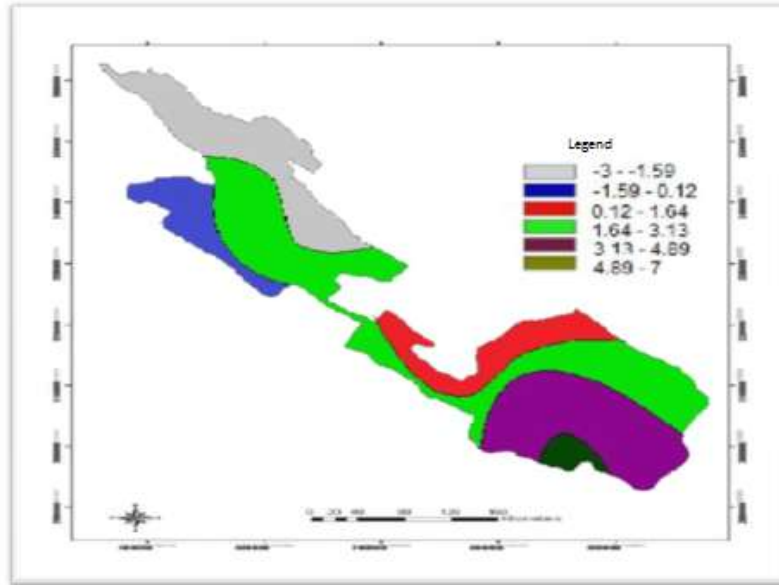


Figure 6- Zoning of minimum temperature (Jan) in Buyerahmad town, source: Author

Table 3- The group features of minimum temperature (Jan) and their weights

| Minimum temperature (Jan) | Weight value | Capability description | Hectare | Area (%) |
|---------------------------|--------------|------------------------|---------|----------|
| -3 to -7                  | 1            | Unsuitable             | 582970  | 19.01    |
| 0-4                       | 3            | Average                | 922995  | 30.1     |
| 0-4                       | 5            | Suitable               | 738267  | 24       |
| 4>                        | 7            | Very suitable          | 822217  | 26.81    |

**Zoning layer and writhing of relative humidity**

To draw the dispersion map of relative humidity in Arc/GIS, annual relative humidity statistics of the stations inside the province by 17-year statistics is used. The suitable humidity for olive cultivation is ranging 50-60% [10](Figures 7, 8) show zoning and weighting of relative humidity of region. Table 3 shows the features of relative humidity and their weight value. Based on the map and table (0.98)% and equal (302175 hectare) of area is very suitable, about 26.36% suitable and average areas are 72.22% (2214616hectare) covering relatively high zoning of Buyerahmad.

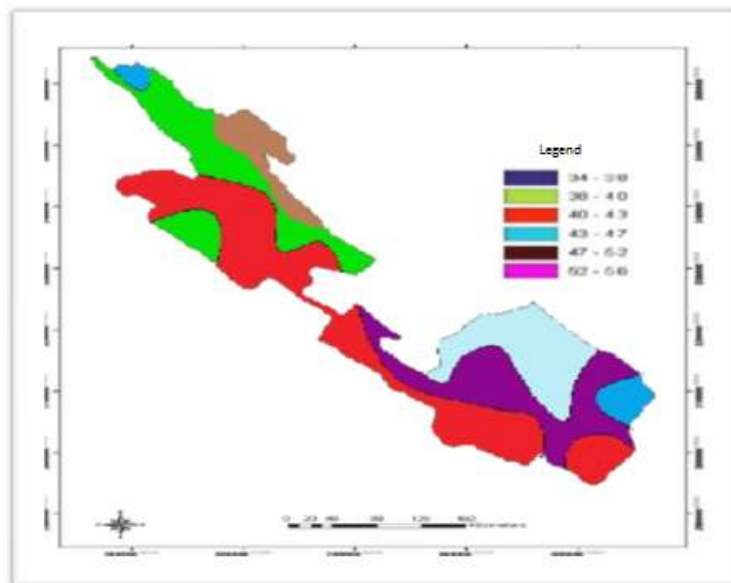


Figure 7- Zoning of relative humidity in Buyerahmad town, Source: Author

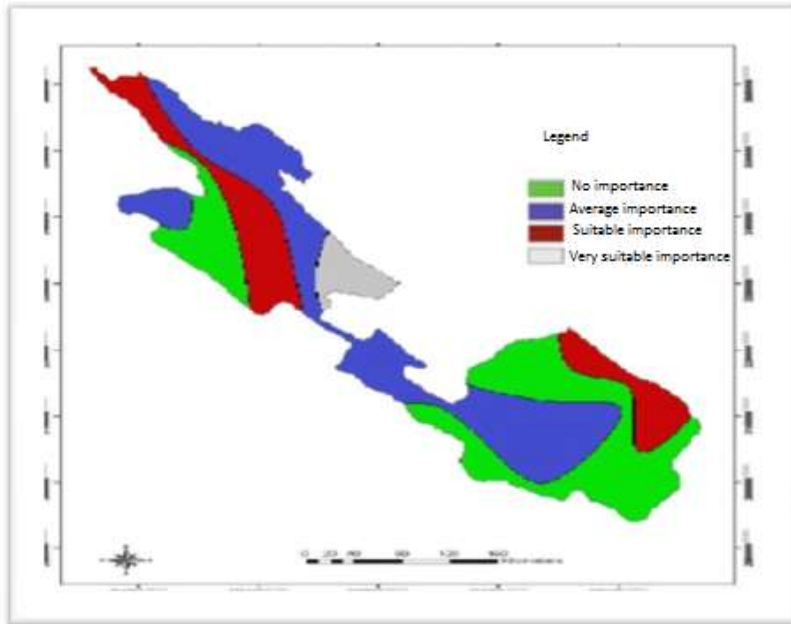


Figure 8- Weighting of relative humidity in Buyerahmad town, source: Author

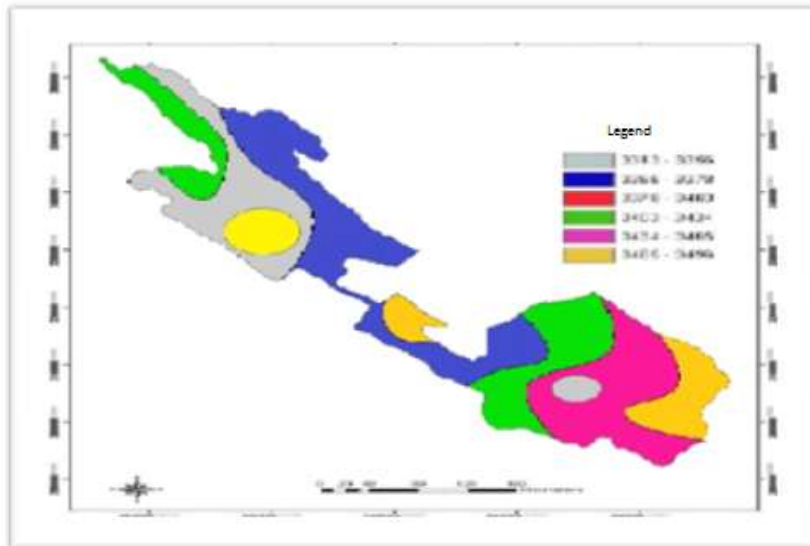


Figure 9- Zoning of sunny hours in Buyerahmad town, source: Author

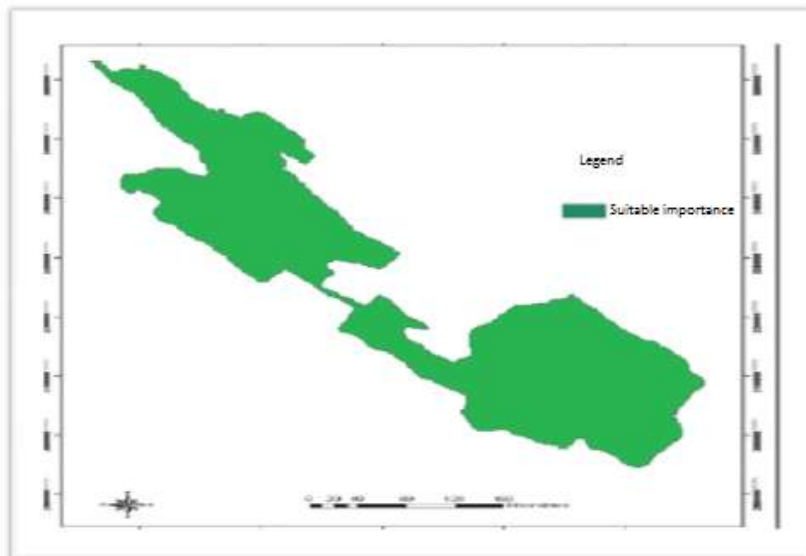


Figure 10- Weighting of sunny hours in Buyerahmad town, source: Author

Table 4- Group features of sunny hours and their weights

| Sunny hours | Weight value | Capability description | Hectare | Area (%) |
|-------------|--------------|------------------------|---------|----------|
| 1500>       | 5            | Suitable               | 314198  | 100      |

### HYPOTHESIS TEST

1- Buyerahmad town is suitable for olive cultivation from climatic aspects.

After data collection and providing required maps and making their numerical (effective factors on olive growth) and using a suitable method (GIS) for analysis and based on the climate variety of Buyerahmad town and the land capability of the studied town (Buyerahmad), the result showed that the regions mostly based on agriculture in town are suitable for olive cultivation and dividing it to some groups.

First group is the regions suitable for olive cultivation including some parts of the studied region. This group is mostly based on agriculture regions of town and in case of providing cultivation water, there is no major limitation for olive cultivation.

The second group is the regions with relatively suitable conditions for olive cultivation and includes mountainous plains located in the north and south of town. The major environmental limitation in these regions is land gradient and type of soil and second climatic limitation namely coldness factor in growing and generative stages.

Third group includes the zones of town without required conditions for olive cultivation. Based on the results of spatial analysis, various factors lead to the unsuitable factors of these regions. In the high mountainous areas located in the northern and southern area of province, the major environmental limitation is due to steep, high height and cold weather and the lack of suitable soil. The regions located in central and east regions of the studied area and surrounding areas have other problems. In these sections, various factors include bad climate condition, limitation of the soil resources namely development of saline areas and etc. for olive cultivation.

Although some climatic barriers can avoid good olive cultivation, by good management, this problem is eliminated.

Based on the fact that in Tunisia, with raining 150mm, non-raining olive is planted. Thus, Iran with raining mean 275mm can grow olive in most areas, even 60% of olive gardens can be cultivated as non-raining that underground water is not used and soil coverage is kept and 75% of olive gardens are cultivated non-rain.

### DISCUSSION AND CONCLUSION

Agriculture is one of the main issues in economic development of the country. Now, more than 0.25 of employment, more than 0.80 of economic needs, 0.35 of non-oil export and 0.90 of industries needs are supplied via agriculture activities [14]. Based on the close relationship between agriculture and weather, without considering climatic conditions, optimal cultivation of agriculture products is not possible.

The agriclimate zoning and identification are the priorities of agriculture planning. The requirement of such development is recognizing effective factors. Climatic factors (raining, temperature, humidity and climatic conditions). In this study by climatic parameters, we can evaluate the feasibility of suitable regions of olive cultivation in Buyerahmad town. At first, based on the scientific sources and the views of experts regarding olive cultivation and suitable products from climatic-land conditions, suitable score is given to climatic elements of annual raining, growth days-degree, annual temperature and minimum temperature of the coldest month of year (Jan). Thus, the percent of participation of effective layers in annual pairwise comparison matrix in locating process is 27.29% annual raining, 21.41% growth days-degree, 16.69% annual temperature and 12.30% about the temperature of minimum coldest month of year (Jan) as the most important information layers in AHP weighting model. The results of study showed that the places that can be uniform from climatic issues and studies regarding locating for combination of climatic and land maps in GIS show the suitable spatial relation from the other climatic elements. Based on the combination of the maps of climatic parameters of west and northwest, some areas of southern and northern are very suitable for cultivation. Some parts of southwest can be economical in this regard. The northern and northeast areas are not suitable for olive tree cultivation and good products.

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