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RESEARCH ARTICLE

Zoning evaluation of Eco-Touristic potentials of bio-climatic comfortability in the province of Fars, using Geographical information system (GIS)

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Abstract

Ecological conditions are important factors in development of tourism in each geographic region. Using Mieczkowski's touristic climate index (TCI) in this research, potentials of touristic climate and ecology in the extent of Fars province are evaluated. For this purpose, climatic data from nine synoptic stations in the province are applied. Then preliminary analyses are carried out in the environment of statistic software, using seven models – related climatic elements. Next, values of TCI for cities of province are extracted, using relations of Mieczkowski's model. Eventually, values of TCI are extended to the extent of province by averaging, based on inverse distance weighted (IDW) and maps of extent separation are provided on monthly scales for the province. The results show that in winter season, southern and eastern parts of province including "Larestan", "Lamerd", "Nairiz" and "Darab possess more desirable conditions than other parts of province. In spring, in contrast to winter season, northern parts including "Abade", "Oghlid", "Ardakan", "Shiraz" safashahr and "Noor a bud" have better conditions than other parts. In summer, only in eastern parts, the cities of "oghlid" and "Estahbun" have proper conditions ecotouristically. In other parts, no desirable condition was obsereved. In fall season, cities of "Oghlid", "Ardakan" and "Shiraz", in first month of fall (Mehr), eastern parts in seond month (Aban), and "Lar" city of southern part in third month (Azar) have proper conditions for tourism. Finally, conditions of touristic climate were analyzed by cluster method, based on different logics for studied province. Three clusters were identified.

Introduction:

One of strategies which have been paid attention in most countries of world, is development of tourism in deprived regions that possess necessary potentials for advancing this industry (Ghaderi, 1996). Job creation and development are some of advantages this industry can provide (Shafizade, 1996). Regarding environmental diversity and existing relative advantages, tourism is diversity creating part of economy (Lee Jhon, 1999). Although, in past time, tourism was considered as a social subject, It should be acknowledged that in present time, It is viewed more economically which contributes to a considerable share in national in com (Ramesht etal., 1999). The statistics world organization of tourism provides, show considerable impact of tourism on economic system. Income resulted from international tourism in 1998 constitutes more than 8% of total income of international exports and 37% of exports revenues in service providing section. Considering the 4 to 5% growth in 1990, the experts anticipate that if

growth of tourism continues at this pace, the revenues resulted from this industry will reach 1055Trillions, and the number of tourists will be more than one billion in 2010 (Farzane, 2001). The studies show that touristic industry in the world is ranked third in the most profitable industries after oil and automobile. Based on statistics, annually 3.5 billions trips are made from which 700 millions are cross-country and 2billions and 800 millions are in – country travels. Form international travels, Iran's Share is one million and 500.000, that is, about 0.2% of world share (Poorkazemiet al., 2006). Considering the fact that tourism needs use of different data and information from different parts, increasingly advanced information technology should be used for its development (Connelland Reynolds, 1999: SOI). Major capabilities of tourism such as progress of various kinds of services, creation of job opportunities, development of infrastructures are the main reason why this industry should be paid the most attention.

Along with growth of tourism, demand for environmental trips, especially ecosystem and its related branch has increased. (Miras Aria, 2009). Undoubtedly, climate and ecology are important factors in the development of tourism in each geographic region. A lot of regions that possess proper infrastructures for development of tourism, have faced failure because of lake of desirable climatic conditions. One of necessary considerations for tourists is climatic conditions in the place of destination. Most tourists pays attention to comfortability and relaxation. And it is a factor which plays a vital role in decision – making about selection of travel destination (sarisarrafet al., 2000). Consideration to climatic conditions in a region is very important in sustainable tourism in order to make plans appropriate to it. Plan – making for using the conditions resulted from bio-diversity by touristiclass a close relation to climatic situations of region. Identification of proper time for attendance of tourists an region, consideration to temperatural changes, seasonal winds and rainfalls and storms are some of those factors which are very important in achieving the goals of sustainable tourism. So far, many efforts have been made in order to initiate empirical indices for evaluating the degree of ecological and climatic comfortability for human. Hoo and Richi (1992) considers the climate as a key driver for tourism and for identifying the main destination of tourism. Goomes martin (2005) knows the climate as a facilitating factor in joyful touristic activities.

Back ground of Research

Limited researches have been carried out in country on the effect of climate and ecology on tourism, however, on international level, many works have been done. DeFrituss (2003) has addressed the relation of ecology and tourism unde the title of eco-tourism. In his study, he states that most ecological parameters in tourism are considered as standard data. He concludes that ecology can be a linking factor between tourist and tourism.

De Fritass (2008), in an article under the title of second generation of climate, says that evaluation of climatic indices improves the industry of tourism. He shows how important is the climate as a tool in different Industries including tourism. Finally stated that other climatic indices which relate to the factor of temperature have a determining role in attraction of tourist. In a study on "the relation of climate and tourism in Bermay" Haillton states that their study is first step in liking local and global aspects about the effects of climatic changes on industry of tourism. Hesimulated national touristic economy and international touristic streams among 207 countries. He finally stated that English, Irish and German speaking countries altogether constitute 25% of international touristic market, however that value is declining how because of climatic changes in this Industry. "Lohaman" and Kayem (1999) as well as scot and Lemyox (2009) consider the climate as one of the main motives for tourists in increasing the demand of tourism in such countries as German, England and Canada Scott and Mcboy (2009) have estimated touristic climate indexes (TCI) in 17 cities of northern states of America. They showed their results by means of seasonal figures for each cities. Ghiabko (2001), Zulfaghari (2007), Mohammadi and saeedi (2008), Nazemussadat and Majooni (2008), Farajzade (2009) and sari sarraf (2010) have worked about evaluation of bio-ecology. Extent-evaluation of Iranُs bio-ecology was studied by "kaviani" (1993), In the field of use of GIS in eco-touristic extent-separation, research have been carried out by Do vand et al (2002), Fung Merissonet al (2002), Bokina et al (2002), Banerji et al (2002) nadJlaksi (2003), and in the countryby Dr.Farayzadeh (2009),this article aims to evaluate and separate Fars province touristic climate using TCI (Touristic climate index) and GIS (Geographic information system). With a systematic sight, this index can determine the effects of ecological elements on touristic activities.

The region under study

Fars province has an area about 122608 km^2. According to census of 2006, itsُ Population is 4,336,878 persons, from which, 1, 227,331 people live in itsُ capital city of "Shiraz". Fars province is located in southern Iran, between axis of 27 and 31 degrees of northern latitude and meridians of 50 and 50 degrees of eastern longitude. On the north, this province neighbors Esfahan province, on eastern north, it neighbors Yazd province, on east with Kerman, on western north with KohgoloyewaBoirAhmad province, on the west with Booshehr and on the south it neigh bursHormuzgan province.

Method of Research

Touristic climate index (TCI), as an integral index, evaluates climatic elements which have the highest relationship with human ecological comfortability. In this research, TCI and climatic data from nine synoptic stations in the extent of Fars province were used in order to evaluate touristic climate conditions. For evaluating the variables and integrating them into the mould of an Index (TCI), both desk and empirical studies as well as statistic analysis were used. Firstly consistency of data was tested and confirmed by means of statistic index soft ware such as SPSS 17 and excel. Then needed data base was made and related data were processed. In order to separate touristic climate conditions in Fars province, resulted data which are on point basis, should be extended to province level.To do so, use of GIS (geographic information system) seems necessary. So, for separating TCI conditions in soft ware environment of Arc GIS, achieved amounts of TCI from stations were extended to all provinces, using mean-finding by method of inverse distance weighted.

Then by using different methods, cluster analysis of touristic climate was carried out. Finally, the best analysis was selected.

Method of Analysis

Used index in this research (TCI) has been provided by Mieczkowski (1985) in which climatic elements which have the most relation with touristic experience quality for tourists had been used. This method was based on previous studies about ecological classification for tourists and about ecological classification for tourists and about free time by some experts like Bernet (1963) and based on theorical discussion about bio-ecology (Farajzadeet al., 2009). In this index, seven climatic elements were used and analyzed:

1- Average of maximum daily temperature
2- Average of day temperature
3- Minimum of day relative moisture (%)
4- Mean day relative moisture
5- Monthly rainfall (mm)
6- Total monthly sunny hours
7- Mean speed of wind (m/s or km/h)

These seven elements in TCI from five sub-indexes which based on a standard ranking system, is from Ideal to too-undesirable and provide a general base for measuring each sub-indexes (To pay: 2007).

Five sub-indices resulted from seven climatic elements are as follows:

1- Daily comfortability index (CID): climatic elements, used in this index are mean of maximum daily temperature and mean of relative moisture. This sub-index shows temperature comfortability when touristic activity is maximum. Its share in TCI is 40 percent. For measuring temperature comfortability whose amount shows individual mental and physiologic feeling, figure of comfortability coefficient was used by elements of moisture and temperature. Itsó values are extracted from crossing points of moisture and temperature in the figure. In the index of comfortability, the best region is temperaturalrange of 20° to 27° and moistural rang of 30 to 70 percent. This region in TCI is determined by value of 5.

2-Comfortability index at day and night (CIA): used climatic elements in this sub-index are mean daily temperature and mean relative moisture. This sub-index shows temperature comfortability during day and night even when the tourists are not present in open spaces that is why it is less important than CID. So, CIAS share in TCI is to percent. For extracting the values of this index, the figure of temperaturalcomfortability is used. The share of the both sub-index of CID and CIA in TCI is 50%.

3- Total monthly rainfall

On a general view,it can be said that rainfall element has a negative impact on touristic activities. Of course, amount and temporal distribution of rainfall have different effect on the rate of desirability in tourism. In most countries, because of lake of rainfall element measurement, only absolute amount of rainfall is used in TCT.For tourists, little but continual rain is less bearable than strong and temporal rain. The amount of this element in TCI is gained through the table provided by Mieczkowki. Generally, by increasing the amount of rainfall in ranking system, Itsóshare in index decreases. Itsó share in TCI is 20 percent.

4- Total sunny hours in a month:

In contrast to rainfall element, this parameter is a positiveFactor in tourism. This factor is, especially, mentally desirable. However, it should be noted that intensive. Light of sun and itsó heat can affect the health of tourists. Similar to rainfall, the share of this element in TCI is 20 percent. In ranking system of TCI, the regions with the most sunny hours have the highest ranks. The way of estimation of this factor is as the average number of sunny hours during a day and by deviding monthly average in number of days.

5- Mean wind speed:

Wind is considered as a complexive element in evaluating touristic activities. Generally, the effect of this parameter depends on air temperature. For example, in hot regions, the wind causes an increase in evaporation and

cooling, however, in cold climate, it has negative and undesirable effects on touristic activities. With respect to the fact that wind has different effects an humanَs rate of comfortability in different climate, itsَ ranking system should be distinguished so that itsَ rate can be estimated in TCI for different climates. To this purpose, Mieczkowki considered four kinds of ranking system. In normal system, the least average speed of wind in a month possesses the highest amount in TCI rating system that is 5. Normal system for wind is used at a time when maximum monthly temperature is between 15°C and 24°C. when maximumtemperature is between 24°C and 33°C. Alize wind system is used, in which the winds with average speed provide the most climatic comfortability and it ranks 5 in the system. When maximum temperature is more than 33°C, hot wind system is used. In this system, generally the wind has negative and destructive effect. For temperatures with maximum less than 15°C. The following monogram is used. After, ranking the five sub-indexes,they are put in relation (I) .

Then, for each city, a number between 0 to 100 is gained, from amount of which region situation relating to touristic climate is found.

Relation (I): TCI=2(4CID+CIA+2P+2S+W)

Where CID is comfortability index at day, CIA is comfortability index at day and night (24 hours), P is monthly rainfall, S is totall sunny hours in a day and W is mean speed of wind in four systems.

The rank of each variable should be put in above mentioned equation (I), so that the amount ofCTI is achieved for stations.

After estimation of TCI amounts for each station, separating out by method of IDW (inverse distance weighted) using GIS and software of Arc GIS. The amounts resulted from final equation are on basis of points that should be extended to the level of province.

After zoning the amounts of TCI in Arc GIS environment, with creating border Layers of province and cities, TCI amounts for each one were interred into the table of descriptive information. Following the creation of informational layer for each city through method of spatial analysis in software environment, TCI extents was made for each city by IDW method. Eventually, 12 monthly maps of TCI were plotted for Fars province.

Findings:

After carrying out different estimations, Fars province touristic climate was evaluated on a monthly scale using touristic climate Index (TIC). The results for different regions of province are as follows:

- Touristic climate condition on the month of Farvardin (First month of Islamic-Iranian calendar: in this month, conditions of touristic climate vary from excellent in northern part of province to acceptable in southern parts. Northern cities of province like Shiraz, Marvdasht, Bowanat, KhorrambidAbade and Oghlid have excellent conditions. Central parts like Ersanjan, Kazeroon, Firoozabad, Nairiz and Estehban have very good conditions. Southernparts are rated as good. Only the rank of Lar city in south of province is acceptable.

Second month (Urdibehesht):

In this month, relative to first month the conditions become down-rated. Around the province, only two cities of Abade and Oghlid have very good conditions. Northern parts have good conditions, exceptingFesa which is ranked as acceptable. Southern parts such as Lamerd, Lar and Darab are less good than other parts.

Third month (Khordad):

Because of predominance of adjacent continental high pressure on climate of province, it is devided into tow parts of acceptable and weak. The first part includes the cities of Abade, Oghlid, Marvdast, khorrambid and Bowanat, and second part covers other regions of province. In this month, only two cities of Nairiz and Estehban have very good condition for tourism, among the reasons, being mountainous can be mentioned.

Fourth month (Tir):

In this month, all parts of province, excepting two cities of Nairiz and Estehban which possess more proper conditions, have weak condition regarding TC.

Fifth month (Mordad):

Comparing to month of Tir, in this month, the conditions become more proper. In addition to two cities of Nairiz and Oghlid have desirable conditions.

Sixth month (Shahrivar):

Because of departure of adjacent – continental high pressure from southern side,conditions of northern parts become better. Nairis has very good condition, Estehban has good condition, Darab, Lar and Lamard are ranked low. And other parts have acceptable condition regarding TC.

Seven month (Mehr):

In this month, conditions of touristic climate have the most diversity, So that city of Shiraz has the best ranking conditions, that is Ideal, at mean time, conditions of Lar city in western south is ranked low. Cities of Abade, Izadkhat, Oghlid, and Zarghan have excellent conditions. Other parts of north like cities of khorrambid, Bouanat,

Marvdasht, Ersenjan, Firoozabad, kazeroon, Mamasani and Sepandan have very good condition. Cities of Nairiz, Estehban and Jahrom have good conditions. Lar and Fesa have acceptable conditions. In south-east, because adjacent continental high pressure has not gone away completely, condition of TC is ranked low.

Eighth month (Aban):

In this month, eastern parts like Abade, Izadkhast, Oghlid, Bowanat, Ersenjan, Marwdasht, Nairiz, Estehban, Fesa, Jahrom and Darab have excellent conditions. In the south, city of Lar has good conditions and Lamard has acceptable conditions. Other parts of province such as Firozabad, Shiraz, kazeroon, Mamasani and Sepandan have very good conditions.

Nineth month (Azar):

In this month, touristic climate conditions become inverse from north to south, in other word, ideal conditions transferred from north to south, so that Lar city in south has excellent conditions, while in the north,Droodzan dam and Sepandan have low conditions regarding TC. By going from north to south, the conditions of TC become more ideal. The reason can be the advancement of western wind activity in northern part.

Tenth month (Day):

Because of progress of western wind, north-east of province has low conditions including Ersanjan, Marwdasht, Kazeroon, Mamasani, Sepandan and Khorrambid. Lar and Lamerd in south have very good conditions. Other cities which are concentrated in central and eastern parts like Abade, Oghlid, Bowanat, Nairiz, Estehban, Fesa and Jahrom have acceptable conditions.

Eleventh month (Bahman):

In this month, climatic conditions in south become best. So that cities of Lar and Lamard, have indeal conditions and Nairiz, Estehban, Fesa, Jahrom and Darab have very good conditions. Firoozabad, Bowanat, Ersenjan, Oghlid, Abade have good conditions. Other cities of province at north. Have acceptable conditions.

Twelveth month (Esfand):

Conditions in this month become balanced, so that, in eastern parts, cities of Nairiz, Darab,Fesa, estehban and jahrom have excellent conditions, in western south, city of Lamard has good conditions, and other points of province have very good conditions.

After the maps of tourist climate had been provided and commented, cluster analysis was carried out for stations, so that, on different similarity level, using the best method, the stations which were located in same cluster, could be indentified. Different analyses were tested and the best analysis for Fars province was selected, that is Pearson'sweighted distance.

Then, at similarity level of 90%, three clusters were identified.

Results:

When the amounts of touristic climate index (TCI) for studied stations were identified, the amounts of index for Fars province were separated and cluster analyses were carried out for cities of Fars, the following results were achieved the TC condition in frost month of spring (Farvardin) are more ideal than other two months of Ordibehesht and Khordad. In this season, the most ideal parts are northern regions of province. From north to south the conditions become less desirable. The reason can be the progress of adjacent continental high pressure from south and climatic stability of province. In contrast to winter, in spring season, northern parts including Abade, Oghlid, Ardakan, Shiraz, Safashahr and Noorabad have better conditions than other parts. In summer because of predominance of continental high pressure on province, and relative stability of air conditions, TC situation become less proper, so that, only in eastern parts such as Oghlid and Estehban have proper TC conditions. In other parts, no proper conditions were observed. In fall season the conditions become the best when most parts of province have excellent and very good conditions in all three months. In First month (Mehr) Shiraz has ideal conditions and in northern parts, the conditions are excellent and very good. While in second mont, all parts of province excepting the city of Lamard have excellent and very good conditions. In med fall, due to withdrawal of adjacent continental high pressure from south and progression of western winds, the conditions reach their best. However, in third month (Azar) because of cold waves entrance, ideal conditions transfer to south. In winter, southern and eastern parts of province including Larestan, Lamard, Nairiz and Darab have more proper conditions than other parts with respect to TC conditions finally, by cluster analysis for studied stations based on pearson weighted distance method at similarity level of 90%, three clasters were identified. Cities of Abade, Zarghan, Shiraz and Droodzan sad were put in first cluster with 63 percent similarity.Cities of Darab,Fasa, Lar and Nairiz were put in to second cluster with 88 percent similarity. And third cluster including Lamard city is located in western – south of province which is dominated by stable air condition in most parts of year and this city is very different.

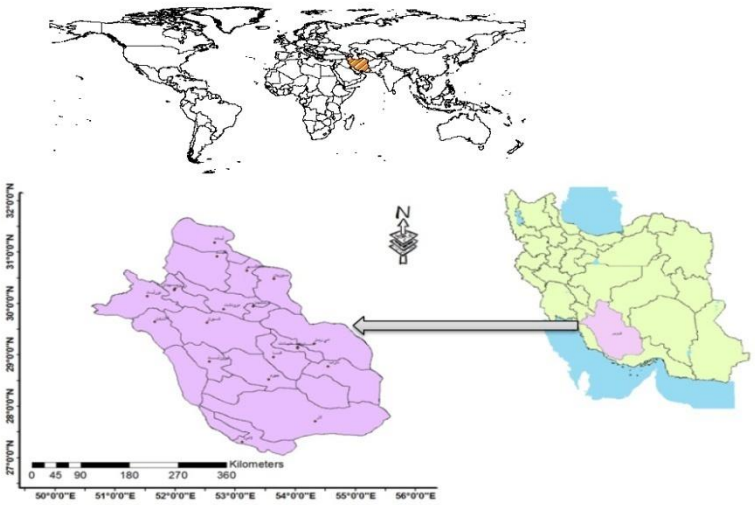

Figure 1.location of Fars province.

In the present research, statistics from nine synoptic stations in the extent of Fars province were used.

Table I shows characteristics of used stations:

Table I.characteristics of studied stations.

Stations	longitude	Latitude	**altitude(m)**
Abade	40 – 52	11 – 31	1- 2030
Darab	54 17	28 47	1098.2
Zarghan	52 43	29 47	1596
Droodzan sad	52 27	30 11	1652
Shiraz	52 36	29 32	1484
Fasa	53 41	28 58	1288.3
Lar	54 17	27 41	792
Lamard	53 07	27 18	411
Nairiz	54 20	29 12	1632

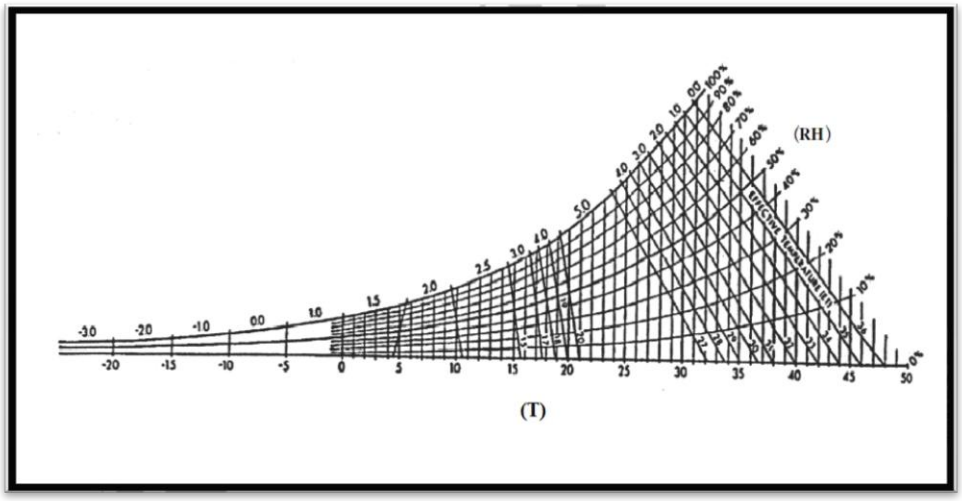

Figure 3.Comfort monogram index(Mieczkowski, 1985)

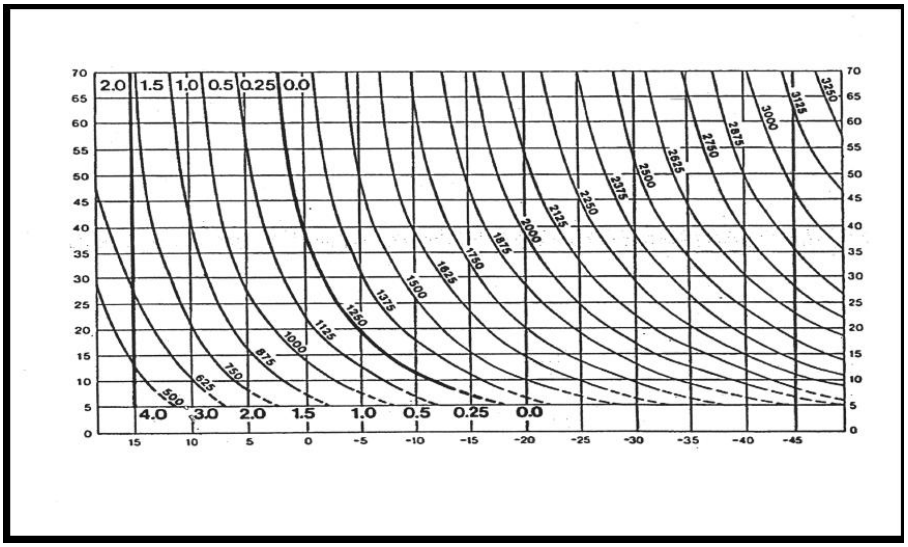

Figure 4.wind cooling system in the index of climatic comfortability (Mieczkowski, 1985).

Table 2.classification of TCI for mapping (Miczkowski, 1985).

category in map	Numerical amount of index
ideal	90-100
excellent	80-89
very good	70-79
Good	60-69
Acceptable	50-59
low	40-49
undesirable	30-39
too	20-29
undesirable	10-19
very bad	10-19
unbearable	0-9

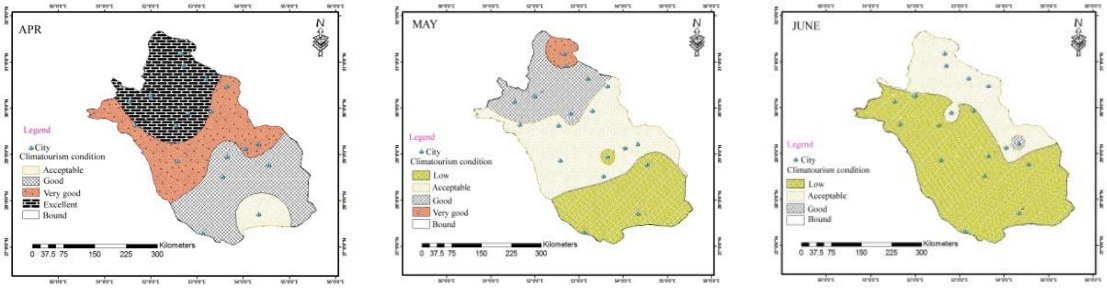

Figure 5.Touristic climate conditions of Fars province in spring, on monthly basis.

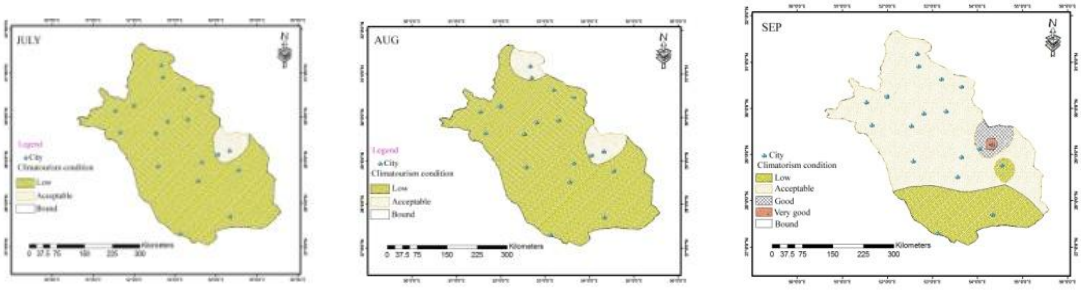

Figure 6.Touristic climate conditions of Fars province in summer, on monthly basis.

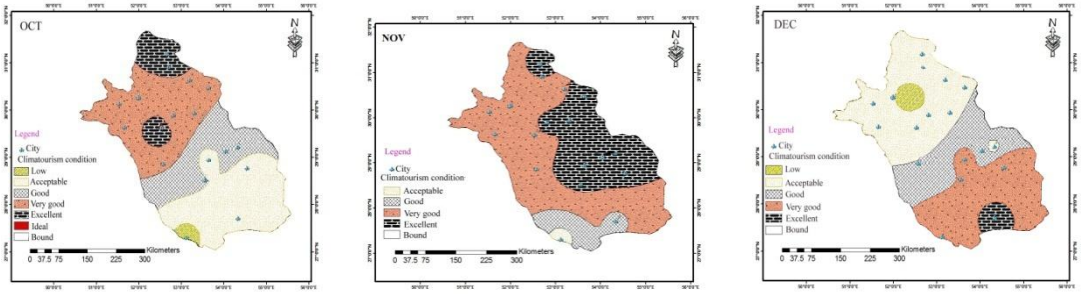

Figure 7.touristic climate conditions of Fars province in fall season, on mouthy basis

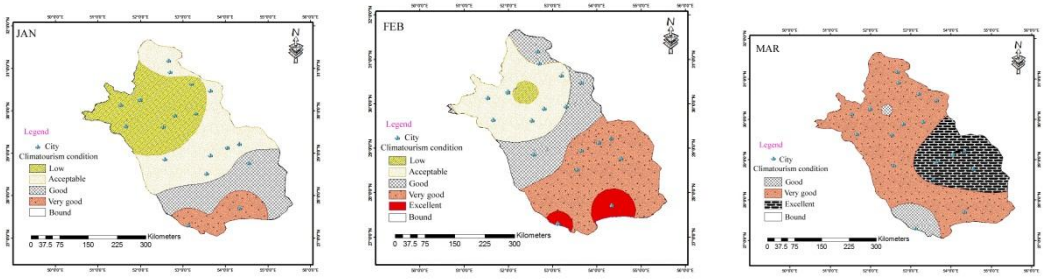

Figure 8.touristic climate conditions of Fars province in winter, on monthly basis.

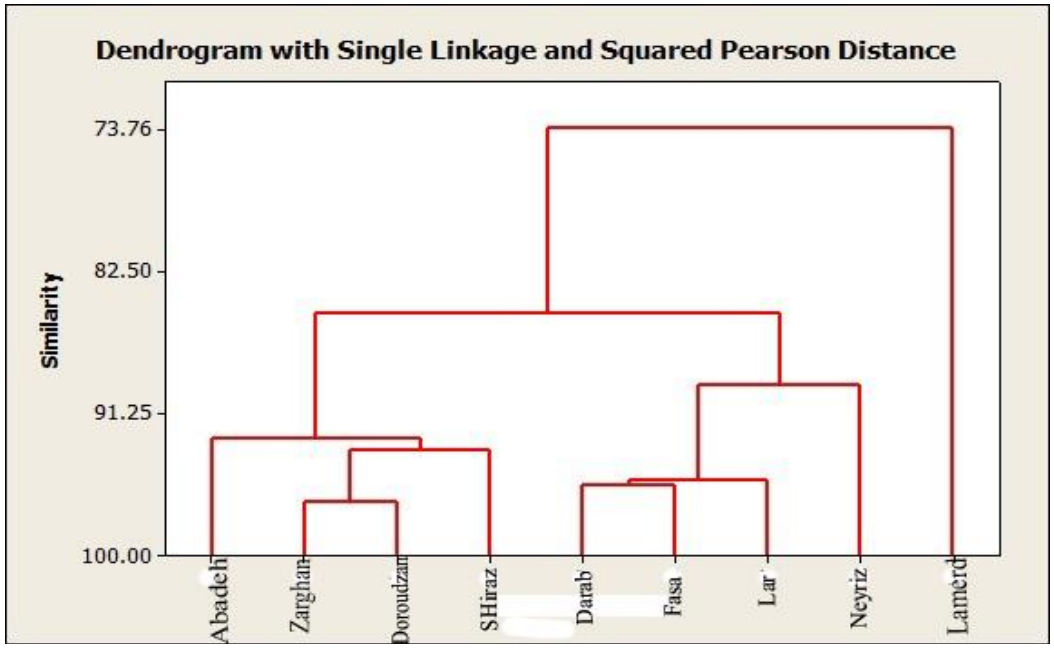

Figure 9.Cluster analysis of Fars province touristic climate based on the method of Pearson weighted distance (PWD).

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