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# Evaluation and zoning of tourism climate of Mazandaran province using the tourism climate index (TCI)

Maryam Gholizadeh<sup>1</sup>, Esmail Shahkooei<sup>2\*</sup> and AbdolazimGhanghermeh<sup>2</sup>

1. Graduate Student, Climatology University of Golestan, Gorgan, Iran
2. Department of Geography, Golestan University, Gorgan, Iran

*Corresponding author:* Esmail Shahkooei

**ABSTRACT:** Today, the role of climatology and the study of atmospheric conditions in human life has a great impact on tourism and biodiversity activities. Due to the shortcomings and problems can be managed properly to achieve sustainable development and appropriate steps in the field of land preparation, these problems fix or minimize. The present study, based on the TCI Tourism Climate Index available in the province of Mazandaran for a 20-year statistical period from 1996 to 2016 and analyzed at 10 synoptic stations in Mazandaran province. The results of this study show that the eastern half of Mazandaran province is ideal for tourism climate and the central and western regions of the province are in acceptable class of TCI climate index. Also, in this study, the stations of White Bridge and Alasht had the highest and lowest frequency, respectively. According to the frequency, summer and July with index of 93 in east and southeast areas of Mazandaran province was the most ideal tourist climate. In winter, March with index of 58 in central and western regions of the study area, The most unsuitable place for climate comfort has been in the province during the 20-year period. Therefore, Mazandaran province has many potentials and attractions for tourism development, which is suitable for tourism development, which can be introduced as an area with high potential for attracting tourists. The climatic condition of the province has been considered due to the favorable climatic conditions.

**Keywords:** Tourism Climate, Sustainable Development, Land Planning, Climate Comfort, Mazandaran Province.

## INTRODUCTION

Nowadays, the study of the impact of climate on human life, health and well-being is studied and studied in the form of one of the scientific features of the human climate (Bieber et al., 2002). The conditions of a given season in a region can have a strong impact on the tourism industry in different regions and countries. The basic role of climatology depends on the situation (climate, temperature, etc.) depending on their relationship with tourism activity. Climatology can include observational data to prepare the frequency of data from days appropriate for tourist activity. Therefore, when the activity of the season in question is concerned, the beginning, duration and termination of the season should be noted, as the study of climate indices is of great importance in tourist studies, as it can provide comfort and prosperity for the tourist and the tourist according to the conditions. The climate governing the area in question should make the necessary planning to obtain maximum comfort (Ebrahimzadeh et al., 2009). Climatic conditions including, blue sky, sunshine, lack of rainfall or difficult rainfall statistics. Mechanism etc. is required for tourism activities in the study area. Aside from the role of climate in creating the conditions necessary for tourist comfort, the climate of each region creates a unique environment and landscape for a region that can play a major role in attracting tourists. Favorable climate increases the attraction of traveler and tourist (Hasanvand et al., 2016). Relationships between air, climate and tourism take many complex forms. The complexity of the issue depends on the multiplicity of forms of tourism on the one hand and on the impacts of climate on the other. However, the effects of climate on tourism are more pronounced than on other factors (Abg et al., 1998). In 2005, studies that specifically examined climate adaptation from the tourism-recreational

sector's point of view found that there was limited evidence of climate adaptation in this area. In a paper in 2005, Emanuel discusses the use of thermal comfort in hot and humid urban areas of the metropolitan area of Colombo, Sri Lanka. An article examines the climate of tourism comfort in Spain using the TCI index and concludes that summer is in the best state of tourism comfort. Giles and Perry (1998) found that the very hot and sunny summer of 1995 in the UK reduced the number of seaside tourists, as travelers chose staying at home and spending their holidays at home. Hasnawa et al. Research using

The TCI bioclimatic index was calculated for 9 synoptic stations in Lorestan province and the results of this study showed that tourism conditions in this region are highly diverse. In the months of April, May and October, we have the highest levels of ideal, ideal and good tourist attraction. Farajzadeh et al. (2012) in an article entitled Evaluation and Zoning of Iranian Tourism Climate by Using Tourism Climate Index and concluded that in winter months southern regions of the country have excellent tourism climate conditions. Ismaili et al., 2013, in a study evaluated the climate-comfort conditions of Chabahar port for tourism development and concluded that the optimal period of comfort climate during the months of December. And it's January, February, and March.

**Materials and Methods**

In this study, using the Tourism Climate Index (TCI), the assessment and zoning of tourism climate for the cities of Mazandaran province was carried out. The statistical period used in this study is 20 years and is from 1996 to 2016 and is used to evaluate the regional climate conditions. The study used 10 stations in Mazandaran province. Bioclimatic data at the level of synoptic stations were obtained from the meteorological organization of Mazandaran province. In this study, different precipitation data, mean and maximum temperature, relative humidity, wind speed, cloudy and sunshine were used to evaluate biochemical parameters. After calculating the TCI index, frequencies were monitored and finally, using GIS technique, the study area was zoned based on the frequency of occurrence of the TCI index. Therefore, in order to achieve the results of this research, software such as Matlab, Excel, TCICalculator and GIS were used. Tourism specification of TCI is generally designed for high latitudes and except in northern parts of Iran, in other parts of Iran it cannot be fully answered. Provide accurate and realistic information about the region's tourism climate. This method was invented in 1985 by Miskowski for climate assessment for tourism activities. In this method, different climatic elements for a region are studied and different coefficients are calculated according to the model and finally points are calculated for each month or time period. Miskowski first identified 12 climate variables, which were then reduced to 7 climate variables. These included mean maximum temperature, mean temperature, mean relative humidity, mean relative humidity, mean monthly precipitation, mean sunshine and mean wind speed. is. Then, by combining some factors, it is reduced to 5 indices of average daily maximum temperature and average minimum relative humidity, average daily temperature and relative humidity, total precipitation, total sunshine and mean wind speed. Indicators and their effects on tourism are mentioned. To calculate the tourism climate index, we have to calculate these five components and indicators and then formulate them. The main and final formulas for calculating tourism climate are derived from (Relation 1).

(Relation 1):  $TCI = 2 [(4 * CID) + CIA + (2 * P) + (2 * S) + W]$  which is in relation to C, daily CID index, CIA daily index, P hour duration, S sunshine and W index.

Table 1. TCI Indicator Factors

Points in the Model	Impact on Tourism	Monthly Climate Variable	Sub-Index
40	shows thermal comfort when tourists are at maximum activity	average daily maximum temperature and average minimum relative humidity	CID
10	Shows thermal comfort during the day, including hours of sleep 20 reflects the negative effects that this element has on holiday enjoyment	Average daily temperature and average relative humidity	CIA
20	Reflects the negative effect that this element has on holiday enjoyment	Total p	P
20	Positive for tourism assessed and negatively impacted by hot sun and inconvenience on hot days	Total S	S
10	Effects of that element depend on temperature (wind cooling effect in warm positive climate is evaluated while wind cooling effect is negative in cold climate)	Average wind speed	W

CID is a daily comfort index with two components of maximum temperature and minimum relative humidity, meaning the combination of the two elements calculates the daily comfort index. All of these 5 components mentioned above take a factor of zero to 5 which means zero conditions and towards 5 ideal conditions. The final coefficient of tourism climate is between 0 and 100, which is obtained from the coefficients of these 5 components. Each of these 5 indices or components comprises part of the final coefficients, with the daily comfort index having the highest share of 40 points out of 100 and in fact the most important in the tourism climate of an area. This means that if the initial coefficient of this index is 5, in the final formula of tourism climate it gets 40 (in the final relation the daily coefficient of daily comfort multiplies by 4).

The circadian comfort index (CIA) is a combination of the two elements of mean temperature and relative humidity. In fact, it has the lowest score (factor 10) in the tourism climate index. The above moisture comfort chart is used to obtain the circadian comfort coefficient. The intersection point of the average relative humidity and temperature calculates the initial coefficient of the index. Monthly rainfall (P) is considered a negative factor in tourism climate. Therefore, low rainfall is an advantage for tourism climate. The final rainfall for the extracted precipitation is 20 months (Panahi & Sattari, 2016).

Shows the amount of sunshine (S), a region or station. The indicator is generally positive, but the risk of sunburn and hot days is a negative factor. A total of 5 to zero leads to dissatisfaction. Used to rank the sunny hour table by day (relation 2). The final coefficient of sunshine is 20.

(Relation 2):  $t = S / 30$

In this respect, t is the unit of time and s of the sun. The number 30 in this respect is a fixed number.

Wind index (W) is a positive indicator in the tourism climate and makes it ideal from zero to 5. Wind plays a positive role as an important factor in tourism. For the normal system, the average maximum air temperature should be between 15 and 24 ° C. The alloy temperature range is between 24 and 33 ° C and the hot air temperature system is above 33 ° C. After the wind scale system is specified, the wind index must be converted to kilometer (Panahi & Sattari, 2016). After calculating the final formula, the final value between zero and 100 is derived (Table 2).

Table 2. Values graded in the index

TCI Index	Ranking	Classification	Overall Class
90to100	9	Perfect	Perfect
80to89	8	Excellent	
70to79	7	Very good	Very good
60to69	6	Good	
50to59	5	Acceptable	Acceptable
40to49	4	Minor	
30to39	3	Unpleasant	Unpleasant
20to29	2	Very undesirable	
10to19	1	Extremely undesirable	
0to9	0	Critical	

**Area of study**

Mazandaran province covers an area of about 328,000,000 (about 5.3 percent of the country's population) with an approximate area of 24100 square kilometers (1.48 percent of the country's total area). The province is located at 35 degrees 47 minutes to 36 degrees 35 minutes north latitude 50 degrees 34 minutes 54 degrees 10 minutes east of the Caspian Sea to the north and Golestan province east. It is bounded on the west by Guilan Province and on the south by the provinces of Tehran, Qazvin, Semnan and Alborz (Figure 1). The study area consists of the marginal lands and beds of the Talar, Neka and Tajar rivers which are part of the main catchment of Mazandaran. Have found. The basin contains rivers that lie between the Sefidrud Delta and the Banders. The area of the basin is estimated to be 28500 square kilometers, 21800 square kilometers of which are in the mountainous areas and 6700 square kilometers in the lowlands or lowlands. The highest part is Damavand peak with 5678 meters altitude. The rivers of this sub-basin generally flow in deep valleys and steep inlets and consist of coarse-grained material. Much of this sub-basin is covered by forest up to 2000 m (Razavi, 2015).

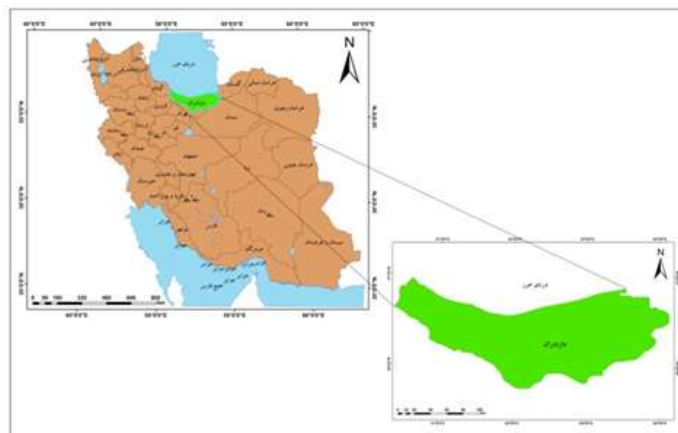


Figure 1. Geographical location of Mazandaran province at national level

**Research findings**

**Spatial Distribution of TCI Index in Mazandaran Province**

According to (Fig. 2) and due to the relatively high humidity of the western regions of Mazandaran and the relatively appropriate temperature of the eastern regions of Mazandaran, the best climatic conditions in terms of tourism climatic characteristics, in April, the central regions were very good and the western and final regions Western regions are considered to be the most ideal and critical places of tourism climate, with acceptable indicators. The same is true in May, except that the eastern and central parts of the province are the most ideal tourist destination. In June, all areas of the province, except the southern and mountainous regions, have a good to very good index in the TCI classification.

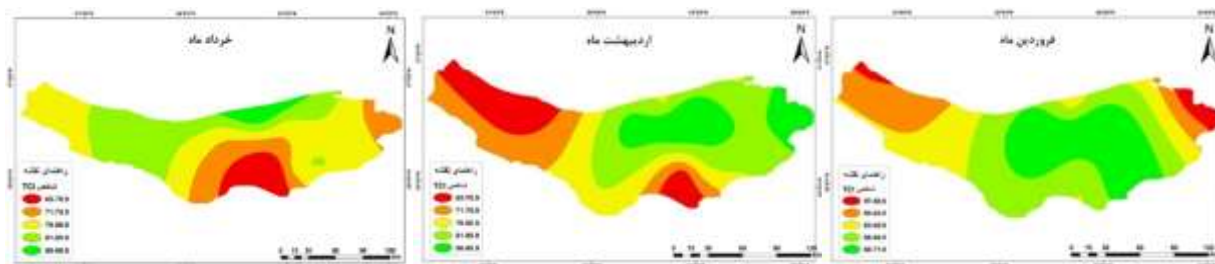


Figure 2. TCI Tourism Index of Mazandaran Province in spring

Also, according to (Figure 3), in the summer season and in July, the southeast areas of Mazandaran province have the best tourism climate and in this regard it is in the ideal index in the TCI classification. This month, on average, has been the best indicator for tourism over a 20-year period, due to good rainfall and good temperature. But in August and September in the same regions due to the heat and humidity intensification, a decline in the TCI index was observed and in the TCI index in the months mentioned, it was good and very good.

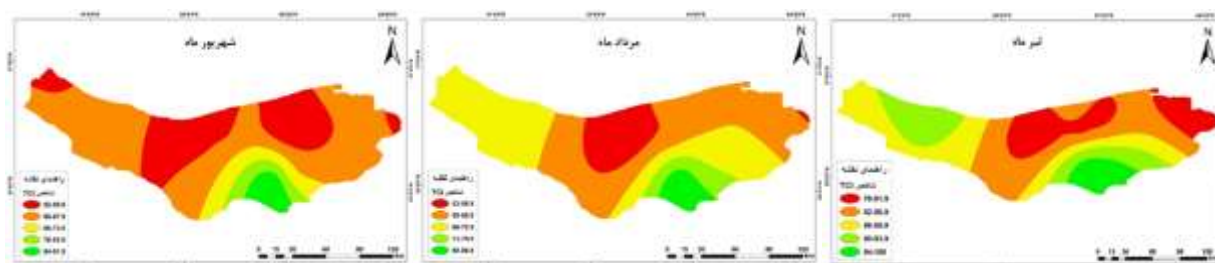


Figure 3. Map of TCI tourism index of Mazandaran province in summer

But due to the decrease in heat and the beginning of the lasting rainfall with the influence of the northern streams, in terms of tourism climate index, the index of the index with one or two downward declines was the best location in the south-eastern regions of Mazandaran province in October. Placed. Conversely, the lowland areas of the province had the highest and best feedback of the TCI index in the cold and cold seasons of November and December, and the southern and southeastern regions of the province, on average, were considered to be the most inappropriate climate tourism destinations (Figure 4).

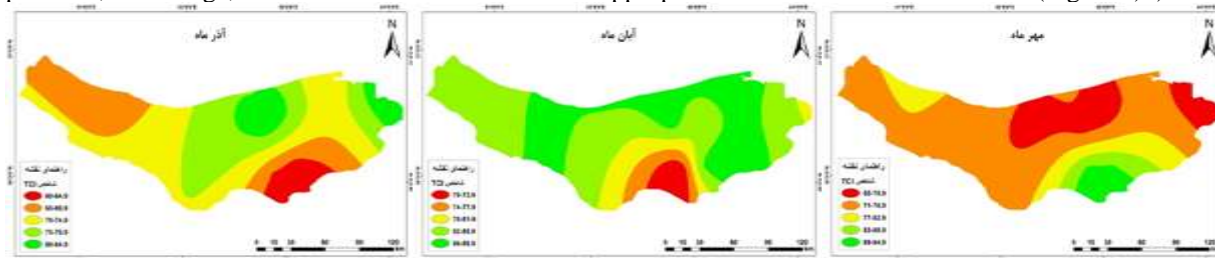


Figure 4. Map of TCI tourism index of Mazandaran province in autumn

In winter (Fig. 5), the index is similar to the months of November and December and is the most ideal coastal and plain area of Mazandaran province and is the most inappropriate tourism climate in the southern and southeastern regions of Mazandaran province. However, the most inappropriate tourism climate in March, which during the 20-year study period, averaged the most inappropriate locations in the TCI classification during the 20-year study period, and climatic conditions in the south of the

province included the worst category. Be. During this period, the eastern regions of the province have favorable climatic conditions.

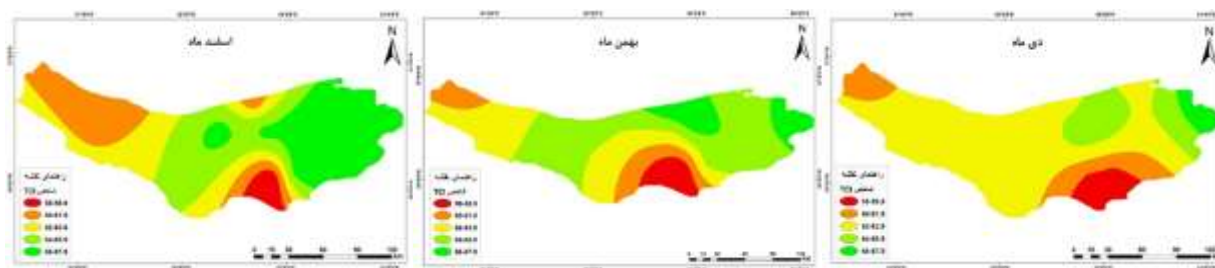


Figure 5. TCI tourism index map of Mazandaran province in winter

**Frequency of occurrence of TCI index in Mazandaran province**

But in terms of frequency of occurrence of tourism climate index, as mentioned in the spatial zoning of TCI index, the highest frequency of this index was from July 1996 to 2016 on average in July and the index ranks 95 which is in the class The TCI ranged from 90 to 100, making it the most ideal climate for climate prosperity. June and November also rank next in the TCI classification. Also, according to (Figure 6), Esfand has the most inappropriate index in the climate classification of Mazandaran province which is ranked 60-70 in this regard. And in the rankings of the TCI index, this rank is considered a good category of climate tourism.

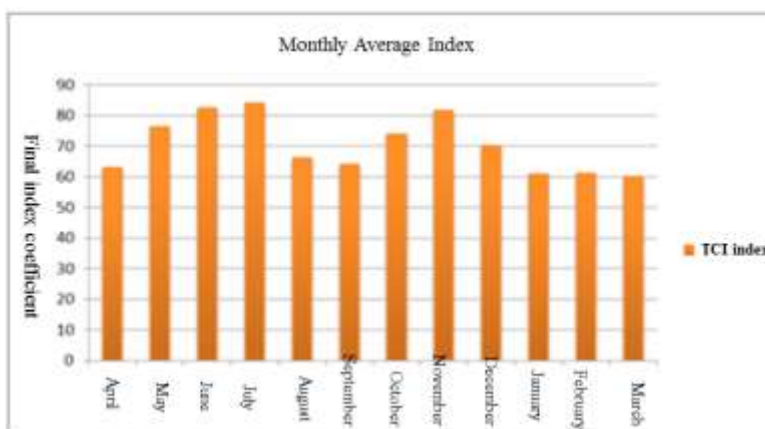


Figure 6. Monthly frequency chart of TCI index event in Mazandaran province

**Distribution of annual occurrence and location of TCI index of Mazandaran province**

But according to (Fig. 7), which shows the annual changes map of the tourism index of Mazandaran province, the qualitative classification of TCI index in Mazandaran province is divided into 5 general categories, which shows the eastern half of Mazandaran province in the best statistical period. The climate model conditions are considered as the most ideal location in these areas and the northern and central regions of Mazandaran province are considered as the most inappropriate tourism climate and have acceptable quality index in the index classification. But what is at stake is the climatic conditions that tourists take into consideration when considering the temperature, rainfall, wind, sunlight, humidity and evaporation, and even issues that concern tourists themselves. A tourist who considers these issues also considers the type of clothing (clothing), physical condition (age, weight, gender) in the tourism characteristics. Therefore, the mentioned climate and medical indicators are considered part of the demands of a tourist, while in the model of tourism climate index deals with the part of the climate which can be favored in some people and in some people To avoid situations.

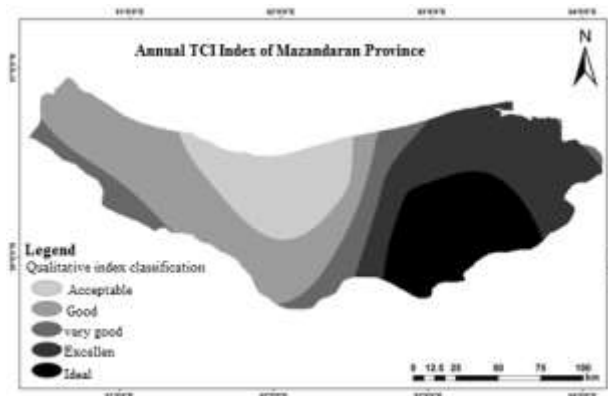


Figure 7. TCI Annual Tourism Map of Mazandaran Province

In terms of annual and station frequency, the White Bridge station with a score of 73.5 is in a very good position, followed by Alasht and Gharakhil with a score of 72 and 70.5, respectively, followed by tourism climate index. But the lowest frequency of annual occurrence among the 10 stations in Mazandaran province was that of the bottleneck station with a score of 68.8 and above that of Ramsar and Nowshahr stations with a score of 69 and 69.2, respectively (Figure 8).

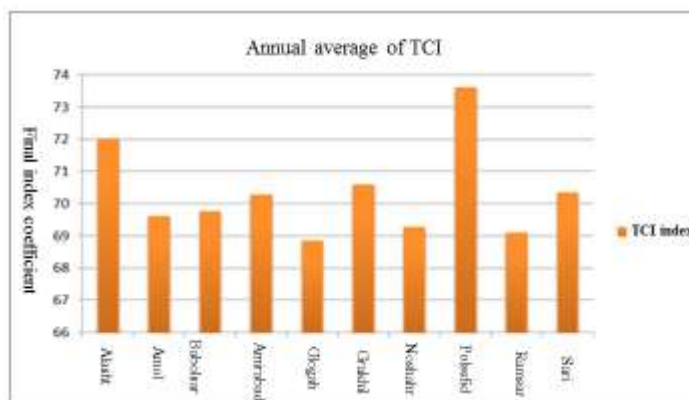


Figure 8. Annual Frequency Chart of TCI Index Based on Mazandaran Province Stations

**Discussion**

Considering the shape of the studied charts, the current indicator of TCI tourism in the province during the years 1996 to 2016 has the highest impact on the school year, and the lowest impact on the student population. Also available are Monthly and Yearly Charts, Ideal TCI Location, East and West Stations, Outdoor, Outdoor, Outdoor, Outdoor, and Outdoor. Therefore, given the recognition of minor characteristics in the province of Mazandaran, it is important to look at the development of the region in the western region. Whereas the central and western regions of the country require the planning of the program as well as the management of the impact on the climate and the activities of the tourism sector in the community.

**Conclusion**

According to TCI output maps, based on 10 well-dispersed stations in Mazandaran province, eastern regions of Mazandaran province are the most ideal tourist climate and northern and central regions have the most critical tourism climate. . Therefore, it can be deduced that climatic conditions such as temperature, precipitation, cold and heat conditions, humidity, wind and altitude and other climatic factors as well as the human body (cover, physical fitness, age, gender, etc.) can be tourist-friendly. Being or defending tourism is a place to be involved. Using the TCI tourism climate model conducted in Mazandaran province, considering the climatic factors, the frequency and frequency of occurrence of TCI index were well determined to select the ideal place for leisure travelers.

## REFERENCES

- Ravi, Seyed Mohsen, (2015). Investigation of Hydrochemical Characteristics of Dams in Mazandaran Province, No. 844/84- Iran Aquatic Conservation Research Center.
- Panahi, AS. Sattari, A. (2016), An Analysis of the Tourism Climate Potentials in the Cities of Sabalan, *Journal of Geography and Programming*, Volume 21, Number 62, Winter 2016, pp. 77-61.
- Honesty, AS. Soleimani, m. God willing, h. (2011), Spatial Explanation of Lorestan Province's Climate Comfort Based on TCI Index, *Spatial Planning*, Vol. 1, No. 1, pp. 121-143.
- Farzadeh, Manouchehr. (2012), Evaluation and Classification of Iranian Tourism Industry Using TCI Tourism Minority, *Geographical Research*, No. 71, pp. 42-31.
- Ismaili, Reza. (2013), An Evaluation of the Minimum Bandwidth Assessment for Tourism Development, *Collection of Four Essays on International Geography in Islam*, Zahedan.
- Ibrahimzadeh, AS. (2009), Feasibility Studies of the West Coast Tourism Area (Chabahar City), Institute of Geosciences and Geography, Sistan and Baluchestan University.
- Bieber, Anne. R., Higgins, K. (1999), *Environmental Planning for Land Development*, translation: Seyed Hossein Bahraini, Keyvan Karimi, 2002, University of Tehran Press.
- Masoumi, Masoud, 2006, "The Nature of Tourism", *Economic, Cultural, Social, Political and Environmental Dimensions of Tourism*, Tehran, Peak Kosar Publications.
- Barbarians, M., Qureshi, M., Arjangroush, B., and Mohajereshi, A. (1985), *Research and Development of Earthquake, Earthquake and Earthquake-Fault Earthquake, Extension of Terranopyrum, Publications of Earthquake Engineering*.
- Tolai, Simin, 2006, "Tool Globalization for Tourism Development in Iran", *Geographical Research Quarterly*, 21st year, No. 3 (successive 82), Fall 2006.
- Naseri, Seyyed Masoud, 1996, *Identifying the Effective Barriers to the Development of the Iranian Tourism Industry and Designing an Explanatory Pattern for Expanding Tourism Attraction* ». , M.Sc. in Management, University of Tehran.
- Mofidi, Arzamohammadokari, Ali. 2008. *Characteristics of coastal areas of England*. Agricultural Research Center of Natural Resources of England. For sanitation research.
- Jafarandi, M., (2014), *Investigating the Impact of Tourism on the West Coast of Khorramiyah*, MA Thesis, Faculty of Social Sciences, University of Tabriz.
- Askari, (2002), *Tourism & Traveling*, Tourism Organization, Country Organization.
- Laikhi, B, (2003), *Investigating the Effects of Traffic on the Tourism Industry of Gilan*, Bureau of Investigation.
- Khosravi, M. (2000), *Investigating the Impacts of Climate and Climate Change on the Tourism Industry*, Sepehr Journal, No. 34, pp. 56-64.
- Imaonoel, Y. , 2005 , *Climatic regionalization mapping of the Murrumbidgee Irrigation Area, Australia* , *Progress in Natural Science* , 19(12):1773-1779.
- Sinonhen, D., T. Wirjanto. 2005. *An analysis of the seasonal variation in the national tourism indicators*. Canadian Tourism Commission, Ottawa, Canada.
- Giels. P, Perry. S. 1998, *Weather, Climate and Tourism a Geography Perspective*, *Annals of Tourism Research*. Vol. 32, NO3, Pp 571-591.
- Scott D, Johnes B and Mac Boyle G (2009) *Climate, Tourism and Recreation: Abibliography*, University of Waterloo Canada.
- Matzarakis, Andreas.(2001), *Climate and bioclimate information for tourism in Greece*, First international workshop on climate tourism and recreate on Halkidi Greece.5-10 October 2001,pp171-184.
- Mieczkowski, Z, (1985), "Recreation and tourism", *Climate and Cultural Enviroments*, pp 42-46.
- Hounam, C. E. (1967), "Meteorological factors affecting comfort (with special reference to Alice Springs, Australia)", Volume 11, Number2, July.
- Terjung, W.H. (1968), "Some thoughts in recreation geography in Alaska from physioclimatic viewpoint", *California Geographer*, 9, 27-39.
- Topay, M. (2007), "The importance of climate for recreational planning in rural areas: Case study of Mugla Province".
- Perry, A. H. (2000), "Recreation and tourism", *ClimateandCulturalEnviroments*, pp 42- 46.
- Gomez Martin ,M. B., 2005, *An evaluation of the tourist Potential of the climate in Catalor (spain): A Regional Study*. *Geogr Ann* 86 A(3), Pp. 249-264.
- Nicoal, A. (2000) , *an improved user-based beach climate index*, *J Coast Conservy*, 6:41-50.
- LechaAboeg.P (1998) *Climate services for Tourism and recreation*.WMO Bulletin 46,47,48.
- Bergei S.J., 2000, *A general equilibrium analysis of climate change impacts on tourism*, *TourismManagement*, Vol. 27, 913-924.