



The Impact of Climatic Conditions on Tourism Development with an Emphasis on TCI Bioclimatic Models (A Case Study: Nir city, Iran)

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Abstract. Studying and identifying potentials and attractions hidden in natural features for consideration in national and provincial planning is of a considerable importance. Nir city has the capacity and a variety of environmental resources including adequate water, fertile soil, suitable climatic conditions, vegetation, communication factors, and tourist attracting natural and human phenomena that, in case of proper planning and use, can help solve many economic and social problems in the region and direct it on the path toward sustainable development. This study seeks to answer the question whether Nir city has the potential for the development of tourist destinations. To this end and in order to collect the necessary data based on scientific documents, the researchers refer to relevant scientific and research centers and make use of databases and computer networks related to the topic. In the field study section, the researchers use regular observation and make interviews. After the categorized collection of documents, the researchers attempt to analyze the data. The present study analyzes climate indices that are effective in tourism in Nir city. The results of the research indicate that, considering the climatic conditions in Nir city, investing on these potentials and creating and equipping proper accommodation facilities can prepare the way for the growth and development of the tourism industry.

Keywords: Environment, climate, tourism development, Nir city, model, TCI

1. PROBLEM STATEMENT

Temperature is of the main elements that cause changes in a region. In a region where the temperature is high, life without cooling systems is unreasonable while another region enjoys the benefit of favorable conditions in terms of temperature. However, in areas where cold weather and snowfall are common, although environmental conditions do not seem appropriate for tourism, cold winter months can still be attracting for special forms of tourism, for example, for skiing and other common practices. As a great and civilized country, Iran is characterized not only by economic, cultural, historical and social capacity but also by special, unique and favorable environmental conditions in the Middle East. Iran has played an important role as a bridge between the East and the West (Ebrahimzadeh et al., 2009:23). One of these effective natural resources in each region is the climate. Regarding the importance of the impact of climate on tourism and the variety of climatic conditions in Iran, it seems compelling to conduct extensive research on this issue (Tavalaee, 2007:13). Climate is the most important factor in the development of the tourism industry. Due to being located in high geographical latitude, a specific topography, and climate systems affecting the region, Nir city has special Bioclimatic conditions and the ability to attract tourists almost all year round.

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2. QUESTIONS AND HYPOTHESES

Based on the problem statement, the study questions are as follows:

1. What climatic model constitutes a good way for identifying the impact of climate indicators on Bioclimatic conditions?
2. What climatic parameter is the most effective in attracting tourists to Nir city?
3. What season is inappropriate for tourism according to Khalkhal city's Tourism Climate Index?

Based on the questions, the study hypotheses are as follows:

- A. TCI Bioclimatic model is a good way for determining the impact of climate indicators on Bioclimatic conditions.
- B. All climatic indicators play a major role in the formation of regional ecotourism and, from among these components, the climatic parameters of precipitation and temperature play the most important role in tourism development in Nir city
- C. In terms of tourism climate comfort, summer is the best time for tourists (*climate comfort rating*) in Nir city.
- D. Reduced temperature in winter is one of the limiting factors of natural tourism in Nir city.

3. RESEARCH METHODOLOGY

The present study uses a field and document-based design. In other words, this study is an applied research project in terms of methodology and a descriptive-analytical research in terms of methodology. For data collection, the researchers conducted field studies and observed the area under study. For data analysis, tables and charts are prepared using the Excel software. In order to determine the eco-climate models of the region, the researchers used the effective temperature method or stress method for temperatures above 20° C, below 20° C, climate and so on.

4. LITERATURE REVIEW

1. In their book titled "the use of climate in the development of the tourism industry," Karimi and Mahbubfar address the use of climate in tourism development and planning. The book has five chapters: chapter 3 deals with the use of climate data in tourism planning; chapter 4 deals with eco-tourism models and indicators; and, chapter 5 summarizes and determines the ideal indicator for tourism planning (Karimi and Mahbubfar, 2011:33).
2. In an article titled "a survey and mapping of the human eco-climate in Iran" published in Iranian Journal of Geographical Research, Kaviani studies the distribution of climatic conditions on geographic maps and addresses the relationship between climate and humans by providing an eco-climate map. He concludes that climate and water are elements that have always had a certain impact on the living conditions of the Earth especially Iran, which has a variety of climatic conditions (Kaviani, 1993: 13).
3. In his book titled "Applied Meteorology," Shahriar Khaledi points to effective climatic factors in spatial and environmental planning and analyzes the importance of climatic parameters and their impact on humans. The results of this work suggest that all climatic elements have a significant impact on the lives of all living organisms, including humans (Khalidi, 1995).

5. ANALYSIS

5.1 Theoretical Principles

Climatologists, biologists and scientists of other scientific areas have tried to illustrate the complex relationship between climate and tourism. These efforts by scientists have resulted in the development of hundreds of models and simple or combinational indicators which are still used despite numerous limits and a long history. Ignoring physiological factors is a major flaw in many of these models. Researchers like Fanger in 1970 and Mieczkowski in 1985 recognized this problem and tried to solve it. Mieczkowski's tourism climate index (TCI) is a flexible and valuable indicator which is widely used in tourism planning. Therefore, determining the climatic potential of regions from the perspective of tourism can be very valuable. TCI is a combinational index which, with an appropriate combination of climatic variables, determines the favorableness of climatic regions for tourists, investors and tourism planning authorities. Using Mieczkowski's tourism climate index, we can detect and determine the reliability of investment in tourist areas despite the danger of climate change in the future (Mohammadi et al., 2004: 39). Overall, 12 climatic variables are used in the TCI index. Meteorological data limitations have reduced the number of variables to seven. Climatic variables incorporated into this index include average minimum temperature, average daily temperature, minimum daily relative humidity, average daily relative humidity, total precipitation, total sunshine hours, and average wind speed. These seven climatic variables are combined into this index and form five sub-indices. This climate index is divided into 11 points on a grading scale from 20 to 100.

5.5.1 Climate and Tourism

Climate is one of the most important factors that form tourism. Recreation and tourist centers in the past and present owe their existence to various factors and in particular to mild and favorable climatic conditions (Adrian, 1991). In general, the proper temperature for tourism varies between 15° and 20° C in summer and between 5° and 15° C in winter. At the moment, tourism is so much entangled with meteorological activities: tourists prefer to know about the climate of the regions they want to visit so that they can create proper plans (Mohseni, 1388: 19).

5.5.2 Seasons and Tourism

Summer holiday is the best occasion for millions of tourists to travel. This global movement of tens of millions of tourists in the summer disrupts the flow of traffic on the road and in cities completely and leads to intolerable conditions. To avoid the concentration of motor vehicles and the poor state of roads and cities, it may be useful to establish a second holiday in other seasons and identify some strategies to end abnormal traffic conditions in the hot season or month (Richard, 2000). Countries that have passed the industrial stage and entered a new era enjoy more options in choosing a travel season as the people of the US and Switzerland have leisure time and can travel throughout the year. Concentration of tourists in certain seasons and the need to select a place for settlement place certain hotels on lucrative tourist routes. In the tourist season, London hotels have a peak period of admitting customers whereas hotels near the sea gain the least benefit (Mohammadi et al., 2004: 39).

1) Summer tourism

Summer tourism, depending on the climate zone, can take many forms such as swimming water skiing, sunbathing, hiking and so on. The factors that play a role in the formation of this type of tourism include:

1. Proper temperature: 15° C to 20° C in summer, and sunshine hours: this factor is determined based on the temperature,
2. Sea water temperature: during the summer, a temperature of 17° C is appropriate for swimming and water sports,
3. Relative humidity and vegetation: appropriate relative humidity ranges between 56 and 70 percent, and,
4. Topographic roughness and water

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supply: summer tourism activities can include activities up on the mountains to the foot of the hills (Mohseni, 2009: 19).

2) Winter tourism

Winter tourism occurs because of special circumstances in winter such as snowfall, low temperature, and so on. Winter tourism has thrived in recent decades and is embraced by all social classes due to numerous facilities and the prevalence of tourist activities in all seasons such as snow skiing. The factors that play a role in the formation of winter tourism include:

1. Proper temperature: 5° C to 15° C in winter; sunshine hours; and wind speed: lower than 35 KPH,
2. Topographic roughness: the shape and slope of topographic roughness is important,
3. Snow: The height of snow for winter sports such as skiing should be between 40 and 60 cm in a minimum period of 30 days. In terms of vegetation, cedar and pine forests provide the best conditions for winter recreation.
4. Precipitation: precipitation should be high and mostly in the form of snow.
5. Winter season should be long enough.
6. Roughness patterns should make it possible for the creation of ski resorts with different applications (Karimi and Mahbubfar, 2011:33).

5.2 Uses of Bioclimatic Models in Tourism

Today, determining the conditions of thermal comfort and the degree of the impact of climate on human physiology is of great importance in the field of tourism and ecotourism planning (Hall and Mand, 2001). The feeling of thermal comfort is an important factor that significantly affects human activities in the environment. In fact, the quantity and quality of human activity depends on an individual's satisfaction or non-satisfaction with bioclimatic conditions in the environment (Karimi and Mahbubfar, 2011: 126). Thus, creating favorable conditions for human comfort using the existing natural conditions is important in terms of tourism and economy. The impact of climate on human comfort is related to one of the major issues in *human climatology*.

6. RESULTS

a. Geographic Location of Nir City

Nir city, which constitutes the study area of this research, includes 8.33 percent of whole province with an area of 1,495.4 square kilometers and is located at 47° 59' east longitude and 38° 2' north latitude and at an altitude of 1,650 meters above sea level. Nir city is adjacent to Sarab on its west border, to Mianeh on the south border, to Ardabil on the east border, and to Mount Sabalan on the north border, and is located 32 km southwest of Ardabil city. The Tabriz-Ardabil road, which is the main road between the provinces of Ardabil and East Azerbaijan, passes through Nir city.

b. Analysis of Nir City's Climatic Parameters via Tourism Climate Index (TCI)

TCI is a useful index for the assessment of climate in tourism not only because it combines climatic variables based on biometeorological studies into one index, which is easily interpretable by tourists but also because TCI is designed to assess the appropriateness of a climate for the most popular tourist activity, that is, "seeing places and landscapes". All the three aspects of climate in tourism are included in TCI, namely thermal factors (temperature, humidity, and wind), natural factors (rain and wind) and aesthetic factors (sunshine hours). In addition, the strength of TCI is its broad applicability since necessary climatological data for TCI are generally available for most places.

TCI Formula:

$$TCI= 8CLd + 2aLC + 4R + 4S + 2W$$

CLd: daily comfort index, including wet and dry average maximum temperatures in degrees Celsius and average minimum relative humidity in percent.

CLa: 24-hour comfort index, including wet and dry average temperature in degrees Celsius and average relative humidity in percent

R: Total monthly rainfall in mm

S: Sunshine hours per day

W: Average wind speed in kilometers per hour

Necessary climatic elements in TCI are monthly average values.

TCI provides a systematic way to assess the source climate of tourism for different places around the world using an eleven-point rating scale (20 to 100) which can be easily interpreted.

Table 6. Subsidiary indicators, their impact and importance.

Importance in TCI	Impact on TCI	Monthly climate variables	Sub-indicator
40%	Shows thermal comfort when tourists have the highest level of activity.	Average maximum temperatures and average minimum relative humidity	Daily comfort index (CLd)
10%	Shows 24-hour thermal comfort and includes sleeping hours as well.	Wet and dry average temperature and average relative humidity	24-hour comfort index (CLa)
20%	Reflects the negative impact of this element on holiday enjoyment.	Total monthly rainfall	rainfall ®
20%	Is considered positive for tourism but can be negative because of the risk of sunburn and increasing irritation in hot days.	Sunshine hours	Sunshine hours (S)
10%	The impact of this element depends on the temperature. (The cooling effect of the wind is considered positive in hot climates but negative in cold climates).	Average wind speed	Wind speed (W)

Other Climatic Elements in TCI

*** Rainfall (R):**

Rainfall has an important impact on climate comfort for tourists both in terms of the total rainfall and through its distribution throughout the year. Continuous light or moderate rainfall, despite a relatively small volume, is more difficult to tolerate than heavy rain over a short period and intense lightning. The volume of monthly rainfall is used for the assessment of the rainfall element in the TCI formula. Due to its fundamental impact on the health of tourists, the rainfall factor scores 20 out of 100 in the TCI formula (Bahadori and Borna, 2012).

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Table 9. Rainfall Ratings in Nir City.

Month Element	Apr il	Ma y	Jun e	Jul y	Augu st	Septem ber	Octob er	Novem ber	Decem ber	Janua ry	Februa ry	Mar ch
Precipitat ion	57. 6	62. 5	21. 2	12. 1	8.5	4.5	23.7	47.7	28.3	26.7	35.1	38.8
Rating	3.5	3.5	4.5	5	5	5	4.5	3.5	4.5	4.5	4	4

Statistical Bulletin of Ardebil Province's Meteorological Center, 2011, 2014

* **Sunshine (S):**

Sunny conditions are generally considered a positive factor in human climate comfort. It is also necessary for better sunbathing and photography, which are both important concepts to the tourist experience. At the same time, sunny conditions can also have negative effects such as the risk of sunburn and skin cancers associated with ultraviolet radiation; discomfort caused by high temperatures associated with direct or indirect solar radiation combined leading to a thermal load on air temperature. Therefore, it is necessary to consider that sunshine is not always a useful and unparalleled element for tourism. However, sunshine is a positive factor for most tourists and it is applied in the TCI formula in the same manner. The TCI formula uses daily sunshine hours. For this purpose, the total number of sunshine hours per month is divided by the number of days in that month. Sunshine, like rainfall, receives 20 points. Overall, more sunshine hours mean a higher score. Sunshine is considered as a negative factor only for stations where long hours of possible exposure to sunshine increases skin temperature – stations which are located in desert climates.

Table 11. Sunshine Hours Ratings in Nir City.

Month Element	April	May	June	July	August	September	October	November	December	January	February	March
Sunshine hours	6.40	8.21	11.06	11.62	11.26	10.51	8.46	6.00	4.49	4.36	4.95	6.06
Rating	3	4	5	5	5	5	4	3	2	2	2	3

Statistical Bulletin of Ardebil Province's Meteorological Center, 2011, 2014

* **Wind (W):**

Wind is a complex factor for the assessment of TCI. The critical role of wind is its acceleration of temperature convection via turbulence and cooling the body. At cooler temperatures, the wind will increase the feeling of coolness by moving away the warm layer of air close to the skin. Wind cools the body pleasantly at higher temperatures between 24° and 33° C (skin temperature). When air temperature exceeds comfortable skin temperature, wind increases the thermal load of the body by convection. This leads to feelings of discomfort in response to an unbearable weather. These considerations yield three outcomes in relation to the importance wind speed rating:

Firstly, wind is basically a negative variable. The rating normally decreases with the extent to which wind speed increases. This is particularly true in cold climatic conditions. Secondly, in cold climatic conditions, it seems that a cooling system based on evaluating the cooling capacity of wind can be useful in order to combine average air temperature with average wind cooling capacity. Thirdly, since high wind speeds may be useful in some circumstances, there is still the need for developing another rating system for areas exposed to the trade winds and areas where

the average maximum temperature is immediately below average comfortable skin temperature. These areas may be located in warm climate areas. In warm climates where the average maximum air temperature exceeds 33° C, any wind is considered uncomfortable. Here, even the lowest wind speed rates the highest with the difference that the highest rating is second.

Table 13. Wind Speed Ratings in Nir City.

Month Element	April	May	June	July	August	September	October	November	December	January	February	March
Average wind speed at the watchtower height (KPH)	9.0	7.4	8.8	11.3	9.5	6.8	6.1	5.6	5.4	5.2	6.8	7.0
Normal system rating	4	4	4	3.5	3.5	4	4	4.5	4.5	4.5	4	4

Statistical Bulletin of Ardebil Province’s Meteorological Center, 2011, 2014

6.4.3 TCI ratings

According to Table 14, TCI value ranges between 20 and 100 and is divided into eleven categories. The value of these categories is described below.

Table 14. TCI Ratings in Nir City .

Index value	Rating description	Category
90 - 100	Ideal	Great
80 - 89	Great	
70 - 79	Very good	Very good/ Good
60 - 69	Good	
50 - 59	Acceptable	Acceptable
40 - 49	Insignificant	
30 - 39	Unpleasant	Unpleasant
20 - 29	Very unpleasant	
10 - 19	Extremely unpleasant	
-9 to 9	Unbearable	
-20 to -10	Unbearable	

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Table 15. Results of TCI application in Nir city station.

Month Element	April	May	June	July	August	September	October	November	December	January	February	March
LdC 8	20	24	40	40	40	40	24	20	12	12	9	16
LaC 2	4	5	6	6	8	6	5	4	3	2	3	3
R4	14	14	15	20	20	20	18	14	18	18	16	16
S 4	12	16	20	20	20	20	16	12	8	8	8	12
W2	8	8	8	7	7	8	8	9	9	9	8	8
TCI	58	67	89	93	95	94	71	59	50	49	44	55
Rating	Acceptable	Good	Great	Ideal	Ideal	Ideal	Very good	Acceptable	Acceptable	Insignificant	Insignificant	Acceptable

According to the above table which presents the ratings of months based on TCI, the months of July, August and September are in an ideal state, June is rated as great, October is rated as very good, the months of April, October, December and March are rated as acceptable, and the rest of the year, including the months of January and February are rated as insignificant. These calculations are based on the above table.

7. CONCLUSIONS AND RECOMMENDATIONS

The spatiotemporal distribution table of Tourism Climate Index in Nir city was used in this study using the TCI model. The importance and advantage of this approach compared with other methods is, firstly, easy access to the data needed for this method and its computability for different regions of the country. Secondly, the model showed that it has sufficient performance to explain appropriate conditions for tourist activities in Nir city and can provide a tourism calendar for the region. Regarding that the average temperature of Nir city is 18.3 degrees Celsius in the summer and in the comfort zone and considering evaluations of Guni, Oleg, effective temperature, stress, climate and tourism indices, we can conclude that Khalkhal city is in ideal conditions and in the comfort zone during summer months. Therefore, the months of July, August and September are the most appropriate months for attracting tourists in terms of thermal comfort. According to studies and observations, the average temperature during winter months is -4.2, which is often less than the tolerance limit for tourists. Thus, winter months are unsuitable for group visits in terms of temperature. However, considering winter precipitation in the form of rain or snow and the fact that the region is mountainous, accurate and appropriate planning can provide favorable conditions for attracting tourists by building ski tracks in the snow. According to the research findings for confirming or rejecting the first hypothesis, and considering the ratings of Tourism Climate Index using the TCI bioclimatic model on a monthly basis, the best places and times of the year for tourism in Nir city were determined. So this is the most appropriate method. according to statistical analysis of the models and the city's tourism climate index in Nir city for confirming or rejecting the first and second hypotheses, it was determined that with the beginning of summer, increased temperature, reduced atmospheric precipitation (snow and rain), and increased number of sunshine hours, the status of tourism climate is appropriate in most parts of Nir city. Therefore, the hypotheses are confirmed. In the case of the fourth hypothesis, considering that the most common type of tourism in Nir city is nature tourism and ecotourism, reduced temperatures in winter and icy and slippery streets and roads limit the activities related to tourism in the province. Although in some areas of Nir city, with the relative decrease in temperature and increase in

precipitation as snow, winter tourism, including tourism related to sports, can reach its peak. Therefore, this hypothesis is also confirmed. Considering the results, the following suggestions are made for improving the situation of tourism:

1. Considering that Nir city has suitable conditions for life in summer months, it is possible to attract more tourists to the region by providing comfort and appropriate facilities for travelers and tourists
2. Considering the regional climate, it is possible to carry out more detailed planning for the construction of appropriate materials and attract more tourists from a variety of aspects, including architecture and other issues related to the study.

REFERENCES

- [1] Ebrahimzadeh et al., 2009. Analysis of tourism underdevelopment in Chababar using the SWOT model, National Conference on Management and Geographical Approaches in the Optimal Utilization of Resources, 2009.
- [2] Bahadori, Kurosh, and Reza Borna, 2012, Evaluation of tourism climate indices in Bushehr using the TCI model, the first National Conference on Geography, Environmental Hazards and Sustainable Development, Ahvaz, Islamic Azad University of Ahvaz, Iran.
- [3] Tavalae, S. 2007. A review of the tourism industry. Teacher Training University of Tehran.
- [4] Karimi, Jafar, and Mohammadreza Mahbudfar, 2011. The uses of climate in the development of the tourism industry.
- [5] Statistical Bulletin of Ardebil Province's Meteorological Center, 2011, 2014
- [6] Khalidi, Shahriar., 1995. Applied Meteorology, 1st printing. Ghomes Publications, Tehran.
- [7] Kaviani, Mohandrez., 1993, Surveying and mapping the human bioclimate of Iran, Iranian Geography Quarterly, No. 28.
- [8] Mohammadi et al., 2004; Bioclimatic indicators for the assessment of human comfort, (A case study: Qom city) Iranian Journal of Ecology, No. 47, Tehran University Press.
- [9] Mohseni, R. 2009, Sustainable tourism in Iran: Functions, challenges and solutions. Iranian Journal of Geographic Space, Year 9, No. 28
- [10] Adrian, B. Pitman.(1991).The Economics of Travel and Tourism. Melmoure. Australia: New York.
- [11] Hall, C. Mand S.J page (2001), The Geography of tourism and recreation, Routledge
- [12] Richard, G. (2000), tourism and the world of culture and heritage, Tourism Recreation Research, Vol, 25 (1).