Indian Journal of Fundamental and Applied Life Sciences ISSN: 2231– 6345 (Online)
An Open Access, Online International Journal Available at www.cibtech.org/sp.ed/jls/2014/04/jls.htm
2014 Vol. 4 (S4), pp. 1222-1231/Kamari et al.
Research Article

HAMEDAN TOURISM COMFORTABLE CLIMATE DETERMINATION UTILIZES THE TCI MODEL

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ABSTRACT
Climate dependence on tourism is an undeniable reality, because good understanding of the climatic conditions of the destination is one of the most effective elements to attract or repel tourist, as the satisfaction of any tourism activity is related to the availability of suitable climatic conditions. So, tourism comfort is very important, in terms of choosing the time and place of travel and physiological aspect of human body. In this study, according to the necessity of ecotourism subject and the potentials of natural indicator in Hamedan, a researcher have tried to identify the best time of tourism with analytical-descriptive method and TCI model. Therefore, since Hamedan is in the cold mountainous climate, the result indicate that the optimal comfortable climate of Hamedan during the months of April, May and October is very good and during the months of January and February is undesirable. Therefore, considering that the most areas of the country, in the warm seasons, are in undesirable conditions, this can be considered as a potential in tourism development of this region.

Keywords: *Tourism, Comfortable Climate, TCI Model, Hamedan.*

INTRODUCTION
Tourism industry, as a social and universal dynamic phenomenon, has its own specific complexities and dedicates major parts of the international trade to itself. This industry can be converting to a huge source of production in regional and national levels, with relying on the allure of tourism initial investment and appropriate planning. According to the World Bank inquiries for four decades, tourism has been approved as a powerful lever in development paradigm, as an overview of the theoretical basis of tourism industry; indicate the role of this industry as an effective factor on development. In this regard, climate, from the point of view of tourism planning, is very important and tourists often seek favorable climate or comfortable climate, in which people have no sense of dissatisfaction and lack of climate and thermal comfort (Matzarakis, 2007). The purpose of human comfort conditions or comfortable area, are conditions that in terms of thermal and moisture, at least 80 percent of those randomly selected and placed in that situations, have the subjective view of welfare state (Kasmaee, 1993). In fact, one of the required information to tourists for traveling is climatic conditions of destination and most of the tourists; consider the climatic consideration for choosing tourism destination. Climate, considered as a major criteria in order to form tourism places (Tavallaee, 2006), and understanding the local climate is increasingly important in tourism studies (Renaudim, 2002). In fact the current study of tourism, believed that the most factor to attraction of tourist is providing information relating to the two associated variables, i.e. Climate conditions and climatology (Bettinger, 2002). Of course the subjective view of welfare state depends on age, sex, diet, health status and also race and the degree of acclimatization to the climate (Matzarakis, 2007). Climate and weather of each region, furthermore that are considered as a kinds of tourism demand, are also affect other tourism demands, like: natural, cultural and etc. Hamedan with natural beauty and historical attractions is one of the tourism places of Iran and an appropriate context for profitability in tourism item. Thus, in this research we are going to help this area for tourism planning by studying the

tourism climate index with TCI model. So, zoning of a region during different seasons and months of a year, in accordance to the referred procedure to provide tourists welfare, not only is a positive choice of places based on the kind of demand in order to gain the tourism purposes, but will help tour operators in order to attract more tourists.

Theoretical Bases

United Nations Statistical Commission in 1993, according to the recommendation of Tourism Global Organization, defined tourism as the movement of people, who travel to the places other than the places of their ordinary life, as long as the trip is not more than one year and it should be done for leisure, business or other purposes. In other words, tourism is a service industry that includes a number of material components (transport systems, reception and related services such as sanitary and safety services) and non-material (rest, peace, culture, adventurism and new and different experiences) (WTO, 2004). Today the weather and the climate of each region plays a significant role in development of its tourism, as the satisfaction of any kinds of tourism activity is related to the availability of suitable climate conditions, so the tourism comfort in terms of choosing the time and the place of travel and in terms of physiological aspect of human body is very important. Therefore, according to the importance of tourism industry, the need of recognizing favorable and unfavorable climatic conditions is essential for local and foreign tourists. The general characteristics of the destination's weather and daily, monthly and seasonal changes, temperature, rainfall, humidity, radiation, wind and other weather elements are important information for tourism destination, that the applicant can do his/her planning in terms of the time of travel, clothing and the needed equipment, proportional to that information (Farajzade, 2005). The purpose of human comfort conditions or comfortable area, are conditions that in terms of thermal and moisture, at least 80 percent of those randomly selected and placed in that situations, have subjective view of welfare state (Kasmaee, 1993). One of the tourism spatial patterns in the modern era is tourism in nature. This spatial pattern, involves the approach of tourists to the natural environment, with different motivations (Paply and Saghaei, 2007). Among these, the effective factors in determining the demand of tourism are the weather and the climate of destination. The weather of a region is one of the most important factors in attracting tourists or vice versa (De Feritas, 2003). Tourism climate indices generally can be divided into three: basic indicators, climatic environmental and combinational indicators (Skinner, 2001). Combinational and climatic environmental indicators which typically consider the combined effect of factors, encompass a greater number of factors (Zolfaghari, 2007). From the perspective of human welfare, there are different methods for climatic classifications, such as physiological temperature index (PEI), the average estimate of vote index (PMV) and cumulative stress index (CS), (Mahmudi, 2008). TCI index, expanded by Mikzukufsky and therein he used the climatic elements that have the most relevant to the quality of tourism experience for tourists. TCI method is build based on previous studies on climatic classification for recreation and tourism by some people like Brant (1963) and the theoretical subjects on basis of environmental climate (Farajzade and Ahmadabadi, 2008). Because the climate of particular region is related to the extreme conditions of weather, then, it must be know something more than average temperature and rainfall. The advantage of this index in comparison to other method is including all effective climatic aspects on tourism such as thermal, physiological and aesthetic dimensions, the mixing index such as climatology, tourism and bioclimatic, less complexity in terms of calculations and the possibility to estimate the index values for next months and tourism courses (Ziyaie and Bakhtiyari, 2008). Of course, the constant mechanisms should be developed with specific conditions for environmental conditions. These mechanisms should provide for tourism guides and travel agencies in terms of instruction, which can help tourists to choose the time and destination for tourism (Rahimi, 2004). Of course, environmental protection makes ecotourism a kind of tourism, as the use of natural resources as a tourism attraction and without harming it, is an ideal concept in the direction of tourism sustainable development (Drum *et al.*, 2009).

Case Study

Hamedan province in the range area of 19491 square kilometers is on the west of Iran, between the geographic coordinates of 33degree and 59 minutes to 35 degree and 44 minutes of north latitude and 47

degree and 47 minutes to 49 degree and 30 minutes of east longitude from prime meridian. This province has 9 cities, 24 districts, 27 towns and 72 villages according to the latest divisions in 2009. This province is limited to Zanjan and Qazvin from north, to Lorestan from south, to Markazi from east and to Kermanshah and parts of Kurdistan from west. According to the results of population and housing census in 2011, the total population of province is 1758268 persons, which, 883436 were male and 874832 were female and also, from the total population, 1040605 persons lived in urban areas, 716669 persons lived in rural areas and 994 persons were nomads. In general, in result of the existence of mountains, rivers and springs of water and many postal and heights, the weather of province is variable, thus the weather of north valleys of Alvand mount is cold, rainy and snowy and in the summer is mild. Hamedan city is located in the eastern part of the province. This city has common borders with Malayer and Toyserkan cities on the south, Bahar city on the west, Razan and Kabudarahang cities on the north and Markazi province on the east. Geografical range of Hamedan, with an area of 2831 square kilometers, covered approximately 14.52 percent of the total area and placed between 34 degree and 36 minutes to 35 degree and 15 minutes of latitude and 48 degree and 27 minutes of longitude. According to the latest division in 2009, Hamedan has four municipal point (Hamedan, Maryanj, Juraqan and Qahavand) and two districts (Markazi and Shara) consisting of 9 big villages dividing into 114 residential villages (Iran statistical center, 2011).

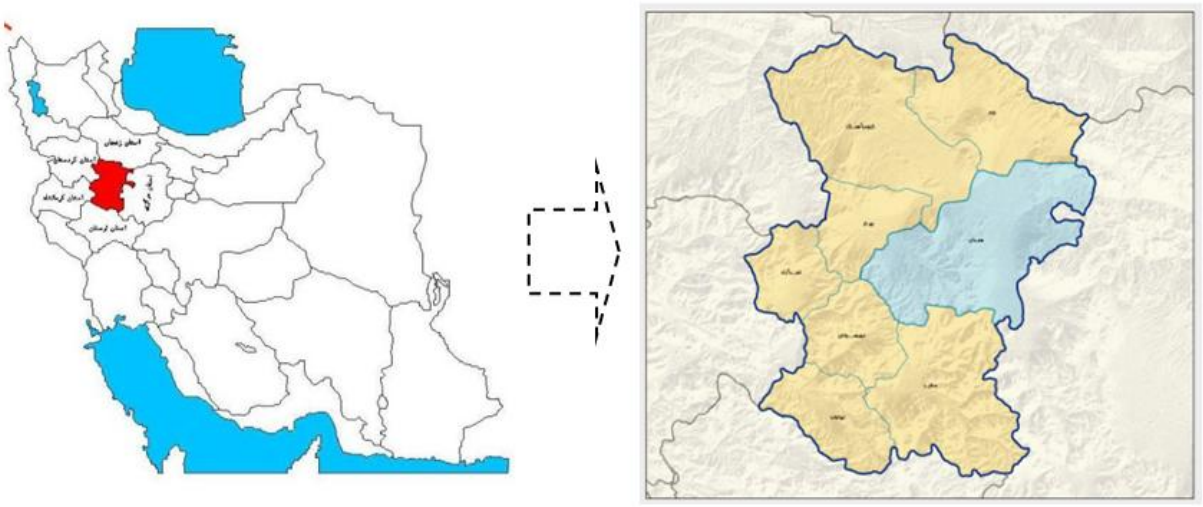

Figure 1: Location map of the study area (Source: Tourism and Urban Development Consulting Engineers Vaspur, 2012)

MATERIALS AND METHODS

The main objective of this research is to evaluating and analyzing the climatic conditions of Hamedan during different months of a year and determining tourism comfortable climate using TCI model. In this direction, using analytical-descriptive method, seven required climatic parameters on a monthly basis was extracted in synoptic and climatology stations of Hamedan, over a period of 20 years (1990-2010) and the necessary convert was applied to data according to the TCI model that the best possible time is determined in terms of tourism comfortable climate in this region. Tourism comfortable climate index using 7 climatic parameters, proceed to study the comfort conditions of tourism in terms of climatic in a region and determine the appropriate times and places for tourism in terms of climatic conditions (Mieczkowski, 1985).

In this index 7 variables are used, 1.the average of maximum daily temperature, 2.average of daily temperature, 3.minimum daily humidity (in percent), 4.average of daily humidity, 5.rainfall (mm), 6.total sunny hours, 7.average of wind speed (km/s or m/s). This seven variables constitute 5 sub-indicators in

TCI that using a standard rating system which its rate is from 5 (an ideal) to -3(exceptionally hostile), makes general basis for measuring any sub-index possible (Topay, 2007). In this regard, in order to determine the tourism comfortable climate index in one region, the following steps must be performed respectively:

Step One: Climate information extraction of each station including: daily average of dry temperature and daily average of maximum dry temperature in Celsius (per month), daily average of humidity and daily average of minimum humidity in percent (per month), the average amount of rainfall in mm (per month), daily average of the number of sunny hours (per month) and daily average of wind speed in k/h (per month).

Table 1: Sub-tables of the TCI and its value (Source: Mieczkowski, 1985)

Index	Climatic Variables	The index
CID	Mean daily maximum and minimum temperatures, relative humidity	40
CIA	Mean temperature and mean relative humidity	10
Rain(R)	Precipitation	20
Sunshine(S)	The number of sunshine hours	20
Wind(W)	Average wind speed	10

Step Two: Calculating daily comfort index (CID) is with two components, the maximum temperature and minimum humidity, which for calculating and estimating this index we use the thermal comfort assessment diagram, figure 2, that the intersection points of these two components shows the index score (CID) and also calculating circadian comfort index, which from the crosses of mean humidity and temperature, the initial coefficient of index calculated and for calculating and estimating circadian comfort index, use thermal comfort assessment diagram, too.

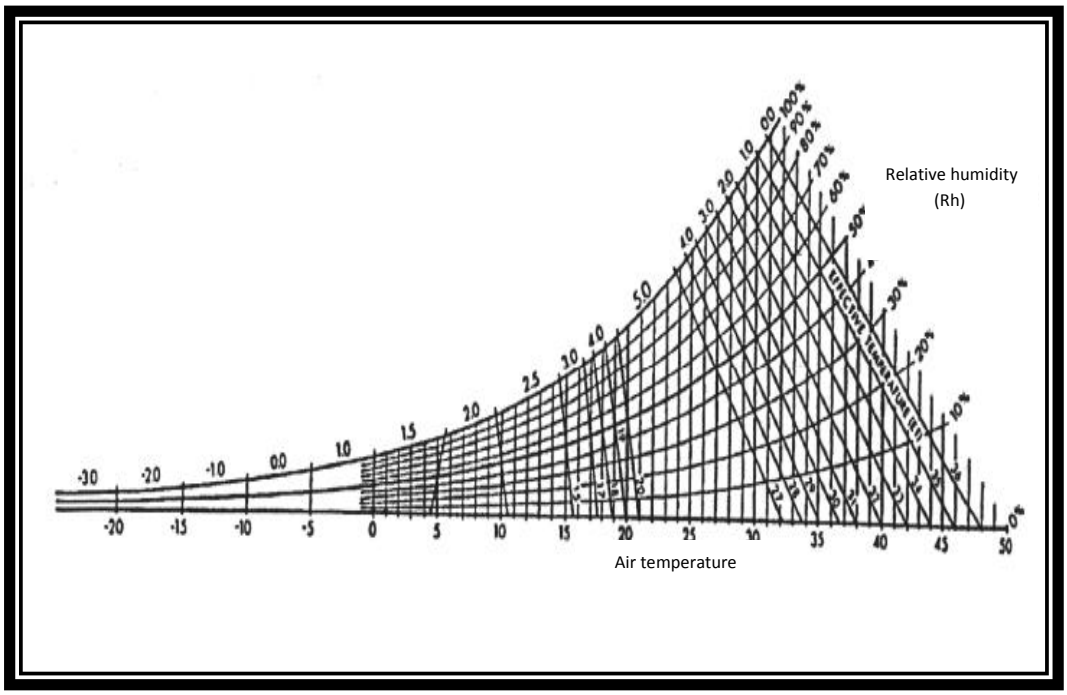

Figure 2: Graphs comfortable climate classification thermal comfort index for tourism (Source: Mieczkowski, 1985)

Step Three: Determination of rainfall rating for each station (R) based on table 2.
Extraction and precipitation of the month, which was in the range of the table, the coefficient on it. The final rate of precipitation is 20.

Table 2: By changing the classification of precipitation in Tourism Climate Index (Source: Mieczkowski, 1985)

Point Cloud	The total monthly precipitation
5	0 to 14.5
4.5	15 to 29.9
4	30 to 44.9
3.5	45 to 59.9
3	60 to 74.9
2.5	75 to 89.9
2	90 to 104.9
1.5	105 to 119.9
1	120 to 134.9
0.5	135 to 149.9
0	150 or more

Step Four: Determination of solar radiation rating for each station (S) based on Table 3.
It should be noted that the numbers of the table, shows the sunny hours depending on the day and if you don't get the daily sunny hours, you should divided the monthly sunny hours on the number of days of month, then put the number in the table and obtain the initial coefficient of sunny hours. The final coefficient of sunny hours is 20.

Table 3: By calculating the index of sunshine hours (Source: Mieczkowski, 1985)

Rating radiation	The number of sunshine hours per day
5	10 hours or more
4.5	9 to 9:59
4	8 to 8:59
3.5	7 to 7:59
3	6 to 6:59
2.5	5 to 5:59
2	4 to 4:59
1.5	3 to 3:59
1	2 to 2:59
0.5	1 to 1.59
0	Less than one hour

Step Five: Determination of wind rating based on Table 4 and three different rating for each station (W).
Estimation of wind score is different in various climates. For normal system, the average of maximum temperature should be between 15 to 24 Celsius degree, for Elyse system, the temperature should be between 24 to 33 and for Thermal system; it should be above 33 degrees.

Table 4: Ranking table measures wind speed (Source: Mieczkowski, 1985)

Wind speed in km / h	Normal system	Elise system	hot climate system
Less than 2.88	5	2	2

2.88 to 5.75	4.5	2.5	1.5
5.76 to 9.03	4	3	0.5
9:04 to 12:23	3.5	4	0
12.24 to 19.79	3	5	0
19.80 to 24.29	2.5	4	0
24.30 to 28.79	2	3	0
28.80 to 38.52	1	2	0
More than 38.52	0	0	0

Step Six: Calculating tourism climate index in different months for each station, using the following relationship:
TCI=2(4CID+CIA+2P+2S+W)
Step Seven: Determining the value of tourism comfortable climate index and identifying its relevant category for each station, using Table 5.

Table 5: Table values indicators, and describe a class of its comfortable climate for tourism (Source: Mieczkowski, 1985)

TCI scores	Rating	Description of the TCI
90 to 100	9	The idea
80 to 89	8	Excellent
70 to 79	7	Very Good
60 to 69	6	Good
50 to 59	5	Acceptable
40 to 49	4	Negligible- marginal
30 to 39	3	Inappropriate
20 to 29	2	Very Poor
10 to 19	1	Extremely unpleasant
9-30	0	Non-

RESULTS AND DISCUSSION

In this section, using weather station statistics of Hamedan, five TCI sub-indicators were calculated for each months of the year during the statistical period 1990-2010 and in the following forms, CIA and CID rates are specified through psychometric charts for each 12 months.

Table 6: table of statistics for each weather station Hamedan city Month (Source: Meteorological province, 2011)

	April	May	June	July	August	September	October	November	December	January	February	March
The mean maximum temperature	11	10.6	11.7	16.5	21.4	25.8	28.6	28.7	25.7	21.6	17.2	13.4
Average Temperature	7.3	7.2	8.8	13.2	18.3	22.6	25.2	25.3	22.5	18.1	13.5	9.5
Relative Humidity	84	85	87	86	84	81	79	81	84	85	85	85
Average minimum	64	62	67	66	64	67	65	62	65	64	64	67

relative humidity												
Sunshine Hours	10 4.9	100	91.1	122	165.2	187	186.5	162.1	122.9	118.8	108.4	96.3
The total daily rainfall	79	74.5	86.3	48.5	47.8	60.2	38	66	162.3	269.6	176.2	109. 4

After obtaining weather station statistics, each of the sub indicators of TCI are calculate for each months of year. In this regard, for calculating the coefficient of each element, there is a special table that we derive the coefficient of each element from them.

Table 7: By the following five TCI index for each month of the year in the city of Hamadan (source: authors)

The index	April	May	June	July	August	September	October	November	December	January	February	March
CID	2.4	2.3	2.5	3	4.7	4.2	3.5	1.9	4.2	4.9	3.5	2.6
CIA	1.8	1.7	1.8	2.3	3	4.8	5	5	4.8	3	2.4	2
Rain (R)	2.5	3	2.5	3.5	3.5	3	4	3	0	0	0	0
Sunshine (S)	1.5	1.5	1.5	2	2.5	3	3	2.5	2	2	2	1.5
Wind (W)	4.5	3.5	3	3	3	3	3	3	3	3.5	4	4

– According to the climatic characteristics of Hamedan, in terms of daily comfort index (CID), i.e. when the tourists have the highest level of activity, in this regard, the city has the best conditions in the months of May, June, October and September.
– Circadian comfort index (CIA), which actually includes the sleep hours, in this city has the best condition in the months of September, August, July and June.
– Rainfall (R), given that this factor is considered as a negative factor in tourism climate and low rainfall is considered as an advantage for tourism climate, in this regard, whatever the score go toward 5 is more ideal, so in Hamedan the rainfall has zero coefficient in the months of September, October, November and December and is the worst case may be and in compared to other months has good rainfall in July.
– Solar radiation rating (S), is a positive direction for tourism and due to the risk of sunburn and discomfort in hot days has a negative effect. In this regard, according to the information of related table, Hamedan in the cold months of the year has the lowest radiation and in the hot months has the highest solar radiation rating.
– Wind (W), that its effect depends on the temperature. Indeed, the cooling effect of wind on a warm climate is positive, while the frosting effect of wind on a cold climate is negative. In this index tending from zero to 5 is the ideal, so, in this direction, Hamedan enjoy from the best conditions in the months of January, November and December.

In order to achieve the end result of TCI model and to identify the best climatic month for tourists in Hamedan, the data of above tables that are related to the sub indicators, are inserted to the following formula that finally, the amount or the value of TCI index has been calculated for each months of each city and according to that, we set the tables of calculated TCI index values.

$TCI = 2(4CID + CIA + 2P + 2S + W)$

Table 8: by the TCI index for each month of the year in the city of Hamadan (source: authors)

	April	May	June	July	August	September	October	November	December	January	February	March
Hamedan	72.8	76.8	55.6	56.6	43.6	63.2	72	53.2	47.2	33.2	30.8	48.8

Table 9: Table describing the TCI index for each month of the year in the city of Hamadan (source: authors)

	April	May	June	July	August	September	October	November	December	January	February	March
Hamedan	Very Good	Very Good	Good	Good	Acceptable	Good	Very Good	Good	Acceptable	Inappropriate	Inappropriate	Acceptable

After calculating the final formula, the value between -30 to 100 is obtained for index, which represents the quality of tourism climate of a region. The final result is obtained from Table 5. The obtaining final value should be matched with the table and ultimately, the quality of tourism climate is characterized. Point 100 is an ideal and desirable conditions and the amount of dissatisfaction and adverse climatic conditions for tourists is increasing toward values less than ideal conditions.

According to the sub indicators rating and the results of TCI index, in the following Table, the descriptive value of each months of a year for Hamedan is shown and indicated that the comfortable climate for tourism is in the ideal conditions in the months of April, May and October, in comparison to other months of a year.

Conclusion

The effect of climatic factors on tourists satisfaction is increased the sensitivity and importance of choosing the right place for tourist. Therefore, a clear view of climatic power and bioclimatic comfort in geographical tourist's zones will have an important role in tourism planning and management and also, the increasing of tourists demand.

Obviously, travel and departure to the tourism destinations without proper information about climatic and comfort conditions can bring numerous problems for tourists (thermal stress, air pollution, the effect of ultraviolet and etc). Hereof, notifying of weather conditions and having climatic comfort in tourism destinations are the main objectives of tour guides and tourism planning, which protect tourist and especially vulnerable (elderly, patients, disabled and children) from the risks of mentioned issues. Therefore, today a large parts of the tourism literature is focused on the economic consequences of tourism and its positive role on job creation and climate and climatic comfort have deep ties with attraction of tourists and the increasing of tourists demand.

Among the west mountainous cities of the country, Hamedan, with lots of attractions and beautiful nature, has the potential to become the hub of tourism in Iran and even in world. This city, according to its numerous capabilities to attraction of tourists, wants to recognize and assess the comfortable climate with accepted scientific methods that systematically determine the effect of climatic factors on tourists activities and its potential and climatic capabilities used by tourists, tour operators and planners of agencies. In this study, Hamedan climatic conditions was evaluated based on TCI model for tourists in

terms of climatic comfort and the result was that the desirable period of comfortable climate in Hamedan during the months of April, May and October is very well, in the months of Jun, July and November is good, in the months of August, December and March is at an acceptable level and in the months of January and February enjoy from the improper tourism climate conditions.

In this regard, given that the most areas of the country in hot seasons are in unfavorable comfort conditions, this can be considered as a potential for tourism development in this area. Therefore, the following methods and suggestion can be offered for achieving a sustainable development of Hamedan's tourism, according to tourism comfort climate of a region:

– Notifying and introducing areas and tourism potential through billboards and publishing books aimed at tourism
– Designing tourism sites to inform the public and create a schedule of ecotourism based on climatic conditions of seasons and months of a year for the region
– Appropriate management and program planning for conservation and sustainable development of tourism
– Considering tourist areas of the region, which are anonymous in terms of tourism climate and to strengthen and enhance these areas as tourism centers
– Designation and implementation of a comprehensive plan for TCI in tourism and virtual tourism networks in the region
– Organizing tourist camps in areas of good weather
– A comprehensive study of climatic based on tourism suitable conditions for city
– Introduction of publication and ecotourism potential of the area of expertise
– Creating proper infrastructure in sustainable tourism at the regional level
– Creating nature tours in the city in order to identify additional aspects of the ecotourism
– Further action of hiking committee and coordination with city sports committees
– Coordination of organizations involved in hiking and city leisure and etc.

ACKNOWLEDGEMENT

We are grateful to Islamic Azad University (Hamedan Branch and Central Tehran Branch) and University of Kharazmi Authorities, for their useful collaboration.

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