ORIGINAL ARTICLE

Prediction of Suitable time for Touring in Ahwaz, Using Predicted Mean Vote (PMV)

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ABSTRACT

In this research, long term statistical period diurnal data have been evaluated to determine the comfortable climate of Ahwaz (1990-2010). The variables include: meteorological variables (temperature, humidity, amount of cloud in the sky, pressure and wind) and individual variables (weight, height, age and gender). The results of the study achieved through Ray Man model and predicted mean vote (PMV), shows that the comfortable climate period in Ahwaz continues from November 6 to March 3, for 118 days. While other days of the year, for 247 days there has been severe heat stress. Obviously, Ahwaz has comfortable and suitable conditions during the cold seasons of the year and is the best destination for tourists in the winter, which requires managerial planning in the tourism industry.

Keywords: Predicted Mean Vote (PMV), Tourism climate, Climate comfort, Ahwaz

INTRODUCTION

Nowadays tourism industry is developing into one of the most important and most lucrative industries worldwide. It is producing 10% of DGP and is providing the very same portion of employment globally[1]. From 1950 to 2007 the number of international travelers increased from 25 million to 903 million and the resultant income surged to 865 billion. Consequently, it is also predicted that the number of travelers will have reached to 1.6 billion in 2020[2,3]. However, despite the fact that Iran is among top ten countries considering tourist attraction and among top five countries regarding variety of tourist activities, it is at the bottom of the list considering tourist travelling to this country[4]. Climate is one of the most important natural indexes in tourism development. Thus, climate is counted as fundamental or complementary factor[5]. Tourism is heavily depended on weather and climate in such a way that fair weather and climate knowledge of destination play a key role in tourism industry and they can be attracting or off putting factors for tourists[6]. Climate and tourism are closely related and the relationship between these two is indicated whereby "Climate Comfort Index". All places depending on their geographical climates have their respective potentials, attractions and limitations for tourists [7]. Over the past decade availability of data and development of softwares and ingenious techniques have made data processing possible[8] whereby we can evaluate the maximum effect of climate on humans and their habitats.

In this regard Rayman which is an improved model calculates the average radiant temperature and thermal indexes in simple and complex environments based on the data from weather stations and climatic elements such as temperature, humidity and wind speed [9]. This model can be used to evaluate urban bioclimate and thermal indexes including (PET), Standard Effective Temperature (SET), Predicted mean Vote (PMV). The model has been developed in Germany according to international guidelines between atmosphere and short-and-long-wave fluxes. Rayman model is a manned model for evaluation of biometeorological weather quality, urban and regional planning at micro and macro level [10]. Sari Sarraf et al [11], in a paper zoned climotourism in Arasbaran region according to Tourism Climate Index (TCI) and concluded that in May, June, July, August, and September there is ideal climate comfort and in late November to late February- in monitored stations-the index is absent. Ranjbar et al [12], in a paper studied the relation between climatic conditions and annual tourism trend in the city of Marvdasht. Results revealed that in cold season –January, February, March, and December due to rain and temperature drop the conditions are unfavorable for tourism. While in spring and fall, April, May, October, and September because of moderate weather conditions and the cease of rain the conditions are
desirable for tourists. Ataei and Hashemi Nasab [13], in a research pointed out that according to (PET) model in September to October and considering figures based on (PMV) in October and November the city of Semnan has favorable climatic conditions. While in other months varying degree of thermal stress was insignificant. Ezzatiyan and Mohammadzadeh [6], in a paper studied the tourism climate in the province of Mazandaran using (TCI). Results reveals that June is the ideal month followed by July, August, September and May. Simpson & al 2008 [14], studied the trend of climatic changes all over the world and the effects of respective climate changes on tourism. As their results revealed, in many region climatic changes have adverse effect on tourism. Deb & et al. [15], in a paper titled "A Study on Thermal Comfort in Indian Railway Terminal” pointed out that one of the most important aspects considering passengers’ satisfaction in these places is a moderate ambient temperature. Hence, they utilized (PET) and evaluated the passengers’ satisfaction at stations in south of India in June and finally proposed to incearse the height of ceilings and doors in these terminals so as to provide the passengers with satisfaction. Matzarakis and Fraj Zadeh [16], in a paper titled "Introducing the Weather Elements in North-West Iran" mentioned that all stations in north-west Iran has a month with (TCI) over 80 which can be considered ideal index comfort. For instance, the stations in the cities of Mako, Ardebil, and Takab have ITCs over 90 which are ideal for summer. From among these cities Ardebil has the most desirable for tourists in summer. The stations in the cities of Mahabad, Jolfa, Saqez, and Pars Abad have two different short-term distributive peaks. Moreover Uromieh Lake is suitable for tourists in June, July and August. Matzarakis & et al 17], in a paper titled "The evaluation of Bioengineering of Human Climatology Resultant from Heat and Death in Vienna- Austria" concluded that there is a correlation between thermal biology and human thermal physiology which obviously shows that the more the thermal stress, the more the death. Besides, the research also points out that in order to reduce the thermal stress on human health, more compatibility with surroundings is desired. Furthermore, to offer a fitting description from effective thermal environment on humans’ body, we need to study the short-term compatibility, human parameters and international organizations at different periods. Ataei and Hashemi Nasab [18], in a research titled " The Evaluation and Zoning of Human Bioclimate Maps of the Province of Semnan" using Terjung model concluded that the bioclimate maps of Semnan province in summer and winter are significantly different regarding the number of predominant types. The study shows that three are only three types in winter and 7 types in summer. The predominant types are 5 in spring and 3 in fall in this bioclimate. Clayskan & Matzarakis, [19], in a study titled "The Effect of Altitude on Thermal Climate Conditions in Bursa and Avd in Turkey" concluded that in areas lower than 1778 meters in summer from August to July pets and people suffer from environmental thermal stress and in winter from November to March lower level of cold stress at 12-9 centigrade occurs.

The purpose of the present paper is to evaluate tourism climate in the city of Ahwaz on daily bases over a year using (PMV) so as to study the effective parameters on tourist activities and poten tialities in this city.

MATERIALS AND METHODS
In this study climate analysis and statistics are used. First, the data from Ahwaz weather station over Twenty years (1990 -2010) and climatic parameters of average dry temperature in Celsius, average dry temperature in percent, average wind speed in meter per second, average of vapor pressure in HectoPascal, the cloud amount in Octa were used. Then the obtained data were fed into "Excel”. Next, considering compatibility with (PMV) method they were fed into Ray man and finally the outputs were analyzed.

(PMV) index:
PMV scale is a kind of 7° C thermal sensation classification which its range changes from -5/3(cold) to +5/3(warm). In this scale, Zero represents a neutral thermal sensation (table 2). Softwares are designed to calculate this index easier and faster than before, Ray Man is one of them. Required variables to determine PMV index are divided into four categories:
- Situational variables, including latitude and longitude, and altitude meteorological variable
- Individual variables, including physiological characteristics of height, weight, age and gender
- Variables related to the type of coverage and activity Rayman modal applies to calculating the index
Related to PMV method, calculations are accomplished by the following equations and then numerical values are extracted from the table (1).
Table (1) models of balance energy for individuals based on PMV

<table>
<thead>
<tr>
<th>Equation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $PMV = (0.303e^{-0.039M} + 0.028)((M-W)H-E_c - C_{rec}E_{rec})$</td>
<td>Equation (1)</td>
</tr>
<tr>
<td>(2) $E = 3.05 \times 10^4 (52T_{sk} - 3573 - P_a) + E_{sw}$</td>
<td>Equation (2)</td>
</tr>
<tr>
<td>(3) $E_c = 3.05 \times 10^3 (5733 - 6.99(M - W)P_a + 0.42(M - W - 58.15)$</td>
<td>Equation (3)</td>
</tr>
<tr>
<td>(4) $C_{rec} = 0.0014M(34 - T_a)$</td>
<td>Equation (4)</td>
</tr>
<tr>
<td>(5) $E_{rec} = 1.72 \times 10^{-3} M(5867 - P_a)$</td>
<td>Equation (5)</td>
</tr>
<tr>
<td>(6) $H = K_{cl} - T_{sk} - T_{cl} / T_{cl}$</td>
<td>Equation (6)</td>
</tr>
</tbody>
</table>

$C_{rec} =$ Convective exchange of transpiration (W/M²)
$E_{rec} =$ evaporative heat exchange of transpiration (W/M²)
$E_c =$ evaporative heat exchange at the skin surface when heated in neutral (W/M²)
$E_{sw} =$ evaporative heat loss of transpiration (W/M²)
$M =$ metabolic rate (W/M²)
$T_{cl} =$ surface temperature of clothing (C)
$T_{sk} =$ mean skin temperature (C)
$W =$ effective mechanical force (W/M²)
$E =$ evaporative heat exchange of the surface of the skin (W/M²)
$H =$ dry heat loss in forms of convection, conduction, radiation (W/M²)
$P_a =$ moisture, slight vapor pressure of air (hp)
$T_a =$ air temperature (C)

Table (2) threshold values of PMV

<table>
<thead>
<tr>
<th>PMV</th>
<th>Thermal sensitivity</th>
<th>Degree of physiological stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3/5</td>
<td>Cold</td>
<td>Severe cold stress</td>
</tr>
<tr>
<td>-2/5</td>
<td>Cool</td>
<td>Men cold stress</td>
</tr>
<tr>
<td>-1/5</td>
<td>Slightly cool</td>
<td>Low cold stress</td>
</tr>
<tr>
<td>-0/5</td>
<td>Comfort</td>
<td>No-cold stress</td>
</tr>
<tr>
<td>0/5</td>
<td>Slightly warm</td>
<td>Low heat stress</td>
</tr>
<tr>
<td>1/5</td>
<td>Warm</td>
<td>Mean heat stress</td>
</tr>
<tr>
<td>2/5</td>
<td>Very warm</td>
<td>Heat stress</td>
</tr>
<tr>
<td>3/5</td>
<td>Hot</td>
<td>Severe heat stress</td>
</tr>
</tbody>
</table>

Source: Razjouyan (1988)[22]

The Region studied
The city of Ahwaz, the center of Khuzestan province. Latitude: 30° 20’ Longitude: 48’ 48’. Located in a plain 18 meters above the sea level in north west Iran. Area: 10556 km². In north and north east confined by Dezful, Shoshtar, Ramhormoz and in west by Dasht-e-Azadegan and in south by Khoramshahr [20].

Map 1: Location of Ahwaz
DISCUSSION AND CONCLUSION

After entering the variables into the model, the final output of Ray Man software is presented by a matrix with the dimensions of 365 days used in drawing the diagram of changes of variables under study. Mean values of PMV for each day of the year, calculated by Ray Man software, are presented in 1 diagram. According to the thresholds defined in table (2), if the index values in Ahwaz are between -5.1 and -5.0, the thermal comfort will dominate in the region; and if the index values are between -5.3 to -5.3, there will be severe cold stress for negative state and severe heat stress for positive state. According to this classification, there are different conditions during the year in Ahwaz so that based on the output of PMV model, there is no-stress condition; and according to the thermal sensation, comfort and slight coldness dominate the region which limits to 118 days. Thus, favorable conditions for tourism in Ahwaz are predicted in November, December, January and February. Low to mean heat stress is observed from March 4 to April 14. From April 15 to October 24, there is a severe heat stress which is not suitable for traveling in Ahwaz at all. The severe heat stress is reduced from October 26 to November 5, and in this period, there is the heat thermal stress. Therefore, according to PMV, the main problem of tourism climatology in Ahwaz is the long dominance of the heat stress period for about 247 days.

So that this decreases the city’s attraction for the purpose of touring and traveling in long period. Hence it is necessary that Iran traveling and touring organization and other relevant institutions and organizations, especially outside and inside tour operators pay more attention and precision to the time of tours and tourist attraction and devote a special place to this fact in their advertisement as a crucial component, so local and foreign tourists can use the city’s tourist attractions in a comfortable thermal environment.

REFERENCES


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