

## DETERMINING THE CLIMATE CALENDAR OF TOURISM IN SISTAN-BALUCHESTAN PROVINCE, IRAN

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**ABSTRACT** - Sistan and Baluchestan Province spans five degrees latitude, with variations in natural phenomena, with cultural and historical resources and beautiful beaches in the south that have a great potential in attracting tourists. To investigate the relationship between climate and tourism, the climate index has been developed so that data are presented showing the individuals' reactions to climate. The current study chose the tourist major cities of Iran and meteorological data was used to calculate the 20-year period up to 2012. In order to calculate the three climate indices (Predict Mean Vote - PMV, the Physiological Equivalent Temperature - PET and the Standard Effective Temperature - SET), RayMan software was used. These indices were then discussed and the spatial distribution of climatic comfort was represented in GIS environment. The most important national, religious, historical, and natural places in the province were presented and the climate calendar of tourism was identified. The results showed that tourism is concentrated in two periods, hot and cold. The cold period in southern cities such as Chabahar, Konarak and Sarbaz makes them tourist destinations, while the cities of Zahedan, Khash, Zabol, located at higher latitudes, are chosen tourist destination in spring and autumn. Summer has the highest thermal stress in the province.

**Keywords:** climate calendar of tourism, Sistan, Baluchestan, bioclimatic indicators

### INTRODUCTION

Weather and climate are known as a determining factor of tourism. In fact, climates have most dominant factors affecting international tourism flows (Burton R., 1995; Boniface B. and Cooper C., 1994). The comfort level is influenced by environmental and physiological factors. Environmental factors include air temperature, relative humidity, air velocity and mean radiant temperature, while physiological factors include metabolic rate and insulation (Gómez Martín M.B., 2005). To assess the impact of climate on human comfort, studies on climate models and indicators have been greatly developed in the second half of the twentieth century (Grigorieva E.A. and Matzarakis A., 2010). These indicators of climate data provide a form indicating their response to climate and climatic classification, from very good to very poor (De Freitas C.R., 2003). Serious attention is given to the issue of tourism as a new phenomenon in the twenty-first century and its importance is continuously increasing in the world (Butler R.W., 2002). Climate and physiological assessments in relation to the degree of comfort or lack of comfort felt in different areas are important in many fields such as tourism, urban planning, architecture, medicine and localization issues for planning tourism (Kaviani M.R., 1992). As a resource used by tourism, climate can thus be regarded as an economic wealth for tourism (De Freitas C.R., 2003). There is no doubt that water determines the main seasonality of the tourism phenomenon (Khaledi Sh., 2004). In addition, the spatial distribution of resources and tourism attractions in Sistan and Baluchestan Province follows the pattern of social and political developments affecting, on the other hand, the distribution of economic resources, infrastructure and administrative-political structures, but it also follows the pattern of the geomorphic structures and the nature of climatology

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(Ebrahimzadeh I. and Esmaelnejad M., 2013). Climate is an important criterion for determining the emergence of tourist centres and for the help given to a tourist town (Gómez Martín M.B., 2005).

Sistan and Baluchestan Province is one of the largest and with the most diverse natural and cultural aspects provinces in Iran that can be considered as a tourism hub. According to the climate characteristics, Sistan and Baluchestan Province is a transition region, with a tropical and extra tropical climate (Esmaelnejad M., 2005). Traditionally, the cold period of the year is generally selected for tourism, especially on the South Coast. Because of frost and cold weather, the cold period is usually the main obstacle to circulation in the province, especially in the northern half. Due to the presence of various types of climate in the province, the bioclimatic index was analyzed in order to identify a suitable climate for tourists throughout the year.

## METHODS

The National Weather Service climate data was presented for communities to absorb the public risk (for example, minimum risk and maximum benefit). Other government agencies and the private sector provide a variety of internal and external proper information to fit the needs of most users, especially of the recent users of customer service, communication access to specific geographical information and communication channels (WMO, 2002). Assessing the impact of climate on tourism is a multidisciplinary effort that includes a variety of ways, the reaction is not limited only to climatic factors but the adaptation process parameters and the feedback effects are also included (Zolfaghari, 1998). To study the tourism climate comfort, relatively complete meteorological data from synoptic and climate stations in eight provinces that have characteristics suitable for tourism were used to calculate the indicators and identify areas of severe climate for tourists. Meteorological data were provided for climate analysis and for the detection of climate comfort at selected stations in the province during the statistical period (1992-2013) for each station.

The data used to calculate the index are classified into three categories:

- ✓ The first group includes the climate factors such as altitude and latitude.
- ✓ The second group contains climate elements that can have many variations. The main elements used in this study are mean air temperature, minimum and maximum temperature (°C), minimum and maximum average relative humidity (%), the water vapour pressure (hPa), average monthly precipitation (mm), cloudiness (okta), wind speed (meters per second), sunny hours ... on monthly basis.
- ✓ The third group consists of variables related to human characteristics such as height, weight and coating so that some indicators such as the Physiological Equivalent Temperature (PET) are used (default data considered is for a 35 year-old man with a height of 175 cm and a weight of 75 kg).

The RayMan model, developed for the study of urban climates, is a useful tool for assessing the climate-tourism relationship and it answers the question (Matzarakys A., 2001) whether it is dependent on meteorological variables (temperature, humidity, level cloud in the sky, etc.; demographic variables (weight, height, age, and gender), situational variables (length, width, and height above sea level, geographic, other classified information, including the amount of clothes (by CLS) and the energy of human activities (in Watts). In case of data above average, the following comfort indices were determined: Predict Mean Vote (PMV), the Physiological Equivalent Temperature (PET) and the Standard Effective Temperature (SET) at selected stations every month. The indices were calculated by using the RayMan software, the database was created and environmental indicators were moved to GIS. The indices were mapped using the Inverse Distance Weighted (IDW) interpolation to produce raster layers using GIS software. A raster layer that represents the spatial distribution of climatic comfort was created in ArcGIS environment for each month. In order to determine the seasonal climate comfort and the right places for tourism, the obtained layers were combined using the fuzzy system tools for the zoning map. The types of fuzzy operators available are Fuzzy-AND, fuzzy-OR, fuzzy multiplication operator, fuzzy algebraic product and fuzzy algebraic sum (Parhizkar A., 1996). The synthesis tool, the Fuzzy Overlay tool, allows the analysis of a phenomenon likely to belong to several sets in an overlay analysis that takes into

consideration several criteria. It also determines the phase transition phenomena, the possibility of membership in certain sets and it also analyzes the relationships between the members of the multiple sets. The method allows the exploration of the membership of each cell belonging to different input criteria (ArcGIS Help, 2010).

The choice of a time and place with comfortable climate conditions for travelling can have a positive effect on the quality and quantity of tourism. When benefiting from a favourable weather during the trip, tourists are more willing to stay and repeat trips. On the contrary, unfavourable climatic conditions create a negative experience. A good access to climate data and the comparison between components determine the terms of quality so that the target selection of a comfortable climate during holidays is effective in selecting an appropriate location (Hejrati M.H. et al., 2010).

**Table 1.** Specified threshold index (PET / PMV / SET)

PET	SET	PMV	Specified threshold index	
+41	+30	+3/5	Excessive thermal stress	
41-35	27/5-30	3/5	High thermal stress	
35-29	25/6-27/5	2/5	Moderate thermal stress	
29-23	22/2-25/6	1/5	Low thermal stress	
23-18	17/8-22/2	0/5	No stress	
18-13	15/5-17/8	-0/5	A slight cold stress	
13-8	1/67-15/5	-1/5	Moderate cold stress	
8-4	-10-1/67	-2/5	High cold stress	
Less than 4	-20-(-10)	-3/5	Excessive cold stress	

Source: Matzarakis A., 2010

**RESULTS**

The findings show that during periods of climatic comfort, the appropriate time is short and the cities of Sistan and Baluchestan Province have different time intervals. These periods occurs in winter, spring, and autumn. Most domestic and foreign tourists are willing to enter the province in the cold season and travel to areas with temperate climate (Ismaili et al., 2012). The assessment of climate comfort features after calculating the PMV index shows that, in Chabahar, there are periods without climatic stress for three months, in March, October and November. In January, February and December, all cities are characterized by climatic stress due to cold temperatures, but in Chabahar, Konarak and Iranshahr these circumstances are minimal. In the months of June to August, all cities undergo high heat stress. In the cities of Saravan, Zahedan, Khash, Zabol and Zahak, there is climate comfort in May. In September, with the exception of Chabahar, Iranshahr and Konarak, there is no thermal stress recorded at the other stations.

**Table 2.** Monthly classification of PMV index for cities

Zahak												
Konarak												
Zabol												
Khash												
Iranshahr												
Zahedan												
Saravan												
Chabahar												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

As for the PET index, it results that in Chabahar, the climatic stress is concentrated during the cold period of four months. The other months are characterized by moderate to high heat stress. The comfort features of Konarak are almost similar to the city of Chabahar. Saravan is characterized by low to high cold stress in the autumn months. It is only in the early spring, during the months of April and May that comfort conditions occur. In the other spring and summer months, there is low to high heat stress. In Zahedan, April and May are the months without climatic stress, while the other months have high cold stress. Late autumn to December and late winter to March are the periods when Iranshahr experiences stress. There is no stress for Khash in May and September, but during the late summer and the other seasons, there is extreme cold and heat stress. May and September are of no climatic stress for Zabol. Zahak has also the comfortable climate conditions of Zabol.

**Table 3.** Monthly classification of PET index for cities

ZAHAK	Blue	Blue	Light Blue	Cyan	Green	Orange	Orange	Orange	Yellow	Light Green	Light Blue	Blue
KONARAK	Cyan	Cyan	Green	Yellow	Yellow	Orange	Orange	Orange	Green	Light Blue	Light Blue	Blue
ZABOL	Light Blue	Light Blue	Light Blue	Light Blue	Green	Orange	Orange	Orange	Green	Light Blue	Light Blue	Blue
KHASH	Light Blue	Light Blue	Light Blue	Light Blue	Green	Orange	Yellow	Yellow	Green	Light Blue	Light Blue	Blue
IRANSHAHR	Light Blue	Light Blue	Light Blue	Green	Yellow	Pink	Red	Orange	Yellow	Green	Light Blue	Blue
ZAHEDAN	Light Blue	Light Blue	Light Blue	Light Blue	Green	Green	Yellow	Yellow	Green	Light Blue	Light Blue	Blue
SARAVAN	Light Blue	Light Blue	Light Blue	Light Blue	Green	Green	Yellow	Yellow	Green	Light Blue	Light Blue	Blue
CHABAHAHAR	Light Blue	Light Blue	Green	Green	Yellow	Yellow	Yellow	Yellow	Green	Green	Light Blue	Cyan
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

The SET index calculated for the province shows that the thermal sensitivity peaked during the warm period. The heat stress peaks in Iranshahr. During the months of January, February, November and December cold stress prevails in the province. In autumn and early spring, the value of the heat stress ranges between 17/8 to 22/2 in most areas and cities. It represents a period with no heat sensitivity.

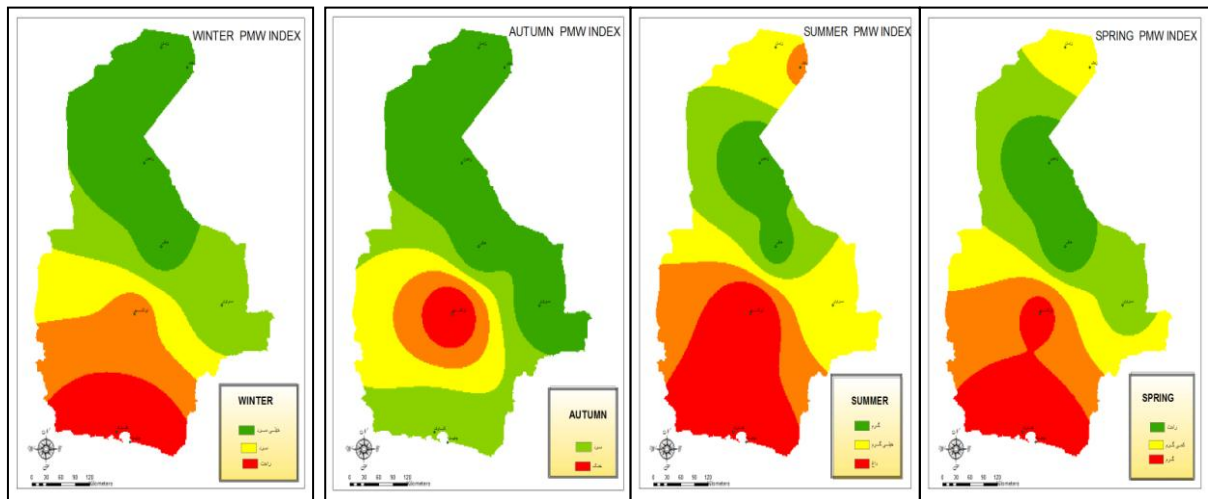
**Table 4.** Monthly classification of SET index for cities

ZAHAK	Blue	Blue	Light Blue	Cyan	Green	Orange	Orange	Orange	Yellow	Light Green	Light Blue	Blue
KONARK	Cyan	Cyan	Green	Yellow	Yellow	Orange	Orange	Orange	Green	Light Blue	Light Blue	Blue
ZABOL	Light Blue	Light Blue	Light Blue	Light Blue	Green	Orange	Orange	Orange	Green	Light Blue	Light Blue	Blue
KHASH	Light Blue	Light Blue	Light Blue	Light Blue	Green	Orange	Yellow	Yellow	Green	Light Blue	Light Blue	Blue
IRANSHAHR	Light Blue	Light Blue	Light Blue	Green	Yellow	Pink	Red	Orange	Yellow	Green	Light Blue	Blue
ZAHEDAN	Light Blue	Light Blue	Light Blue	Light Blue	Green	Green	Yellow	Yellow	Green	Light Blue	Light Blue	Blue
SARAVAN	Light Blue	Light Blue	Light Blue	Light Blue	Green	Green	Yellow	Yellow	Green	Light Blue	Light Blue	Blue
CHABAHAHAR	Light Blue	Light Blue	Green	Green	Yellow	Yellow	Yellow	Yellow	Green	Green	Light Blue	Cyan
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Based on the monthly raster layers, seasonal maps were created by using the Fuzzy Overlay Program in GIS environment (Figure 1). Thus, the northern half of the province is cold, with the exception of Sistan in spring. Sarbaz and Sistan are slightly warm, while the weather is hot in the southern province. Therefore, the areas of Zahedan and Khash are perfect for travel. Intense heat occurs in the south in summer and is hot in the north. Spring comes with cold weather in the northern half of the province, in northwest and in the centre, and a cool area is created in the southern province of Iranshahr. In winter, south is the perfect spot for a trip as the northern weather is extremely cold.

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In autumn, most areas of the province are the least stressful. There is low thermal stress and a cooling phenomenon is common for most of the areas. Thermal stress in the southern half is slightly moderate. However, it is in the northern half that cold stress prevails. The travel destination hotspots in winter are the south of the Makran coast and Chabahar. The climate of the area is moistened for 200 km from the coast and there are favourable conditions. As we move to higher latitudes, cold stress rises and reaches its peak in Khash and Zahedan.



**Figure 1.** Zoning by climate comfort based on PMV index in winter, autumn, summer and spring

The climate-tourism survey in Sistan and Baluchestan Province, based on different indicators, led to the Calendar for convenient travel throughout the province, which was confirmed by several indices. These calculations showed that the weather conditions of four to five months a year that characterize the southern cities of the province, such as Sarbaz, Nikshahr, Chabahar and Konarak have an important influence on the travel direction in the cold period. Early spring in April is the best month to travel to many cities. Cities such as Zahedan, Khash, Zabol, Iranshahr and Saravan are prone to travel in April.

**Table 5.** Destinations recommended for each month based on the evaluation criteria in terms of quality, comfortable climate

Months Appropriate for Travel	Tourism Destinations
Apr., Jan., Feb., Mar., Dec.	Chabahar
Apr., Sep., Oct., Nov.	Zahedan
Apr., May, Sep., Oct.	Khash
Mar., Apr., Oct., Nov.	Zabol
Nov., Mar., Apr.	Iranshahr
Nov., Mar., Apr.	Saravan
Apr., Dec., Jan., Feb., Mar.	Konark
Mar., Apr., Oct., Nov.	Zahak

In the case of Iranshahr, Khash and Zahedan, it is somewhat convenient for travel in May. In June, July and August there is no tourism demand and many other areas in Khash and Zahedan located at the foot of the Taftan Mountains and in the highlands are not suitable for tourism because of the local climate. As for Zahedan and Khash, the suitable climate for the travel is in late September.

In autumn, in October, Khash and Zahedan, Zabol and Zahak have comfort for climate tourism. In November, Iranshahr, Zabol, Saravan and Zahak are characterized by comfort climate and there is less thermal stress.

In December, Chabahar, Konarak, Sarbaz, Iranshahr and Nikshahr have the least sensitivity to heat. Coastal cities such as Chabahar and Konarak have minimal thermal stress in February because of low latitude - sea effect. In March, most cities, except for Khash and Zabol, undergo periods of heat stress. The Travel Calendar resulted from the Tourism Climate Comfort, investigated by means of various indicators, and the trips to places of national, religious, historical, and natural importance is presented in Table 6 and Table 7.

**Table 6.** *The Calendar of climate - tourism, trips to places of national, religious, and historical importance*

<b>National, religious and historical sites Tourist attractions</b>	<b>Travel time (Month)</b>
The traditional village of Balal Abad	Apr., Dec., Jan., Feb., Mar.
Tiss Old Castle	Apr., Jan., Feb., Mar., Dec.
PisHin Old Castle	Dec., Oct., Apr.
Archaeological site and dome of Seid Omar	Mar., Oct., Apr.
Irاندegan Castle	Apr., May, Sep., Oct.
Bampour Castle	Nov., Mar., Apr.
Godvarh of Sikhism	Apr., Sep., Oct, Nov.
Khajeh Mount	Mar., Apr., Oct., Nov.

**Table 7.** *The Calendar of climate – tourism, trips to places of natural importance*

<b>Natural sites Tourist attractions</b>	<b>Travel time (Month)</b>
The Summer region of Ladiz and Tamin	Apr., Sep., Oct., Nov.
The Mud volcano of Aden and Borborak	Apr., Dec., Jan., Mar., Dec.
The Protected areas of Gando and river of Sarbaz	Mar., Dec., Apr.
Citrus trees, groves, orchards of Ghasreghand	Mar., Oct., Apr., Dec.
Green valleys and fertile of Damen	Oct., Mar., Apr.
Blue waters, Mud volcano miniature mountains	Apr., Jan., Feb., Mar., Dec.
Taftan complex (and mineral hot springs and mountains and valleys that Taftan)	Apr., May., Sep., Oct.
Half the wells and lakes of Hamoun (Hirmand and Saberi)	Mar., Apr., Oct., Nov.

## CONCLUSIONS

Climate is also used as a concept in decision-making and tourism vacation experience. Climate has value and global importance in determining the degree of attractiveness and in motivating tourists to choose a certain holiday trip destination and plan the duration of stay. Travel models are affected by climate (according to international and local holidays) and reflect satisfaction in tourism. Tourists have to know climate in order to plan a stable and desirable long trip to destination in the context in which Sistan and Baluchestan Province, located in the south-east of Iran, has a high diversity of anthropogenic and natural tourist attractions. There is a variety of unique natural phenomena such as mud volcanoes, Taftan volcano, beaches and pristine natural landscapes with high tourism potential.

In addition, the appropriate time for travel to each region can be determined to assist tourism planning. All indices show that travel in Sistan and Baluchestan Province can be classified. In winter, the whole area undergoes cold stress with the exception of the cities located in the south such as Konarak, Chabahar and Nikshahr, which have no stress and become travel destinations. In early spring, especially in April, most of the areas are prone to travel and visit. The unfavorable season for travel is summer, according to all indices of the province. The mountain areas of Zahedan and Khash are a travel destination for tourists only at the end of the season, in September. Coefficients of various indices showed a gradually cold autumn, characterized by low thermal stress, but most cities can reverse travel destination for tourists.

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