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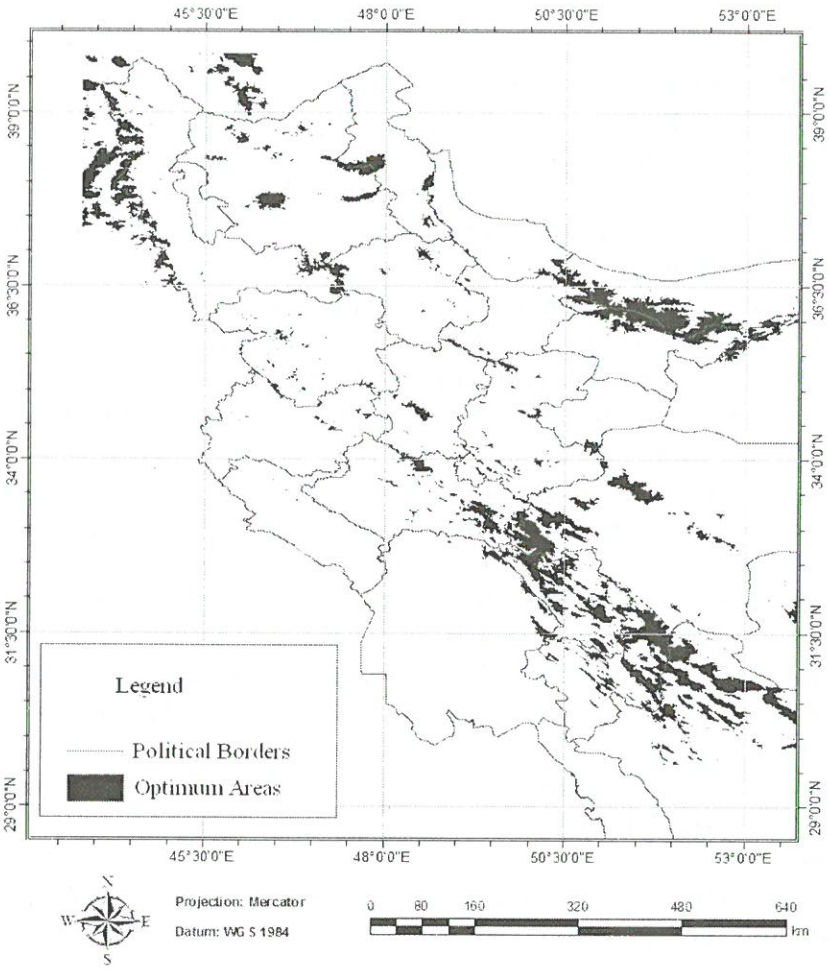

Figure 1.Optimum areas for development of ski runs based on suitable days for skiing.

Optimum areas for this activity are basically located in Elborz ranges between Tehran and Mazandaran provinces and mountainous areas of Chaharmahal.

Based on this equation, correlation coefficient turned out to be 0.83.

Another prerequisite for skiing is associated with annual snowfalls. Most of the studies insist on 500 centimeters and above as an appropriate figure. Correlation between annual snow falls and altitude were made out of the following equation:

$y = ax^2 + bx + c$

Where

Y=annual snowfalls in centimeter

X=elevation in meter

a , b , and c are the equation Parameters with the corresponding values of 9.10^{-5} , $0-.01582$, and 158.84 .

Fairly high Correlation coefficient (0.72) supports this relationship.

Another criterion for ski resort development is associated with altitude restriction. As already mentioned the minimum altitude good for skiing is above 750 meters. This study suggests that with the exception of Caspian regions, most of western and North-western provinces are suited regarding skiing.

Overlaying of these three layers led to the final map demonstrates areas suitable for development of ski resort (figs 1).

Evaluation of snow ski development in Iran

In order to evaluate the ski resorts capability development in Iran, 90 synoptic possibly mountainous stations located in central, western, Northern, and North-western provinces of the country were selected.

Snow ski run development is associated with daily snow depth, daily and annual snowfalls, daily precipitation, wind speed pertaining to 12 o'clock according to Greenwich Time, and maximum daily temperature.

However, reliable snow depth and snowfalls are virtually non-existence in Iran.

Based on these deficiencies, manipulated data were utilized in this study. As such, present air parameters which indicate the status of each synoptic station weather conditions, daily average temperature and precipitation were used for reckoning the amount of daily snowfalls. Fatahi , Qayoor& Mosayebi believe that daily mean temperature below 2°c would turn rainfall into snow (Fatahi , 1998 , Qayoor & Others , 2004 , and Mosayebi , 1998) .

As such, every millimeter of daily rainfall would be equal to 1 centimeter of snow.

Snow depth for each station was calculated using snow cumulative value subtracted from daily snow melting rate.

Relatively ideal conditions for snow skiing are attributed to the following statistics: Minimum snow depth of 10 centimeters, 2.00 pm [1] wind velocity equal or less than 8m/s. Maximum temperature equal or less than 8 degree centigrade.

Annual number of skiable days for each station was determined. This is followed by determination of relationship between numbers of skiable days and altitude:

$$y = ax^2 + bx + c$$

Where

y= number of skiable days

x= Amount of elevation

a, b ,and c , are the equation parameters with value of 2×10^{-5},–0.0374 and 22.981 respectively .

1 -Due to lack of 2.00pm wind velocity,3.30 pm wind velocity were substituted

eliminated (40-100% reduction) under a doubled atmospheric carbon – dioxide climate change scenario (Harrison. et al, 1986).

Patrick O'Donnell, recently referred to climate change as the 'most pressing issue facing the ski industry today' (Erickson, 2005).

Winter tourism and the ski industry more specifically, have been repeatedly identified by governmental climate change assessments (Canada Country Study, 1998; ACACIA 2000; Intergovernmental Panel on climate Change (IPCC), 2001; US National Assessment Team, 2001; WTO, 2003).

In Scotland the skiing industry is likely to experience increased numbers of snow – deficient winters which will impact adversely on the financial viability of the industry. (Harrison and Winterbottom 2001).

The number of skiable days in southern Quebec would decline by 42 – 87 % (Canada country study, 1998).

Cline, estimated a 2.5 °C warming would reduce the length of the ski season across the United States by 60% and cause economic losses of approximately U S$I. 7 billion annually (Cline 1992). Resorts making multi – million dollar investments in snowmaking technology in order to reduce their vulnerability to current climate variability and increase the average length of their ski seasons.

In Scotland the warm winter of 1991 / 92 saw a reduction in the numbers of skiers visiting Glenshee to only 20% of what would be regarded as necessary to maintain viability (Climate Change Impacts Review Group, 1996).

Mohnl has shown that there is a statistically significant trend in snow cover reduction in the Alps over recent years (Mohnl 1996). Burki has also shown the threat to tourism in the Alps (Burki, 2002).

Abegg & Froesch have suggested that assuming a 3 degree C rise in mean temperatures the snow line in winter will rise by 300m in the Central Alps, the first snowfall of the season will be delayed and below an altitude of 1200m there will not be sufficient snow cover (.Abegg & Froesch 1994).

However, knowing the fact that extreme events might threaten winter tourism, climatic risks studies need particular attention which is beyond the scope of this study.

Konig &Abegg and Elsasser & Burki believe that, one of the economic indicators used in previous climate change in impact assessments of the ski industry in Europe is the '100 – day rule' (König & Abegg, 1997; Elsasser & Bürki, (2002). The original southern Ontario study area revealed that over the 17 years where observed data were available, the average observed season lengths, were 123 days (Scott & others, 2003).

Cross-country skiing requires a minimum snow depth of approximately 10 cm, whilst snowboarding 30 cm. (Perry 2000).

Crowe & others argue that snow depth required for skiing would be 2.5 inches to define a skiable day (Crowe & others 1973). According to Stowe Mountain resorts reports, average base depths of snow should be between 14″– 28″ (Stowe Mountain resorts 2006).

Meeting the above conditions of greater snow depth than 30 cm and duration of 100 days or more has been termed as 'snow reliable'. (Elasser &Burki 2002) .

Amount of winter snowfalls is another prerequisite for skiing.

According to ski info statistics, snowfalls needed for ski ground should be around 300 cm (ski info 2006).

Another criteria assigning for a valuable ski ground is the slope magnitude. Tapia &others argue that slopes ranges should be between 2460-6540 feet (Tapia & others 2005).

Temperature is being used as another indicator regarding ski resort development. Minimum Temperature required for ski-ground should be 6°C (ski info 2006). Summit Temperature in ski areas should be around 34° (Stowe Mountain 2006).

While climate is obviously important for international tourism, only a few tourism studies make a link with climate change.

However, climatic changes could have major implications for the tourist industry, for instance, by making currently popular areas less attractive and bringing new competitors to the market.

Even though, tourism has been largely neglected by the climate change impact research community (Scott et al, 2004), there exists some relevant studies that need considerable attention.

Some of the earliest research on the potential impact of climate change on the ski industry in the international literature was conducted in Ontario and Quebec (Canada). Harrison estimated that the ski season in southern Ontario would contract substantially or possibly be

Furthermore, in analyzing any resort site, it is important to consider extreme events that might threaten the life and property of tourists, or services and infrastructure.

Psychological Impacts of climate upon tourism

Climate and weather influence the tourists' enjoyment. A number of studies (Campbell and Beets 1977; Cunningham 1979; Tromp 1974; Williams, Dossa and Hunt 1997) have highlighted the links between weather and human behavior. Certain conditions can stimulate positive psychological reactions (such as optimism, euphoria, good moods) that can help to enhance the sensation of enjoyment. Conversely, weather conditions can generate negative psychological reactions (such as pessimism and bad moods).

In short, climate and weather influence the degree of satisfaction, allowing tourists to enjoy their holiday activities safely and comfortably, helping them fulfill the desires that originally brought them to the resort and, consequently, raising their satisfaction levels.

The impact of weather and climate upon snow skiing

Skiing is one of the tourism activities which is most affected by

Weather and climate .Without snow or low temperature for the artificial production of snow, the development of ski resorts would not have been possible.

Daily temperature, daily precipitation namely snowfall; and daily snow depth are climatic elements regarding skiing. Specific attention has been focused on winter snowfall and summer wetness as these would appear to have a major bearing upon visitor activity in ski resorts (Hay, 1989).

Winter tourism is obviously dependent upon snow cover for tourism activity to be cost effective.

Rainy summers and winters with less than ideal snow conditions can adversely affect the number of tourists and consequently have a major effect on the location and revenues of tourist organizers (Abetz 1996).

It is generally accepted that sufficient snow cover should last for at least 100 days for a resort to be economically viable. (Elasser and Burki 2002).

buildings receive the most sunlight and how long the sun stays with those sides. The long axis of the building should ideally stretch east to west. To minimize and reduce heat loss many rooms contain low ceilings, thick stonewall, small windows, and centrally located heating.

Great contribution in the area of climatic design is being devoted to Vaheed Ghobadian in his pioneer work entitled "Climatic Design: principle and practice". In his book he thoroughly and technically discussed climatic control measures, ways of reducing thermal circulation as well as reduction in absorption of out door air and the like.

According to the study which was conducted in Iran (Tabriz) building should be oriented to the south, but also horizontal shelters of one meter depth are required for the south wall windows (Alijani, 1994).

To sum up climate and weather have a major influence on the architecture of tourism complexes and infrastructure. They largely determine whether or not a region will be frequently visited by tourists and determine the type of stay and the types of accommodation and constructions built (Monferrand 2002).

Climate determines the ideal type of tourism accommodation. For example, cool wet climates are not the most appropriate in which to camp; hotel accommodation is less sensitive to the meteorological conditions than other forms. Installation of artificial devices such as air conditioning, suitable systems of ventilation and humidification, heating and cooling, and air conditioning are all influenced by climate and weather elements of the tourist areas.

Climate and weather have a major influence on whether transport and communication systems work smoothly and facilitate or confine tourist's mobility.

Weather and climate are frequently considered when planning airports, coastal infrastructure, and river navigation projects are concerned.

Climate has a strong influence on the seasonality of tourism activities. Long seasons mean the infrastructure and services are more extensively exploited and, consequently, allow a higher return on the capital invested (Belen Gomez Martin, 2005, p. 581).

conducive to the human requirements of comfort using the surrounding climatic conditions. Olgyay's chart is a "zone of human comfort in relation to ambient air temperature and humidity, mean radiant temperature, wind speed, solar radiation, and evaporative cooling" (Givoni, 1969, p. 280).The bioclimatic chart is important because it allows builders and architects to figure out the right specifications for design factors such as orientation, location, size, shading, and form.

In a hot-humid climate, the main function of the buildings is to simply moderate the daytime heating effects of the external air (Ibid, 290).

In other words, it is important to design buildings especially in tourism destinations whose structure and interior are best able to keep warm air out. It is important for the buildings structures to have effective ventilation and an internal temperature below the outdoor level. The ventilation keeps air moving through the environment and, therefore, keeps the inhabitants cooler.

In many arid, desert regions, buildings are designed with flat roofs, small openings, and heavy weight materials. The thick exterior roof and walls help to absorb temperature fluctuations and, therefore, keep internal temperatures from rising above the outside surface temperature. An important function of the roof is its color. A white or light colored roof will stay approximately the same temperature as the outdoor air during the day, and six to ten deg C cooler than the outside air at night (Givoni ,1969,319).

Windows are arranged so that equal areas are open on the windward and leeward sides of the building.

Courtyards, patios, and verandas are other common features of buildings in hot climate. Concrete is the most common material used in the walls because it has low cost and high thermal capacity which in turn reduces internal temperatures (Ibid, 316).

In cold tourism destinations, buildings should ideally have healthy and comfortable indoor thermal conditions and a reasonable fuel economy with the heating methods locally employed (Ibid, 291). The key to reaching that goal is good insulation and sunshine exposure, which helps to keep the warm air inside the building. Windows to capture much needed heat from the sun is required as well (Oktay, 2002). Orientation is important because it affects which sides of the

Climate as a basic resource of tourism

Some types of tourism, however, are highly affected because they promote climate as the main attraction, since it acts as a basic input. This is the case of sun and beach tourism, health tourism, winter sports, and water sports. Climate can be a main appeal of an area, as shown by the popularity of many enclaves of the Mediterranean, Caribbean and Pacific, and the success of many ski resorts.

Health tourists place considerable value on the climate in terms of comfort and health. In this type of tourism, the climate acts as the raw material that cures or prevents the appearance of certain illnesses.

Weather influences tourists and what and when (especially outdoor) activities can be carried out.

The tourist desiring an activity should consider the weather when deciding whether the activity can be completed with satisfactory safety, enjoyment and comfort. Thus, for example, those interested in hunting will need to consider the day's weather conditions because the performance of their tracking dogs, the effectiveness of the hunters themselves, and the presence or absence of the prey will depend on elements such as temperature, wind velocity, sun strength, and rainfall. The wrong combination of these conditions may cancel the scheduled program. (Belen Comez Marthin, 2005, p. 582).

Climate and architecture and its implication upon tourism Infrastructure

Around the world architects are continuously expanding and inventing new ideas that make use of the natural environment and its extraordinary effects on the way humans live comfortably in their homes and workplaces and tourism destinations. The first documentation of architectural design and its relationship with climate dates back to fourth century B.C. in Greece.

In Rome, architects made note of the reduction of temperature created by the huge stonewalls and their shadows.

Climate responsive architecture takes advantage of free energy in the form of heat and light. Each region of the world employs its own techniques and designs in its buildings that are best suited to that particular region and that encompass the region's cultural patterns.

A man by the name of Olgyay is credited with creating a bioclimatic chart that helps in the design of buildings so that they are

quality of the tourism experience for the average tourist. Monthly means for maximum daily temperature, mean daily temperature, minimum daily relative humidity, mean daily relative humidity, total precipitation, total hours of sunshine, and average wind speed are being considered as integrated elements of TCI.

Understanding of local climatology is becoming increasingly important in the study of tourism prospects (Renaudin, 2002).

Viner & others argued that three facets of climate, aesthetic, physical and thermal, affect tourism (Viner & others, 2003, p.11).

The elements of climate that have the greatest influence on tourism are temperature, number of sun hours, precipitation, wind, humidity, and fog.

Furthermore, some climatic elements could be exploited as resources. These are the high number of sun hours, high temperatures, and snow. Climate does not directly generate tourism but does facilitate its development, given that the climate and weather conditions allow or favor certain outdoor tourist or recreational activities such as hiking, rafting, golf, hunting, fishing and climbing. To use Smith's terminology, these are activities sensitive to the climate and weather (Smith, 1993).

Further more; Climate affects the environmental context in which tourism can be undertaken: it is a key to vegetation patterns, morphogenetic processes, and distribution of flora and fauna. All of these are vital to the development of an attractive and functional setting for tourism.

While each activity requires its own particular climate and weather, there appears to be a strong tendency among tourists for sun and relatively high temperatures as environmental comfort indices. They most seek to have a holiday in places characterized by gentle temperatures and plenty of sun.

In other word, climate and weather combine to form environmental conditions that have a direct bearing on the tourists' perceptions of comfort (sense of well-being) and their health.

Climate can also be an attraction in itself and plays a decisive role in the selection of destinations.

Climate and weather, have implications for tourism planning. Without first analyzing climate, any attempt regarding tourism planning activities would be deficient.

The Impact of Climate & Weather upon Tourism with Particular emphasis on snow Skiing development in Iran

By: Simin Tavallai (Ph.D)

Abstract

Tourist activities are not distributed homogeneously in space; rather, certain activities are concentrated in specific points or areas. Numerous factors account for this pattern.

Climate is one of the geophysical factors that make up geographical space, contributing to the environmental conditions that facilitate or hinder human settlement in general and tourism activities in particular.

Therefore, climate is an important criterion for locating tourism centers, helping to determine how an area is to be used.

It has been argued that local climatology and succession of different weather types influence the location of resorts, the calendar of tourist activities, the use and efficiency of the infrastructure, and the return on investments.

The impact of climate ad well as climatic changes upon Snow skiing is being pursued as another objective of this study. As such, evaluation of Ski-resort potentials in Iran was conducted as an applied nature of this study. This study suggests that optimum areas regarding snow skiing are basically Elborz ranges between Tehran and Mazandran and to a lesser extent Charmahal province nested in Zagrous mountain.

Introduction

The tourism climate index (TCI) was originally conceptualized by Mieczkowski (1985) as a composite measure that would systematically assess the climatic elements most relevant to the