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Tourism Climatic Comfort Index

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ABSTRACT: Tourism is a major sector of the global economy. Climate has a strong influence on the tourism and recreation sector and in some regions of the world constitutes the resource on which the tourism industry is predicated. The present paper aims to highlights the application of Mieczowski's (1985) ' Tourism Climate Comfort Index '(TCI) for Solapur and its environ. Along with this Comset's Comfort Index and Thom's Discomfort Index. The Solapur District is laying on the south eastern border of Maharashtra has a large number of tourist places particularly religious and historical centers such as Akkalkot, Pandharpur , Tuljapur, Ganagapur, Solapur, Bijapur and Gulbarga in its vicinity. Lakhs of tourist are attracting towards these destinations.T he study area is located far away from the influence of maritime. For the present study data has been collected from Meteorological Dept..Pune and Agricultural Research center Solapur. The study reveals that according to E.C.Thom's Comfort Index the Temperature Humidity Index (THIvalue for the months of Nov. (70.34), Dec. (66.69), Jan. (66.95) and Feb.(71.45) shows comfortness for tourism, while Camuset Climate Comfort Index (CI) shows the months of Dec.(899.36), Jan. (2007.080) Feb (2351.08) and Mar.(951.41) were comfort months for tourism. As per Mieczkoski's formula the TCI for the months of Nov.(21), Dec.(31), Jan (31) and Feb. (28) are the comfort months for tourist to visit Solapur and its environ.
Keywords: Tourism, climate change, tourism comfort index.

I. INTRODUCTION:

Tourism is a major sector of the global economy, with international tourism receipts of US$439billion in 1998 (World Tourism Organization 1999). It is projected that by 2020, there will be 1.6billion international tourist arrivals, spending over US$2 trillion worldwide (WTO 1999 & 1998).

Climate has a strong influence on the tourism and recreation sector and in some regions of the world constitutes the resources on which the tourism sector is predicated. Inter- annual climate variability influences the length and quality of recreation seasons and the profitability of the tourism industry.There has been little consideration of how climate change might affect the tourism. Yet despie the importance of climate to tourism. Smith (1993:389) indicated that, "There have been comparatively few investigations into the relationships between climate and tourism."Existing methods for the evaluation of climate for tourism purposes are based on mean monthly values and climate elements i.e. air temperature,air humidity or precipitation(Mieckzkowki,1985, abegg,1996 Matzarakis and de Freitas 2001, Matzarakis 2004).

To be comfort, or to be at case represent both physiological and psychological state and opposite of these are discomfort and disease respectively. The physiological concept of comfort basically depends upon age, health, acclimatization. etc. the feeling of comfort is highly subjective and is related to the environment, physical activity, shelter, clothing, cultural traditions, and acclimatization's (Menon).Therefore here an effort has been made to identify the comfort seasons/durations to visit various tourist places in Solapur and its environ.

The bioclimatic and combined tourism indices involve more than one climatological parameter and consider the combined effects of them.The biometeorological literature, upon which the weightges of the five climatic variables that comprise the TCI and the thresholds used to devise the rating systems for each of the TCI.

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 quality of the tourism experience for the 'average' tourist (i.e., the most common tourism activity of sight-seeing and shopping). The TCI developed by Mieczkowski (1985) was based on previous research related to climate classifications for

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tourism and recreation (Heurtier 1968, Crowe 1976) and theoretical considerations from the biometeorological literature related to human comfort, particularly with reference to tourism activities (Burnet 1963, Dammann 1964, Hofer 1967, Heurtier 1968, Danilova 1973, and Kandror et al. 1974). Initially, 12 monthly climate variables were identified from the literature as pertinent to the TCI. Meteorological data limitations reduced number of climate variables that were integrated into the TCI to seven (monthly means for maximum daily temperature, mean daily temperature, minimum daily relative humidity, mean daily relative humidity,

Table -1

Sub-indices within the tourism climate index:

Sub-Index	Monthly Variables	Climate Influence on TCI	Weighting in TCI
Daytime Comfort Index (CID)	maximum daily temperature & minimum daily relative humidity	Represents thermal comfort when maximum tourist activity occurs	40%
Daily Comfort Index (CIA)	temperature & mean daily relative humidity	represents thermal comfort over the full 24 hour period, including sleeping hours	10%
Precipitation (P)	total precipitation	reflects the negative impact that this element has on outdoor activities and holiday enjoyment	20%
Sunshine (S)	total hours of sunshine	rated as positive for tourism, but acknowledged can be negative because of the risk of sunburn and added discomfort on hot days	20%
Wind (W)	average wind speed	variable effect depending on temperature (evaporative cooling effect in hot climates rated positively, while 'wind chill' in cold climates rated negatively)	10%

Source:Smith K (1993) The influence of weather and climate on recreation and tourism. Weather 48: 398-404

total precipitation, total hours of sunshine, and average wind speed). These seven climate variables were combined into five sub-indices that comprised the TCI. A standardized rating system, ranging from 5 (optional) to -3 (extremely unfavorable), was devised to provide a common basis of measurement for each of the sub-indices. The five sub-indices and their relative contribution to the TCI are outlined in Table 1. Although devised on the basis of available biometeorological literature, the rating systems of the five sub-indices and their relative weightings within the TCI.

STUDY AREA:

Solapur district is situated entirely in Bhima river basin in southern Maharashtra. It lies between 17^0 10' and 18^0 32' north latitudes and 74^0 42' and 76^0 15' east longitudes. It has an area of 14,895 Sq. kms. and accounts 4.32% area of Maharashtra state. The district consist of 11 tahsils, the average annual rainfall is 584.3 mm and maximum temperature is 45^0 C. The population of the District according to 2011 Census is 4.317,756. There are some principal places of tourist interest such as Tuljapur, Pandarpur, Akkalkot, Gangagapur, Bijapur, Gulburga etc. which are located at 55 Kms. 75 Kms. 35 Kms. 100 Kms., 100 Kms. and 120 Kms. away from Solapur respectively.

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Objective:

The objective of the present paper is to identify and confirm climatic comfort index as proposed by Z. Mieczkoski and effort has been made to refer to Comuset's Comfort Index and Thom's Discomfort Index.

Data Base And Methodology

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 quality of the tourism experience for the 'average' tourist (i.e., the most common tourism activity of sight-seeing and shopping). To support and apply the formula given by the above mentioned authors appropriate data was procured from meterological observations published by meteorological Dept. Pune and data from agricultural Research Center, Solapur.

Comfort Indices : E.C. Thom's Discomfort Index

E.C. Thom's Discomfort Index, which is identical to the US Weather Bureau, takes into account, two important parameters- temperature and humidity. The formula is as follows..

THI = 0.4 (T dry + T wet) + 15

Where, THI refers to Temperature Humidity Index,

T dry refers to dry bulb temperature in ^{0}F.

T wet refers to wet bulb temperature in^{0}F.

Table No.2

Comfort Indices : E.C. Thom's Discomfort Index(Solapur Centre)

Months	T dry (^{0}F)	T wet (^{0}F)	THI Value
January	76.28	53.6	**66.95**
February	80.87	60.26	**71.45**
March	87.17	63.14	75.12
April	93.83	68.72	80.02
May	87.98	71.33	91.79
June	84.11	73.31	77.96
July	80.69	72.77	76.38
August	74.93	71.41	77.54
September	80.42	80.69	79.44
October	81.59	60.62	71.88
November	78.44	59.92	**70.34**
December	75.48	61.25	**69.69**

Source: Complied by Researcher

The above data and graph indicates the THI value for the months of November (70.34), December (69.69) Jan.66.95) and February(71.45), show less of discomfort and the other months of the year show greater discomfort. The same results are observed for the other two formulas..

THI= 0.55 (T dry + 0.2 T dew) + 17.5 &

THI= T dry – (0.55 – 0.55 RH) (T dry – 58)

Where, THI refers to Temperature Humidity Index

T dry refers to dry bulb temperature in degree F,

T dew refers to dew point temperature in degree F,

RH refers to Relative Humidity expressed in decimals.

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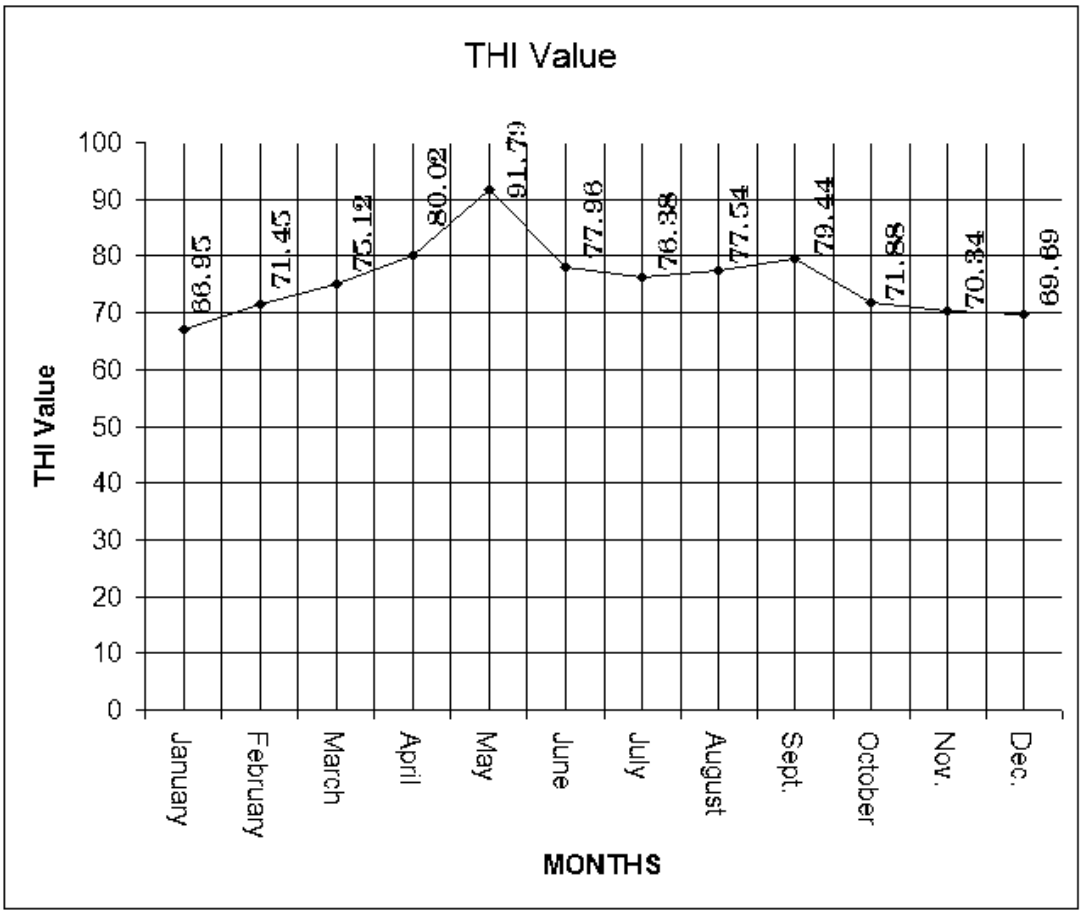
Fig. 1.1
Thom's Discomfort Chart for Solapur



Camuset Climatic Comfort Index (CI)

Camuset Climatic Comfort Index (CI) is applied for the studies for identifying the French resorts which is as follows.

$$CI = \frac{\text{Monthly Hrs. of isolation} \times \text{Monthly Mean Temp}}{\text{Monthly Rainfall}}$$

Table No.3 Camuset Climatic Comfort Index (CI)(Solapur Centre)

Months	Insolation	Temperature (0^0C)	Rainfall (mm)	Cl
January	301.6	23.30	003.5	**2007.8**
February	275.6	25.60	003.0	**2351.8**
March	253.4	29.10	007.2	**951.41**
April	252.8	31.80	013.8	582.54
May	254.8	34.45	026.3	333.76
June	194.5	27.65	106.7	050.40
July	122.1	26.85	127.7	025.67
August	131.2	26.60	139.9	024.95
September	167.7	26.50	133.8	033.21
October	221.3	26.45	092.2	063.42
November	202.6	24.10	028.0	174.38
December	271.9	21.50	006.5	**899.36**

Source: Complied by Researcher

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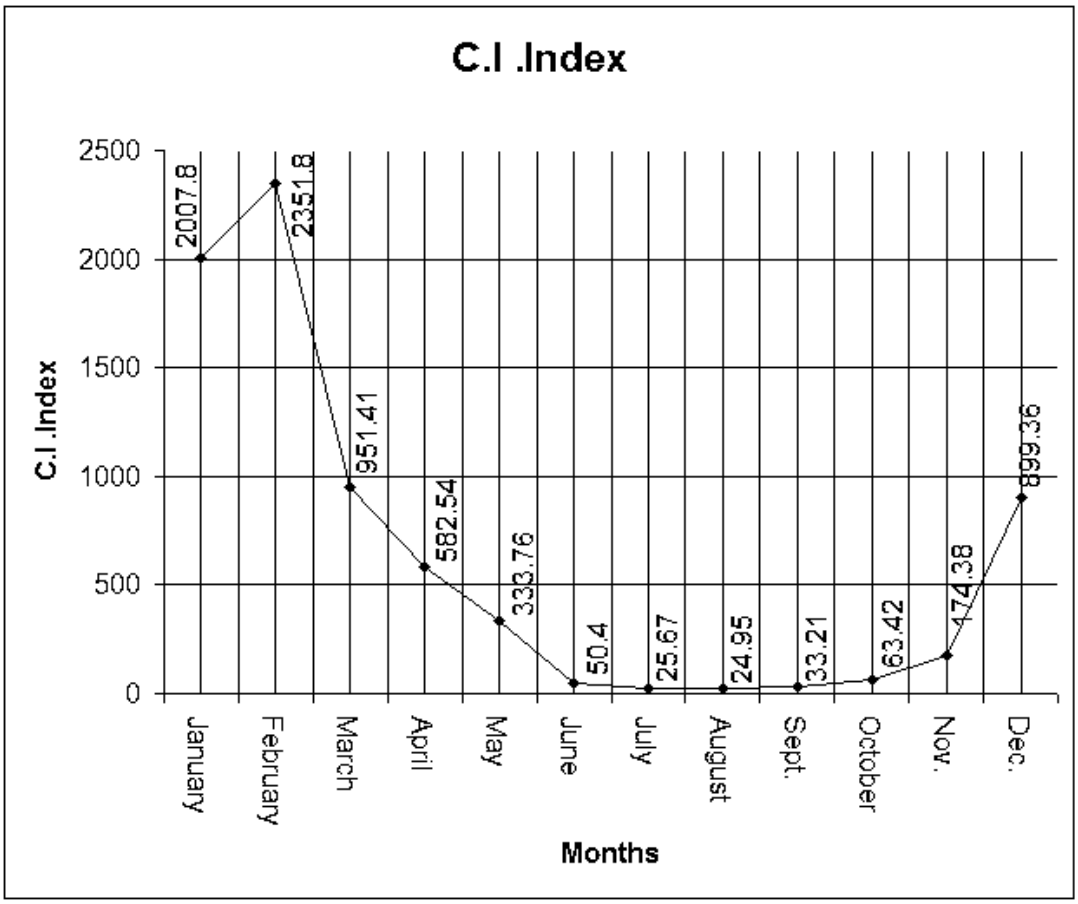
Fig.No.1.2
Camuset Climatic Comfort Index (CI) Chart--Solapur



According toCamuset Climatic Comfort Index (CI) the months of Dec.(899.36), Jan. (2007.08) Feb.(2351.8) and Mar.(951041) shows comfort months for tourism in Solapur and its environ.It is also shown in table No. 3 and Fig.N0. 1.2

Z. Mieczkowski's Climatic Comfort Index:

Mieczkowsk's Climatic Comfort Index is modification of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), which is as follows...

TCI = 2[CID + CIA + 2 R + 2S + W]

Where, TCI :Refers to Tourism Comfort Index.

CID :refers to Daytime Comfort Index, Composed of

T_1:Maximum Daily Dry Bulb Temp. in ^{0} C.

Rh_{min} :Minimum Daily Relative Humidity

CIA :refers to Daily Comfort Index, Composed of

T_2 :Mean Daily Dry Bulb Temp. in ^{0} C.

Rh_{min} :Daily RH.

R :refers to precipitation in mm

S :refers to Daily Hours of Bright Sunshine.

W :refers to Wind Speed in Km/Hr.

The Ideal Tourism Climatic Comfort Index is obtained as follows....

TCI ideal = 2[20 + 5 + (2 x 5) + (2 x 5) + 5] = 100

The weightings for all the values are given to indicate the comfort for the tourists, some of which are numerical, others being graphical.Mieczkowski modified the ratings given by ASHRAE for the identification of thermal comfort, which is basically a graphical method, the x-axis representing the wet bulb temperature in degree C. and nearly horizontal part of the graph represent relative humidity in percentage. Combined figures represent the ratings. The precipitation rates are between zero and five. The sunshine ratings are also between zero and five. The wind ratings, in case of Solapur, the tropical trade wind climate are found to be between 2 and 5 . The CID ratings are basically marked with 4, while CIA ratings are fall between 0 & 5. The

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following table shows ratings in the formula of Comfort index by **Mieczkowski** for Solapur

Fig.No.1.3
Mieczkowski'sTouristComfortIndex**(SolapurCentre)**

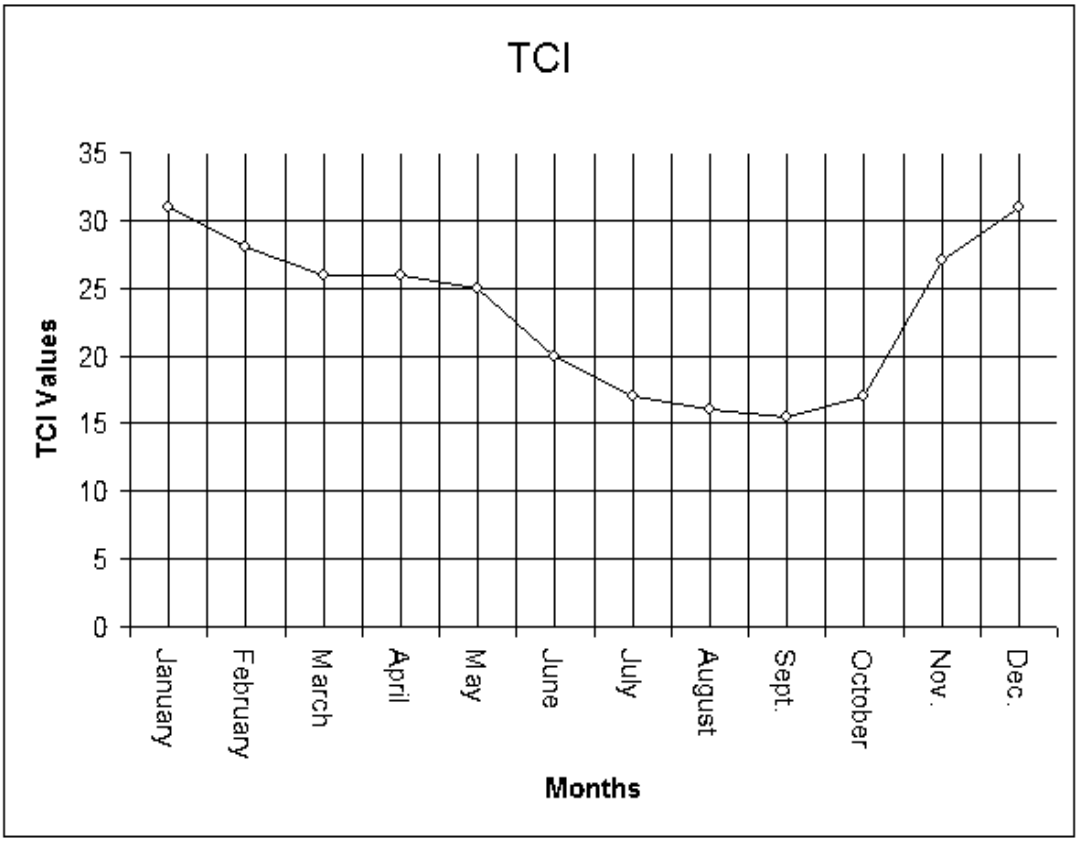

Table No.4
Mieczkowski's Tourist Comfort Index (Solapur Centre)

Months	CID	CIA	R	S	W	TCI
January	4	5	10	9	3	**31**
February	4	2	10	9	3	**28**
March	4	1	10	8	3	26
April	4	0	10	8	4	26
May	4	0	9	8	4	25
June	4	2	3	6	5	20
July	4	3	2	3	5	17
August	4	2	1	4	5	16
September	4	2	2	5	2.5	15.5
October	4	0	4	7	2	17
November	4	4	9	6	4	**27**
December	4	5	10	8	4	**31**

Source: Complied by Researcher

As per Mieczkowski's formula the TCI for the month of Nov.(27), Dec.(31),Jan.(31) and Feb.(28) are the comfort months for tourist to visit Solapur and its environ.

II. CONCLUSION:

Tourism is a major sector of the global economy. Climate has a strong influence on the tourism and recreation.. Solapur district is attracting tourists from far and wide even from abroad. The study reveals that according to

E.C.Thom's Comfort Index the Temperature Humidity Index (THIvalue for the months of Nov. (70.34), Dec. (66.69), Jan. (66.95) and Feb.(71.45) shows comfortness for tourism, according to Camuset Climate Comfort Index (CI) the months of Dec.(899.36), Jan. (2007.080) Feb (2351.08) and Mar.(951.41) shows comfort months for tourism. As per Mieczkoski's formula the TCI for the months of Nov.(21), Dec.(31), Jan (31) and Feb. (28) are the comfort months for tourist to visit Solapur and its environ. After applying various climatic comfort formulas the study reveals that the month of winter i.e. November to February are the comfort months for tourism in Solapur and its environ.

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REFERENCE:

[1]. Burnet L (1963) Villégiature et tourism sur les Côtes de France. Librairie 1.Hachette, Paris, France Canadian Climate Impact Scenarios Project (2001) http://www.cics.uvic.ca/scenarios/
[2]. Crowe RB (1976) A climatic classification of the Northwest erritories for recreation and tourism.Environment Canada, Toronto, Canada
[3]. Chritchfield H.J.(1968)- General Climatology, II Edition, Prentice-Hall of India Pvt. Ltd.
[4]. Dammann W (1964) Die Schwule als Klimfaktor. Beriche zur Deutschen Landeskunde 32(1): 100-9
[5]. Danilova NA (1973) Klimat pribaltiki i prodolzhitelnost perioda blagopriyatnogo dia turizma. In:
[6]. Heurtier R (1968) Essaie de climatologie touristique synoptique de L'Europe occidentale etMediterranéene pendant la saison d'été. La Météorologie 7: 71-107 and 8: 519-66
[7]. Hofer K (1967) Klimabehaglichkeit und Kurort. Wiener Medizinische Wochenschrift 16: 444-6
[8]. Höppe P (1999) The physiological equivalent temperature – a universal index for thebiometeorolgical assessment of the thermal environment. International Journal ofBiometeorolgy 43: 71-75
[9]. Jansen-Vebeke M (2001) Urban tourism and tourism research. In: Wall G (ed.) Contemporaryperspectives on tourism, Department of Geography Publication Series, Occasional PaperNovember 17, University of Waterloo, Waterloo, Ontario, Canada: pp 129-142
[10]. Kandror ID, Demina DM and Ratner YM (1974) Fiziologicheskye principy sanitarno – Klimatologicheskogo rayonirovanya territoriè SSSR. Moskva: Meditsina
[11]. Mieczkowski Z.(1985)- The tourism Climatic Index : A Method of Evaluating World Climates For Tourism. The Canadian Geographer Vol. 29 No. 3 (PP-220-233).88
[12]. Menon P.A.(1997)- Our Weather, National Book Trust of India, (PP-181-191)
[13]. Scott D, Jones B, Lemieux C, McBoyole G, Mills B, Svenson S, and Wall G (2002) Climate changeand winter recreation in the Lakelands tourism region (Ontario, Canada). Occasional Paper,Department of Geography Publication Series, University of Waterloo, Waterloo, Canada
[14]. Smith K (1993) The influence of weather and climate on recreation and tourism. Weather 48: 398-404
[15]. Strahler A.N.(1971)- Physical Geography. Wiley Eastern Pvt. Ltd.
[16]. Subramnyam V.P.(1983)-- Applied Climatology. Heritage Publishers, New Delhi
[17]. World Tourist Organization (1999) Tourism highlights 1999. WTO Publications Unit, WorldTourism Organization, Madrid, Spain.
[18]. World Tourist Organization (1998) Tourism 2020 vision. WTO Publications Unit, World TourismOrganization, Madrid, Spain.