Holiday Climate Index, Destination Competitiveness Index, and Risk Analysis of Cappadocia

Kapadokya'nın Tatil İklim Endeksi, Destinasyon Rekabetçiliği Endeksi ve Risk Analizi

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Abstract

Climate change, which is experienced today, affects the tourism sector as it affects every sector. Since climatic conditions affect the attractiveness of destinations and have an important place in travel intentions, it is necessary to investigate the effects of climatic conditions and climate conditions on destination competitiveness. Concepts such as the Holiday Climate Index, Destination Competitiveness Index, and risk analysis are methodological tools used to evaluate factors affecting the tourist experience. In line with this purpose, in the study, along with the calculation of the Holiday Climate Index and Climate Destination Competitiveness Index of Avanos, Ürgüp, and Göreme, a risk analysis was carried out regarding the climate problems that occur/may occur in the region. Based on the study results, it was determined that Avanos ranked first in 11 months according to the destination competitiveness index. According to the Holiday Climate Index, the climate of all three destinations was found to be suitable for holidays between May and November. In addition to these, the risk analysis identified climate-related problems such as temperature increase, drought, desertification, erosion, and flooding. Furthermore, it was determined that destinations should be controlled against flood risk and that infrastructure improvements should be made. As a result, in order to increase the climatic competitiveness of the region and ensure the sustainability of the tourism sector, environmental management strategies need to be strengthened.

__Anahtar Kelimeler:__ Climate Change, Holiday Climate Index, Destination Competitiveness Index, Risk Analysis, Cappadocia

Öz

Günümüzde yaşanan iklim değişikliği, her sektörü etkilediği gibi turizm sektörünü de etkilemektedir. İklim koşulları destinasyonların çekiciliğini etkilediği ve seyahat niyetinde önemli bir yere sahip olduğu için iklim koşulları ve iklim koşullarının destinasyon rekabetçiliğine olan etkisinin araştırılması gerekmektedir. Tatil iklim endeksi, destinasyon rekabetçiliği endeksi ve risk analizi gibi kavramlar, turist deneyimini etkileyen faktörleri değerlendirmek için kullanılan metodolojik araçlardır. Bu amaç doğrultusunda çalışmada, Avanos, Ürgüp ve Göreme'nin Tatil İklim Endeksi ve İklim Destinasyon Rekabetçiliği Endeksi'nin hesaplanması beraberinde, bölgede oluşan/oluşabilecek iklim sorunlarıyla ilgili risk analizi yapılmıştır. Çalışma sonuçlarına bağlı olarak destinasyon rekabetçiliği endeksine göre Avanos'un 11 ayda birinci sırada olduğu saptanmıştır. Tatil iklim endeksine göre üç destinasyonun iklimi Mayıs ve Kasım ayları arasında tatil için uygun bulunmuştur. Bunlara ek olarak yapılan risk analizinde sıcaklık artışı, kuraklık, çölleşme, erozyon ve sel gibi iklimle ilgili sorunlar tespit edilmiştir. Ayrıca, destinasyonların sel riskine karşı kontrol altına alınması ve altyapı iyileştirmelerinin yapılması gerektiği belirlenmiştir. Sonuç olarak, bölgenin iklimsel rekabet gücünü artırmak ve turizm sektörünün sürdürülebilirliğini sağlamak için çevre yönetimi stratejilerinin güçlendirilmesi gerekmektedir.

__Keywords:__ İklim Değişikliği, Destinasyon Rekabetçiliği Endeksi, Risk Analizi, Tatil İklim Endeksi, Kapadokya

Araştırma Makalesi [Research Paper]

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Introduction

Tourism has become an important sector worldwide with several positive effects, such as economic growth, cultural exchange, and increased interaction between individuals. In this context, increasing competition among destinations brings to the forefront the sustainability of tourist regions and their ability to maintain their competitive advantage. The success of destinations depends on the interaction of several factors, the most important of which are climatic conditions, environmental characteristics, and risk analysis.

Climate change has a significant impact on daily life and business life, as it has negative effects such as increasing temperatures and rising sea levels, as well as affecting health. The measures taken to avoid negative consequences that may emerge from climate change will contribute to avoiding crises. There is a need for studies that would prevent problems arising from climate change because tourism is among the most environmentally interactive and climatic change-affected sectors. Considering this, it is necessary to focus on evaluating tourism stakeholders and the potential for change related to tourism rather than making predictions in climate studies related to the tourism sector (Dubois & Ceron, 2006). While climatic conditions that affect tourists' preferences stand out as one factor determining the destination's competitive advantage, understanding and managing potential risks that may arise in destinations is critical for sustainable tourism.

As tourism activities are closely related to climatic conditions and the relevance of the latter with regard to destination attractiveness, it is highly relevant for the tourism industry to become aware of and prepare for climate change (Demiroğlu et al., 2020). In this regard, the protection and development of tourism resources require an analysis of the climatic conditions of destinations. This examination, planning, and time allocation are facilitated by climate indices (Hejazizadeh et al., 2019). There are some indices that scientists develop to measure the appropriateness of climatic conditions in destinations. Among them, the most favorite ones were the "Tourism Climate Index (TCI)," developed by Mieczkowski (1985), and the "Holiday Climate Index (HCI)," developed by Scott et al. (2016). In addition to an assessment of the acceptability of the climatic conditions of the destinations for tourism, there is a need to determine the effect of climatic conditions on destination competitiveness and possible climatic problems in destinations. In this study, the researchers defined the framework based on these three main attractive destinations (Avanos, Ürgüp, and Göreme) in the Cappadocia Region in Türkiye. In this line, this research aimed to calculate the HCI and the climate destination competitiveness index of the Avanos, Ürgüp, and Göreme destinations that take their place within the Cappadocia Region.

This study aims to find answers to the following questions: In which months is the climate of Avanos, Ürgüp, and Göreme suitable for holidays according to HCI? How is the destination competition among the three destinations according to climate? What are the risks posed by the problems arising from climate change in terms of tourism in the three destinations, and how can we mitigate them?

1. Literature Review

The term "climate change" is used to describe alterations in temperature and climate patterns over an extended period. These changes can be triggered by shifts in solar activity or volcanic eruptions. Additionally, the utilization of fossil fuels, including oil, gas, and coal, since the 1800s has been identified as a significant influencing factor in climate change (United Nations, 2023). When the studies on climate are analyzed, it is seen that unprecedented changes in climate conditions have occurred and will occur worldwide in the 21st century. At the same time, it is known that climatic conditions have affected and will further affect the tourism sector (Rosselló-Nadal, 2014).

Tourism is one of the fastest-growing global sectors and contributes significantly to local and national economic development. It is widely acknowledged that climate is a pivotal factor influencing tourism activity. However, it is also crucial to ascertain the impact of climate change on the tourism sector (de Freitas, 2001; Scott & McBoyle, 2001; Hoogendoorn & Fitchett, 2016). In this respect, it is possible to say that tourism is a climate-dependent sector; tourists care about climatic conditions, and destination competitiveness is related to climate (Amelung et al., 2007). Considering this network of relationships, it is necessary to determine in which period the demand for destinations is intense and whether the climatic conditions are suitable for this period.

The effects of climatic change on tourism are both direct and indirect, and it is anticipated that these effects will have a significant impact on the industry. The detrimental effects of climate change on the ecosystem include erosion, reduced snowfall (for winter tourism), and damage to reefs, which can lead to damage or destruction of a destination's touristic products. It is also expected that in the future, especially during periods of high demand, climate change will affect the basic needs of tourism, such as water (Becken & Hay, 2007). The potential impacts and consequences of climate change for the tourism sector are presented in Table 1.

Table 1. Effects and Results of Climate Change on Tourism

Impacts	Results	Results for Tourism
Higher Temperatures	Changing seasonality, heat overwhelming tourists, cooling costs, increased risk of infectious diseases	Demand shifts to colder (more northern) destinations
Fewer Snowy Days and Shrinking Glaciers	Fewer snowy days, more expensive snowmaking, a shorter winter sports season, and less beautiful scenery	Focusing on high altitude destinations, developing alternative markets and touristic products (such as climbing, hiking)
More Extreme Storms	Tourism facilities are at risk, insurance costs are rising, and business interruption costs are rising.	Reduced demand for destinations at risk
Some Regions Have Less Rain and More Evaporation	Water scarcity, competition for water between tourism and other sectors, desertification, increased forest fires	Reduced demand due to reduced attractiveness and increased risks. Traveling to cooler and safer destinations
Some Regions are Getting More Heavy Rain	Floods damage historical, architectural, and cultural sites and tourist facilities and affect seasonal patterns.	Decrease in demand, high infrastructure repair costs
Rising Sea Levels	Higher costs for coastal erosion, beach loss, protection, and maintenance of waterfronts	Loss of tourism opportunities and decline in tourism
Increasing Sea Temperatures	Degradation of marine resources and aesthetics increased coral bleaching in diving and snorkeling destinations.	Decline in demand
More Frequent and Larger Forest Fires	Flooding, damage to tourist sites, and loss of natural beauty	Decline in demand
Soil Changes (e.g., moisture level, erosion, acidity)	Destruction of natural resources damages a destination's appeal	Decline in demand

Source: Sharpley, 2009.

The literature on climate change for tourism reveals several results. Firstly, there will be a shift in travel preferences due to climate change. Secondly, there will be a decrease in demand for some destinations while an increase in demand for others. Thirdly, additional costs will be imposed on tourism stakeholders. From this perspective, taking measures to reduce the negative effects of climate change on tourism and creating new competitive strategies will contribute positively to tourism development.

Environmental changes due to climate change significantly affect destination competitiveness. When tourism types are analyzed within themselves, it is expected that these changes will reduce the destination attractiveness, considering that the decrease in the amount of snowfall will affect winter tourism, the rise in sea levels will affect coastal tourism, and changes in nature will affect nature tourism. At the same time, these changes are also assumed to affect destination competitiveness. In this line, it becomes evident that destinations must adapt to the realities of climate change and adopt sustainable tourism practices to ensure their viability for the future (Scott et al., 2012).

Climate-related changes in the length and quality of tourism seasons affect the competitive advantage of destinations and decision-making processes in the tourism sector (Hoogendoorn & Fitchett, 2016). Rising temperatures and precipitation, emerging natural disasters, rising sea levels, and other effects of climate change affect tourists' travel plans and preferences. These situations make it necessary for the tourism sector to develop strategies to minimize its effect on climate change. Examples of strategies that can be created include energy efficiency, water conservation, and renewable energy sources. Additionally, tourism businesses can organize training to raise awareness about climate change (Kaján & Saarinen, 2013). Thanks to these strategies, it will be possible to reduce the negative effects of climate change on tourism and gain an advantage in terms of destination competitiveness.

1.1. Holiday Climate Index (HCI)

Climate is one of the most important factors for tourism activities in the world. Climate and weather conditions affect travel preferences as much as factors such as geographical location, flora and fauna, and landscape (Hejazizadeh et al., 2019). In this case, various studies have been carried out to measure the suitability of climatic conditions for tourism activities for tourism types (Scott et al., 2016). Depending on the purpose, in the case of the analysis of the suitability of climatic conditions for tourist types, the type of data may vary, along with the method of presentation. While the duration of snow on the ground and snow depth is some of the climatic data needed for a place that is a winter tourism

destination, the number of sunny days and temperature values are climatic data that would be needed for a place that is a sea-sand-sun tourism destination (de Freitas, 2001). In this direction, several studies were carried out, and methods were developed to determine the suitability of a destination for tourism activities. Among these, the most preferred methods are the Tourism Climate Index developed by Mieczkowski (1985) and Scott et al. (2016), which developed the Holiday Climate Index. TCI is the method used in the evaluation of climate concerning tourism. The HCI, in turn, helps provide a systematic basis for evaluating the quality of the climatic conditions of destinations as a support for planning tourism seasons and preparing tourists' travel plans. The calculation of the TCI requires four climate data. These are thermal comfort, average monthly precipitation (mm), average monthly sunshine duration (hours), and wind (km/h) (Mieczkowski, 1985). Though TCI presents the most applied way to assess climate suitability at the global scale, methodologically, this method is considered to have some deficiencies, also expressed below (Scott et al., 2016):

- Subjective rating and weighting system of climate variables,
- Ignoring the possibility that physical climate parameters (e.g., rain, wind) may dominate,
- The low temporal resolution of climate data (monthly data) has limited relevance to tourists' decision-making,
- It ignores climate requirements that vary according to the destination (sea, city, winter tourism, etc.).

To develop an index that addresses these shortcomings in the TCI, Scott et al. (2016) developed the HCI. The HCI is an index used to assess climate suitability for tourism purposes. This index is considered to measure the climate suitability of a destination for tourism more accurately. HCI evaluates destinations' climate characteristics by considering tourists' stated climate preferences. This way, it offers a more comprehensive and accurate assessment opportunity for the tourism sector. The HCI calculation is as follows (Scott et al., 2016):

$$\text{HCI: Urban} = 4(TC)+2(A)+ (3(P)+W) \tag{1}$$

$$\text{HCI: Beach} = 2(TC)+4(A)+(3(P)+W)$$

TC: Thermal comfort $\tag{2}$

A: Aesthetics

P: Precipitation

W: Wind

Table 2 shows TC, A, P, and W ratings of HCI and the HCI assessment obtained after the calculation.

Table 2. Holiday Climate Index Descriptive Ratings

HCI Urban Ratings

TC	Rating
≥39	0
37-39	2
35-36	4
33-34	5
31-32	6
29-30	7
27-28	8
26	9
23-25	10
20-22	9
18-19	7
15-17	6
11-14	5
7-10	4
0-6	3
(-1)-(-5)	2
≤-6	1

A (%)	Rating
11-20	10
1-10	9
21-30	9
0	8
31-40	8
41-50	7
51-60	6
61-70	5
71-80	4
81-90	3
90-99	2
100	1

P	Rating
0.00	10
<3.00	9
3.00-5.99	8
6.00-8.99	5
9.00-12.00	2
>12.00	0
>25.00	(-1)

W (km/h)	Rating
1-9	10
10-19	9
0	8
20-29	8
30-39	6
40-49	3
50-70	0
>70	(-10)

Score	Descriptive Rating
90-100	Ideal
80-89	Excellent
70-79	Very good
60-69	Good
50-59	Acceptable
40-49	Marginal
30-39	Unacceptable
20-29	
10-19	Dangerous
0-9	

Source: Scott et al., 2016.

The effective temperature based on maximum temperature and relative humidity calculates thermal comfort in HCI. In the rating scores, 0 points are given when the effective temperature is greater than or equal to 39; 1 point when it is less than or equal to -6; 2 points when it is between 37-39 and (-1)-(-5); 3 points when it is between 0-6; 4 points when it is between 35-36 and 7-10; 5 points when it is between 33-34 and 11-14; 6 points when it is between 31-32 and 15-17; 7 points when it is between 29-30 and 18-19; 8 points when it is between 27-28; 9 points when it is between 26 and 20-22; and 10 points when it is between 23-25.

HCI's cloud pattern (aesthetics) is calculated using the average cloud pattern. In the rating scores, 1 point is given when the cloud pattern is 100, 2 points when it is between 90-99, 3 points when it is between 81-90, 4 points when it is between 71-80, 5 points when it is between 61-70, 6 points when it is between 51-60, 7 points when it is between 41-50, 8 points when it is between 31-40 or 0, 9 points when it is between 21-30 and 1-10, and 10 points when it is between 11-20.

In HCI, precipitation is calculated in mm of daily precipitation. In the rating scores, a score of -1 is given when precipitation is more than 25.00 mm; 0 when it is more than 12 mm; 2 when it is between 9.00 and 12.00 mm; 5 when it is between 6.00 and 8.99; 8 when it is between 3.00 and 5.99; 9 when it is less than 3.00 mm; and 10 when it is 0.00.

In HCI, wind is calculated according to the km/h speed of the wind. Rating scores are (-10) for more than 70, 0 for 50-70, 3 for 40-49, 6 for 30-39, 8 for 20-29 or 0, 9 for 10-19 and 10 for 1-9.

In the HCI calculation, as a result of the process with climate data, the destination's score between 90-100 is ideal, between 80-89 is excellent, between 70-79 is very good, between 60-69 is good, between 50-59 is acceptable, between 40-49 is marginal, between 30-39 and 20-29 is unacceptable, between 10-19 and 9-0 is dangerous. A literature review reveals that some studies have been conducted on the HCI calculation of some destinations. These studies are as follows:

Scott et al. (2016) calculated the TCI and HCI of Barcelona, Istanbul, London, Paris, Rome, and Stockholm for the past and future years. They concluded that all six cities are at an ideal level until 2039, while climate conditions are unacceptable for holidays between 2040 and 2099. Öztürk and Göral (2018) aimed to calculate the HCI values of Izmir and concluded that Izmir's climate is suitable for 12-month holidays. Similarly, Hejazizadeh et al. (2019) aimed to compare the TCI and HCI calculations of the desert region in central, eastern, and southeastern Iran and concluded that the TCI progresses from negative to positive throughout the year, the HCI fluctuates less and the most suitable holiday time for the region in September, October, and April.

Demiroğlu et al. (2020) calculated the HCI of the destinations in the Mediterranean coastal region. They stated that the seasonal conditions in the Mediterranean coastal area will be excellent in the spring months and worsen in the summer months. Rutty et al. (2020) aimed to compare the TCI and HCI values of Barbados, Saint Lucia, and Antigua and Barbuda in the Caribbean and concluded that HCI is suitable for 12-month Holidays in all three destinations, while TCI is low in July and October. Amiranashvili and Kartvelishi (2021) calculated the HCI of 12 destinations in Kakheti (Akhmeta, Dedoplistskaro, Gombori, Gurjaani, Kvareli, Logodekhi, Omalo, Sagarejo, Shiraki, Telavi, Tsnori and Udabno). They concluded that all of the destinations are suitable for 12-month holidays.

2. Methodology
2.1. Purpose, Importance, and Scope of the Research

Climate conditions (e.g., warm weather and water temperature) are now impacting destination competitiveness, which depends on local ecosystems and increasing diversity among destinations on a global scale. Therefore, it is essential to ascertain the extent to which climate change affects destination competitiveness and other factors that contribute to a destination's competitive advantage by undertaking a comparative analysis of different destinations. In this context, it is necessary to examine the effects of climate change on destinations, the demand for destinations, and their touristic attractiveness (Dubois & Ceron, 2006). The literature review revealed that HCI calculations had been conducted for various destinations. However, the study sample was identified as Avanos, Göreme, and Ürgüp, which are significant destinations in Cappadocia. This is because the existing studies are limited to specific destinations in Türkiye, and there is a lack of research on Cappadocia.

The study aims to calculate the Urban HCI for Avanos, Ürgüp, and Göreme in the Cappadocia Region with 1991-2021 data, as well as to compare the Climate Destination Competitiveness Index and to conduct a risk analysis regarding the climate problems that have occurred and may occur in the Cappadocia Region. Considering the general purpose of the study, the main objective is to understand how climate factors affect destinations' competitive advantage. In the methodology part of the study, HCI was used to calculate the suitability of Avanos, Ürgüp, and Göreme for holidays (the method is explained in detail in the literature section). The monthly calculation was made using the TOPSIS method to calculate climate destination competitiveness. Finally, for the risk analysis of destinations according to climate change, the literature was utilized, and possible effects and solutions were determined. Secondary data from the General Directorate of Meteorology for HCI and climate destination competitiveness index and secondary data from sources for risk analysis were used.

It is thought that this study, which will calculate the impact of climate on destination competitiveness and determine the influential non-climate antecedents to maintain competitive advantage, will contribute to both the tourism sector and the literature. From this perspective, the strategic importance of the study is evident, as it will provide the tourism sector in the region with valuable insights into the touristic appeal of its key destinations. This will inform sustainable tourism planning, enabling the region to gain a competitive advantage. Based on this framework, the results will contribute to the literature as they will constitute a primary reference source for understanding the relationships between tourism and environmental variables. Regarding destination managers, the data obtained will provide essential information to help tourism businesses and other relevant stakeholders plan strategically by considering climate change and other important factors. Within the framework of these important situations, the study will provide a proactive approach to determining the measures for sustainable tourism development in the region.

2.2. Research Area

Cappadocia, known as the "Land of Beautiful Horses," is a region that UNESCO should protect due to its cultural and historical riches. Today, there are 429 registered buildings and 64 protected areas belonging to 10 different civilizations in Cappadocia. Approximately 60 million years ago, the layer formed by the lava and ashes of Erciyes, Hasandağı, and Güllüdağ was eroded by rain and wind, giving the region a natural landscape (TÜRSAB, 2008). Fairy Chimneys, called the unique natural landscape of Cappadocia, are formed by erosion and are among the most important tourist products at the destination. They are pointed, mushroom-shaped rocks with cones, columns, and hats. While Fairy Chimneys are widely seen in the valleys between Ürgüp, Uçhisar, and Avanos (Nevşehir Governorship), the traces of the ancient civilizations living in the region have been carried to the present day with the houses and churches built by ancient cultures in these Fairy Chimneys. Due to the volcanic structure of the Cappadocia region, stone, which has a soft structure and can be quickly processed, was used as the only architectural material in the region in the past. In addition, the abundance of this stone in the region and its easy processing enabled the development of stone craftsmanship specific to the region, which has become an architectural tradition (Ministry of Culture and Tourism, 2023).

Although the Fairy Chimneys seen in the Cappadocia Region are located in several different parts of the world, the fact that they are not as common and numerous as in Cappadocia increases the region's tourism potential. Furthermore, the destination is of significant interest to tourists, both the local and international communities, due to its rich historical and cultural heritage. Frequently visited places in Cappadocia can be listed as Göreme Ruins, Zelve and Paşabağları Ruins, Çavuşin Ruins, Derinkuyu Underground City, and Kaymaklı Underground City. In addition, the churches in the region are among the places that should be visited because they are important to Cappadocia (Cappadocia Area Directorate, 2023). The most visited places among these places are Göreme Open Air Museum, Zelve Ruins, and Kaymaklı Underground City (Anadolu Agency, 2023). The Cappadocia Region is preferred for several tourism types, such as culture, faith, nature, congress, golf, and wine tourism (Şamiloğlu & Serin-Karacaer, 2011). However, the research area (Avanos, Ürgüp, and Göreme) mostly has a cultural identity. Avanos stands out with a coffin, as it is the only sarcophagus found in the region so far. At the same time, ceramics made with ceramic mud obtained from the red soil and clay of Kızılırmak have been a source of livelihood for Avanos since the Hittite Period. Ceramics made in the region are an important tourist product today. Ürgüp was an important religious center during the Byzantine Period. The rock churches and monasteries in the area took their place among the important episcopal centers of the period. Göreme bears significant traces of Byzantine church architecture and religious art. Due to the limited transportation opportunities to Göreme in the past and the hilly structure of the region, it has been an important destination for those who want to retreat (TÜRSAB, 2008).

2.3. Data Collection Tool

The study obtained climate data from the General Directorate of Meteorology (Kayseri/Erkilet 32.82°N/35.43°E) to calculate the HCI and Climate Destination Competitiveness Index of Avanos, Ürgüp, and Göreme. To calculate the climate destination competitiveness of Avanos, Ürgüp, and Göreme, the climate data in the destination competitiveness index Proposal made by Burnaz and Ayyıldız (2018) and the criteria weights determined for these data were used. These data are the average highest temperature, average lowest temperature, average sunshine duration, and average rainy days. The HCI developed by Scott et al. (2016) was used for the HCI calculation.

3. Findings

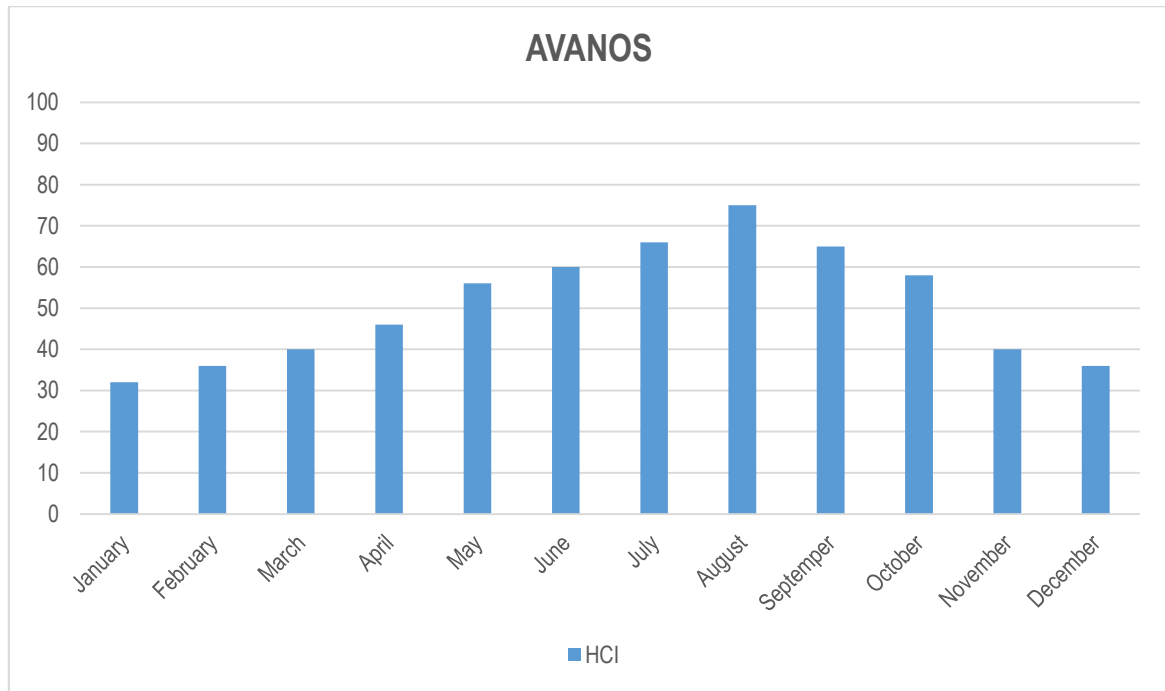The HCI calculation for Avanos, Ürgüp, and Göreme is shown in Figures 1, 2, and 3.

Figure 1. HCI of Avanos (Monthly)

When the HCI calculation of Avanos is examined, it is seen that it has a rating score of 32 (unacceptable) in January, 36 (unacceptable) in February, 40 (marginal) in March, 46 (marginal) in April, 56 (acceptable) in May, 60 (good) in June, 66 (good) in July, 75 (very good) in August, 65 (good) in September, 58 (acceptable) in October, 40 (marginal) in November and 36 (unacceptable) in December. Based on this situation, it can be said that the ideal months for holidays in Avanos are May, June, July, August, September, and October (Figure 1).
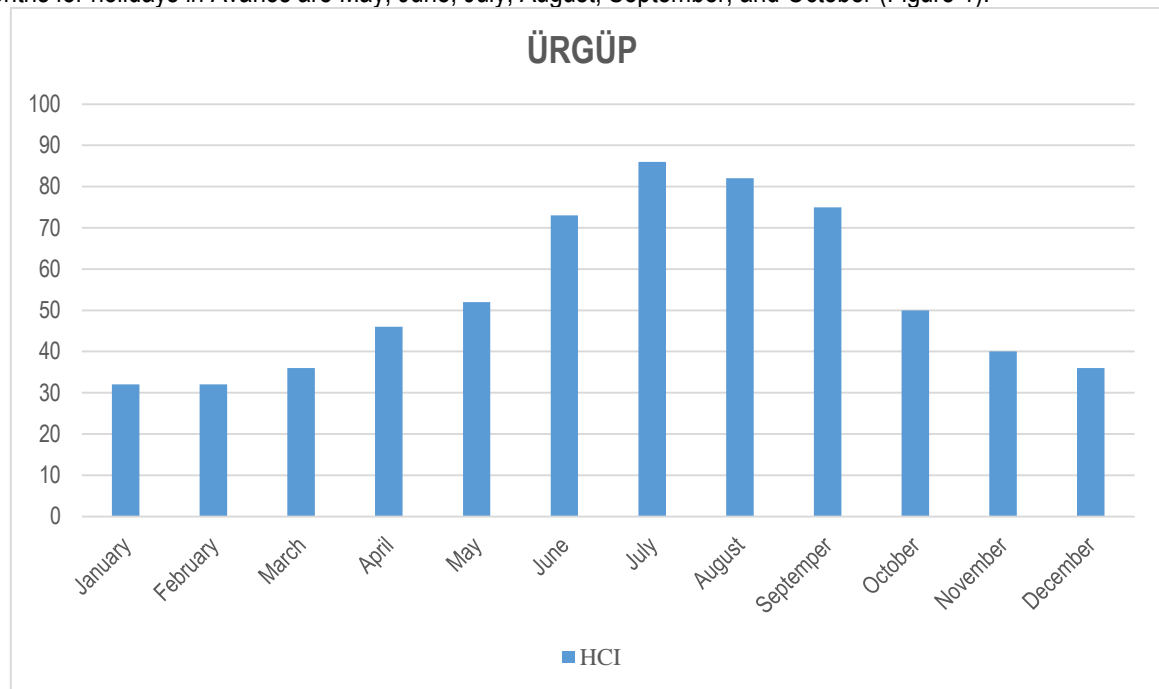

Figure 2. HCI of Ürgüp (Monthly)

When the HCI calculation of Ürgüp is examined, it is seen that it has a rating score of 32 (unacceptable) in January, 32 (unacceptable) in February, 36 (unacceptable) in March, 46 (marginal) in April, 52 (acceptable) in May, 73 (very good) in June, 86 (excellent) in July, 82 (excellent) in August, 75 (very good) in September, 50 (acceptable) in October, 40 (marginal) in November and 32 (unacceptable) in December. Based on this situation, it can be said that the ideal months for holidays in Ürgüp are May, June, July, August, September, and October (Figure 2).
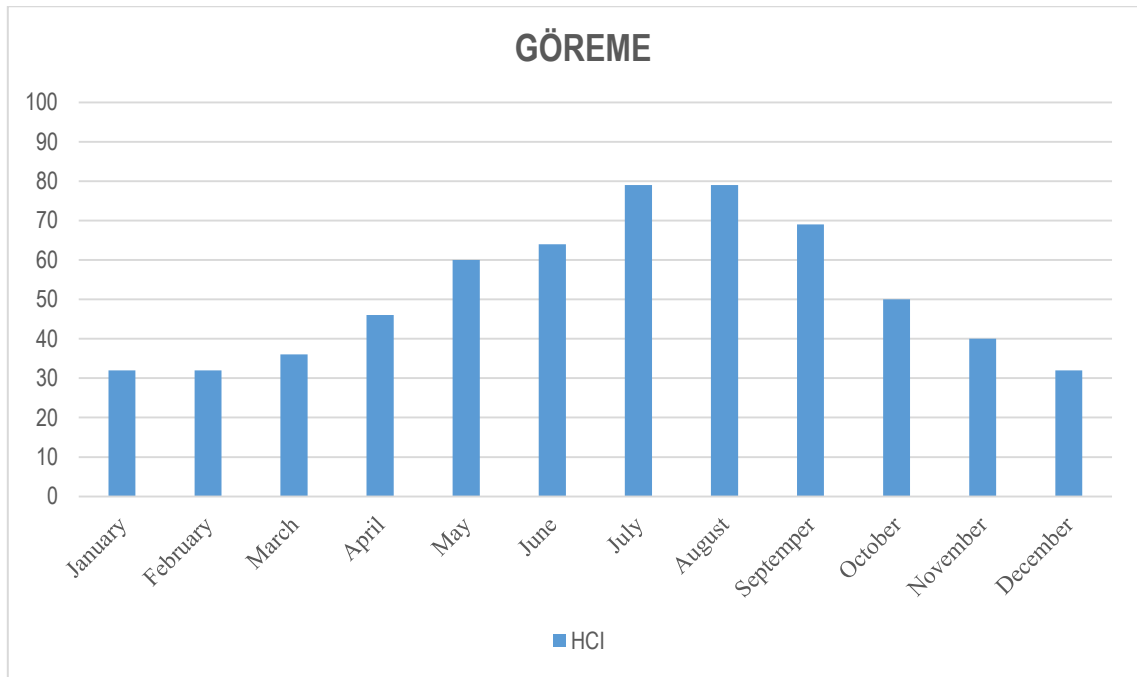
Figure 3. HCI of Göreme (Monthly)

When the HCI calculation of Göreme is examined, it is seen that it has a rating score of 32 (unacceptable) in January and February, 36 (unacceptable) in March, 46 (marginal) in April, 60 (good) in May, 64 (good) in June, 79 (very good) July and August, 69 (good) in September, 50 (acceptable) in October, 40 (marginal) in November and 32 (unacceptable) in December. Based on this situation, it can be said that the ideal months for holidays in Göreme are July, August, April, May, September, and October (Figure 3).
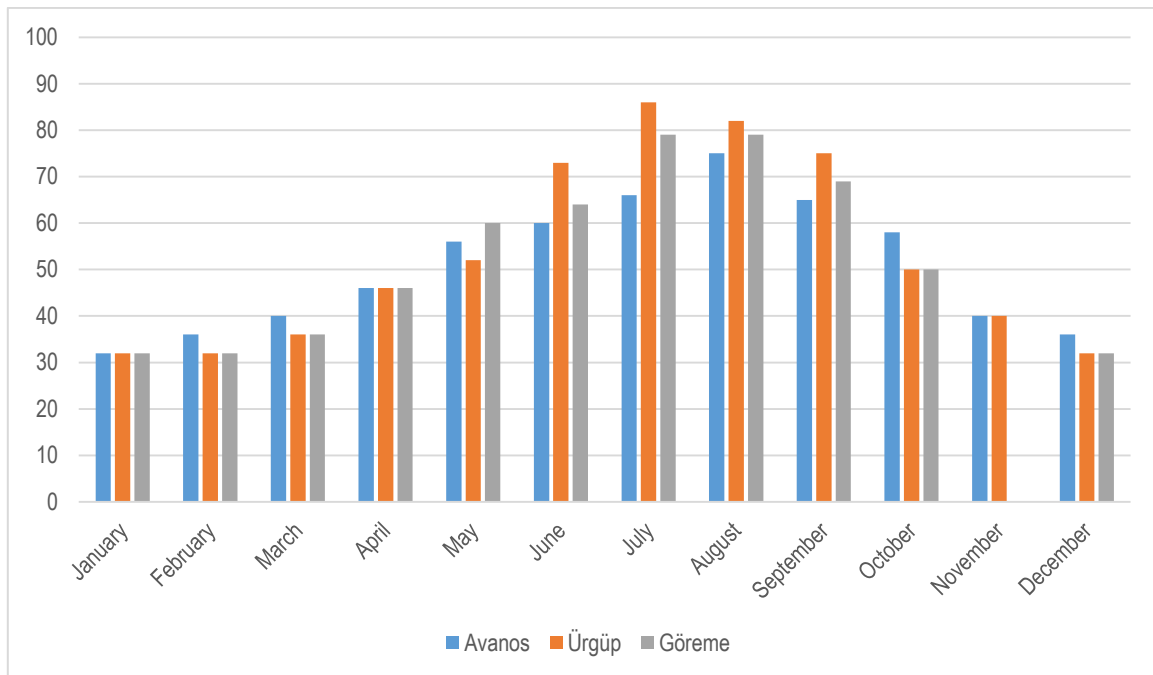

Figure 4. HCI Scores of Avanos, Ürgüp, and Göreme (Monthly)

When the HCI scores of Avanos, Ürgüp, and Göreme were compared, all three of them had the same score (32) in January; Avanos had the highest score (36) in February and March (40). They all had the same score (46) in April; in May, Göreme (60) had the highest score. In June (73), July (86), August (82), and September (75), Ürgüp had the highest score. In October, Avanos (58) had the highest score. It is seen that all three of them had the same score (40) in November, and Avanos had the highest score (36) in December.

To calculate the climate competitiveness of Avanos, Ürgüp, and Göreme according to the destination competitiveness index, the climate data in the Destination Competitiveness Index Proposal made by Burnaz and Ayyıldız (2018) and the criteria weights determined for these data were used. These data are the average highest temperature, average lowest temperature, average sunshine duration, and average rainy days. Their criteria weights are shown in Table 3.

Table 3. Criteria Weights

Highest Temperature	Lowest Temperature	Sunbathing Duration	Rainy Day
0,24	0,16	0,48	0,12

Source: Burnaz and Ayyıldız, 2018.

When the criteria weights of the climate data shown in Table 3 are analyzed, the average highest temperature has a criterion weight of 0.24, the average lowest temperature has a criterion weight of 0.16, the average sunshine duration has a criterion weight of 0.48, and the average number of rainy days has a criterion weight of 0.12. TOPSIS calculated the Climate Destination Competitiveness Index of Avanos, Ürgüp, and Göreme, utilizing data sourced from the General Directorate of Meteorology. The results are shown in Table 4.

Table 4. Climate Destination Competitiveness Index Calculation of Avanos, Göreme and Ürgüp (Monthly)

JANUARY		FEBRUARY		MARCH		APRIL	
Destination	Score	Destination	Score	Destination	Score	Destination	Score
Avanos	1	Avanos	1	Avanos	1	Avanos	1
Göreme	0,268106	Göreme	0,275519	Göreme	0,144117	Göreme	0,127409
Ürgüp	0	Ürgüp	0	Ürgüp	0	Ürgüp	0,392842
MAY		**JUNE**		**JULY**		**AUGUST**	
Destination	Score	Destination	Score	Destination	Score	Destination	Score
Avanos	1	Avanos	1	Avanos	1	Avanos	1
Göreme	0,083355	Göreme	0,167162	Göreme	0,206821	Göreme	0,157553
Ürgüp	0,539544	Ürgüp	0	Ürgüp	0	Ürgüp	0
SEPTEMBER		**OCTOBER**		**NOVEMBER**		**DECEMBER**	
Destination	Score	Destination	Score	Destination	Score	Destination	Score
Avanos	1	Avanos	0,37167	Avanos	0,907532	Avanos	1
Göreme	0,05832	Göreme	0,296189	Göreme	0,029126	GÜreme	0,229325
Ürgüp	0,662998	Ürgüp	0,703811	Ürgüp	0,125035	Ürgüp	0

When Table 4 is analyzed, it is seen that Avanos ranked first in the Climate Destination Competitiveness Index in 11 months and second in October. Göreme ranked second in 7 months and third in 5 months. Ürgüp ranked first in 1 month, second in 4 months, and third in 7 months.

As a result of the climatic conditions of the Cappadocia Region and the effect of climate change, it is possible to categorize the climate problems that may be experienced in the region as temperature increase, drought and desertification, erosion, and flood. Cappadocia: It is a unique natural and cultural heritage site located within the borders of Nevşehir and is on the UNESCO World Heritage List. The region is famous for its Fairy Chimneys, which are formed by wind and erosion of soft tuff rocks from volcanic eruptions millions of years ago. Periodic reports have been published twice by UNESCO regarding Göreme National Park and Cappadocia, which are on the UNESCO World Heritage List, in 2006 and 2014. According to the report published in 2014, factors such as temperature increase and erosion in the region hinder the renewal and preservation of natural structures (UNESCO, 2023).

Cappadocia Region has semi-arid and continental climate conditions. In these climatic conditions, temperature changes between day and night and summer and winter accelerate the dissolution and disintegration of rocks (Atiker, 1991). Bayer-Altın (2017) states that there was a 0.05% increase in year-round and summer temperatures in Nevşehir between 1960 and 2016. The average annual temperature is above the temperature that should be suitable for the region's climate. He also noted that temperature increases have been particularly pronounced since 1994. Human activities, in particular, need to be planned to take precautions regarding temperature increases. It can thus be proposed that regulations pertaining to tourism activities are an effective means of combating the observed increase in temperature.

When the climate in the Cappadocia Region is examined in terms of precipitation and temperature, it is seen that the region is sensitive to drought and desertification processes. It has been determined that factors such as erosion in the

region, deterioration of the physical and chemical structure of the soil, and extinction of fauna will accelerate the desertification process. In addition, it has been determined that human activities and agricultural and tourism practices in the region accelerate the desertification process. Considering all these results, it is thought that an effective environmental management strategy should be implemented in the region, and measures should be taken according to these strategies (Türkeş & Akgündüz, 2011).

Fairy Chimneys, which were formed as a result of erosion in the Cappadocia Region, are expected to disappear as a result of erosion (Atiker, 1991). In their study, Yılmaz et al. (2012) determined that the average soil erosion in the Cappadocia Region was 1.19 mm and that the most important cause of erosion was rainfall. In other words, erosion also increases as the amount of precipitation in the region increases. Although Fairy Chimneys, one of the important natural formations and touristic products of the region, are formed by erosion, these erosions can affect their shape and durability. In order to mitigate the adverse impacts of erosion on the region, particularly on the Fairy Chimneys, precautions such as regulating tourism activities, controlling agricultural activities, protecting the soil cover, building erosion control dams, and afforestation should be taken.

Kızılırmak, located in Avanos and the longest river in Türkiye, is one of the region's important tourist products. The provision of gondola trips in Kızılırmak has become a prominent feature of the regional tourism industry, attracting considerable attention and participation (NTV, 2023). However, due to the decrease in precipitation and the increase in temperatures in recent years, the water level in the river has decreased significantly and is in danger of drought (NTV, 2020).

Nevşehir province is generally under flood risk. According to the report published by the Disaster and Emergency Management Presidency (AFAD, 2021), the risk of floods has increased throughout Nevşehir as of 2011, and 80 floods occurred across the province between 2011 and 2020[5]. Flood disasters caused a lot of damage to the infrastructure and superstructure of the province. It has been determined that floods threaten some settlements in the province in the following years and that there is a high probability of floods occurring in some settlements, especially around the Kızılırmak River, Avanos, and Ürgüp.

When the Cappadocia Region is examined within the framework of climate change and related risks and natural disasters, it is seen that the region is faced with the risk of temperature increase, drought and desertification, erosion, and flood. Since the mentioned risks may affect the tourism sector, it is necessary to determine the possible risks affecting regional tourism and what can be done to eliminate the risk to minimize or completely eliminate the negative effects. Academic studies and various reports (AFAD, UNESCO, etc.) related to the Cappadocia Region have been examined, the negative situations that may occur in the region due to climate change and the risks that these situations may pose to regional tourism have been evaluated, and the findings (risks) and possible solution suggestions obtained as a result of this evaluation have been assessed/measures are combined in Table 5.

Table 5. Possible Effects of Climate Risks That May Occur in the Cappadocia Region on the Tourism Sector and Solution Suggestions

Name of Risk	Possible Effects of Risk on the Tourism Sector	What to Do for eliminating of risks to Eliminate the Risk
Temperature Increase	• Decrease in the number of visitors, especially in the summer months • Periodic decline in tourism revenues • Increase in energy use during summer (Air conditioning)	• Increasing the diversity of activities in the region by developing alternative tourism types in the region (such as winter tourism) • Taking measures in the region (such as afforestation) within the scope of combating climate change
Drought and Desertification	• Decrease in the number of visitors • Decline in tourism revenues • Damage to Fairy Chimneys • Damage to flora and fauna • Drying of the Kızılırmak River	• Taking precautions regarding agriculture and tourism activities (such as paying attention to the use of energy resources) • Improving irrigation systems • Afforestation • Construction of erosion control dams
Erosion	Decrease in the number of visitors Decline in tourism revenues Damage to Fairy Chimneys Decrease in grape cultivation	• Regulating tourism activities • Taking agricultural activities under control, • Protecting the soil cover, • Building erosion control dams

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[5] For the latest flood disasters in Cappadocia, see: https://l24.im/NpF9a; https://l24.im/SonxJkA

		• Afforestation
Flood	• Decrease in the number of visitors • Decline in tourism revenues • Damage to Fairy Chimneys. • Damage or destruction of tourism establishments. • Damage to the infrastructure and superstructure of the region	• Stopping rapid and uncontrolled urbanization. • Cleaning of stream beds. • Terracing and afforestation on sloping slopes

When the risks listed in Table 5 are examined, it is seen that the tourism sector is exposed to various climate risks that may affect destination sustainability and tourism revenues. When climatic risks are discussed specifically in the Cappadocia Region, it is predicted that events such as temperature increase, drought and desertification, erosion, and floods may cause serious problems, and precautions must be taken regarding these problems. The rise in temperature in the region may cause a decrease in the number of visitors, especially in the summer months, an increase in energy use, and a corresponding reduction in tourism revenues. To eliminate these risks that the increase in temperature may cause, it will be right to extend the tourism activity in the region to 12 months and to increase its mobility in the winter season. Drought and desertification that may occur in the Cappadocia Region may lead to a decrease in the number of visitors, a decrease in tourism revenues, damage to the Fairy Chimneys, damage to the flora and fauna, and drying of the Kızılırmak River. To eliminate these risks that may be caused by drought and desertification, it is necessary to take precautions regarding agriculture and tourism activities, improve irrigation systems, improve afforestation works, and build erosion control dams. In this way, the decrease in the number of visitors, tourism revenues, and ecosystem damage can be minimized.

A potential decline in the Cappadocia Region may result in a reduction in tourist numbers, a corresponding decrease in tourism revenue, damage to significant cultural and historical assets, such as the Fairy Chimneys, and a decline in grape cultivation. In order to eliminate these risks that erosion may cause, tourism activities should be regulated, agricultural activities should be controlled, soil cover should be protected, and erosion dams and afforestation works should be carried out. In this way, damage to important tourism values such as Fairy Chimneys and a decrease in tourism revenues will be prevented. Flood disasters may cause damage to historical and cultural values such as Fairy Chimneys, financial damage to tourism businesses or structural collapses, damage to the infrastructure and superstructure of the region, a decrease in the number of visitors, and a decrease in tourism revenues. In order to eliminate these risks that may arise from floods, rapid and uncontrolled urbanization should be stopped, stream beds should be cleaned, and terracing and afforestation work should be carried out on sloping slopes. These measures will contribute to the protection of Fairy Chimneys, the safety of tourism businesses, and the sustainability of the economic balance in the region by minimizing the damage caused by floods.

Since climate change has caused/will cause severe problems in the Cappadocia Region, precautions must be taken against the problems caused by climate change. The potential for adverse effects on the region's natural and cultural resources is heightened by several environmental threats, including temperature increase, drought and desertification, erosion, and floods. In this context, measures such as encouraging winter tourism and increasing the use of environmentally friendly energy resources to balance the decrease in tourism revenues can reduce the effects of climate change on the region. Sustainable management of water resources, erosion control, and infrastructure works to reduce flood risk are also crucial in protecting the region's ecosystem. At the same time, reducing the use of fossil fuels and carrying out afforestation activities to reduce the environmental damage within the scope of combating climate change can reduce the effects of climate change in the region. As a result, it is possible to say that the measures to be taken against climate risks in the Cappadocia Region will make the destination more sustainable. At the same time, it is possible to say that these measures will help development by protecting the regional economy, helping balance the income from tourism, and protecting the tourist products of the region.

Conclusions and Suggestions

Tourism is a notable example of one of the industries significantly impacted by climate change. Given its constant interaction with environmental factors and susceptibility to climatic conditions, it is not surprising that the sector has been affected to a considerable extent. Considering the effects of climate change, it is necessary to investigate whether the climatic conditions of the destinations are suitable for holidays, to make plans accordingly, and to determine appropriate strategies for the destinations.

In this respect, among the important destinations of importance to Türkiye is the Cappadocia Region; the studies used in the research involve the calculation of the Destination Competitiveness Index and Holiday Climate Index for Avanos,

Ürgüp, and Göreme, evaluating the obtained results. It has been observed that the research findings regarding Avanos, Ürgüp, and Göreme Districts provide an important highlight of HCI and the Destination Competitiveness Index. Since the Destination Competitiveness Index was calculated in the study, Avanos district ranks first in many months. For 11 months, Avanos district became the destination with the highest score regarding climate competitiveness. This situation indicates that Avanos generally has a more competitive climate for holidays. It has a middle level of competitiveness because the Destination Competitiveness Index kept this district in second place for so many months. On the other hand, the Ürgüp district had the highest ranking due to the Destination Competitiveness Index in October, but it showed a deficient performance in different months. These findings have thus determined whether climate conditions significantly affect destination competitiveness. Consequently, it was confirmed that Avanos is generally the most competitive destination, while Göreme and Ürgüp come into prominence in certain periods. Besides, it can be said that considering climatic data in tourism planning can support the better management of regional tourism strategies.

When the HCI of Avanos is analyzed, it is determined that it is good in June and July and very good in August and September. It is concluded that May and October have acceptable values; that is, these months are also suitable for holidays. March, April, and November have marginal values, while January and December have unacceptable ones. An examination of the Ürgüp HCI revealed that it was rated as very good in June and September and excellent in July and August. It is concluded that May and October have acceptable values, April and November have marginal values, and January, February, March, and December have unacceptable values. An examination of the Göreme HCI revealed that it was rated as very good in July and August and good in May, June, and September. It is concluded that October has acceptable values, March and November have marginal values, and January, February, and December have unacceptable values.

Considering the HCI, it is evident that all three destinations are more conducive to tourism activities during the summer season. However, given that Cappadocia also receives visitors during the winter season, it is necessary to implement strategies to enhance visitor numbers during these periods. Aydın and Sezerel (2017) stated that destinations are affected by cultural values, natural attractions, recreational activities, comfort, and shopping opportunities in terms of demand. When these factors, which are considered necessary other than climate, are evaluated, it can be stated that increasing recreational activities and shopping opportunities and highlighting cultural values in all three destinations will increase the number of visitors to the destination. Rosselló-Nadal (2014) mentioned that hot destinations will lose their attractiveness due to climate change, and the attractiveness of some destinations will increase during the winter months. In addition, he stated that tourism activities can be continued outside the summer months by taking advantage of the climate changes experienced in the winter season. When this situation is explicitly examined in Cappadocia and considering that it has broken visitor records in the winter months in recent years, it is possible to say that the region will maintain its advantage in destination competitiveness with effective marketing strategies.

The research has determined that the climate problems that have occurred or may occur in the Cappadocia Region are temperature increase, drought, desertification, erosion, and flood. These problems may lead to a decrease in the number of visitors in the region, a reduction in tourism revenues, an increase in energy use, damage to the Fairy Chimneys, drying of the Kızılırmak River, a decrease in grape cultivation, damage to tourism businesses and damage to the infrastructure and superstructure of the region. To minimize or eliminate these risks, it is necessary to extend tourism to 12 months, develop alternative tourism types, take precautions, regulate agricultural and tourism activities, improve irrigation systems and afforestation, and protect the soil cover. When examined from an environmental perspective, these measures will help protect the region's natural elements and make it sustainable. When examined from a tourism perspective, it will maintain or help increase tourism activity and protect the economic income the region receives from tourism.

Since the study examined Avanos, Ürgüp, and Göreme, which are the important destinations of the Cappadocia Region, it has some limitations. In future studies, obtaining more comprehensive data on the HCI comparing destinations in different places to conduct risk analysis regarding climate problems will help better understand the issue and obtain results in a broader context. In addition, it is thought that comparing the HCI and TCI on the same destination will contribute to both the literature and the sector in terms of better understanding the indices, as it will reveal the difference between the two climate indices. In addition to HCI and TCI, qualitative and quantitative research is also recommended for researchers to determine the impact of climate change on destinations.

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