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J. Geogr. Inst. Cvijic. 2023, 73(1), pp. 79–92

Original scientific paper

UDC: 911.3:380.8:007
https://doi.org/10.2298/IJGI2301079U

Received: October 24, 2022
Reviewed: February 1, 2023
Accepted: March 17, 2023

DETERMINATION OF WINTER TOURISM POTENTIAL AREAS IN TÜRKİYE USING A GIS-BASED MULTI-CRITERIA ANALYSIS

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Abstract: Tourism, one of the expeditiously growing and most important sectors, contributes to the national economy by increasing employment and foreign exchange income. As in many countries, the place of tourism in the country's economy is very important in Türkiye (formerly known as Turkey). As one of the sources that have contributed significantly to the country's economy for many years, it has played a locomotive role in its development. Türkiye is trying to increase its share of international tourism revenues with investments and incentives. Although it is a country that draws attention with its areas suitable for winter tourism, the development of winter tourism centers is very slow when some aspects are taken into account. Konya Province is one of the few religious and cultural tourism centers of Türkiye. The region has qualified winter tourism areas. Bringing these areas to tourism can be an important resource for both the provincial and national economy. This study proposes a Geographical Information System based Multi Criteria Evaluation (MCE) model using Best Worst Method (BWM) to identify the most suitable locations for winter tourism facilities in the Konya region of Türkiye. Among some suitable areas determined according to the results of the analysis, Aladağ Mountain in Derbent region has been seen as the most suitable place for winter tourism investments, as it has all the features such as snow quality, transportation, and snowy day duration that should exist in a winter tourism center.

Keywords: winter tourism; site selection; Best Worst Method; multi criteria evaluation; Konya (Türkiye)

1. Introduction

Tourism is an expeditiously growing and the most important economic sector in the world. Therefore, many countries in the world attach importance to this sector. The tourism industry provides many jobs to skilled and unskilled workforce. Women constitute 54% of the 330 million people who are directly or indirectly connected with tourism (United Nations World Tourism Organization [UNWTO], 2019). Tourism, in addition to its tendency to indirectly affect different

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sectors such as transportation, construction, food, livestock, energy, as well as activities such as accommodation, travel organization, and sale, it appeals to groups that ordinarily have slighter access to the workforce such as rural population, immigrants, young workforce, etc. (Garsous et al., 2017). It increases competition, productivity, and tax revenues by directly or indirectly affecting the economy through different channels such as tourism, employment, infrastructure, technology, and investment. In addition, tourism is an alternative form of export and thus can be considered as a source of foreign currency earnings for countries. Tourism also contributes to the exchange of culture and experience between countries (Shahzad et al., 2017).

One of the most striking forms of tourism activity is winter tourism, which has many advantages and is an significant source of economic income. It is not only an activity where skiing is done, but also a whole of activities and relations consisting of trips to these regions, alternative sports, accommodation, and other services (Ay et al., 2016). In mountainous regions where development is not economically sufficient, winter tourism can contribute to the improvement of the region. In addition, it can be mentioned that it has an employment-creating effect by enabling the personnel working in the tourism sector during the summer period to find a job in the winter months as well. People who usually spend their holidays in summer season have started to keep these habits in the winter season and have caused the winter tourism movements to accelerate. Therefore, developed countries in tourism are working on developing the sector in regions where winter tourism is intense.

The tourism sector is of great importance for Türkiye's economic growth and development. In Türkiye, the tourism sector remained below expectations until the 1980s, but this situation was reversed with the policies implemented after 1980 (Bulgan et al., 2019). While Türkiye's income from international tourism was around five billion dollars in the early 2000s, it has reached 37 billion dollars today. In the same period, the number of international tourists increased at the same rate, reaching 46 million from seven million (Şeker, 2022).

The coronavirus pandemic has significantly affected and continues to affect tourism industry all over the world. Although such an impact can hardly be calculated, the UNWTO constantly emphasizes the effects of negativities such as political upheavals, wars, and economic crises on the sustainability of the tourism sector (Charfeddine & Dawd, 2022). Türkiye is a country that draws attention with its areas suitable for winter tourism, but considering some issues, the development of winter tourism centers in Türkiye is very slow. However, winter tourism in Türkiye has been showing quite successful developments recently (Kazan et al., 2015).

1.1. Literature review

In order to determine winter tourism areas, many criteria such as topographical situation, number of sunny days, duration of snow cover, and accessibility should be taken into account. The choice of the best alternative is difficult, because it is a contradiction between criteria and a sacrifice from another to improve each other. Various methods have been developed to achieve consensus among these criteria and to select the most appropriate one among the alternatives. Multi criteria evaluation (MCE) methods began to be developed in the 1960s, with the need for tools to help decision-making. In the last decade, in parallel with the developments in computer technology and software, more reliable and effective results have been obtained by using MCE methods and Geographic Information System (GIS), which perform an important role in the processing and analysis of spatial data as a whole in different site selection studies (Akar et al., 2023; Uyan, 2019). There is a wealth of literature on site selection studies. For example, with combining MCE methods

with GIS, Uyan and Yalpır (2016) studied medical waste sterilization plant site selection in Türkiye; Vasileiou et al. (2017) studied wave energy systems and hybrid offshore wind site selection in Greece; Bejari et al. (2017) presented an application for a chromite processing plant site selection in two different regions; Sai Krishna et al. (2017) used geospatial multi-criteria analysis with multi spatio-temporal remote sensing data to find municipal solid waste collection areas. Gigović et al. (2017) suggested a model to locate wind farms and Uyan (2013) used GIS and Analytic Hierarchy Process (AHP) to evaluate the most productive areas for power plants facilities.

MCE and GIS techniques have rarely been applied to select tourist areas. Gigović et al. (2016) improved a reliable model for the sustainable development and strategy development and management of ecotourism. Nouri et al. (2016) compared MCE tool and Huff model for selecting mountain tourism sites. Chou et al. (2008) presented a fuzzy MCE model for hotel location. Yang et al. (2022) assessed the performance of medical tourism using Bayesian best-worst method (BWM) and Grey PROMETHEE-AL methods.

The AHP technique is one of the most widely used methods to determine land suitability, and pairwise comparisons are used to define the relative significance of criteria. In recent years, BWM is one of the constantly operated methods for determining criteria weights. BWM uses two pairs comparison vectors based on two reverse sample points, and reduces potential provision making prejudice in the model weighting process (Kheybari et al., 2021).

2. Materials and methods

2.1. Study area

The research on the selection of the most suitable areas for winter tourism was carried out in Konya, Türkiye. Konya is Türkiye's largest and the sixth most populous city. Konya city's area is approximately 39,000 km^2. In Konya, which is located in the southern part of the Central Anatolia (Figure 1), winters are harsh, cold, and snowy, and summers are warm and dry. The annual average temperature in the 1929–2021 measurement period was 11.7°C (Uyan, 2014). According to Turkish Statistical Institute's 2022 data (2023), the population of the Konya is approximately 2,297,000.

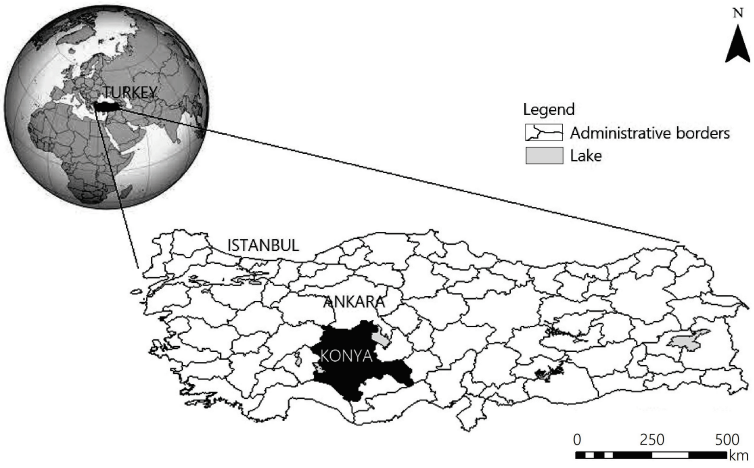

Figure 1. Location of the study area.

The history of the settlement in Konya goes back to prehistoric times. Catalhoyuk (Çatalhöyük), the oldest and most developed Neolithic settlement center ever found, is within the borders of Konya. Catalhoyuk is also on the UNESCO World Heritage List. The city is home to the tomb of the Islamic thinker Mevlana (Rumi), which attracts worldwide attention. Visited by millions of tourists every year, Konya has an important potential in terms of history, culture, and religious tourism (Invest in Konya, 2017). In 2021, the most visited museum in Türkiye with 1.5 million visitors was the Mevlana Museum in Konya, where Mevlana's tomb is located (Oğan & Emekli, 2022).

Besides the financial contributions of the ski and winter sports centers in Türkiye to these cities, it has a great function in making these cities a brand. In Türkiye, current winter sports tourism centers are seen in Figure 2. Bedding capacity for winter tourism is more than 11,000 and this number is targeted to be increased to 80,000 (Sakcalı & Büyükipekçi, 2022).

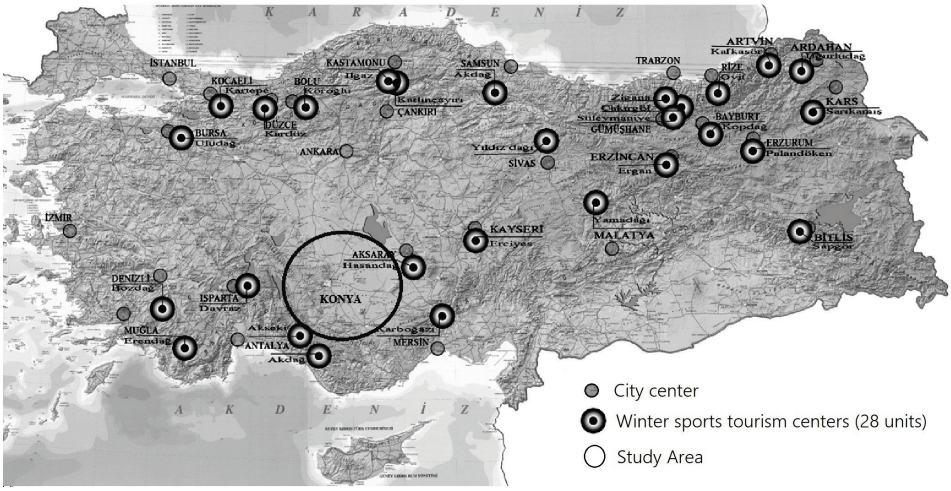

Figure 2. Current winter sports tourism centres in Türkiye.
Note. Modified from "Sürdürülebilir kış sporları turizmi: Sarıkamış'ın potansiyelinin SWOT analizi ile değerlendirilmesi [Sustainable winter sports tourism: Evaluation of Sarıkamış's potential with SWOT analysis]," by B. Eşitti, 2018, *Turizm Akademik Dergisi/Tourism Academic Journal, 5*(1), p. 207. In the public domain.

2.2. Methodology

In the study, a BWM model was applied to define the most suitable areas for winter tourism in Konya. The criteria for the selection of suitable areas for winter tourism have been determined in line with the views of experts in winter sports. The determined criteria were evaluated and weighted using BWM, which enables decision makers to make their evaluations in a systematic way and they were spatially modeled with the help of GIS. The methodology is represented in Figure 3.

In this study, meteorological and solar radiation data were obtained from the WorldClim data set (WorldClim, 2021), which evaluated the climate data in the period 1970–2000, with a spatial resolution of 30 seconds. The raster maps were reevaluated using ArcGIS 10.5 software (ESRI, 2022) and converted to raster format. By using 30 m × 30 m Shuttle Radar Topography Mission data (United States Geological Survey, 2022), a digital elevation model was created

for Konya region. With the help of this model, topography, slope, and aspect maps were reevaluated in raster format.

Six criteria were selected for winter tourism site selection. These criteria are as follows: Meteorological data, Aspect, Slope, Topography, Solar radiation, and Impacts of buildings in areas over 1,800 m a.s.l.

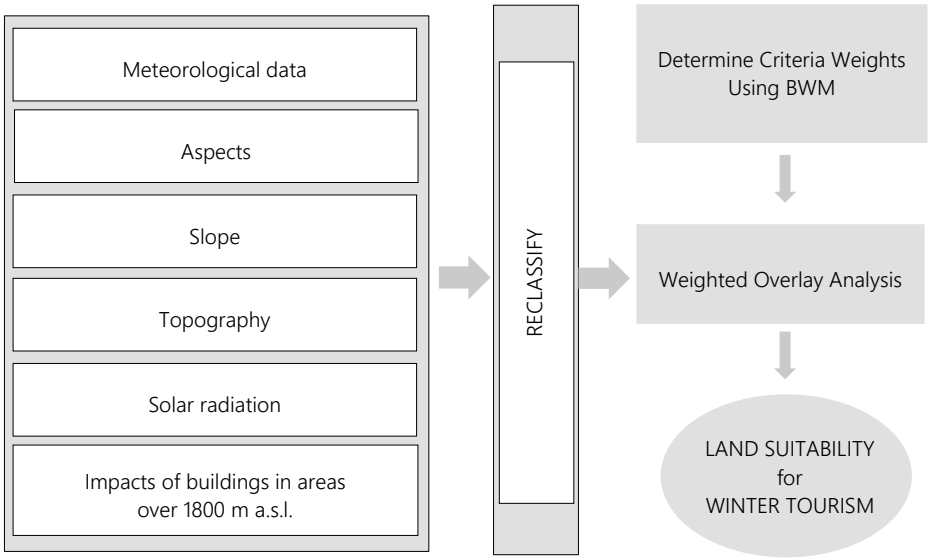

Figure 3. General framework of land suitability mapping.

2.2.1. Meteorological data

One of the important criteria for winter tourism is meteorological data. The choice of the snowiest areas is important because snow is an indispensable element of winter tourism. The high pressure and the fact of being on the route of moist air masses enable mountainous areas to get more snow. In winter tourism, the wind conditions of ski areas are also important. For ski areas, the northern slopes, which are closed to the southern winds, should be selected. The analyses of meteorological data are shown in Figure 4.

2.2.2. Aspect

Many factors are influential in the distribution of temperature, and one of them is aspect. Secondly, analyses of the north, south, east, west, and transit directions according to the topographical situation of the area were conducted and north, northwest, and northern orientations which were considered suitable for winter sports were selected from the obtained digital elevation model (Figure 5).

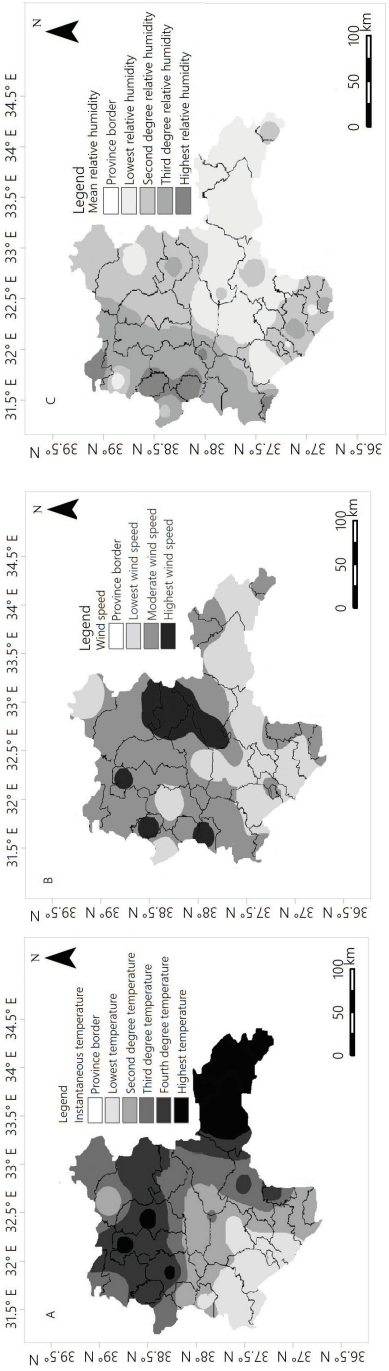

Figure 4. Cartographic presentation of meteorological data: instantaneous temperature (A), wind speed (B), and mean relative humidity (C).

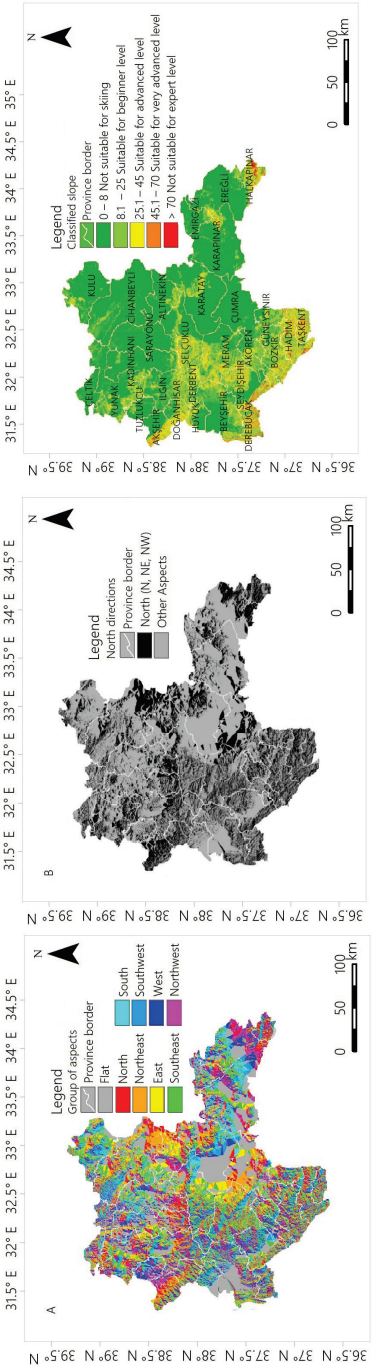

Figure 5. Cartographic presentation of the aspects: group of aspects (A) and north directions (B).

Figure 6. Classified slope map.

2.2.3. Slope

Ski slopes are divided into three classes according to the degree of difficulty. "Blue" colored ski slopes—for moderate skiers, a minimum slope of 15%, a maximum of 35%. "Red" colored ski slopes—for good skiers and official competition ski slopes, minimum 35%, maximum 60% slope. "Black" ski slopes—difficult tracks with the inclination minimum of 60% and maximum of 100% (a maximum angle of 45 degrees). Classified slope map for skiing is shown Figure 6.

2.2.4. Topography

Topographic maps of the region were created. This analysis shows the areas where the topographic curves are high and where valley occurrences are visible (Figure 7).

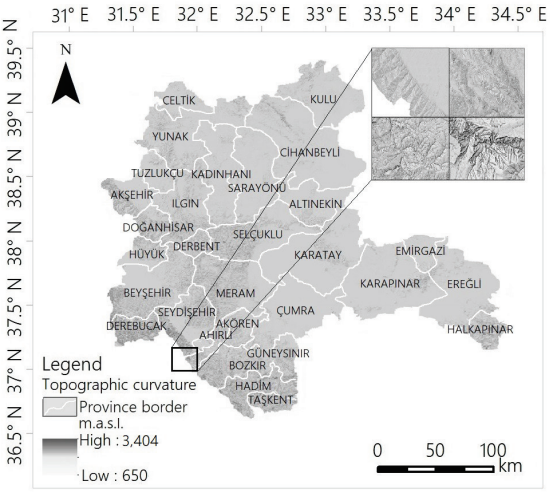

Figure 7. Topographic curvature map.

2.2.5. Solar radiation

The winter tourism season in Türkiye lasts between November and May. One of the necessary features for ski areas is to choose the northern slopes where the snow stays long and the solar radiation is less. Figure 8 shows the values of solar radiation between November 1 and May 15 for Konya. In the analysis, the regions from red to blue are the topographic regions where the sun is weakening.

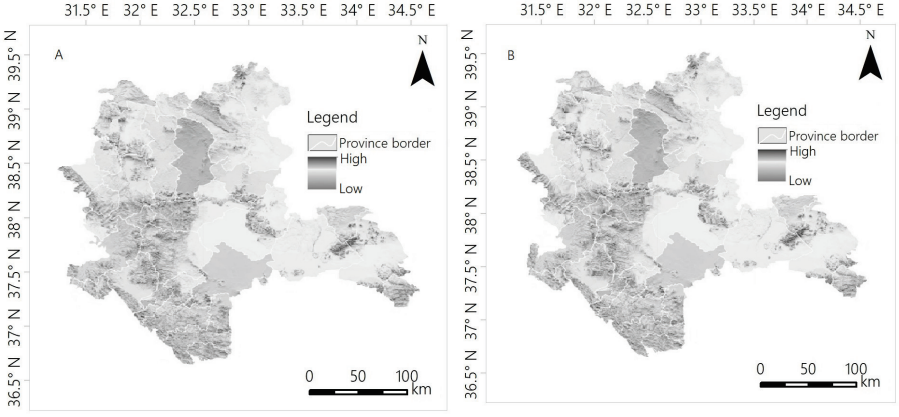

Figure 8. Konya city solar radiation values: November 1 – December 31 (A); January 1 – May 15 (B).

2.2.6. The impacts of buildings in areas over 1,800 m a.s.l.

The proximity of the winter tourism areas to the settlements is important in terms of transportation and accommodation. An aggregation analysis of these buildings was conducted at a distance of 500 m a.s.l. using the buildings in the settlements with an altitude of over 1,800 m a.s.l. As a result of the analysis, a 5 km impact area of the building collection areas was determined (Figure 9).

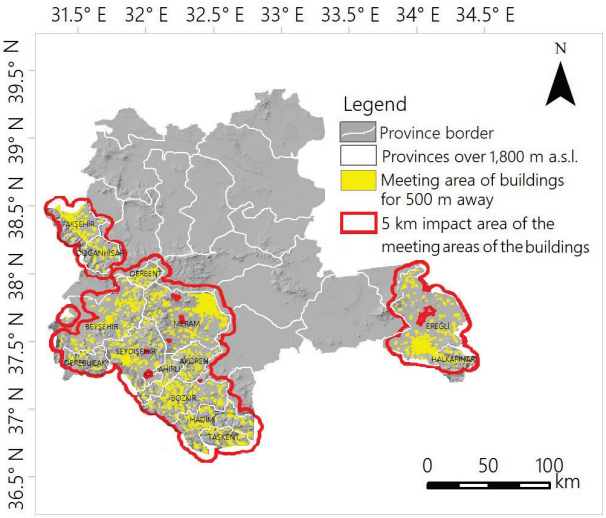

Figure 9. Analysis of the impacts of buildings in areas over 1,800 m a.s.l.

2.3. BWM weights of the preferred criteria

BWM is a one of the multi criteria decision making methods based on pairwise comparisons of criteria (Rezaei et al., 2015). The most distinctive feature of this method is that it demands fewer comparison data and produces more consistent and more dependable results compared to other multi-criteria decision-making methods (Rezaei, 2015). When applying BWM, first the decision makers need to determine the most important and the least important criteria. Pairwise comparisons are made between these two criteria and other criteria (Ertunç & Uyan, 2022; Rezaei, 2015). For the reliability of comparisons, the consistency value to be calculated must be less than 0.10. With pairwise comparisons, the weighted values of each criteria or alternative are determined. The method was described by Rezaei (2015) in five basic steps (Bahrami et al., 2019).

Step 1. Decision criteria (C_i) is determined.

Step 2. In line with expert views, the most important (B) and the least important criteria (W) are determined among the criteria.

Step 3. The rate of preference of the most important (B) criteria over other criteria is identified by using a number between one and nine (where one is equally important and nine is extremely more important). The vector resultant of the best to the other would be as Equation 1:

$$A_B = (a_{B1}, a_{B2}, \ldots, a_{Bn}) \quad (1)$$

wherein, A_B is the pairwise comparison vector of the best criteria and the other criteria, a_{B1}, a_{B2}, and a_{Bn} show the comparison scores of the best criteria with the first, second and nth criteria, respectively.

Step 4. The rate of preference of the least important (worst) criteria over other criteria is determined by using a number between one and nine. The vector provided from the others to the worst comparisons would be as Equation 2:

$$A_w = (a_{1w}, a_{2w}, \ldots, a_{nw})^T \quad (2)$$

wherein, A_w is the pairwise comparison vector of the worst criteria and the other criteria, a_{1w}, a_{2w}, and a_{nw} show the comparison scores of the worst criteria with the first, second and n_{th} criteria, respectively.

Step 5. The optimum weights (W_1, W_2, ..., W_n) and consistency indicator (ξ) are calculated. The optimum weights are unique for each pair of W_B/W_J and W_J/W_W that would be as Equation 3:

$$\begin{gathered} W_B/W_J = a_{Bj} \text{ ve } W_j/W_W = a_{jw} \\ Min\ \xi \text{ s.t.} \\ |W_B/W_J - a_{Bj}| \le \xi \quad \text{for all } j \\ |W_j/W_w - a_{wj}| \le \xi \quad \text{for all } j \\ \sum_j W_j = 1,\ W_j \ge 0 \text{ for all } j \end{gathered} \quad (3)$$

If the consistency indicator is close to 0, it indicates high consistency.

3. Results and discussion

Konya has hosted many cultures and civilizations with its long historical past. This city, where the world's first Christian settlement and temples are located, has an important potential in cultural tourism. The city, which was visited by approximately two million domestic and foreign tourists in 2022, has a bed capacity of 14,000 (Garda, 2022). The establishment of a professional winter tourism center in the region means that many tourists from major cities such as Ankara and Antalya come to the region. In the study, the criteria used to define the suitable areas for winter tourism were determined by the view of experts on winter sports. Pairwise comparisons of these criteria were also made by these experts. The defining criteria of the study are grouped under six main headings. Meteorological data were determined as the most important criteria for this study. The criteria of the Impacts of buildings in areas over 1,800 m a.s.l. were defined as the least important criterion. The evaluation of the criteria and their weighting with BWM were carried out and concluded by experts in the field of winter sports. According to BWM, criteria weights were carried out with an excel file named BWM-Solver-4 developed by Rezaei (2016). In the weighting process with pairwise comparisons using BWM, the Slope criteria had the same weight value (0.33) as the Meteorological criteria, which were chosen as the best criteria at the beginning of the study. This means that the Slope criteria are as important as the Meteorological criteria in the site selection. The effect of both

criteria on site selection was 66%. The weights of the criteria Aspects, Topography, Solar radiation, and Impacts of buildings in areas over 1,800 m a.s.l. were 0.13, 0.10, 0.08, and 0.03, respectively.

These weights were used in the GIS environment to integrate the variables into the terrain suitability assessment and allowed us to generate the result maps with overlay analysis. Overlay analysis is a technique applied to create a unified analysis using different criteria. The criteria used may not be equally important. In this case, criteria should be weighted according to their importance before being combined (Esri, 2017).

The weighted sum was used in the study to create the suitability values and result maps of the winter tourism areas. The ξ value calculated in the weighting process for each criterion was calculated as 0.06. If this value is less than 0.10, it means that the weights are appropriate. Finally, a suitability map was created by overlay analysis in ArcGIS software of the places on the 1,800 m a.s.l. where the north directional orientation is appropriate, the slope is suitable to the expert level, and snowflakes can be formed. Figure 10 shows the final potential map of suitable areas for winter tourism.

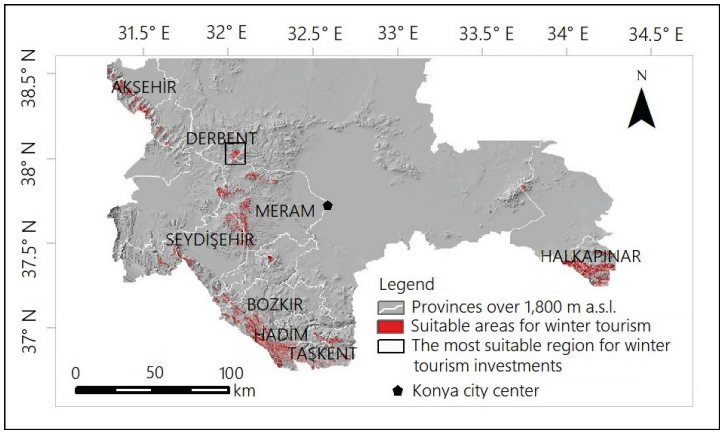

Figure 10. Suitability map for potential winter tourism areas.

This study has identified suitable areas for winter tourism in Konya. Konya has the largest area of Türkiye with an area of approximately 39,000 km^2. Aladağ Mountain in the Derbent region of Konya is seen as the most suitable place for winter tourism investments. The ideal snow for skiing is powder snow. In this region there is snow near the powder snow quality. Aladağ Mountain in the Derbent region has all the features that should exist in a winter tourism center.

Some features of the region can be listed as follows:

- It has an intense and high-quality snowfall during the winter season;
- The snow remains on the ground for at least four to five months;
- It has ski track alternatives with different slopes and difficulty;
- It has an attractive nature and plant cover; and
- Easy and quick access (Konya–Derbent = 57 km, Ankara–Derbent = 284 km, Antalya–Derbent = 302 km).

With the studies carried out until this section, the most suitable areas for winter tourism in Konya have been determined on a macro scale. Among the determined areas, the most suitable area was chosen for the Derbent region. In order to determine the ski center in this region at the micro level, spatial analyses (such as aspect, north direction, and suitable slope for skiing at different levels) were made and the most suitable ski track route was determined, as can be seen in Figure 11. In some parts of the determined region, the locals are already skiing in an amateur way. It is visited by many people, especially at weekends.

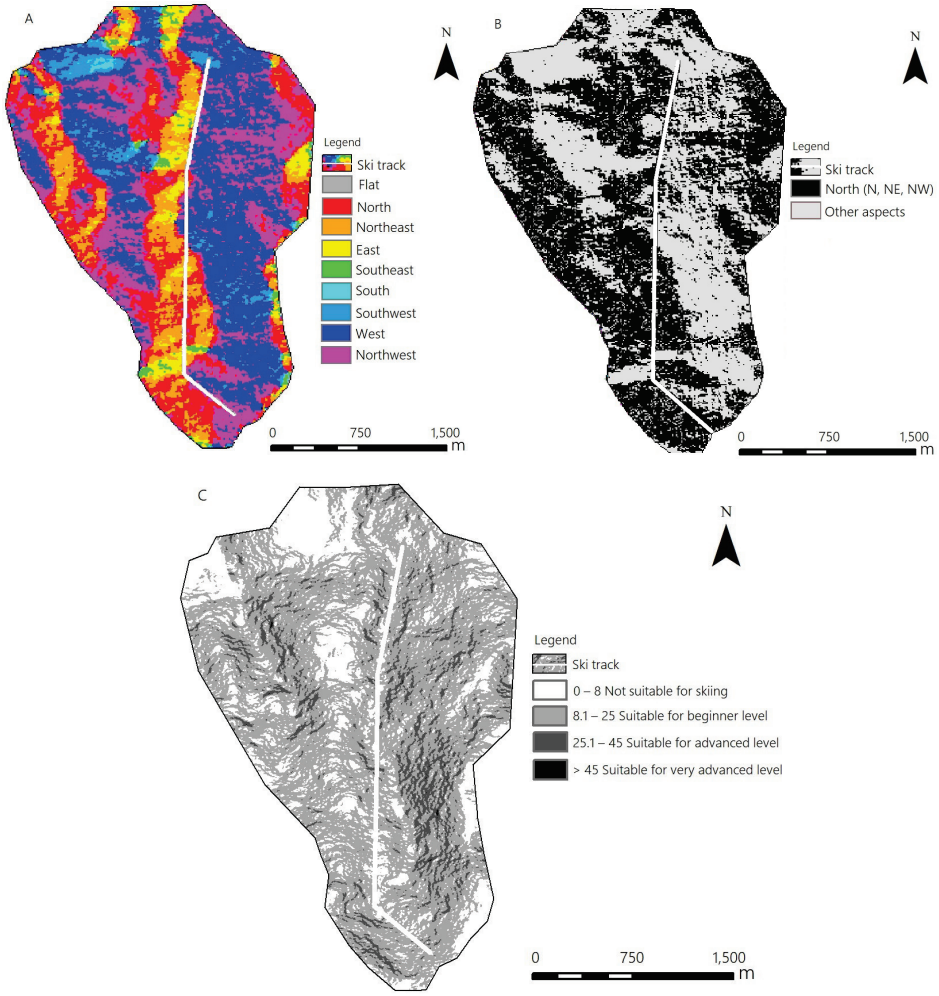

Figure 11. Analyses for aspect (A), north direction (B), and slope (C).

4. Conclusion

In this study, suitable areas for winter tourism in the Konya city's area were evaluated using BWM with six different criteria, and the study was completed by combining it with ArcGIS 10.5, a GIS software. The results of the weighting, both of the Meteorological and Slope criteria were identified as being the most important criteria on level one with 33% weight values. According to experts, meteorological criteria significantly affect the seasons of the facilities in the region. Therefore, the choice of the snowiest areas also increases profitability. The slope of the land is the most important criteria for the creation of ski tracks at different levels. This study shows that suitable areas are quite limited for winter tourism areas in Konya. Some areas in the south and west of the region were identified as suitable areas. Derbent region has been decided on due to the features described in the discussion section. Detailed field studies were performed for the final site selection in Derbent region. Due to the close proximity to the center of Konya, Derbent will have a significant multiplier effect on tourist accommodation. Investments will bring the vitality of the regional economy and bring about sectoral diversification. The region, because of its location, has the potential to attract tourists from many different locations. In the literature, the number of studies on the determination of suitable regions for winter tourism with GIS-based MCE models is almost non-existent. In addition, the absence of a study using BWM in the selection of suitable regions for winter tourism adds a unique value to this article. The determined criteria within the scope of the proposed framework study can assist investors in determining the most suitable areas for winter tourism investments. There are many different criteria that affect the possible location of a facility. These criteria may differ from region to region. It is extremely important that these criteria, which will significantly affect the sustainability of the facility to be established, are determined by experts in their fields.

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