DEVELOPING A GEOGRAPHIC INFORMATION SYSTEM FOR SARİKAMIŞ WINTER TOURISM CENTER

Serbülent ÖCAL, Nurünnisa USUL

ABSTRACT

Due to her geographic location, climate and history, Turkey has a very big potential for tourist activities throughout the year. When the weather and geographical conditions are considered, Turkey has to spread the duration of domestic and foreign tourism activities to the whole year, to increase income in this area. However, due to economical reasons and lack of winter sports promotion, fairly small amount of winter tourism potential of Turkey is utilized.

In this study, one of the winter tourism centers of Turkey, Kars-Sarıkamış, which has a big potential, is studied by using Geographical Information Systems. The aim of the study is integrating GIS and a decision analysis technique to determine suitable places for ski trails and related settlements in Kars-Sarıkamış region. A procedure is developed to produce georeferenced ski resort information, based on data comprised of all environmental and urban features. Multiple Criteria Decision Analysis method is used as the decision analysis technique and the results of the analyses are presented.

Keywords: Ski Resort, Winter Tourism, Geographic Information Systems, Sarıkamış - Turkey, Multi-Criteria Decision Analysis

1. Introduction

Snow is a meteorological phenomenon which is formed in the clouds produced by the water vapor originating as evaporation from mainly free water surfaces such as seas, rivers and lakes. On one hand, as a natural disaster snow has negative effects such as excess snowfall in cities, especially on the roads, and the effect of icing on structures and energy lines, effects of snow drift on the locations such as drifts in front of the houses and shops and negative effects of snow avalanches to human life. On the other hand; the main positive effects of snow cover to human life are water supply to dams, lakes and reservoirs due to snow melt and development of winter tourism and ski areas (Gürer et al., 2004).

Snow, seen as a natural disaster in the undeveloped countries, can be appreciated as “white gold” in many developed countries. Winter tourism activities have leading roles for the economic contribution for those countries as Switzerland and Austria. However, planning of winter tourism activities is rather complex and has its own special characteristics and problems.

Having natural beauties, and favorable weather and geographical conditions, Turkey has to spread domestic and foreign tourism activities throughout the year to provide economic income like the other developed countries mentioned above. In the Central and Eastern Anatolia Regions of Turkey, skiing can be made on the mountains and high plateaus at least three months due to the long term enough snow depth and duration of winter days (Gürer et al., 2004). Unfortunately so far, these winter tourism potentials are not being utilized to their full extends.

Geographic Information Systems (GIS) has some possible problem-solving roles for increasing tourism potential of the winter tourism development in planning stage. It can be
applied to tourism planning, particularly tourism and recreational resource management. Examples of tourism applications can be tourism resource inventories, measuring tourism impacts, assessing potential impacts of tourism development and identifying most suitable locations for development (Ülker, 2002). By integrating tourism, environmental, climatic, socio-cultural and economic data, GIS can be used to identify suitable locations for tourism development for many tourism types as well as for winter tourism.

The aim of this study is to determine suitable places for ski trails and related settlements in Kars-Sarıkamış region in Turkey. A procedure is developed to produce georeferenced ski resort information. This information contains environmental (water sources, topography, etc) and urban (hospital, airport, main and secondary roads, rail road and quarters) features for Kars-Sarıkamış region. Multi-Criteria Decision Analysis (MCDA) method is used as the decision analysis technique and the results of the analyses are presented. Finally, the potential areas for settlements (hotels, pensions, cafes or restaurants) and for ski trails are provided through the results of the analyses.

2. Study Area

Study area is in the Eastern Anatolia, which is the most mountainous region of Turkey. It is approximately 55 km south-west of Kars (Figure 1), almost at the north-east corner of Turkey.

![Figure 1 The study area in Turkey](image)

Sarıkamış Ski Resort region is on the Çamurlu Mountain, which reaches up to 2634 m elevation (Figure 2). The existing skiing area is between the altitudes of 2100 and 2634 m, and located within the beautiful pine forests (Figure 3). It has a terrestrial climate, quite typical of Alpine conditions with an average snow depth of 1.5 m, south-westerly dominant wind direction, and the temperature is below zero centigrade degree in winters.

The nearest airport is at Kars which takes 40 minutes from the Ski Resort by bus. The existing resort has a single surface lift with a capacity of 750 persons per hour. The altitude at the lowest station of the surface lift is 2.200 m, and at the highest station it is at 2.415 m. There is one ski trail covering approximately 20 hectares area which has 1,200 m length and 227 m vertical drop.
Figure 2 Çamurlu mountains

Figure 3 Existing ski resort area
Kars Sarıkamış is one of the renowned winter tourism centers of Turkey. There exist comfortable hotels and a ski trail for different ranges of skiers in this center. A view of the existing ski trail is seen in Figure 4 and the hotels in the region are shown in Figure 5.

![Figure 4 The existing ski trail in the study area](image)

![Figure 5 The existing hotels in the area](image)

### 3. Data Collection

In this study, a 1/25000 scale topographic map sheet (named “KARS - H49a4”) obtained from Culture and Tourism Ministry is used to obtain some of the necessary data layers by on screen digitizing. They are: facilities like airport and hospital, hydrology as lakes
and rivers, transportation as main, secondary and rail roads, and topography of the area with 10 m interval contour lines. These layers are produced as ArcGIS-feature classes.

By using contour lines, Triangulated Irregular Network (TIN) and Digital Elevation Model (DEM) of the area are also created (Figure 6). Then, by using TIN as an input in the software, aspect and slope layers are obtained (Figure 7), since the basic criteria, used for further analyses such as settlement suitability and ski trail suitability of a certain place, are related to the slope and aspect information of the place.

**Figure 6 TIN of the area**

**Figure 7 Slope map of the area**
In a ski resort; the geographical forms such as basins, ridges or valleys indicate opportunities or threats for skiing and settlement areas. In these areas; the main conditions for constructing a settlement such as a hotel and a ski trail, are related to the slopes of the mountain surfaces from top to the valley below and the aspects of these surfaces. North-east and north-west facing hills are ideal for accumulating and keeping snow on land; however if the hills have west to south aspect then necessary snow accumulation can not be achieved.

In the literature there are some criteria to determine the best locations for ski trails or accommodations. The accepted criteria of this study for the suitable slope and aspect values are given as percentage and directions in Figure 8.

<table>
<thead>
<tr>
<th>Settlement Suitability</th>
<th>Ski Trail Suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Slope:</strong></td>
<td></td>
</tr>
<tr>
<td>0-5 Settlement (low cost)</td>
<td>Suitable for all sports</td>
</tr>
<tr>
<td>5-25 Settlement (medium cost)</td>
<td>Suitable for all sports</td>
</tr>
<tr>
<td>25-30 Settlement (high cost)</td>
<td>Suitable for all sports</td>
</tr>
<tr>
<td>30-50 Settlement (very high cost)</td>
<td>Suitable for ski trail</td>
</tr>
<tr>
<td>&gt; 50 Settlement (very high cost)</td>
<td>Suitable for mountaineering and climbing</td>
</tr>
<tr>
<td><strong>Aspect:</strong></td>
<td></td>
</tr>
<tr>
<td>Settlement (south)</td>
<td>Ski trail (north)</td>
</tr>
<tr>
<td>Settlement (southwest)</td>
<td>Ski trail (northeast)</td>
</tr>
<tr>
<td>Settlement (southeast)</td>
<td>Ski trail (northwest)</td>
</tr>
</tbody>
</table>

*Figure 8 Criteria used for slope and aspect*

4. Analyses

4.1. Proximity analysis

In this study, proximity analysis is used as the main spatial analysis. It is made by obtaining buffer zones around the features such as the main road, rail road, hospital and airport in the previously prepared layers.

The hospital proximity analysis is shown in Figure 9, where the hospital is marked as a point (H) and its buffer zones as circular areas. During this analysis, buffer zones are determined by taking radius values of 500 m, 1000 m, 1500 m and 2000 m. These zones are determined according to flying distance or closeness of a certain point to the hospital, in case if it is necessary to take an injured person to the hospital by a helicopter. It is obvious that, people in the ski resort must be able to reach the hospital in a short time for their healthcare needs.

As seen in Figure 9, the distance to the hospital is classified into four ranges and the area shown in light blue is the most reachable area according to proximity analysis for the hospital.
4.2. Reclassification of the layers

After performing similar proximity analyses for the urban and environmental features such as airport, main road, and railroad to obtain buffer areas, they are all reclassified. The reason for the reclassification is to be able to evaluate all the buffer layers together in a meaningful way.

As seen in Figure 10, the buffers around the airport are reclassified into ten classes. Buffer area between 0 and 100 meters distance (most reachable), the area between 100 and 200 m (more reachable), etc. are given new class values decreasing from ten to one respectively. This means that the most reachable area, which is near the airport, gets ten and the least reachable area, which is farthest away from the airport, gets one.

4.3. Site selection

Multi-Criteria Decision Analysis (MCDA) is very useful for site selection studies. Decision analysis is a set of systematic procedures for analyzing complex decision problems (Saaty, 1990). These procedures include dividing the decision problems into smaller more understandable parts; analyzing each part; and integrating the parts in a logical manner to produce a meaningful solution (Malczewski, 1999). In an actual ski resort site selection process, there would be a variety of laws, regulations and factors, in addition to large volume of spatial data to be evaluated and processed. To overcome this difficulty, MCDA can be used very effectively to select suitable sites for the potential ski trails and settlement areas in a ski resort facility.
In MCDA method, every criterion under consideration is ranked in the order of the preference of decision maker. To generate criterion values for each evaluation unit, each factor is weighted according to the estimated significance. The ranking method is applied to these factors as 0 for the least important and 10 for the most important.

In this study, a small example for the usage of MCDA is given as the application on Sarıkamış ski resort data layers. For this research, the buffer zones in the layers or the layers themselves are not that detailed, therefore all the numbers in 1-10 interval are not used. The ranks used in this study are only 0, 3, 5, 7, 10. The degree of importance, definition of a MCDA table and reclassified layers are given in Tables 1 and 2.

**Table 1** MCDA table

<table>
<thead>
<tr>
<th>Importance degree</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>not important</td>
</tr>
<tr>
<td>3</td>
<td>less important</td>
</tr>
<tr>
<td>5</td>
<td>important</td>
</tr>
<tr>
<td>7</td>
<td>more important</td>
</tr>
<tr>
<td>10</td>
<td>most important</td>
</tr>
</tbody>
</table>

**Table 2** The importance degrees of the reclassified layers for the settlement suitability analysis

<table>
<thead>
<tr>
<th>Reclassified Layers</th>
<th>Importance degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airport</td>
<td>5</td>
</tr>
<tr>
<td>Aspect of settlement area</td>
<td>7</td>
</tr>
<tr>
<td>Main road</td>
<td>7</td>
</tr>
<tr>
<td>Rail road</td>
<td>3</td>
</tr>
<tr>
<td>Aspect of settlement slope</td>
<td>9</td>
</tr>
<tr>
<td>Hospital</td>
<td>7</td>
</tr>
</tbody>
</table>

As mentioned before, layers have different weights according to their importance, by using the MCDA table the user assigns the importance degrees to the reclassified layers by his/her subjective decision. As seen in Table 2, the settlement slope has the maximum importance degree, since slope is considered the most important factor technically and...
economically for the construction of a settlement feature. On the other hand, the railroad has the minimum value, since its effect on construction of a settlement is not considered very important in that region.

After deciding on the weights of layers and also on the buffer areas in these layers, site selection can be performed in two parts. One of them is related to finding the suitable areas for settlement features such as hotels, motels, restaurants, etc., and the other one is for suitable areas to place the ski trails. As it is obvious, these two parts have two different criteria sets, which are taken from Table 2. At the end, the most suitable potential settlement and ski trail areas are determined paying attention to their easy accessibility and convenient morphology as slope and aspect.

The result of the settlement suitability analysis is given in Figure 11. According to the shades of the green in the legend; the light green areas are the least desirable for the settlement construction, and the dark green areas are the most desirable for the settlement construction.

![Figure 11 The result of settlement suitability analysis](image)

The result of the similar analysis to find possible areas for future ski trails is shown in Figure 12. As seen in the figure, there is good potential for having new trails in the region for future development.

5. Result and Conclusion

Using GIS for locating settlement and ski trail areas provides results for economical and practical solutions. Because they have capabilities of producing useful and high quality maps in a short period of time for ski resort site selection which may include determining the sites of ski trails, hotels, pensions, cafes or restaurants. In addition to that, the multi-criteria decision analysis is also a useful tool in making decisions about the locations of ski resort facilities in the area by supplying consistent ranking and weightings to the potential areas, and also making it easy to change the weights for alternative solutions depending on the changing conditions.
In this study, firstly the necessary criteria including constraints and thresholds, as seen in Figure 4, are gathered through literature review. According to data availability, the data layers are prepared, processed and made ready as input for the analyses. Different criteria are defined to select suitable areas for settlements and ski trails. The method of MCDA is used to find the resulting maps. The output maps, such as settlement and ski trails suitability maps, indicate the areas changing gradually from unsuitable to most suitable regions for settlements and ski trails.

When the resulting map of ski trail suitability analysis is studied, it is seen that in the north, northeast and northwest sides of the study area there are potential locations for ski trails. When compared with the existing ski trail location (Figure 2), it is seen that it matches with the area found in the north side. This shows that the existing site is in a good location, and also the result of the study, although obtained with not enough data, can be accepted as good.

According to the settlement suitability analysis; in the flat areas, south and southwest sides of the study area there are potential settlement locations. During a site trip made on December 2005, it was also seen that at the flat areas at the bottom of the mountain there were already some hotels (Figure 3), and on the top of the mountain (on flat areas at the south side) there were one restaurant and one café, indicating again the match between the result of the study and the existing situation.

In this study, targeted aims were to develop a Geographic Information System for the Kars Sırkamış Ski Resort area, to show capabilities of GIS to analyze a winter tourism potential in the region, and set an example for similar applications. During the study, it is seen that GIS is a powerful tool in handling large amounts of data and narrowing areas of interest for potential ski resort sites.
References


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