Title: Erosion Risk Mapping Using GIS and Remote Sensing in Nurdağı/Gaziantep Province (Turkey)

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Erosion Risk Mapping Using GIS and Remote Sensing in Nurdağı/Gaziantep Province (Turkey)

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Abstract: In addition to all these, intensity of human activity resulting from increased population boosted pressure on the land. Also, improper use of land widens areas susceptible to erosion. Thus, erosion risk mapping of Nurdağı District is made up in order to bring to light the erosion risk in relation with settlement, Land Use Capability Classes (LUCC) and agriculture or planning studies in Nurdağı District. The risk map was created by using the Multi-criteria Decision-making Model and produced with GIS. In order to make up the map, certain parameters affecting erosion were used such as slope, landuse and intensity of vegetation. According to the analysis carried out to find out areas under high risk of erosion, 28% of the study area was determined. In this context, local administrators should consider, during land use planning, these sites where the erosion risk is high-very high.

Keywords: GIS, Erosion, Nurdağı District, Risk Mapping.

1. Introduction
Risk assessment of soil erosion, one of the most important land degradation problems worldwide, is necessary for soil, vegetation, water resources and public management and development of soil conservation methods (Asadi et.al, 2017). An appraisal of spatial and quantitative information on soil erosion is a major challenge for human sustainability (Shit et. al, 2015). The methodology enhanced allows understanding of the soil erosion mapping that lead to the spatio-temporal variability of soil erosion risk, and as a consequence improves the potential to achieve sustainability of this ecosystem through proposed conservation measures (Ochoa et al, 2016).

An enormous effort is underway in Gaziantep to address soil erosion and restore overall land productivity (Tamene et al, 2017). This study was conducted in the Nurdağı district. Soil erosion is among the most challenging and continuous ecological issues in the Nurdağı district. This paper attempts to provide information for policymakers and soil conservation planners in the form of district-wise soil erosion risk mapping prepared for the state of Nurdağı, Gaziantep. To achieve these objective, has been applied in a geographical information system and remote sensing framework. Since Geographic Information Systems (GIS) technology has various skills such as storing, producing, analyzing and visualizing spatial data, it possesses a great potential to solve and manage spatial problems (Erol and Çanga, 2004; Ekinci, 2005; Bouaziz et.al, 2011; Demirel and Tüzün, 2011; Wu and Wang, 2011; Çelik, 2012; Othman et.al, 2012; Tunc et.al, 2013). Nurdağı is a district of Gaziantep Province of Turkey. Nurdağı is 45 km west of Gaziantep (Figure 1).

Figure 1. Location map of study area.
2. Data and Method

This study followed two steps to produce a erosion risk mapping. In the first step, a field survey was performed in eastern and western parts of the Nurdağı district. In field surveys, photographs were taken in the areas where erosion risk occur and their coordinates were obtained with GPS.

Also, crown and heel sections of erosion in the area were drawn for accuracy assessment. Drawing crown and heel sections of erosion is important for reliability of the erosion susceptibility map. In other words, the accuracy assessment was obtained by superposing crown and heel sections of erosion risk mapping.

The second step of the study was office work. The first part of the office work consisted of data provision. The data obtained consist of the downloaded satellite images, the 1/25000 scale topographic map obtained from the General Command of Mapping and detailed analysis of studies performed previously on the subject. The 1/25000 scale data of the General Command of Mapping related to the Nurdağı district were digitized in the GIS environment. Digitized contour data were applied to spatial analysis. Vegetation density, soil, Digital Elevation Model (DEM), slope and landuse maps were generated as a result of the spatial analysis. Soil erosion risk and intensity maps were generated, then integrated with physical factors (terrain units, elevation, slope, and land uses/cover) to explore the influence of these factors on the spatial patterns of soil erosion loss (Biswas et.al, 2015).

MODIS satellite image of the year 2018 was used to present vegetation density of Nurdağı. Normalized Difference Vegetation Index (NDVI) method was applied to the MODIS satellite image of the July, 2018. Erosion risk mapping of Nurdağı District was produced to take the erosion risk into consideration in the works of land use intended for settlement, transportation and agriculture or of planning. In our study, Multi-Criteria Decision Making Method was used. Erosion risk mapping created with the said method was produced on GIS and remote sensing platforms.

The risk map was created by using the Multi-criteria Decision-making Model and produced with ArcGIS 10.3.

In order to make up the map, certain parameters affecting erosion were used such as slope, precipitation, aspect, lithology, and intensity of vegetation. First of all, GIS values were appointed to these parameters depending on their respective impact values, and then impact degrees of the same were found out depending on their respective GIS weight values within erosion risk. In the last instance, each of the parameters effective in erosion was turned into Raster, and overlaying was realized by means of Raster Calculator option.

3. Results

Soil, pedogenesis of which has occurred over thousands of years, is in danger of disappearing in a lot of regions in the World (Ergene, 1997; Atalay, 2008; Atalay, 2011). Soil erosion is one of the most important environmental problems in arid and semi-arid regions especially (Atalay, 2002). For this reason, we also confront with the erosion as an important problem in Turkey where arid and semi-arid regions cover a wide area. A great part of Turkey is faced with the danger of erosion. The industrial revolution and associated improvement in welfare triggered a rapid increase in population growth and the resulting population increase led to an increase in demand for food (Tümer, 2006). With the addition of promotion of consumption by the economic system, the importance of lands, which meet the need for shelter and clothing, increased even more. Not all lands are suitable for human activities. For example, the ratio of flat and moderately sloping lands suitable for agricultural purposes in Turkey is about 21% (Ünal and Çelik, 2016).
Nurdağı District in the position of an important agricultural field by the help of the fertile and large land it has got. Nurdağı District, which is partially located in one of the most fertile, biggest and irrigated of Gaziantep. In Nurdağı District, the most common land use class is dry farming areas. In Nurdağı District, the most common land use class is irrigated areas on the second level. One of the most important problems in Nurdağı District, which has entered a rapid development process in recent years, is the wrong land use (Esen, 2017). Irrigated farming activities are being carried out on the nonarable pastures. This situation leads to salinization of soils. There is a need for an integrated work of protecting-planning including Nurdağı District.

There is an inconsistency between the land capability classes and their usage in the Nurdağı District. While the area occupied by 1st, 2nd and 3rd classes which should be used as agricultural areas covers 25 %, the area occupied by the agricultural fields covers currently 30 %. This situation shows that, in the area, lands have not been used according to their capability classes.
Figure 3. Landuse and NDVI maps of study area.

Slope values between % 0 and 88 in the Nurdağı District. Forests are extending across mostly brown forest soils and lime Brown forest soils and these soil classes. In this district, agricultural activities are commonly carried out in the slope field that is covered. In the district, agricultural activities are performed on the colluvial and alluvial soils the altitude of 500-600 metres (Figure 2, 3 and 4).

Vegetative cover in the study sites is variable, greatly controlling the erosional activity which is mainly affected by the amount and distribution of rainfall. Vegetation cover is very crucial for runoff generation and can be readily altered along the Nurdağı hilly areas depending on climatic conditions and the period of the year. (Figure 4).

Figure 4. Soil and slope maps of study area.

Soil erosion is one of the most important environmental problems in arid and semi-arid regions especially. For this reason, we also confront with the erosion as an important problem in Turkey where arid and semi-arid regions cover a wide area. A great part of Turkey is faced with the danger of erosion (Çepel, 1997; Zeybek, 2002; Karaburun et. al, 2009; Doğan, 2011; Tunç and Çelik, 2014). It is important to manage lands in a more careful, planned and sustainable manner is important against the degredation and erosion dangers in Nurdağı District. The areas with very high erosion risk in the Nurdağı District are generally mountainous areas above 760 m with 20° slope and northern and sometimes southern exposure consisting of sedimentary rocks. In summary that erosion risk is high especially in the South-east part of the Nurdağı District. The areas with moderate and low erosion risk in the Nurdağı District are generally slopes between 400-700 m with 6 to 12° slope and southern and sometimes northern exposure consisting of volacanite and resistant sedimentary rocks (Figure 5 and Table 1).
In the Nurdağı District, the erosion risk is high on the areas that are inclined, the average elevation of which is above 700 m. and the vegetation cover density is low. In Çiğli District the erosion risk is high around residential areas where the vegetation cover has been destroyed.

<table>
<thead>
<tr>
<th>Erosion Risk</th>
<th>%</th>
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<tbody>
<tr>
<td>Low</td>
<td>34</td>
</tr>
<tr>
<td>Moderate</td>
<td>38</td>
</tr>
<tr>
<td>High</td>
<td>17</td>
</tr>
<tr>
<td>Very High</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1. Erosion risk distribution of study area.

4. Conclusions

In this study, the areas the erosion risk of which is high in the Nurdağı District were determined by using the multi-criteria decision making method. Remote sensing and satellite technologies have been developed significantly in recent years. In this study, we produced base maps for the District of Nurdağı using GIS and remote sensing methodologies. Base maps in question were created taking parameters effective in the event of erosion mapping into account. The research results showed that 28 % of the District of Nurdağı, in the west and northwestern of it in particular, had very high erosion risk. According to the analysis carried out to find out areas under high risk of erosion, 28 % of the study area was determined as having erosion risk at medium, high and too high levels. 72 % of the remaining area is subject to low and too low risk values.

It is important to manage lands in a more careful, planned and sustainable manner is important against the degredation and erosion dangers. In this context, we must not plan our lands considering human benefit alone. In this context, local administrators should consider,
during land use planning, these sites where the erosion risk is very high. Otherwise, possible erosion risk may cause losses of life and property. In addition, the foundation of the Natural Disaster Planning Center of the District of Nurdağı would be a positive step.

References


