LAND COVER AND LAND USE ASSESSMENT IN RELATION TO TOURISM DEVELOPMENT IN THE MUNICIPALITY OF TROYAN IN BULGARIA

Rumiana Vatseva, Severina Bordzhukova, Kristina Gartsianova

Prof. Rumiana Vatseva, D.Sc.
National Institute of Geophysics, Geodesy, and Geography
Bulgarian Academy of Sciences
Acad. G. Bonchev Str., Bl. 3, 1113 Sofia, Bulgaria
Tel.: +3592 9793370; e-mail: rvatseva@gmail.com

Severina Bordzhukova
PhD Student
National Institute of Geophysics, Geodesy, and Geography
Bulgarian Academy of Sciences
Acad. Georgi Bonchev Str., Bl. 3, 1113 Sofia, Bulgaria
Tel.: +359884714955; e-mail: severina_17@mail.bg

Assist. Prof. Kristina Gartsianova, PhD
National Institute of Geophysics, Geodesy, and Geography
Bulgarian Academy of Sciences
Acad. G. Bonchev Str., Bl. 3, 1113 Sofia, Bulgaria
Tel.: +3592 9793943; e-mail: krisimar1979@gmail.com

Abstract
Tourism is a priority sector in the local economic development of the municipality of Troyan in Bulgaria. The municipality's tourism resources are characterized by a combination of unique natural landmarks, cultural and historical heritage, attractive landscapes, as well as favorable climate, waters and geographical location. However, how tourism destinations should be planned properly using land cover resources to enhance community well-being and sustainability has not yet been extensively elaborated issue. This study aims to explore and analyze the structure of land cover and land use in relation to tourism development. Spatial analysis of land cover and land use state is based on quantitative assessment of Corine Land Cover data and thematic mapping in GIS environment. The interrelation of land cover and tourism development is discussed. The results presented in this study can be used in defining priorities for long-term land use planning and sustainable tourism development.

Keywords: Land cover, Land use, Tourism, Spatial analysis, GIS

INTRODUCTION
Tourism is an economic sector that is highly dependent on natural resources. Therefore, the sustainable development of tourism is closely related to environmentally friendly land cover and land use long-term plans. This study aims to explore and analyze the structure of land cover and land use in relation to tourism development. The municipality of Troyan in Bulgaria was selected as a case study.

Tourism is a priority sector in the local economic development of the municipality of Troyan. This municipality has unique natural resources, well-preserved nature and rich biological diversity, as well as favorable geographical location, climate and waters, which are prerequisites for the development of various forms of tourism. However, how tourism destinations should be planned properly using land cover resources to enhance community well-being and sustainability has not yet been extensively elaborated issue.

The major source of spatial data about land cover and land use is remote sensing technology. Remote Sensing (RS) and geographic information systems (GIS) currently provide new tools for advanced land cover mapping and monitoring. RS has the advantage to cover large geographical areas, to perform systematic observations for a long time period, and
to offer cost-effective approaches for change detection. Both RS and GIS are powerful tools for monitoring, mapping and spatial analysis of land cover change at various spatial and temporal scales, as well as for identifying trends of change patterns. A series of studies present wide range of RS and GIS applications in the fields of landscape change and land cover/land use mapping and modelling in last decade (Gillanders et al., 2008; Feranec et al., 2010; Kopecka, 2011; Sohl, Sleeter, 2012; Feranec, Soukup, 2013; Vatseva, 2015; Goga et al., 2019, etc.).

STUDY AREA

The study area is the Municipality of Troyan in Lovech District in Bulgaria (Figure 1). It is located in Central-North Bulgaria, 160 km northeast of Sofia, at coordinates 42°71' – 43°03'N and 24°43' – 24°89'E. The municipality covers a territory of 894.82 km² with a population of 28,195 inhabitants, as of December 2019 (NSI, 2019).

The territory of the study area covers a part of the longest and highest part of the Central Balkan Mountains (Central Stara Planina) – the Troyan-Kalofer Mountains, as well as adjacent parts of the Central Fore-Balkan (Georgiev, 1979). The northern part of the Troyan municipality is located in the Central Fore-Balkan, where the dominant terrain is a hilly – ridge, formed by normal folds and slopes to the north. These are relatively low landforms with an average altitude of about 350 m. The southern part of the Troyan municipality is located on the steep northern slopes of Balkan Mountains. The relief is typically mountainous and is characterized by strong dissection. The slopes on most of the territory are steep and very steep to the precipices, and the ridges are sharp and slightly rounded. The terrain is heavily rugged with a well-developed and dense hydrographic network. The largest rivers in the municipality are Beli Osam and Cherni Osam, uniting in the Osam River.

The natural resources of the municipality of Troyan provide good opportunities for the development of tourism as a priority sector in the local economic development. The municipality of Troyan has an appropriate combination of unique natural landmarks, cultural and historical heritage, attractive landscapes, as well as a favorable climate, waters and geographical location.
MATERIALS AND METHODS

Geospatial data and information about the land cover / land use and tourism in the municipality of Troyan were provided by available remote sensing data, vector data, topographic maps and technical documents.

The remote sensing data used include digital orthophoto images provided by the Bulgarian Ministry of Agriculture, Food and Forestry (MAFF, 2017). The orthophoto images (Figure 2) were acquired in 2014 and 2016 with spatial resolution of 0.4 m.

CORINE Land Cover (CLC) 2018 data (ExEA, 2020) was used to assess land cover/land use of the municipality of Troyan. The land cover and land use mapping is produced through the CLC project based on application of computer aided visual interpretation of high resolution remote sensing data in GIS environment according to the CLC methodology (CEC, 1995, Bossard et al., 2000; EEA, 2007). Further, in our study CLC data was combined with available orthophoto images as reference data in order to provide more detailed land cover / land use data with high spatial accuracy.

The additional data includes digital topographic maps 1:50000, thematic maps, technical documents (Municipal development plan, 2013), expert knowledge and fieldwork.

The applied methodological approach for land cover mapping includes the next main methodological procedures:

1. Image processing
2. Additional data processing
3. Identification and classification of land cover by visual image interpretation
4. Fieldwork for verification of the interpretation done using the imagery
5. Application of GIS procedures for control and correction of the land cover database.
In this study, the mapping and assessment of land cover and land use state in the municipality of Troyan includes statistical analysis of the spatial distribution and the quantitative assessment of presented land cover classes.

**RESULTS AND DISCUSSION**

The produced map of CLC in Figure 3 visualizes the structure and spatial distribution of land cover and land use in the municipality of Troyan in 2018. The reference ellipsoid of map is WGS 84, cartographic projection: Universal Transverse Mercator (UTM) Zone 35N, geographical coordinates. The Table 1 shows registered land cover classes (see also Legend in Figure 3) according to CLC nomenclature.

![Figure 3. CORINE Land Cover (CLC) map of the municipality of Troyan in 2018](image_url)

**Table 1. CORINE Land Cover classes in the municipality of Troyan**

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.2. Industrial, commercial and</td>
<td>1.2.1. Industrial or commercial units</td>
</tr>
<tr>
<td></td>
<td>transport units</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.4. Artificial non-agricultural</td>
<td>1.4.2. Sport and leisure facilities</td>
</tr>
<tr>
<td></td>
<td>vegetated areas</td>
<td></td>
</tr>
</tbody>
</table>
The statistical analysis of land use and land cover of the municipality of Troyan in 2018 represents the distribution of forest and semi-natural areas (62.17%), agricultural areas (34.08%), artificial surfaces (3.33%), and water bodies (0.42%) (Table 2).

<table>
<thead>
<tr>
<th>Land cover and land use</th>
<th>CLC code</th>
<th>CLC level 3</th>
<th>Area (ha)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Artificial surfaces</td>
<td>112</td>
<td>Discontinuous urban fabric</td>
<td>2645.11</td>
<td>2.96</td>
</tr>
<tr>
<td></td>
<td>121</td>
<td>Industrial or commercial units</td>
<td>301.21</td>
<td>0.34</td>
</tr>
<tr>
<td></td>
<td>142</td>
<td>Sport and leisure facilities</td>
<td>32.53</td>
<td>0.04</td>
</tr>
<tr>
<td>2. Agricultural areas</td>
<td>211</td>
<td>Non-irrigated arable land</td>
<td>4504.64</td>
<td>5.04</td>
</tr>
<tr>
<td></td>
<td>221</td>
<td>Vineyards</td>
<td>53.59</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>222</td>
<td>Fruit trees and berries plantations</td>
<td>978.84</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>231</td>
<td>Pastures</td>
<td>4294.51</td>
<td>4.80</td>
</tr>
<tr>
<td></td>
<td>242</td>
<td>Complex cultivation patterns</td>
<td>5027.23</td>
<td>5.62</td>
</tr>
</tbody>
</table>

Table 2. CORINE Land Cover 2018 in the municipality of Troyan
<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Land principally occupied by agriculture with significant areas of natural vegetation</th>
<th>15619.05</th>
<th>17.47</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3. Forest and semi natural areas</td>
<td>311 Broad leaved forest</td>
<td>29428.39</td>
<td>32.91</td>
</tr>
<tr>
<td></td>
<td></td>
<td>312 Coniferous forest</td>
<td>1024.67</td>
<td>1.15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>313 Mixed forest</td>
<td>17505.52</td>
<td>19.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>321 Natural grassland</td>
<td>4847.86</td>
<td>5.42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>324 Transitional woodland scrub</td>
<td>2730.39</td>
<td>3.05</td>
</tr>
<tr>
<td></td>
<td></td>
<td>333 Sparsely vegetated areas</td>
<td>57.90</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>5. Water bodies</td>
<td>512 Water bodies</td>
<td>377.88</td>
<td>0.42</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>89429.32</strong></td>
<td><strong>100.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

For the purposes of this study, CLC data was combined with available orthophoto images as reference data in order to verify land cover and land use data in the fieldwork and to provide data with high spatial accuracy (Figure 4).

![Combined orthophoto images and land cover data for the municipality of Troyan](image)

Figure 4. Combined orthophoto images and land cover data for the municipality of Troyan

The analysis of the land cover and land use state is focused mainly on the CLC classes that represent natural resources for tourism development, such as forest and semi-natural areas and water bodies.

Forest and semi-natural areas predominate in the municipality of Troyan covering 62.17% of its total area. The following tree species are observed (Municipal development plan, 2013): oak, maple, ash, hornbeam, poplar are widespread. Over 800 m above sea level beech communities are located, which significantly give the general appearance of the forest vegetation. Within the beech belt in the higher mountain parts there are firs, spruce, white pine and other conifers. Forests play a significant role in the formation of the local climate, protect soils from erosion,
regulate the water regime of rivers, reduce wind strength, have great aesthetic value and are important for the realization of tourism and recreation of people.

The floristic diversity is represented by about 2337 species and subspecies of plants, of which about 1900 species and subspecies of higher plants. The number of conservation-significant plants is as follows: local endemics - 10 species, Bulgarian endemics - 10, Balkan endemics - 67, protected by Bulgarian legislation - 30, included in the national Red Book - 81, in the Red List of Europe - 9, endangered worldwide - 10 species. An extremely large number of medicinal plants are found in agricultural areas and forests (Municipal development plan, 2013). Plant species of conservation importance are located in three protected territories: the National Park “Central Balkan”, the "Steneto" Biosphere Reserve and the "Kozya stena" Reserve.

The water wealth of the municipality in connection with the land cover is presented in a study by Gartsiyanova (2016). It includes the largest rivers Beli Osam and Cherni Osam, which merge into the river Osam, as well as their tributaries. The Sopot Dam has been built in the northwestern part of the municipality. There are 5 mineral springs in the village of Shipkovo. The water was captured in 1936. The total flow of all water sources is 62 l / s, the temperature is 18-38 °C. The water is weakly mineralized, hyperthermal hydrocarbonate-sulphate calcium-magnesium. It is used for medicinal purposes - for drinking and baths. There is also a mineral spring in the village of Chiflik.

Tourism is a well-developed industry, influencing the overall vision of the municipality of Troyan. The main factors for development of tourism sector in the municipality are the favorable combination of natural resources and recreational resources with religious and cultural-historical landmarks, as well as the attitudes of the population for development of tourism business. Based on this, the following types of tourism are developed in the Troyan municipality: cultural and cultural-historical; religious; cognitive; mountainous; hiking, eco and green tourism; ski tourism; SPA and balneal tourism; extreme tourism and alternative tourism. The most important for the municipality development are religious tourism, SPA and mountain tourism. The main natural landmarks for tourism development include: the century-old tree "Kartsov beech", a stone bridge “Crali markova dupka”, the vertical “Pitica Dupka” cave, the precipice “Raychova Dupka” cave, the "Toplya" cave, the rock chapel "St. Peter and Paul", and waterfalls (Brambar skok, Koman, Lopushnitsa, Bankovski skok).

CONCLUSIONS

Tourism is a sector in which almost all activities and services depend on nature itself. In this regard, the presented study of land cover and land use is needed to achieve environmentally sound land use plans and tourism development. Analysis of land cover and land use state is focused mainly on the CLC classes that represent natural resources, such as forest and semi-natural areas and water bodies. The distribution of forest and semi-natural areas in the municipality of Troyan in 2018 represents 62.17%. The following types of tourism are developed in the Troyan municipality: religious; cultural and cultural-historical; cognitive; mountainous; hiking, eco or green tourism; ski tourism; SPA and balneal tourism; extreme tourism and alternative tourism. The most important for the municipality development is religious tourism, followed by SPA and mountain tourism.

The modern geoinformation technologies can provide new knowledge and can ensure a scientific support for an informed decision-making on sustainable tourism development. The research results can be used in defining priorities for long-term land use planning and development of tourism in the municipality of Troyan.

REFERENCES


**BIOGRAPHY**

Rumiana Vatseva is a Professor, Doctor of Science at the Department of Geography at the National Institute of Geophysics, Geodesy, and Geography at the Bulgarian Academy of Sciences. Her research interests are in Remote Sensing, GIS, Spatial Analysis and Modelling, Cartography, Land Use, and Land Cover, Landscape Ecology, and Protected Areas. She is the author of over 100 publications including books, book chapters, articles and papers in international and national journals and conference proceedings. She has coordinated 25 international and national research and development projects.

Severina Bordzukova is a PhD student at the National Institute of Geophysics, Geodesy, and Geography – Bulgarian Academy of Sciences, Department of Geography, section GIS and Cartography. She graduated from Sofia University “St. Kliment Ohridski” in Geography in 2009. She has a Master's degree in Geographic Information Systems and Cartography from Sofia University “St. Kliment Ohridski”, Faculty of Geology and Geography in 2011. Her main research interests are in Cartography, Geographic Information Systems, Tourism, Landscape Ecology, and Hydrogeology.

Kristina Gartsiyanova is an Assistant Professor at the Department of Geography at the National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Sciences (NIGGG - BAS). She graduated with a PhD degree at the NIGGG - BAS in 2015. Her main research interests are in Hydrology, Hydrochemistry, Water resources management, Groundwater, Spatial analysis and modelling.