



Original scientific paper

UDC: 911.372.7(497.11)

Received: October 20, 2021

Reviewed: January 30, 2022

Accepted: March 2, 2022

<https://doi.org/10.2298/IJGI2201033P>



IMPLEMENTATION OF THE CARPATHIAN CONVENTION IN SERBIA—THE ANALYSIS OF SUSTAINABILITY ASPECTS

Marijana Pantić^{1*}, Tamara Maričić¹, Saša Milijić¹

¹Institute of Architecture and Urban & Spatial Planning of Serbia, Belgrade, Serbia; e-mails: marijana.d.pantic@gmail.com; tamara@iaus.ac.rs; sasa@iaus.ac.rs

Abstract: One of the biggest and most important mountain ranges in Europe, the Carpathians, is being threatened by different human activities. The Framework Convention on the Protection and Sustainable Development of the Carpathians (the Carpathian Convention) represents one of the international efforts to protect the biodiversity of this area through multilateral cooperation. Serbia is one of the signatory parties, where the area protected by the Convention currently coincides with the Đerdap National Park (ĐNP) boundaries. Serbia mainly lags in protocol and amendment ratifications, which is suspected to hinder the potential benefits regarding the sustainable development of this region. By analyzing the selected sustainability indicators for the years 2003, 2011, and 2019 we tried to enlighten if developments were sustainable. The data were also presented by the spider evaluation method. Despite certain limitations in data availability, research showed that there are positive economic and environmental changes, despite depopulation and aging of local inhabitants. However, major efforts are still to be undertaken, especially regarding environmental sustainability and implementation of national and international regulation.

Keywords: Carpathian Convention; sustainable development; indicators; Serbia; Đerdap National Park

1. Introduction

The Carpathian Mountains represent one of the most important ecosystems in Europe, stretching 1,500 km across seven countries in Central and Eastern Europe. In contrast to Western Europe, the negative impact of the “closeness” of communist regimes in the Eastern Bloc countries on cross-border cooperation and the development of economic activities has paradoxically enabled the relatively good preservation of natural treasures and biodiversity in this “benignly neglected” area (Turnock, 2002; World Wildlife Fund [WWF], 2007). As a “biodiversity hot spot” of European and global importance, the Carpathian region is home to 30% of Europe’s flora, with the richest community of large carnivores (40% of the population of brown bears and 30% of the populations of wolves and lynx) and the largest share of virgin forests (United Nations Environment Programme, 2007). Despite many pristine ecosystems, it is also still rich in seminatural traditional landscapes. The end of the Cold War enabled regional

*Corresponding author, e-mail: marijana.d.pantic@gmail.com

cooperation among all the Carpathian countries, which was embodied in the Carpathian Convention in 2003 (Carpathian Convention, 2003). The main aim was to support cross-border cooperation and develop a multidisciplinary ecoregional approach in order to boost the protection, conservation, and sustainable development of this mountain region.

Today, almost two decades after the Carpathian Convention was signed, new threats to this important and fragile ecosystem have been recognised. Widespread land-use change (Gurung et al., 2009; Turnock, 2002), including habitat loss and fragmentation, along with climate change, air pollution, infrastructure, tourism development, and mines and industry (WWF, 2007), and intensive forest management (WWF, 2018) strongly affect biodiversity and ecosystem services. Based on the mentioned framework, this research tends to add some light on the ongoing sustainability trends in the Serbian Carpathians.

2. The Carpathian Convention in Serbia

An international network of non-governmental organizations (WWF, International Union for Conservation of Nature, etc.) and research institutes from the Czech Republic, Hungary, Poland, Romania, Serbia, Slovakia, and Ukraine (Figure 1) gathered in 1999 around the Carpathian Ecoregion Initiative intending to protect this environmentally valuable area. The Carpathian Convention followed up and brought the cooperation to a higher level by directly involving state governments.

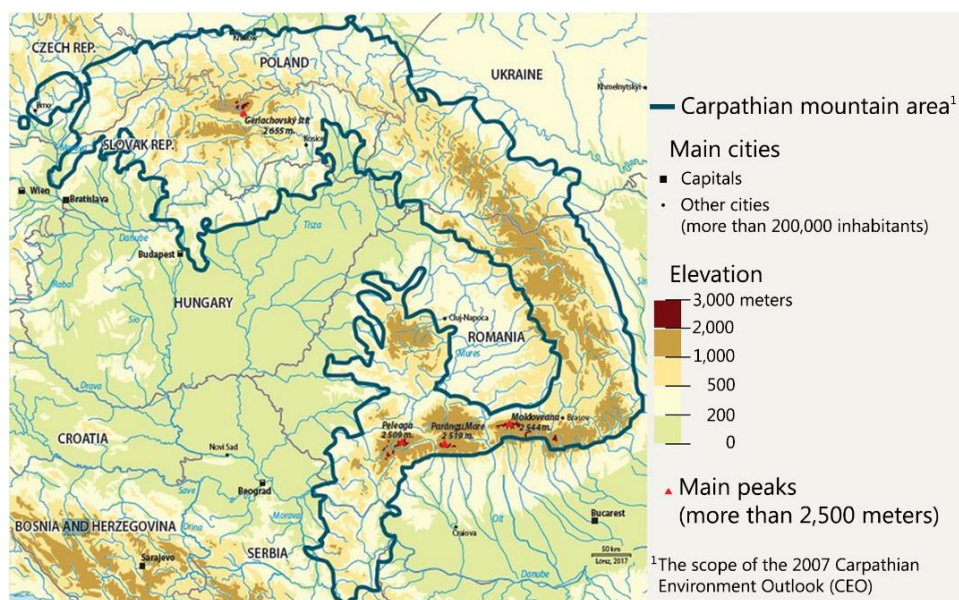


Figure 1. Carpathian mountain area.

Note. Adapted from *Adaptation in Carpathian Mountains*, by Climate ADAPT, 2021 (<https://climate-adapt.eea.europa.eu/countries-regions/transnational-regions/carpathian-mountains/general>). CC BY-NC-ND.

Serbia signed the Carpathian Convention in 2003 and ratified it in 2007, but it entered into force only in 2013 (Status of signature and ratification, 2021). Although Ukraine initiated the establishment of the Convention, the first years of practicing showed that Ukraine and Serbia

progressed less than other signatory parties (Pantić, 2014). Serbia is still lagging behind in the ratification of the Convention protocols and amendments (Status of signature and ratification, 2021). As the Carpathian Convention is the only international treaty explicitly addressing mountain areas in Serbia (Pantić, 2014), it shows the importance of this act of cooperation and its possible implications. Therefore, this research aims at identifying sustainability aspects and prospects in Đerdap National Park (ĐNP) in Serbia in the period that starts with the establishment of the Convention until 2019.

3. The case of Serbia and ĐNP

There are several delimitations of the Carpathian Mountains within Serbia. According to Popović et al. (2012), the Carpathian region in Serbia encompasses mountains of Šomrda, Liškovac, Miroč, Homoljske planine, Veliki Krš, Mali Krš, Deli Jovan, Beljanica, Kučajske planine, Rtanj, Tupižnica, Ozren, and Devica. However, Turnock (2002, 2008), did not address the Serbian Carpathians as a part of this mountain range. The Carpathian Convention counts that 5% of the Carpathian Mountains are in Serbia, which coincides with the protected area of ĐNP. Besides, it also envisages the possibility to further expand its geographic coverage (Popović et al., 2012).



Figure 2. ĐNP—administrative and protected area borders.

Note. Adapted by the authors based on *Zaštićena prirodna dobra Srbije* [Protected natural areas of Serbia], by the Institute for Nature Conservation of Serbia, 2021 (<https://cloud.gdi.net/visios/zps>). CC BY-NC-ND.

ĐNP encompasses the very southern part of the Carpathian Mountain range, spreading over approximately 638 km² (Uredba o utvrđivanju Prostornog plana područja posebne namene Nacionalnog parka Đerdap, 2013) and covers parts of the local administrative units (municipalities) Golubac, Kladovo, and Majdanpek (Figure 2). It is located on the right bank of

the Danube River, which is a natural border with Romania. The Danube River and Đerdap George are the dominant elements of ĐNP, prevailing following the river in a relatively narrow belt that is 117 km long and 50–800 m high (Đerdap National Park, 2020a). The Đerdap valley is the largest and the oldest mountain pass in Europe, composed of three gorges and two canyons divided by three basins. The flora, fauna, cultural heritage, geological, and geomorphological unique features candidate the Đerdap George for the protected area status (Đerdap National Park, 2020b).

Due to its secluded geographical features, the climate in the Đerdap George is warmer and more humid than in the surrounding areas, which provides a shelter for sub-Mediterranean and Mediterranean flora so far to the north (Đerdap National Park, 2020c). In terms of fauna, ĐNP is home to the European lynx—an extirpated species in most of the European countries (Đerdap National Park, 2020d). Archaeological excavations have shown that the territory of ĐNP has been inhabited since the Neolithic. Later, the area was inhabited and culturally influenced by the ancient Romans, Hungarians, Turks, and others. Each culture left a historical and cultural layer—Neolithic settlement Lepenski Vir, Roman Tabula Traiana, Diana fortified military camp, Golubac Fortress, and local architectural heritage (Đerdap National Park, 2020e). These are the reasons for obtaining the Important Plant Areas, Prime Butterfly Areas, and UNESCO Geopark designations (Đerdap National Park, 2020c, 2020d, 2020f).

4. Methodology

Jabareen (2008) states that the sustainable development framework is not entirely clear and that its definitions are open to multiple interpretations. However, the most common definition of sustainable development advocates “meeting the needs of the present without compromising the ability of future generations to meet their needs” (World Commission on Environment and Development, 1987, p. 16). This definition indicates the significance of the temporal aspect of the sustainability concept. The sustainability approach is often interpreted through the three pillars—social, economic, and environmental (Abrahams, 2017; Bell & Morse, 2018). In contrast, there is no common or fixed set of sustainability indicators, but they span from simple ones to the aggregated indicators such as Human Development Index, Environmental Performance Index, or Ecological Footprint (Bell & Morse, 2018). As sustainability pillars are correlated (Schönborn et al., 2019), all the three of them, as well as their mutual synergy, should be covered in the interpretation of sustainable development.

This research aims to address three sustainability pillars through secondary data analysis and interpret sustainable development trends in ĐNP after Serbia signed the Carpathian Convention. Due to the lack of regular monitoring and consistent collection of primary data (Pantić & Milijić, 2021), the analysis was focused on the data published in annual statistical reports. This was the most favorable way to find comparative longitudinal data related to social, economic, and environmental aspects. The year 2003 was taken as the starting year in the comparison because it was the year when Serbia signed the Convention. The year 2019 was chosen for the newest available data and the year 2011 for being the middle point between 2003 and 2019. For the indicator values lacking for certain years, the substitute years were addressed. The analysis relied on the data at the municipal level because it is the smallest scale for which relevant data are collected. The majority of indicators were presented as trends in Golubac, Majdanpek, and Kladovo municipalities, and at the level of ĐNP for which data

were aggregated as a sum of absolute values for consisting municipalities or as an average (Table 1).

Table 1. List of analyzed sustainability indicators for ĐNP

| Sustainability pillars | Indicator | Aggregation type for ĐNP | Referent year |
|------------------------|---|--------------------------|----------------|
| Social | Population size | Absolute values | 2003/2011/2019 |
| | Average population age | Average value | 2003/2011/2019 |
| | Young population (0–14), in % | Absolute values | 2003/2011/2019 |
| | Health workers with university education per 1,000 inhabitants | Absolute values | 2003/2011/2019 |
| Economic | Employment structure (selected sectors)* | Average value | 2003/2011/2019 |
| | Employment rate | Average value | 2003/2011/2019 |
| | Unemployment rate | Average value | 2003/2011/2019 |
| | Number of tourists | Absolute values | 2003/2011/2019 |
| | Number of tourists per 1,000 inhabitants | Absolute values | 2003/2011/2019 |
| | Number of overnight stays per tourist | Absolute values | 2003/2011/2019 |
| | Local budget income per 1,000 inhabitants (EUR) | Average value | 2003/2011/2019 |
| Environmental | Length of roads (km) | Absolute values | 2003/2011/2019 |
| | Forested areas (%) | Absolute values | 2003/2011/2019 |
| | Households connected to both water supply and sewage system (%) | Absolute values | 2011/2019 |
| | Difference between households with water supply, but without sewage system connection (%) | Absolute values | 2007/2011/2019 |

Note. *The busiest sectors (public sector, industry), environmentally harming sectors (mining), sectors that are considered to be in accordance with sustainable development (agriculture, forestry, fishery), and activities with ambivalent environmental impact (tourism).

To increase understanding of the synergy between sustainability pillars, we also applied one of the simple baseline qualifications common for comparative and scenario studies, especially effective as a visualization tool in the decision-making process—the spider analysis (Baycan-Levent et al., 2007). Spider method has already been used for scenario evaluation of Serbia’s spatial development at the national and regional level (e.g., Vujošević et al., 2010; Zeković et al., 2015). Indicator values were transformed into standardized Spider values for each analyzed year (Table 2, Figure 9). The axes were scaled from zero (interior) to ten (outer edge), under the assumption that a higher score represents better performance in the way that there is no mutual weighing between different indicators (i.e., a score of four for one indicator is not necessarily better than the score three of another).

The inconsistency regarding the selection of indicators provided in statistical reporting is one of the limitations of this research. Another limitation is statistical reporting at the level of local administrative units (municipalities) whose territory does not fully coincide with the protected area borders. A compromise was a selection of Golubac, Majdanpek, and Kladovo municipalities, whose territories cover the entire territory of ĐNP (Figure 2). As activities on the outer border of ĐNP also have an impact on the trends within the borders, analyzing the data at the municipal level seemed appropriate.

5. Results

5.1. Social sustainability

The social sustainability in ĐNP was measured by the change in the population size, population average age, the share of the young population (0–14 years), and the number of health workers per 1,000 inhabitants. In 2003, the total population size in the analyzed municipalities was 56,303 inhabitants, which dropped down by more than 25% by 2019 (Statistical Office of the Republic of Serbia [SORS], 2005, 2020). Furthermore, if the decrease would keep the same progression, this area could be entirely depopulated by the year 2065. The population size in Golubac municipality was and remained the smallest. Majdanpek and Kladovo municipalities had a similar population size at the beginning of the analyzed period, but, in the 16-year-time-frame, Kladovo lost about 20% and Majdanpek even 30% of its population (Figure 3).

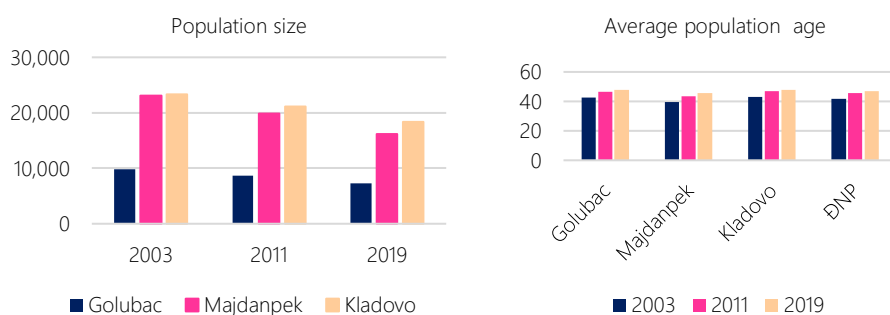


Figure 3. Social sustainability in ĐNP.

Note. The data in the charts are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>). In the public domain.

Parallel to the depopulation, the average age of the population in ĐNP increased (Figure 3), showing another negative trend. From 2003 to 2019, the population in Majdanpek municipality remained “the youngest” (39.3 average age in 2003; 45.6 in 2019), while Golubac (42.6; 47.9) took over the title of the municipality with the oldest population from Kladovo (43.2; 47.7). Starting with 41.7 in 2003 and reaching 47.7 average population age in 2019 indicates that the population in ĐNP has been deeply aged for some time already (SORS, 2005, 2012, 2020). By the year 2065, if keeping the same aging pace, settlements in ĐNP could be inhabited almost only with elderly population (63.3 average age). At the same time, the share of young population (0–14 years) significantly decreased from 15.8% in 2003 to 11.2% in 2019 (Table 2).

Health is a significant indicator of life quality and social sustainability. In ĐNP, a positive change has occurred regarding health care quality when measured by the number of health workers with university education per 1,000 inhabitants. The trend increased at the level of ĐNP from 2.8 in 2003 to 3.5 in 2019 (Table 2; Institute of Public Health of Serbia, 2021). The lowest indicator values were and remained in Golubac (1.2 and 1.6, respectively), whereas the best social

care with this regard was in Kladovo (3.6 and 4.4). However, this positive trend is not connected only to the increase in the number of health workers but also to the strong depopulation.

5.2. Economic sustainability

Economic sustainability was analyzed through the employment structure, with particular attention to tourism, basic (un)employment indicators, local budget income, and length of roads. Figure 4 shows the share of employees in ĐNP by the most common sectors and the sectors the most closely related to sustainable development in protected areas such as agriculture and tourism. It indicates that neither agriculture nor tourism are the leading sectors of employment. In contrast, employment in the public sector (governing, social care and social services, education, and health care) was about 21.0%, and employment in the processing industry grew from 15.5% to 20.6% from 2003 to 2019, thus taking a leading role. Employment in trade, services, and tourism decreased in 2011 when compared to 2003, but it grew even more by 2019. The share of workers in the sectors of mining, electricity, gas, and water production, agriculture, forestry, water management, and fishery decreased over time.

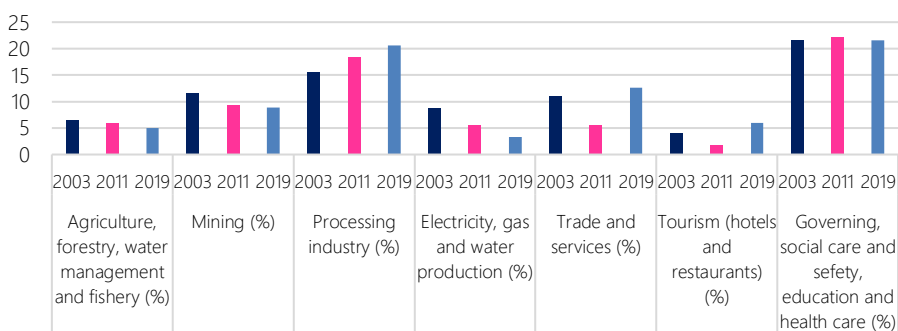


Figure 4. Employment structure by the most common sectors in ĐNP (%).

Note. The data in the charts are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>). In the public domain.

Nevertheless, the distribution by sector was not equal in all the municipalities. Namely, Golubac dominated in the sector of agriculture and had slight leadership in tourism. Majdanpek had the highest share of employees in mining and processing industry in 2003, although outside of ĐNP territory. Kladovo took the lead over in processing industry by 2019, dominated in electricity, gas, and water production, and used to dominate in public sector employment. However, public sector employment became equally significant in all the three municipalities in 2019 (around 21.5%).

Except in Majdanpek, an absolute number of tourists had an increasing trend from 2003 to 2019. In Majdanpek, the number of tourists dropped down in 2011, but in 2019 it recuperated and overgrew the number measured in 2003 (SORS, 2005, 2012, 2020). However, measured by the number of tourists per 1,000 inhabitants, all the municipalities and ĐNP recorded a growing trend (Figure 5). In contrast, the number of overnight stays per tourist

was unstable in all the territorial entities except in Majdanpek. At the level of ĐNP, the relative number of overnight stays increased from 2.1 in 2003 up to 2.3 in 2019.

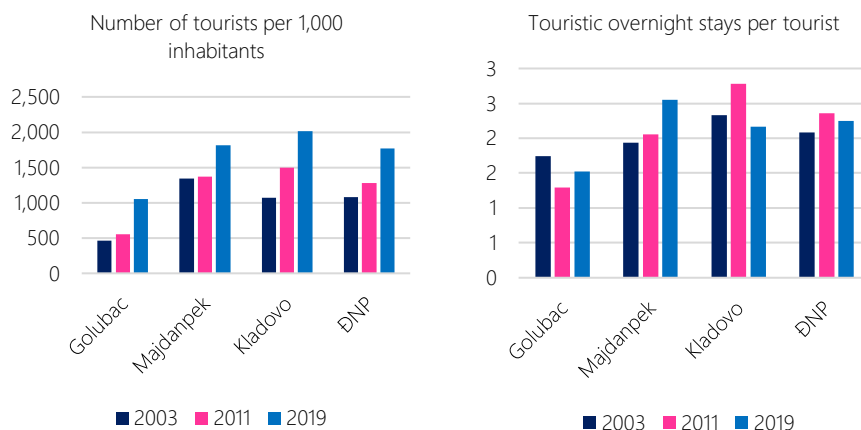


Figure 5. Tourism in ĐNP.

Note. The data in the charts are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>). In the public domain.

Due to the decreasing unemployment rate (number of unemployed per 1,000 inhabitants) in Majdanpek and Kladovo, unemployment in ĐNP decreased from 2003 to 2019. The fluctuations of employment rate trends differentiate in the analyzed municipalities, and at the level of ĐNP it increased (Figure 6).

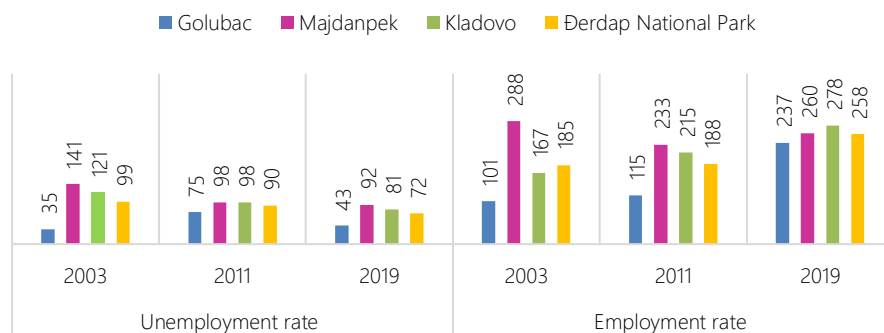


Figure 6. Employment in ĐNP.

Note. The data in the charts are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>). In the public domain.

The annual budget of the local administrative units per 1,000 inhabitants increased parallel to the increase of the employment rate (Figure 7). The most significant increase occurred in Majdanpek while being the humblest in Golubac.

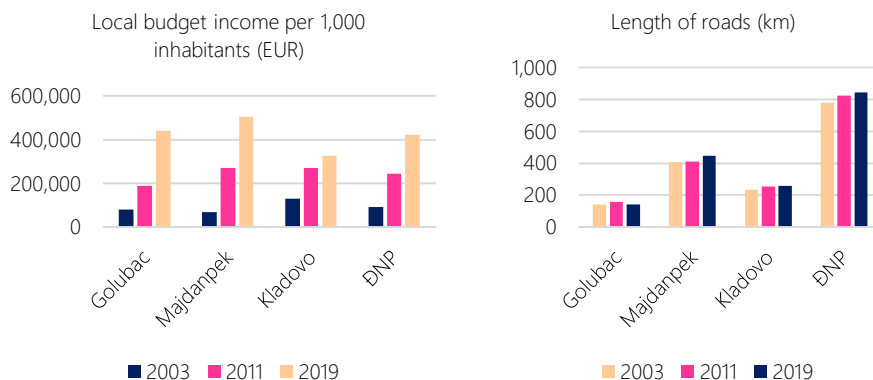


Figure 7. The local budget income per 1,000 inhabitants (EUR) and the length of roads per municipality and in ĐNP.

Note. The data in the charts are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>). In the public domain.

The length of local roads might indicate a predisposition for economic and tourism development in developing areas such as ĐNP. If so, prospects of economic progress of ĐNP increased by the construction of the additional 70 km of roads over 16 years (Figure 7). In the case of Kladovo, this progress was more intensive between 2003 and 2011, whereas in Majdanpek municipality it occurred later. Due to the substantial infrastructural changes, the total length of roads in Golubac municipality decreased by the end of the analyzed period.

5.3. Environmental sustainability

Environmental sustainability was measured by the changes in the share of forested areas, the share of households connected to the sewage system, and the difference in the share of households connected to the water supply system but without a connection to the sewage system. Figure 8 shows inconsistency in the change of forested areas in the municipalities within ĐNP. For example, Majdanpek municipality had 69.5% of forested areas in 2003, 69.4% in 2011, and 67.5% in 2019. An opposite dynamics was recorded in the case of Kladovo, where the share of forested areas firstly increased and then decreased (44.6% in 2003 and 44.7% in 2019). Golubac had the lowest share of forested areas, fluctuating over time, but with an increase of 2.7% between 2003 and 2019. At the level of ĐNP, the share of forested areas slightly decreased from 56.7% to 56.3%.

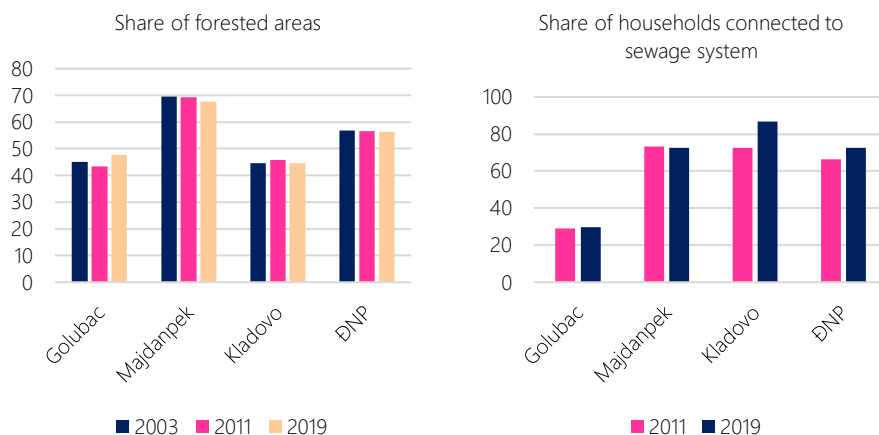


Figure 8. Environmental sustainability—forested areas and connection to the sewage system.

Note. The data in the charts are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *2011 Census of Population, Households and Dwellings in the Republic of Serbia: Book 20. Comparative overview of the number of population in 1948, 1953, 1961, 1971, 1981, 1991, 2002 and 2011 – Data by settlements*, by SORS, 2014 (<https://publikacije.stat.gov.rs/G2014/Pdf/G20144008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>). In the public domain.

In the 8-year-time-span, an endowment of settlements with sewage in ĐNP improved by 6.3% (SORS, 2012, 2014, 2020). In 2011, Majdanpek was the one to have the highest share of households connected to the sewage system (73.2%), which undersized by 0.5% by 2019 (72.7%). Although the number of households in Majdanpek also decreased from 2011 to 2019 (5,281 and 5,246, respectively; SORS, 2012), the difference in the share of households connected to sewage might be additionally emphasized by the fact that it was calculated for the year 2019 based on the number of households in 2011 (SORS, 2014). The reason behind this is that the number of households is measured only in census years. In 2019, Kladovo took over the first place due to an improvement of 14.5% with 86.9% of the connected households. Only 29.0% of households in Golubac were connected to the sewage system in 2011, which improved only by 0.8% in 2019. By the end of the analyzed period, only 72.5% of the households in ĐNP had solved the wastewater disposal issue.

A significant discrepancy between the number of households with the connection to the water supply system, but without a connection to the sewage system indicates potential environmental problems related to the disposal of untreated wastewater. In this regard, ĐNP progressed significantly over time. In 2007, there were almost 60% of households with this discrepancy, whereas it improved to 42.4% in 2011 and 14.7% in 2019 (SORS, 2009, 2012, 2020). At the beginning of the analyzed period, Golubac and Kladovo were similar with almost 85% of discrepancy. By 2019, Kladovo grew into the most prosperous example in the Carpathian Serbia with only 5.4% of a discrepancy, whereas Golubac remained hindered with 57.9%. This indicator value in the case of Majdanpek was 12.2% in 2019.

5.4. Comparative analysis of the obtainable sustainability aspects

The comparison of the selected sustainability aspects using the Spider method is presented in Table 2 and Figure 9. It visually simplifies the comprehension of the indicators and sustainability pillars.

Table 2. Comparative analysis of the relevant sustainability indicators for DNP

| Sustainability pillars | Indicator | Indicator values | | | Spider values | | |
|------------------------|--|------------------|-----------|-----------|---------------|------|------|
| | | 2003* | 2011 | 2019 | 2003 | 2011 | 2019 |
| Social | Population size** | 56,303 | 49,650 | 41,796 | 10.0 | 8.8 | 7.4 |
| | Young population (0–14), in % | 15.3 | 13.7 | 11.2 | 10.0 | 9.1 | 7.3 |
| | Health workers with university education per 1,000 inhabitants | 2.8 | 3.2 | 3.5 | 8.0 | 9.1 | 10.0 |
| Economic | Employment rate | 185.3 | 187.7 | 258.3 | 7.2 | 7.3 | 10.0 |
| | Number of tourists per 1,000 inhabitants | 1,077.8 | 1,282.1 | 1,769.0 | 6.1 | 7.2 | 10.0 |
| | Number of overnight stays per tourist | 2.1 | 2.4 | 2.3 | 8.9 | 10.0 | 9.6 |
| | Local budget income per 1,000 inhabitants (EUR) | 96,323 | 257,036.7 | 712,835.9 | 1.4 | 3.6 | 10.0 |
| Environmental | Length of roads (km) | 779.0 | 825.0 | 845.2 | 9.2 | 9.8 | 10.0 |
| | Forested areas (%) | 56.7 | 56.7 | 56.3 | 10.0 | 10.0 | 9.9 |
| | Households connected to both water supply and sewage system (%)*** | 40.1 | 57.6 | 85.3 | 4.7 | 6.8 | 10.0 |

Note. *Data for households with water supply but without sewage system refer to the year 2007.

**Data refer to the entire territories of the Golubac, Kladovo, and Majdanpek municipalities.

***Data for households with water supply but without sewage system refer to the year 2007.

The data in the table are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities in Serbia 2008*, by SORS, 2009 (<https://publikacije.stat.gov.rs/G2009/Pdf/G20092001.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *2011 Census of Population, Households and Dwellings in the Republic of Serbia: Book 20. Comparative overview of the number of population in 1948, 1953, 1961, 1971, 1981, 1991, 2002 and 2011 – Data by settlements*, by SORS, 2014 (<https://publikacije.stat.gov.rs/G2014/Pdf/G20144008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>); *Health Statistical Yearbook of Republic of Serbia 2020*, by Institute of Public Health of Serbia, 2021 (www.batut.org.rs/download/publikacije/pub2020.pdf). In the public domain.

Spider graph (Figure 9) indicates that population size and share of young population were the only analyzed sustainability indicators that had a long-term negative trend. While the size of forested areas did not change significantly (it had a small decrease), smaller progress can be noted regarding the length of roads and the number of overnight stays per tourist. The most significant positive change can be noticed in the employment rate, the number of tourists per 1,000 inhabitants, local budget income per 1,000 inhabitants, and the share of households connected to both water supply and sewage system.

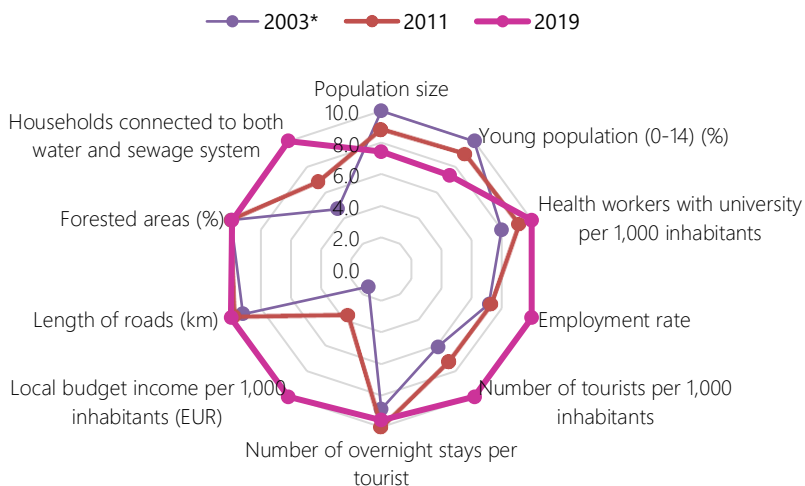


Figure 9. Comparative analysis of selected sustainability indicators for ĐNP (spider method).

Note. *Data for households with water supply but without sewage system refer to the year 2007.

The data in the charts are calculated based on *Municipalities in Serbia 2004*, by SORS, 2005 (<https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>); *Municipalities in Serbia 2008*, by SORS, 2009 (<https://publikacije.stat.gov.rs/G2009/Pdf/G20092001.pdf>); *Municipalities and regions in the Republic of Serbia 2012*, by SORS, 2012 (<https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>); *2011 Census of Population, Households and Dwellings in the Republic of Serbia: Book 20. Comparative overview of the number of population in 1948, 1953, 1961, 1971, 1981, 1991, 2002 and 2011 – Data by settlements*, by SORS, 2014 (<https://publikacije.stat.gov.rs/G2014/Pdf/G20144008.pdf>); *Municipalities and regions in the Republic of Serbia 2020*, by SORS, 2020 (<https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>); *Health Statistical Yearbook of Republic of Serbia 2020*, by Institute of Public Health of Serbia, 2021 (www.batut.org.rs/download/publikacije/pub2020.pdf). In the public domain.

6. Discussion

The local population represents an inevitable precondition to preserve the culture and tradition of an area (Vallance et al., 2011). Its quality, quantity, and development trends represent the basis in estimating the social sustainability of an area. The identified trends in population size and age in ĐNP are rather pessimistic and threaten to hinder genuine preservation of the local culture, customs, and tradition in 50 years, which, according to Schönborn et al. (2019), can paralyze economic development. Additionally, locals are the first to notice and act upon the appearance of an illegal building or a catastrophe such as fire and floods (Starr, 2004), therefore, representing a significant precondition for environmental protection.

The unfavourable age structure did not prevent the increase of the employment rate in ĐNP. This is due to the positive changes in Golubac and Kladovo as administrative centers located at the Danube River. As rivers, particularly the large ones such as the Danube, have a positive correlation to the potentially sustainable economic activities such as tourism (Kovačić et al., 2017), transport of raw materials (Song et al., 2019), sustainable energy production (Wagner et al., 2019), and specific economic activities such as fishery, those two municipalities have higher chances for sustainable development than Majdanpek. The electricity production

from water in Kladovo corresponds to the environmental sustainability criteria because it relies on water as a renewable energy source (Kaygusuz, 2016). The employment rate decreased in Majdanpek that significantly depends on mining, which can also be understood as a positive precondition for environmental sustainability. Additionally, the majority of employees in ĐNP are engaged in the public sector, followed by industry. As the public sector does not produce Gross Domestic Product (Caponi, 2017), this aspect does not contribute to the sustainable economic model. Industry belongs to economic activities with the largest negative impact on air, water, and soil quality (Sinding, 1999), thus obstructing environmental sustainability.

Tourism, agriculture, and their mutual development are considered the primary activities in the sustainable development concept of mountainous areas (Pantić, 2019). Even though employment in tourism does not represent a significant part of the employment in ĐNP, it gives a glimpse of hope. Even though the trend in tourism employment is unstable, the share of employees raised in comparison to almost two decades ago. This indicates that tourism could make a significant contribution to ĐNP area, especially when taking into account all the existing cultural and natural preconditions. Unfortunately, this is not paired with the increase of engagement in agricultural production. The number of tourists fluctuates, still giving hope that each municipality in ĐNP possesses a certain capacity to attract tourists.

Woods as an energy and economic resource is still locally relevant to the population in rural and mountainous areas in Serbia (Pantić, 2019). However, the relevance of forests goes beyond the local level because their role in climate and hydrological regulations is global (Gratzer & Keeton, 2017). In ĐNP, the share of the forested areas slowly decreases, thus requiring additional attention in the reduction of its negative impact on environmental sustainability. Also, indicator values reported in the statistical yearbooks fluctuate to the unrealistic extent that indicates a necessity to improve monitoring or data collection methodology, or both. Both consistent biological (Danielsen et al., 2005) and human-made infrastructure monitoring play a significant role in securing sustainable development (Lindholm et al., 2007).

The first protocols of the Carpathian Convention emphasized the environmental aspect but later expanded on economic and social sustainability (Status of signature and ratification, 2021). In contrast to that, environmental improvements in the Serbian Carpathians are insignificant regarding the change of forested areas (a small decrease instead of an increase). A positive trend for environmental sustainability appears to be related to a positive trend of economic sustainability, e.g., increase of households with water and sewage endowment. Despite the significant improvement in the field of economic sustainability (employment rate, number of tourists, etc.), the social sustainability of the area remained seriously endangered (notable depopulation and population aging). Those results show that signing and ratifying the Carpathian Convention and some protocols did not coincide with their proper implementation in Serbia. Despite signing it at the very beginning, Serbia took ten years to take the first protocol into force. It was almost always the last Carpathian country to sign and ratify protocols and their amendments. There are protocols that Serbia has not yet signed, such as the Sustainable Agriculture and Rural Development Protocol and the New Article on Climate Change. Last but not least, it appears that Serbia is not ready to implement the Carpathian Convention and follow the priorities promoted by the Convention. Therefore, the message of the United Nations Environment Programme Executive Director (Andersen, 2020), addressed at the latest conference of the Parties of the Carpathian Convention (November 2020), highlights the most important actions for the Serbian Carpathians: acceleration of the

implementation of plans on the conservation and sustainable use; strengthening the rule of law, enforcement, and protection; an increase of transboundary collaboration, and proactive combat against climate change.

6. Conclusion

ĐNP certainly possesses a development potential, especially regarding its natural and archaeological rarities in the Đerdap George. However, the possession of the potential does not necessarily correspond to its utility, nor is each development approach considered to be sustainable. A balance between social, economic, and environmental aspects is, therefore, necessary.

In the case of ĐNP, demographic trends do not contribute to social sustainability, which indirectly hinders environmental and economic aspects. So far, the abundance of available indicators and positive trends are the most prosperous regarding the economic sustainability pillar. The economic activities are still rather humble and their intensity does not leave an irreversible mark on environmental sustainability, but some ecologic indicators already show the negative trend that invites the future development to respect sustainability principle with the holistic integrity of its three pillars.

The future of environmental and social sustainability in ĐNP greatly depends on the direction that the economic development will take. It should follow the course toward the sustainable utilization of resources and activities that are believed to have a sustainable alternative to a traditional one. Those activities include eco-, soft-, agri-, community-tourism, etc., based on small-scale accommodation and local products in synergy with traditional agriculture and energy production from renewable energy sources. Currently, the largest economic drawback is the decrease in agricultural production, which is related to social sustainability.

This research showed that the interpretation of sustainability pillars is hindered by a lack of monitoring. Not many indicators are available and those that are, are often reported inconsistently, which makes the comparison, understanding of trends, and following of the Carpathian Convention implementation difficult. Therefore, it is necessary to conduct certain improvements in the monitoring system of Serbia.

The Carpathian Convention is designed as soft-law cooperation. Even though the participation in the pact brings certain obligations and investments, it appears that its “soft” side dominates in the case of non-EU countries with limited access to structural funds, such as Serbia. It resulted in the minimized territorial designation in the Convention, late ratification of protocols, and development of social and environmental sustainability pillars in the opposite direction than it is aimed by the Convention. The Convention with protocols, along with other related EU and international hard and soft legislation, provides relevant safeguard tools and instruments for ensuring sustainable development, although they are sometimes circumvented and violated in practice. Out of 13 of the most relevant international projects related to this area, Serbia has been involved only in six (Our projects, 2021). Although the demographic trends do not seem to be mitigated by the Carpathian Convention, nor environmental quality significantly improved, positive economic changes coincide with the ratification period.

Cross-border cooperation with other Carpathian countries plays a specific and positive role in strengthening the sustainability of the Serbian Carpathians. The fact that Serbia and Ukraine are the only Carpathian countries without the European Union membership increases the difficulty in obtaining funding for the development and implementation of international environmental legislation. The lack of adequate implementation and enforcement of national

legislation is also a substantial obstacle. Therefore, the role of local authorities is crucial as they need to find a balance between environmental protection and development (infrastructure, tourism, agriculture) on a daily basis (WWF, 2007), along with respecting the existing legislation.

References

- Abrahams, G. (2017). Constructing definitions of sustainable development. *Smart and Sustainable Built Environment*, 6(1), 34–47. <https://doi.org/10.1108/SASBE-03-2017-0009>
- Andersen, I. (2020). *The Carpathian Convention: a push to implementation, speech*. <https://www.unep.org/news-and-stories/speech/carpathian-convention-push-implementation>
- Baycan-Levent, T., Brunisma, F., & Nijkamp, P. (2007). Urban Spiders: A Comparative Framework for Evaluation and Scenario Analysis. In M. Deakin, G. Mitchell, P. Nijkamp, & R. Vreeker (Eds.), *Sustainable Urban Development Volume 2, The Environmental Assessment Methods* (pp. 236–253). Taylor & Francis.
- Bell, S., & Morse, S. (2018). Sustainability Indicators Past and Present: What Next? *Sustainability*, 10(5), Article 1688. <https://doi.org/10.3390/su10051688>
- Caponi, V. (2017). The effects of public sector employment on the economy. *IZA World of Labor*, 332, 1–10. <http://doi.org/10.15185/izawol.332>
- Carpathian Convention, May 22–25, 2003, www.carpathianconvention.org/text-of-the-convention.html
- Climate ADAPT. (2021). *Adaptation in Carpathian Mountains*. <https://climate-adapt.eea.europa.eu/countries-regions/transnational-regions/carpathian-mountains/general>
- Danielsen, F., Jensen, A. E., Alviola, P. A., Balete, D. S., Mendoza, M., Tagtag, A., Custodio, C., & Enghoff, M. (2005). Does Monitoring Matter? A Quantitative Assessment of Management Decisions from Locally-based Monitoring of Protected Areas. *Biodiversity and Conservation*, 14, 2633–2652. <https://doi.org/10.1007/s10531-005-8392-z>
- Đerdap National Park. (2020a). *About the Park*. <https://npdjerdap.rs/en/about-the-park/>
- Đerdap National Park. (2020b). *Geoheritage*. <https://npdjerdap.rs/en/geoheritage/>
- Đerdap National Park. (2020c). *Flora*. <https://npdjerdap.rs/en/flora/>
- Đerdap National Park. (2020d). *Fauna*. <https://npdjerdap.rs/en/fauna/>
- Đerdap National Park. (2020e). *Cultural Heritage*. <https://npdjerdap.rs/en/cultural-heritage/>
- Đerdap National Park. (2020f). *Đerdap Geopark*. <https://npdjerdap.rs/en/djerdap-geopark/>
- Gratzer, G., & Keeton, S. W. (2017). Mountain Forests and Sustainable Development: The Potential for Achieving the United Nations' 2030 Agenda. *Mountain Research and Development*, 37(3), 246–253. <https://doi.org/10.1659/MRD-JOURNAL-D-17-00093.1>
- Gurung, A. B., Bokwa, A., Chełmicki, W., Elbakidze, M., Hirschmugl, M., Hostert, P., Ibsch, P., Kozak, J., Kummerle, T., Matei, E., Ostapowicz, K., Pociask-Karteczka, J., Schmidt, L., van der Linden, S., & Zebisch, M. (2009). Global change research in the Carpathian Mountain region. *Mountain Research and Development*, 29(3), 282–288. <https://doi.org/10.1659/mrd.1105>
- Institute for Nature Conservation of Serbia. (2021). *Zaštićena prirodna dobra Srbije* [Protected natural areas of Serbia]. <https://cloud.gdi.net/visios/zzps>
- Institute of Public Health of Serbia. (2021). *Zdravstveno-statistički godišnjak Republike Srbije 2020* [Health statistical yearbook of Republic of Serbia 2020]. www.batut.org.rs/download/publikacije/pub2020.pdf
- Jabareen, Y. (2008). A New Conceptual Framework for Sustainable Development. *Environment, Development and Sustainability*, 10, 179–192. <https://doi.org/10.1007/s10668-006-9058-z>
- Kaygusuz, K. (2016). Hydropower as clean and renewable energy source for electricity generation. *Journal of Engineering Research and Applied Science*, 5(1), 359–369. www.journaleras.com/index.php/jeras/article/view/52/52
- Kovačić, M., Zekić, A., & Violić, A. (2017). Analysis of Cruise Tourism on Croatian Rivers. *Naše More*, 64(1), 27–32. <https://doi.org/10.17818/NM/2017/1.11>

- Lindholm, O., Greatorex, J. M., & Paruch, A. M., (2007). Comparison of methods for calculation of sustainability indices for alternative sewerage systems—Theoretical and practical considerations. *Ecological Indicators*, 7(1), 71–78. <https://doi.org/10.1016/j.ecolind.2005.10.002>
- Our projects. (2021). www.carpathianconvention.org/projects.html
- Pantić, M. (2014). *Sustainable Development Perspectives for Serbian Mountain Areas: Lessons from the European Context* [Doctoral dissertation, Technische Universität Dresden]. QUCOSA - Quality Content of Saxony. <http://nbn-resolving.de/urn:nbn:de:bsz:14-qucosa-144339>
- Pantić, M. (2019). *Izazovi demografskih promena u planinskim područjima Srbije* [Demographic change challenges in Serbian mountain areas]. Institut za arhitekturu i urbanizam Srbije.
- Pantić, M., & Milijić, S. (2021). The European Green Capital Award—Is It a Dream or Reality for Belgrade (Serbia)? *Sustainability*, 13(11), Article 6182. <https://doi.org/10.3390/su13116182>
- Popović, V., Milijić, S., & Vuković, P. (2012). Sustainable tourism development in the Carpathian region in Serbia. *Spatium*, 28, 45–52. <https://doi.org/10.2298/SPAT1228045P>
- Schönborn, G., Berlin, C., Pinzone, M., Hanisch, C., Georgoulas, K., & Lanz, M. (2019). Why social sustainability counts: The impact of corporate social sustainability culture on financial success. *Sustainable Production and Consumption*, 17, 1–10. <https://doi.org/10.1016/j.spc.2018.08.008>
- Sinding, K. (1999). Environmental impact assessment and management in the mining industry. *Natural Resources Forum*, 23(1), 57–63. <https://doi.org/10.1111/j.1477-8947.1999.tb00238.x>
- Song, P., Qi, L., Qian, X., & Lu, X. (2019). Detection of ships in inland river using high-resolution optical satellite imagery based on mixture of deformable part models. *Journal of Parallel and Distributed Computing*, 132, 1–7. <https://doi.org/10.1016/j.jpdc.2019.04.013>
- Starr, S. F. (2004). Conflict and Peace in Mountain Societies. In M. F. Price, L. F. Jansky, & A. A. Istenia (Eds.), *Key Issues for Mountain Areas* (pp. 169–180). United Nations University Press.
- Statistical Office of the Republic of Serbia. (2005). *Opštine u Srbiji 2004* [Municipalities in Serbia 2004]. <https://publikacije.stat.gov.rs/G2004/Pdf/G20042002.pdf>
- Statistical Office of the Republic of Serbia. (2009). *Opštine u Srbiji 2008* [Municipalities in Serbia 2008]. <https://publikacije.stat.gov.rs/G2009/Pdf/G20092001.pdf>
- Statistical Office of the Republic of Serbia. (2012). *Opštine i regioni u Republici Srbiji 2012* [Municipalities and regions in the Republic of Serbia 2012]. <https://publikacije.stat.gov.rs/G2012/Pdf/G20122008.pdf>
- Statistical Office of the Republic of Serbia. (2014). *2011 Census of Population, Households and Dwellings in the Republic of Serbia: Book 20. Comparative overview of the number of population in 1948, 1953, 1961, 1971, 1981, 1991, 2002 and 2011 – Data by settlements*. <https://publikacije.stat.gov.rs/G2014/Pdf/G20144008.pdf>
- Statistical Office of the Republic of Serbia. (2020). *Opštine i regioni u Republici Srbiji 2020* [Municipalities and regions in the Republic of Serbia 2020]. <https://publikacije.stat.gov.rs/G2020/Pdf/G202013047.pdf>
- Status of signature and ratification. (2021). www.carpathianconvention.org/status-of-signature-and-ratification.html
- Turnock, D. (2002). Ecoregion-based conservation in the Carpathians and the land-use implications. *Land Use Policy*, 19(1), 47–63. [https://doi.org/10.1016/S0264-8377\(01\)00039-4](https://doi.org/10.1016/S0264-8377(01)00039-4)
- Turnock, D. (2008). The Drive for Modernization in Inter-War Eastern Europe: Changes in Rurality in the Carpathian Mountains 1918–1945. *Geographica Pannonica*, 12(1), 12–38. <https://scindeks-clanci.ceon.rs/data/pdf/0354-8724/2008/0354-87240801012T.pdf>
- United Nations Environment Programme. (2007). *Carpathians' Environment Outlook, 2007*. www.unep.org/resources/report/carpathians-environment-outlook-2007
- Uredba o utvrđivanju Prostornog plana područja posebne namene Nacionalnog parka Đerdap [Decree on Adopting the Special Purpose Area Spatial Plan of the Đerdap National Park]. Službeni glasnik Republike Srbije, No. 43 (2013).
- Vallance, S., Perkins, H. C., & Dixon, J. E. (2011). What is social sustainability? A clarification of concepts. *Geoforum*, 42(3), 342–348. <https://doi.org/10.1016/j.geoforum.2011.01.002>
- Vujošević, M., Zeković, S., & Maričić, T. (2010). *Postsocijalistička tranzicija u Srbiji i teritorijalni kapital Srbije – stanje, neki budući izgledi i predvidljivi scenariji* [The post-socialist transition in Serbia and the territorial capital of Serbia – the state of the art, future prospects and scenarios]. Institut za arhitekturu i urbanizam Srbije.

- Wagner, B., Hauer, C., & Habersack, H. (2019). Current hydropower developments in Europe. *Current Opinion in Environmental Sustainability*, 37, 41–49. <https://doi.org/10.1016/j.cosust.2019.06.002>
- World Commission on Environment and Development. (1987). Report of the World Commission on Environment and Development: *Our Common Future*. <https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf>
- World Wildlife Fund. (2007). *Addressing threats to nature in the Carpathian Mountains*. https://www.suske.at/files/addressing_threats_to_carpathians.pdf
- World Wildlife Fund. (2018). *Carpathian Mountains: significant losses in Europe's biodiversity hotspot*. https://wwf.panda.org/wwf_news/?338710/Carpathian-Mountains-significant-losses-in-Europes-biodiversity-hotspot
- Zeković, S., Vujošević, M., & Maričić, T. (2015). A Preliminary Analysis of Sustainable Development in the Belgrade Metropolitan Area. *International Journal of Social, Behavioral, Educational, Economic and Management Engineering*, 9(7), 839–846. <https://doi.org/10.5281/zenodo.1107674>