ЗБОРНИК РАДОВА

ГЕОГРАФСКОГ ФАКУЛТЕТА УНИВЕРЗИТЕТА У БЕОГРАДУ

COLLECTION OF PAPERS

FACULTY OF GEOGRAPHY AT THE UNIVERSITY OF BELGRADE

Свеска
Vol. LXXII
Београд - Belgrade, 2024.
ISSN 1450-7552
UDC 911

Универзитет у Београду
ГЕОГРАФСКИ ФАКУЛТЕТ

University of Belgrade
FACULTY OF GEOGRAPHY

УНИВЕРЗИТЕТ У БЕОГРАДУ - ГЕОГРАФСКИ ФАКУЛТЕТ
UNIVERSITY OF BELGRADE - FACULTY OF GEOGRAPHY

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2024.

Publisher

University of Belgrade - Faculty of Geography, Studentski trg, 3/III, Belgrade
scindeks.ceon.rs/journalDetails.aspx?issn=1450-7552

Cartographic editor

Jasmina Jovanović

Technical Editor

Ivana Injac

The authors are responsible for translation of their papers

Copies
100

ISSN 1450-7552
eISSN 2334-9441

Printing was supported by Ministry of education, science and technological development of the Republic of Serbia

Printed by
Planeta print d.o.o, Beograd

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Original scientific article
Received: 28.5.2023;
Received in revised form: 07.09.2023;
Accepted: 28.09.2023;
Available online:14.10.2024.

UDC: 556.166(497.16)
doi: 10.5937/zrgfub2472005V

SITUATION OF THE EXTREME WATERS OF GRLJA AND LIM IN THE AREA OF THE PLAV-GUSINJE BASIN

Danijela Veličković[1]*, Marijana Krivokapić**, Ivan Mijanović***

Abstract: This paper presents an overview of the extreme values of maximum and minimum discharge (at two hydrological stations on the Grlja watercourse in the town of Vusanje and on the Lim River in the town of Plav, where the hydrological station is also located), which play an important role in the construction of flood protection facilities and the dimensioning of hydrotechnical objects. Based on eight-hour data series from the two hydrological stations HS Plav on the Lim River and HS Vusanje on the Grlja watercourse for the period from 2008 to 2021, the available data were used to apply statistical methods (Pearson 3, logPearson 3 and Gumbel) for the assessment of small and large floods. The data for the Grlja watercourse in the period from 1963 to 1995 for maximum flows were also analyzed.

Keywords: extreme discharges, statistical methods, monitoring stations, Grlja, Plav, Lim.

Introduction

Extreme water levels (minimum and maximum water levels) have a direct impact on economic movements and a whole range of activities. Minimum water levels can restrict the extraction and use of water, and maximum water levels can lead to large-scale catastrophic flooding (Milošev, Savić, 2009).

Numerous and interdependent factors are the result of extreme hydrological phenomena (Leščanin, 2019). Hydrological works on the topic of large water bodies are numerous, but only a few of them deal with the volumes of large water waves and the assessment of their value. Most statistical methods are based on the observation of the elements of large water bodies, their duration and volume, and consider them

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as random variables. Then, distribution models with several random variables are adopted, their marginal distributions are determined and the corresponding return periods are calculated (Ashkar, 1980; Yue et al., 1999). Other researchers introduce regional analysis based on correlation techniques to assess large water bodies in unstudied watersheds (Ourada et al., 2000).

The proposed hypothesis is: it is possible to develop multiple approaches for accurately estimating the maximum and minimum discharge of a hydrological event by applying the joint distribution function of large and small water bodies of the main Lim River and its tributaries. For the analysis, hydrological stations on the Lim River in Montenegro and the hydrological station on the Grlja watercourse were used. The aim of this study is to analyze the extreme values of maximum and minimum flow, which play a very important role in the dimensioning of hydrotechnical facilities and the construction of flood protection facilities. The discharge data were taken from the database of the Hydrometeorological Institute of Montenegro. The selection of data for the analysis is guided by the assumption that more information about a hydrological event can be taken into account if each river is analyzed by its water regime and then their joint impact is quantified by information on the common return period of flow exceedance at the mouth.

Probability distributions have been and are used today in numerous hydrological studies. Despite intensive research and use, no particular model has proven to be universal for practical application. Therefore, researchers apply several different distributions and then compare the results depending on the research problem and available data. The distributions presented have been used in numerous papers (Cunnane, 1979; Kite, 1988; Stedinger et al, 1993; Hosking and Wallis, 1997; Pavlović & Vukmirović, 2010; Amirataee & Montaseri, 2013).

From a safety, economic and structural point of view, large bodies of water are of great importance (Sekulić et al., 2016). Numerous examples from the distant and recent past around the world indicate that large floods are one of the largest natural disasters (Topalović et al., 2018). The development of a methodology for the standardization of large flood calculations in the USA illustrates well the complexity of this task (Stedinger & Griffis, 2008; Griffis & Stedinger, 2007).

Despite major research efforts and protection plans, large bodies of water pose a major threat to human life and material assets. Since the occurrence of major floods cannot be avoided, measures (structural and non-structural) must be taken to reduce the risk of damage to people and property. Precipitation is the most important factor in the formation of large bodies of water, as it leads to an increase in water levels and runoff, while the influence of snow only becomes noticeable when it melts. The flood protection zone is regulated in almost all countries. Serbia has experienced several major floods in the last ten years, which have had considerable economic

consequences. Ten people died, several thousand buildings and large agricultural areas were flooded. The largest floods occurred in spring 2006, when the absolute maximum water level was reached on many rivers. The damage at that time was estimated at around 36 million euros (Mihailović et al., 2010). The characteristics of the water balance of the individual parts of the Drina catchment area are very different, from hilly plains to hilly mountains, which is confirmed by the studies of Milovanović et al. (2014). Precipitation of shorter and longer intensity contributes to maintaining a constantly high water level and flow rate. The possibility of large water floods depends on the characteristics of the river, i.e. its ability to absorb a new amount of water up to the height of the "critical level". The most common causes of floods are precipitation of longer duration with shorter and longer intensity, which enable the maintenance of a constantly high water level and discharge (Gavrilović, 1981). Floods do not have to be spatially large, but they can cause considerable material damage, as river valleys are usually narrow and expand where settlements and roads connecting to settlements have developed (Burić et al., 2016).

In November, December 2010 and January 2011, catastrophic floods were recorded in the Lim basin on the territory of Montenegro. Since 1952, when water level measurements on Montenegrin rivers began, historical hydrological data on the occurrence of floods have been analyzed. The 2010 flood affected the tributaries of the Lim in the upper reaches: Ljuča, Vruja, Grnčar, Đurička rijeka, Plavska rijeka on the territory of the Municipality of Plav, Zlorečica, Kraštica, Trebačka rijeka in Andrijevica, Lim with tributaries through Bijelo Polje and Lim on the territory of Beran. In the water area of the Danube basin, floods were recorded after 2010 in 2012 at the Grlja watercourse, at the hydrological station in Grlja and in 2016 at the hydrological stations in Bijelo Polje na Lim (hs Dobrakovo) and at the hydrological station in Plav. The floods had a torrential and riverine character. Since the 70s of the last century, very little work has been carried out on the design of watercourses. Due to the incomplete approach to this issue, the lengths of the regulated riverbeds are very short, from a few hundred meters to 2 km. Flood protection systems were installed after the catastrophic floods in 2010. Little attention is paid to biological and biotechnical work on the arrangement of torrents, so the possibility of torrents occurring is increasing, especially in the upper reaches of the Lim, where torrents have been active for years, such as Martinić potok, Bjelićko, Bijelo potok and, through the municipality of Bijelo Polje, the tributaries of the Lim: Lješnička, Bistrička, Boljanska, Lipnica and Orahovicki brook.

In the Municipality of Plav, the tributaries of Lim in the period from November 2010 to January 2011: Ljuča, Dolja, Grnčar, Vruja burst their banks, and the regions affected by this flood were the villages: Prnjavor, Bogajiće, Malo selo, Jesenice, Hakanje, Vojno selo, Martinović, Dosuđe. On this occasion, 80 residential buildings,

i.e. 320 inhabitants, were threatened. The torrential watercourses Grnčar, Vruja, Dolja and Ljuča cover an area of about 700 hectares. The Grnčar river valley is threatened over a length of 5 km, the Vrulje valley is flooded over a length of 2,500 m, and its tributary Dolja over a length of 2,200 m in the section from the mouth of the Vruja to the existing sediment barrier. The Ljuča River is at risk at a width of 1200-1500 m over a length of 8 km. The water level of the Vusanja hydrological station on the Grlja River recorded a water level of 179 cm on December 2, 2010, which means that the record of October 30, 2008, which was 131 cm, was surpassed (Blagojević et al., 2014). Each watercourse in Montenegro is characterized by a large difference in the flow of small and large water bodies (Gavrilović, 1981).

The Grlja watercourse is located in the municipality of Gusinje, and its catchment area extends to the northern part of the Prokletija massif in Montenegro. It originates from the Bjelić and Skakavica streams and a number of strong springs along the tectonic fault at the edge of the basin in a north-south direction under the steep slopes of Vezirova brdo (Karanfil 2110 m). It has its source in the Ropojani valley. The Grlja watercourse is actually a continuation of the Skakavica River, which flows through the Grlja Gorge and bears this name, and downstream from the gorge to the mouth of the Ljuča River it is called Vruja (Radojičić, 2008). The river of the same name forms the Grlje gorge, which is very narrow and which the river has cut through a limestone overhang called Suka.

The plan also provides for the construction of SHP Grlje, which includes the damming of the watercourse, the collection and discharge of the affected water through the drainage system, the discharge pipe to the powerhouse and the subsequent return of the affected water to the Grlje watercourse.

The Lim River is the largest tributary of the Drina. The area of the Lim catchment in Montenegro is 2280 km2. The entire basin consists mainly of impermeable rocks from the Devonian, Carboniferous, Permian and Lower Triassic periods. In the higher parts of the river valleys and in the surrounding mountains there are Triassic limestones, which are tectonically fissured and heavily eroded by corrosion, as well as dolomites with quite rounded shapes, which were formed by various erosion processes. The Plavsko-Gusinjska basin with Lake Plavsko is located in the headwaters. The length of the Lim River from its outlet from Lake Plav to its mouth in the Drina is 219 km. Of this, 83 km are on Montenegrin territory. The length of the Lima River should include the 12.5 km long tributary of Lake Plav, Ljuča, from which the Ljuča, Skrobotuša 7.5 km, Ljuma and Vermošit 9.5 km and Grnčar 8.5 km flow, as well as the length of Lake Plav of 1.5 km, which increases the total length of the Lima River by 39.5 km. Of the 39.5 km, 17 km are in Albania (Skrobotuša, Ljumi and Warmoshit). At the mouth of Lake Plav, the average flow of the Lim is 19.3 m3/s (minimum 2.1 m3/s) and the absolute maximum 688 m3/s), at the mouth of the Lješnica 41 m3/s (the minimum flow at Beran is 6.0 m 3/s). The

average flow of the Lim in Bijelo Polje is 65.4 m3/s (the absolute minimum is 7.1 m3/s and the maximum is 2,942 m3/s). The maximum flow is in May and April and the minimum in August and September (Radojičić, 2008, Radojičić, 2015).

Materials and methods

Calculations of large bodies of water can be based on different approaches and methods. In general, the choice of method depends on several factors. The most important is whether there are flow records of the profile of the watercourse of interest, i.e. whether continuous hydrometric measurements are available. The basic task of large water body analysis is to assess the relevant large water bodies along watercourses. In a technical sense, these are the largest and expected large water waves and their characteristics. We can never confirm these assessments with certainty. All efforts in this area are limited by the correctness of the assumptions made in describing the phenomenon. In the work, standard statistical methods were applied at the monitored hydrological stations for the period from 2008 to 2021, for which data are available, and for the period from 1963 to 1995 for HS Vusanje on the Grlja River, where the maximum flows were calculated. The methods widely used in practice to analyze extreme hydrological variables so far have been the method of annual extremes and the method of peak values (POT series).

The method of extremes was used because it is easier to adapt to the available data series of the HS Vusanje, Grlja and HS Plav on the Lim River. The extrema method is based on the statistical analysis of the highest observed values in each year (one maximum per year) during the observation period of N years. The data in this document were collected by the Institute of Seismology and Hydrology in Montenegro.

Monitoring stations in the Grlja and Lim catchment areas

On the territory of Montenegro there are three hydrological stations on the Lim River, namely the automatic HS Bijelo Polje (put into operation in 1949, at an altitude of 559.67 m, 149.9 km from the mouth) and the HS Plav, observatory type, put into operation in 1962, at an altitude of 906 m, 111.2 km from the mouth, automatic type. It is part of the Drina catchment area. The hydrological station HS "Dobrakovo" was established in 1969 in the town of Dobrakovo, on the territory of the municipality of Bijelo Polje". Elevation "0" is 906.8 m, it is 196.8 km away from the mouth (Tomović, 2006).

The Ljubovića River (the left tributary of the Lim) is the longest tributary of the Lim on the territory of Montenegro. The large river basin includes parts of Bjelasica,

Burenje and the vast area of Mataruga. The springs furthest from the mouth are located on the border between the Ćehotina and Lima watersheds, on the surface of Grab (110-1150 m), Kovren (1062) and Stožer (1200-1300 m). The Ljubovića is 36 km long, from its sources in Grab and Mramor (1180 m) to its mouth (580 m). It flows mostly in a north-south direction and in a west-east direction for the last 7 km until it flows into the Lim River (Radojičić, 2015). The Ravna Rijeka hydrological station (HS) is located on the Ljubovića River at 582 m above sea level. It was put into operation in 1979 and is 0.8 km from the estuary.

The Bistrica River (Bjelopoljska Bistrica) is the right tributary of the Lim. It flows into the Lim 10 km downstream of Bijelo Polje at an altitude of 520 meters. The springs furthest from the mouth are located in Serbia, around the Mačkovac mountain (Jelenak 1617 m). From its source to the Đalovića Gorge, the course of the river runs north-south for 13 km, in Đalovića it turns west, and from the town of Bistrica to the mouth it flows northwest for 9.7 km. The catchment area of the Bistrica River, as part of the north-eastern part of the Bijelo Polje municipality, belongs to the area called Korita, which consists mostly of limestone and dolomite from the Middle and Lower Triassic and Jurassic periods (Radojičić, 2015). The Bistrica hydrological station was put into operation in 1949, it is 2.2 km away from the estuary and is located at 545 m above sea level. Since 1959, there has been the Vusanje hydrological station on the Grlja River at an altitude of 960 meters. It is 3.5 km from the mouth of the river. The Grlja River is part of the Vruja catchment area, which has an area of 48.5 km^2 (Tomović, 2006).

Figure 1. Location of the Plav hydrological station on the Lim River (Basis: Topographic map 1:25,000, Real Estate Administration of Montenegro, 2009)

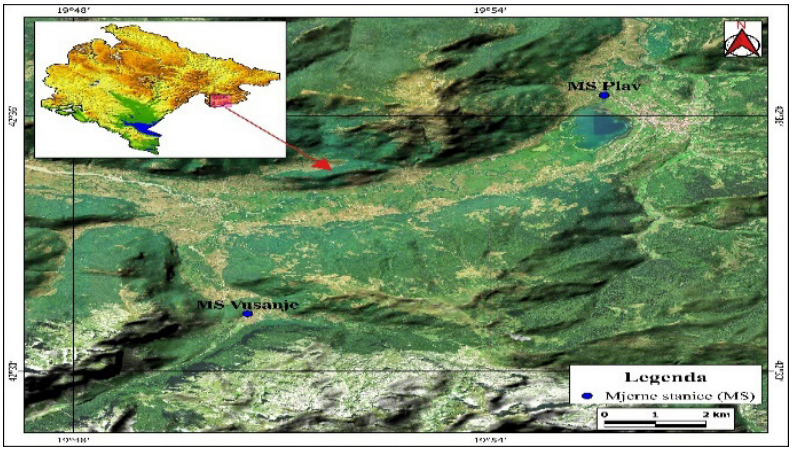

Figure 2: Location of the hydrological station Vusanje on the river Grlja, source: author

Results and discussion

HS Vusanje, watercourse Grlja (1963-1995)

The available data series covered the period from 1963 to 1995, on the basis of which the large watercourses were analyzed using the Pearson 3, logPearson 3 and Gumbel distribution functions. The probability scale of the maximum annual discharges is shown in Figure 3, while the quantile values corresponding to the probabilities of occurrence, i.e. the return periods, are given in Table 1. Table 1 shows that the quantile values are similar, with the highest quantile values given by the Gumbel distribution. Large floods were recorded on the Grlja River in 1960, 1972 and 2010, and the calculated return period was 30 to 65 years. According to the data of the National Plan for Disaster Risk Assessment in Montenegro, the return period of the mean probability of flooding for the Grlja River is about 100 years.

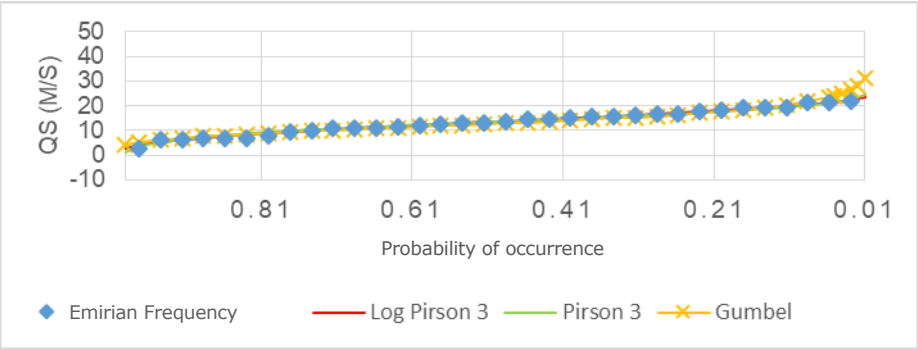

Figure 3. Probability scale of maximum annual flows, HS Vusanje 1963 – 1995

Table 1. Values of large waters according to three distribution functions for HS Vusanje 1963 – 1995

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	-3.09	1.23	2.50
1.010101	0.99	1.26	2.81	4.29
1.052632	0.95	5.01	5.11	6.19
1.111111	0.9	6.96	6.68	7.35
1.25	0.8	9.27	8.86	8.93
2	0.5	13.55	13.53	12.65
3.333333	0.3	16.12	16.43	15.59
10	0.1	19.72	20.11	20.97
20	0.05	21.40	21.54	24.15
100	0.01	24.45	23.51	31.35
1000	0.001	27.74	24.71	41.54
10000	0.0001	30.35	25.08	51.71

Hs Vusanje, watercourse Grlja (2008-2021)

The results of the analysis on the scale of maximum annual flows for the period 2008-2021 show that the Gumbel distribution provides the highest quantile values, followed by the Pearson 3 distribution, while logPearson 3 deviates significantly from the Pearson 3 and Gumbel distribution functions at smaller return periods T.

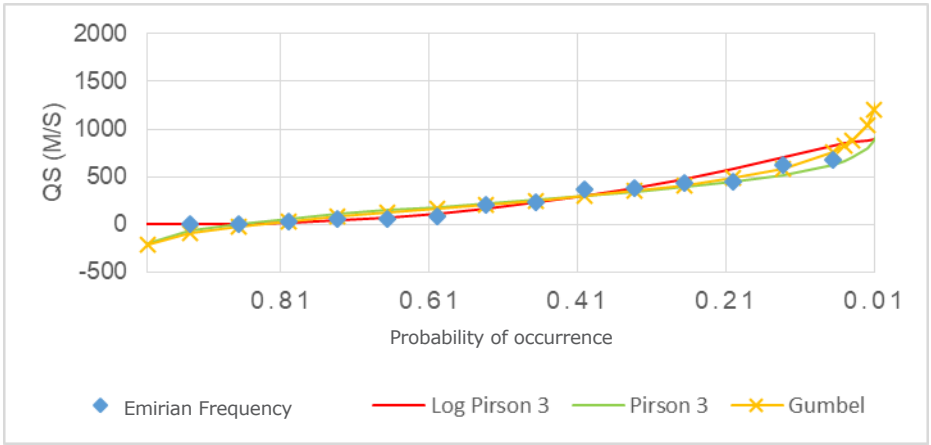

Figure 4: Probability scale of maximum annual discharges, HS Vusanje 2008 -2021 Year

Table 2. values of large water bodies according to three distribution functions for HS Vusanje 2008 -2021 Year

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	-300.56	0.00	-303.30
1.010101	0.99	-196.19	0.01	-210.12
1.052632	0.95	-87.92	0.62	-111.33
1.111111	0.9	-23.99	3.69	-50.87
1.25	0.8	59.50	20.94	31.41
2	0.5	238.71	193.08	224.95
3.333333	0.3	364.00	427.57	377.59
10	0.1	564.49	759.29	657.75
20	0.05	669.26	845.77	823.13
100	0.01	881.48	888.10	1197.60
1000	0.001	1144.75	919.08	1727.65
10000	0.0001	1382.58	1133.76	2256.76

Table 3 shows the quantile values for characteristic water levels (from 2008 to 2021) at the hydrological station HS Vusanje (Grlja River), the probability scale of maximum annual water levels is shown in Figure 5. It can be seen that the Gubmel distribution produces the highest quantile values.

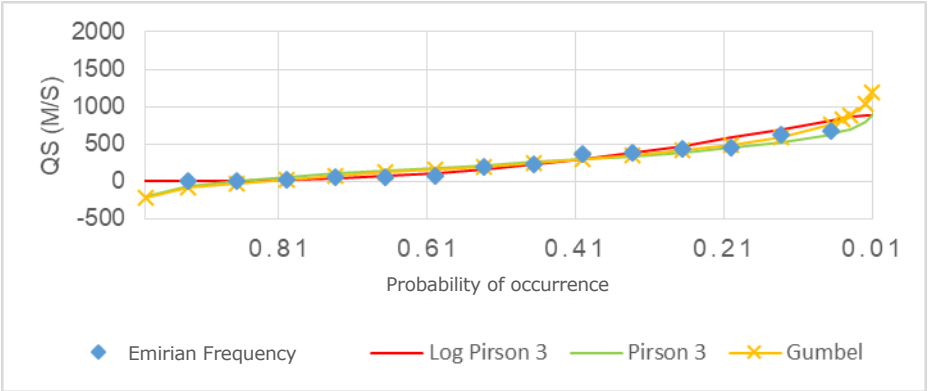

Figure 5. Probability scale of the maximum annual water levels, HS Vusanje, Grlja 2008-2021

Table 3. Maximum water level values according to three distribution functions, HS Vusanje,Grlja 2008-2021

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	39.81	45.22	16.73
1.010101	0.99	56.73	61.36	40.14
1.052632	0.95	76.96	80.09	64.96
1.111111	0.9	89.97	92.10	80.14
1.25	0.8	107.99	108.88	100.81
2	0.5	149.98	149.03	149.43
3.333333	0.3	181.61	180.50	187.78
10	0.1	235.39	236.75	258.16
20	0.05	264.84	269.06	299.70
100	0.01	326.92	340.70	393.77
1000	0.001	407.81	441.26	526.93
10000	0.0001	484.01	543.40	659.85

HS Plav

The results of the analysis on the scale of maximum annual flows are shown in Figure 6, while the quantile values of the distributions are shown in Table 4. The highest quantile values were obtained with the Pearson 3 distribution, followed by the Gubmel distribution, while the logPearson 3 distribution yields significantly lower quantile values.

HS Plav can be considered authoritative and most meaningful for analysing the flood risk of the Lim River in the Beran area. Major floods were recorded in the Lim River (Plav site) at the HS Plav hydrological station in 1979, 2000, 2003, 2010 with a calculated return period of 10 years (Preliminary flood risk assessment for the Danube basin).

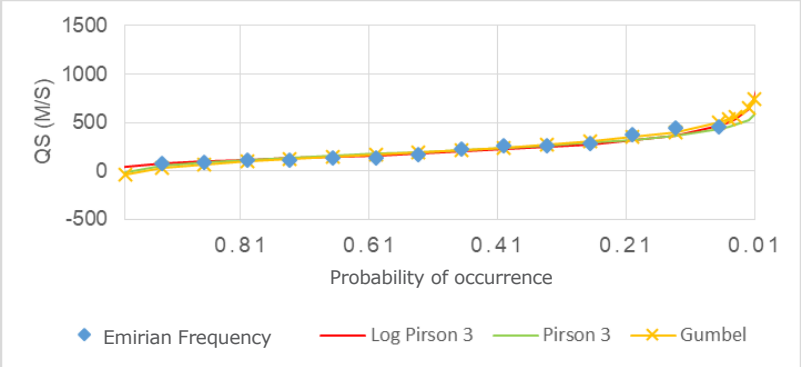

Figure 6. Probability scale of maximum annual discharges, HS Plav 2008-2021

Table 4. Values of large water bodies according to three distribution functions for HS Plav, 2008-2021

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	-55.84	28.84	-87.97
1.010101	0.99	-11.26	46.06	-36.61
1.052632	0.95	38.87	69.79	17.83
1.111111	0.9	69.97	87.02	51.16
1.25	0.8	112.02	113.59	96.51
2	0.5	206.83	188.68	203.17
3.333333	0.3	276.17	258.45	287.31
10	0.1	391.36	406.23	441.72
20	0.05	453.34	504.24	532.86
100	0.01	582.04	755.17	739.25
1000	0.001	746.73	1184.79	1031.39
10000	0.0001	899.52	1713.33	1323.01

The theoretical and empirical frequencies are shown in Figure 7, while the values of the quantiles resulting from the distributions are shown in the table. 5. The quantile values of the Pearson 3 and logPearson 3 distributions are very similar, while the highest quantile values are given by the Gumbel distribution.

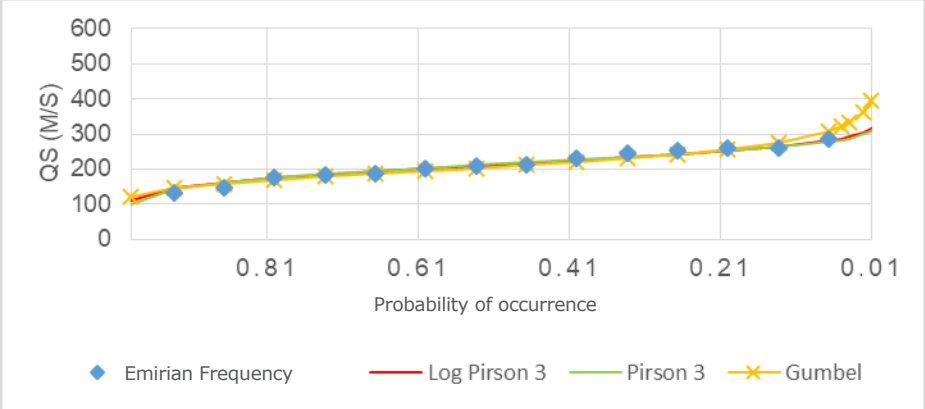

Figure 7. Probability scale of maximum annual water levels, HS Plav 2008-2021

Table 5. Maximum water level values according to three distribution functions, HS Plav 2008-2021

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	58.22	83.75	104.37
1.010101	0.99	100.41	111.12	122.35
1.052632	0.95	136.02	138.74	141.41
1.111111	0.9	154.25	154.46	153.07
1.25	0.8	175.64	174.18	168.95
2	0.5	214.50	213.08	206.28
3.333333	0.3	237.37	237.38	235.73
10	0.1	268.65	271.40	289.78
20	0.05	282.94	286.92	321.68
100	0.01	308.52	314.07	393.93
1000	0.001	335.34	340.74	496.18
10000	0.0001	356.00	359.30	598.26

Assessment of small water bodies on the basis of existing measurements

Small water bodies are caused by low water levels and small amounts of water in rivers, small amounts of water in reservoirs, moisture deficits in the soil and lowering of the groundwater table. Small bodies of water are one of the most important elements of water management and a very important hydrological condition. They can be the result of natural conditions, but also the result of undesirable or desirable human activities.

Knowledge of the characteristics of small water bodies is very important for the design, construction, maintenance and management of various water management systems [6,7]. Knowledge of these characteristics is also very important for the water supply of users downstream of where the water is used for various needs, as well as for the survival of plant and animal life. Numerous meteorological, hydrogeological and weather-related factors are the causes of low water. The characteristics of the low water regime are of great importance for maintaining and protecting the quality of river waters, because it is during periods of low water that the recipient is least able to decompose waste and organic matter, leading to a deterioration in water quality.

HS Vusanje, Grlja watercourse

The results of the analysis are shown on the minimum flow scale in Figure 8, while the quantile values of the distributions are shown in Table 6. The highest quantile values result from the logPearson 3 distribution.

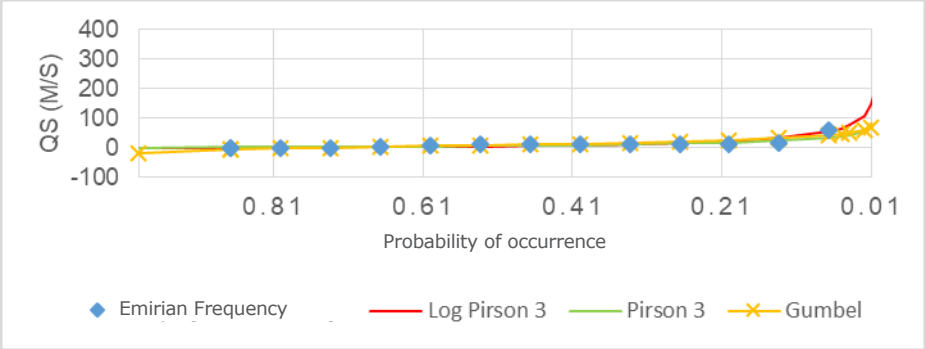

Figure 8. Probability scale of minimum flows, HS Vusanje, Grlja watercourse, 2008-2021

Table 6. Values of small water bodies according to three distribution functions for HS Vusanje, Grlja watercourse, 2008-2021

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	-1.99	0.00	-23.95
1.010101	0.99	0.28	0.01	-18.14
1.052632	0.95	0.48	0.09	-11.97
1.111111	0.9	0.57	0.23	-8.20
1.25	0.8	1.20	0.70	-3.07
2	0.5	5.75	4.45	9.01
3.333333	0.3	12.09	11.89	18.53
10	0.1	28.08	39.89	36.01
20	0.05	39.28	65.71	46.33
100	0.01	67.76	147.02	69.69
1000	0.001	113.26	301.08	102.76
10000	0.0001	163.29	476.45	135.78

The quantile values of the distributions presented in Table 6 show that the Gumbel distribution provides the highest quantile values, while Pearson 3 and logPearson 3 provide very similar quantile values in the later return periods, i.e. the results of the matching tests are similar.

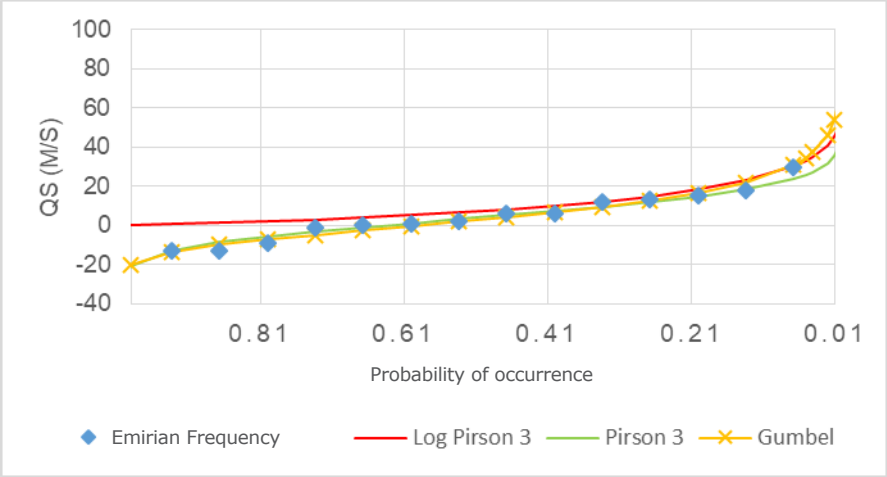

Figure 9. Probability scale of annual minimum water levels, HS Vusanje, Grlja watercourse, 2008-2021

Table 7. Values of quantiles of minimum water levels (msm) of the Lim River according to three distribution functions for HS Vusanje, Grlja watercourse, 2008-2021

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	-27.88	0.01	-24.73
1.010101	0.99	-20.92	0.07	-19.83
1.052632	0.95	-14.19	0.39	-14.63
1.111111	0.9	-10.40	0.86	-11.45
1.25	0.8	-5.60	2.01	-7.12
2	0.5	4.20	7.29	3.07
3.333333	0.3	10.74	13.43	11.10
10	0.1	20.77	26.00	25.84
20	0.05	25.85	32.89	34.54
100	0.01	35.84	45.32	54.25
1000	0.001	47.77	55.76	82.14
10000	0.0001	58.20	60.52	109.98

HS Plav

The assessment of the value of small water bodies for HS Plav is presented in Figure 7 on the scale of probability of annual minimum flows, while the values of quantile distributions are given in Table 7. The highest quantile values result from the logPearson 3 distribution.

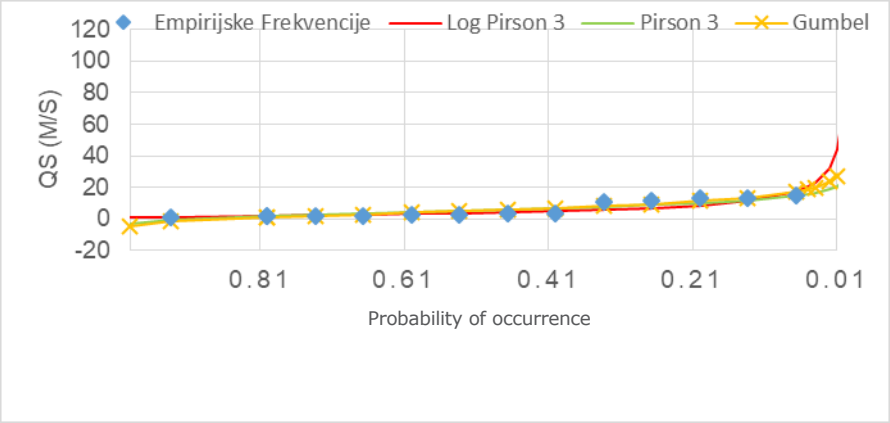

Figure 10. Probability scale of minimum flows, HS Plav, Lim River, 2008-2021

Table 8. Values of small water bodies according to three distribution functions for HS Plav, Lim River, 2008-2021

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	-5.41	0.34	-6.78
1.010101	0.99	-3.60	0.56	-4.66
1.052632	0.95	-1.55	0.93	-2.43
1.111111	0.9	-0.28	1.24	-1.06
1.25	0.8	1.44	1.79	0.81
2	0.5	5.33	3.78	5.19
3.333333	0.3	8.18	6.25	8.65
10	0.1	12.92	13.62	14.99
20	0.05	15.48	20.24	18.74
100	0.01	20.78	44.32	27.22
1000	0.001	27.58	113.79	39.23
10000	0.0001	33.89	260.73	51.21

Figure 11 shows the theoretical and empirical frequencies of the water level, while from Table 9 it can be concluded that the highest quantile values are given by the Gumbel distribution.

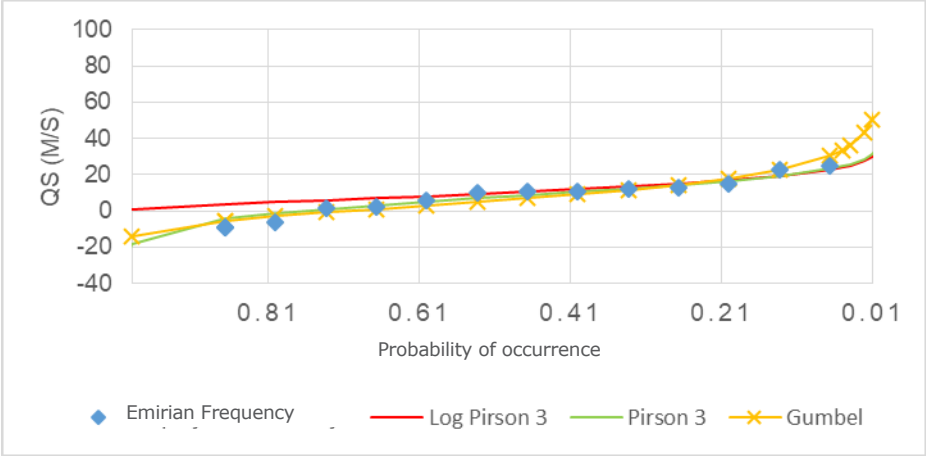

Figure 11. Probability scale of annual minimum water levels, HS Plav, Lim River, 2008-2021

Table 9. Quantile values of minimum water levels (mnm) according to three distribution functions for HS Plav, Lim River, 2008-2021

T	Probability of incidence	P3	LP3	GUM
1.001	0.999	-27.86	0.26	-18.22
1.010101	0.99	-18.50	0.85	-13.94
1.052632	0.95	-10.45	2.09	-9.41
1.111111	0.9	-6.27	3.16	-6.63
1.25	0.8	-1.31	4.95	-2.85
2	0.5	7.85	10.00	6.04
3.333333	0.3	13.35	14.14	13.06
10	0.1	21.01	20.91	25.93
20	0.05	24.58	24.21	33.52
100	0.01	31.07	29.95	50.72
1000	0.001	38.05	35.02	75.07
10000	0.0001	43.56	37.82	99.38

Conclusion

The main goal of this work was to determine extreme values, maximum and minimum flows based on the analysis of hydrological data. It is particularly important to analyze the extreme waters due to the floods that occurred in Montenegro in 2010, when the level of the Vusanja hydrological station on the Grlja river registered a water level of 179 cm on December 2, 2010, which means that the record of 30 was broken. 10, 2008, which was 131 cm. The calculated return periods for 2010 are from 50 to 60 years. In 1960 and 1974, large floods also occurred due to the spilling of the Grlje watercourse. No records were registered at the hydrological stations on Lim and the tributaries Bistrica, Ljubovića, Zlorečica in 2010, but the floods destroyed large areas of agricultural land, caused erosive processes and caused great material damage. High waters registered at the hydrological stations in the water area Grlje, "Vusanje" in 2012 with a return period of 10 years and at the hydrological station Plav in 2016 with a return period of 10 years.

The definition of large waters is most often based on a long-term authoritative series of observations and flow measurements, using the method of mathematical statistics and probability theory. However, due to the inadequate network of HS and interruptions on them, especially with the arrival of high water, it is not always possible to use the method of mathematical statistics. Considering the hydrological, ecological, economic and biological importance of the river Lim and its tributaries, as well as the river Grlja, the hydrological measurement of maximum and minimum flows and water levels on the river are not in accordance with the importance of these rivers and their tributaries, since the data are very scarce and during the year continuous measurements are not performed, especially during high water. These results provide an important basis for monitoring the state of large and small waters, which are of great importance for the preparation of studies and projects related to the water regime of Lim, but also of the river Grlja, on which the construction of a mini hydroelectric power plant by the Austrian company "Judenburg" is planned. That is why it is important to continue measuring all parameters, especially due to the inadequate management of watersheds and the increased volume of anthropogenic activities, all with the aim of protecting human and material goods from floods and droughts.

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Original scientific article
Received: 25.11.2023;
Received in revised form: -
Accepted: 21.02.2024;
Available online: 14.10.2024.

UDC: 314(497.11)
doi: 10.5937/zrgfub2472025D

POPULATION DYNAMICS OF THE SETTLEMENTS AND DISTANCE FROM THE CITY CENTER: CASE STUDY OF THE CITY OF SMEDEREVO

Petar Vasić[1]*, Vojislav Đanski**

Abstract: The main idea of this article is to investigate the correlation between the distance of the settlement from the city center on the one hand and the dynamics of the natural growth rate and net migration on the other, which would determine the range of positive demographic influence of the urban settlement on its immediate surroundings. In the analysis, mainly demographic and geographical methods were used, supplemented by the statistical method of simple linear correlation. The results show that the range of positive demographic influence of the urban settlement extends up to a distance of 12 kilometers for the rate of natural growth and 14 kilometers for the rate of net migration. The importance of distance for the rate of natural increase increased over time, while the importance of distance for the rate of net migration decreased. The correlation analysis confirmed a moderately strong inverse (negative) relationship between the distance of the settlement from the city center. The positive demographic influence of the urban settlement extends to the area north of the E-75 highway and the state road of the first B category (Belgrade – Požarevac) No. 33, which roughly coincides with the Danube belt of the Smederevo urban area, with the exception of settlements that are not characterized by transport transitivity and functional integration into the urban/municipal system.

Keywords: Smederevo, distance, population dynamics, settlements, net migration, natural increase.

Introduction

The City of Smederevo is located in central Serbia, on the border with Šumadija, Pomoravlje and the Pannonian Plain. It comprises 28 settlements with a population

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of 97,930 according to the 2022 census. These settlements are characterized by certain mutual differences, which become apparent when analyzing the physical-geographical, economic, functional and socio-economic characteristics. The area of the city can be conditionally divided into three larger geographical units: the Danube belt (the part of the city that extends between the Danube and the Ralja River, i.e. north of the highway), the Pomoravlje belt (the part of the city that extends in the alluvial plains of Velika Morava and Jezava), the Šumadija belt (the part of the city that includes the gently indented surface of the Šumadija area) (Figure 1).

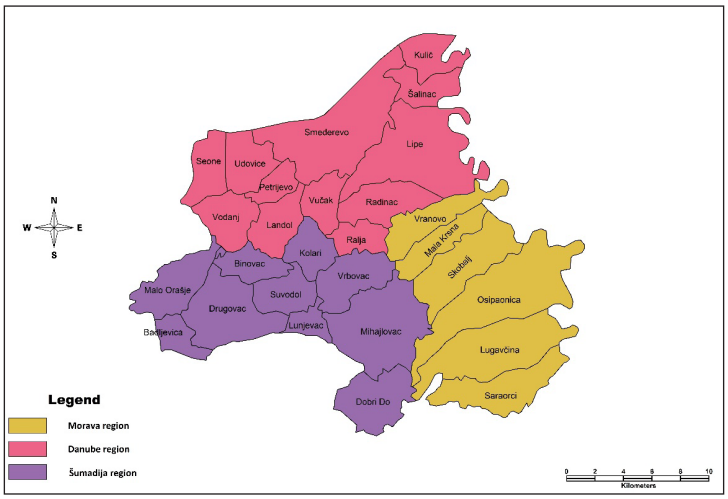


Figure 1. Geographical units of the City of Smederevo

The Danube belt includes the urban settlement of Smederevo, the suburban settlements of Udovice, Petrijevo, Landol, Vučak, Ralja and Radinac (Official Gazette of the Municipality of Smederevo, 2005; Antonić, 2022), all other settlements north of the river Ralja and the highway (Seone, Vodanj and Kolari) and the villages of Lipe, Šalinac and Kulič, which are located near the confluence of the Velika Morava and the Danube. Considering the previous spatial and functional development, the expansion of the built-up area developed in the direction of merging the city and the surrounding (suburban) settlements. In this case, the "border" of the urban fabric with the suburban settlements is represented by the ring road (transit) around the city in the direction of the Belgrade – Smederevo road to the steelworks (Železara), including the settlements that extend along the said road. The Pomoravlje belt consists of several large settlements in the alluvial plains of Velika Morava and Jezava. These settlements are generally compact settlements of the linear type, including Vranovo, Mala Krsna, Skobalj, Osipaonica, Lugavčina and Saraorci. The Šumadija belt consists of rural settlements with a smaller population than the settlements on the Danube and in Pomoravlje, and which are more fragmented and scattered. There

are nine of them (Malo Orašje, Badljevica, Binovac, Drugovac, Suvodol, Lunjevac, Dobri Do, Mihajlovac and Vrbovac). They are located south and southwest of the highway and are mostly situated on hills between 150 and 250 meters above sea level.

Although the geographical characteristics of the urban area of Smederevo did not represent a limitation for the spatial distribution of the population, the basic idea of this work is based on the intention to determine the area of "demographic influence" of the urban settlement on its immediate surroundings. In this sense, the spatial distance and transport connections to the city center are defined as the primary geographical factor for the population dynamics of the settlements in the area of the City of Smederevo.

One of the few domestic papers that directly deals with the relationship between the spatial distance from the urban settlement and population dynamics, the role of transport accessibility on population dynamics and the spatial scope of the positive demographic influence of the urban settlement on its surroundings is the dissertation by Suzana Lović Obradović (2019) entitled "Models of spatial manifestation of demographic processes in Serbia". However, many authors dealt with the population dynamics of settlements as part of local self-government units and emphasised the importance of geographical factors for the spatial distribution of the population (Mihajlović & Novović, 2023; Bratić & Stojiljković, 2015; Stričević, 2015). In addition, some studies pay special attention to the spatial aspect of depopulation and emphasise the peripheral location of settlements and their altitude as very important (Joksimović et al, 2023; Babović, Lović Obradović & Prigunova, 2016). The demographic change of rural areas as the immediate surroundings of urban settlements in the second half of the 20th century in Serbia was a topic that demographers, economists, geographers and sociologists dealt with simultaneously (Radivojević, 1999; Vojković, 2003; Rajković, 2014; Marković, 1986). The demographic impact of cities on the immediate surroundings has also been considered as an important element of population dynamics of settlements through complex systems of daily migration (Nikolić & Mirić, 2018; Lukić, 2011; Stamenković & Gatarić, 2007). In foreign literature, this topic has been discussed in relation to economic development (Salvia et al., 2020), distances and transport accessibility (Stjernberg & Penje, 2019), population concentration poles (Kupiszewski et al., 1998) and the availability and accessibility of services in cities (Linard et al., 2012).

In this case, the topic investigated in this thesis can be considered as an independent scientific contribution, as there are no such studies in the domestic literature that attempt to determine the area of positive demographic impact of the city on the surrounding settlements in its administrative area in this specific way.

Methodology

Various scientific methods were used to test the initial hypothesis that the proximity and good transport links to the urban settlement have a positive effect on the population dynamics of the surrounding settlements. Among the methods used, demographic and geographical methods of scientific analysis dominate. The demographic research method refers to a specific method of studying the population of the observed area, which is used in combination with a mathematical-statistical method whose main task is to identify and quantify the relationship between demographic and geographical variables. To this end, a correlation analysis was carried out to determine the degree of quantitative linear correspondence between different demographic components of population growth as the dependent variable and distance from the city center as the independent variable. By combining these methods, the demographic statistical data was analyzed and processed. To analyze the population dynamics of the settlement, vital statistics data from the documentation tables of the Institute of Statistics of the Republic of Serbia (number of births and deaths at the settlement level) and census statistics data (number, distribution and migration characteristics of the population) were used. In addition, the vital statistics method was also used to calculate net migration at settlement level in the period 1991-2022.

Broadly speaking, the time frame of the study includes the second half of the 20th century and the first two decades of the 21st century, i.e. the period from 1948 to 2022. However, different time frames were used at the different levels of analysis, both in terms of the indicators studied and in terms of spatial coverage. The analysis of the population dynamics of the City of Smederevo as a whole covered the largest period (1948-2022), but the analysis of the components of the city's population growth (natural growth and migration) covered the period from 1961 to 2022, for reasons explained in detail below. The long-term analysis was important for understanding the general demographic context in which the population dynamics of each settlement took place. In addition, the analysis of the components of population growth at settlement level includes the period of the last four censuses (1991-2022), which is also explained in detail below.

Finally, it is necessary to point out two methodological remarks on the data of the Kulič and Šalinac settlements, as well as the reason why the data of the Smederevo settlement were not analyzed. The comments on the Kulič and Šalinac settlements refer to changes in the territorial-administrative division. The settlement of Kulič, although it has existed just as long as the settlement of Šalinac, appeared as a separate unit in the administrative and statistical sense until 1959 and after 2011. In the meantime, the data for Kulič was reported together with the data for Šalinac. Although the official statistics have retroactively extracted the data on the

population of Kulič from the aggregated data for Šalinac, the data on life events from the documentation tables before 2011 cannot be tracked separately. For this reason, the population change indicators for Kulič and Šalinac were calculated together for the period before 2011, but expressed separately in the form of identical values. Finally, the settlement of Smederevo itself was not analyzed, as it is essentially not included in the basic idea of this work, namely the influence of distance from the urban settlement on the population dynamics of the settlement. In this sense, the territorial framework of the study represents the local self-government unit of the town of Smederevo and refers to all settlements other than the City.

Subject and aim of the research

The period under study is characterized by depopulation in most of the settlements observed, although it is assumed that the intensity of depopulation is greater in settlements at a greater distance from the urban settlement, regardless of the direction of change in the number of inhabitants. The main idea of this work is to demonstrate the relationship between the transportation distance (connectivity) and the geographical periphery on the one hand and the intensity of depopulation and the relationship between vital and migratory components of population dynamics on the other. In this sense, natural increase and net migration at the settlement level will be the subject of the study. In the period from the beginning of the 1960s, the urban settlement and other settlements of the peri-urban belt dominantly increased the number of inhabitants due to the migration component, while at the same time the other settlements in the direction of Pomoravlje and the Šumadija belt compensated for the outflow of population through natural growth. At the beginning of the primary analysis period (1991-2022), however, there was a significant decline in economic activity in the area of the city and a generally turbulent social situation in the country. These socio-economic disadvantages can be roughly dated to the period between 1991 and 2002, after which economic activity in the city began to increase again. It is assumed that the settlements that experienced a significant influx of migrants until the 1990s reached a similar socio-economic "level" to other settlements during the said period, bringing them into line in terms of population dynamics. Of course, this claim does not apply to urban settlements. Since 2003, with the resumption of economic activity, the previous differences in the attractiveness of the settlements have reappeared.

Based on this basic assumption, the secondary objective of the study is to identify settlement groups with a dominant influence of migration on population dynamics and to determine the critical distance from the city center (or the center of economic activity) that separates the two mentioned settlement groups.

Demographic context of the population dynamics of the settlements

The course for the urban sprawl of Smederevo was set at the beginning of the 20th century with the founding of the Smederevo Winegrowers' Cooperative (forerunner of the later Godomin Agricultural Combine) in 1909 and the founding of the Serbian Mining and Metallurgical Industry Company (SARTID) in 1913. However, full-scale industrial development did not take place until after the Second World War, particularly with the opening of the Smederevo Metallurgical Combine (Nova železara) in Radinac in 1963. With this in mind, we will follow the population dynamics of the city and observe the acceleration of absolute population growth after the 1961 census (Table 1).

Table 1. Population dynamics of the City of Smederevo in period 1948-2022.

Category	1948	1953	1961	1971	1981	1991	2002	2011	2022
Number of inhabitants	59545	66132	77682	90652	107366	115617	109809	108209	97930
Annual increase rate in ‰	/	20,96	20,08	15,41	16,88	7,40	-4,68	-1,63	-9,07
Absolute annual increase	/	1317	1444	1297	1672	825	-528	-178	-934

Source: Comparative overview of the number of inhabitants 1948-2011, Age and gender in 2022 and author's calculation;

Although the number of inhabitants increased mainly naturally throughout the entire period (up to 1998), the period between 1961 and 1981 is characterised in particular by the extent of immigration. During this period, the population of the city increased by almost 30,000 inhabitants (53.3% due to immigration), and the population of the urban settlement itself more than doubled. In other words, the urban settlement absorbed up to 95% of the population's migratory influx. However, the crisis of the 1990s also coincided with the beginning of open biological depopulation, which is still ongoing. Looking at the period of the last six decades, the city of Smederevo grew almost twice as fast due to the natural component than due to migration. The net migration for the period 1961-2022 amounted to 7095 (35%), while the natural increase amounted to 13153 inhabitants (65%) (Table 2).

Table 2. Natural and migratory component of the population dynamics of the City 1961-2022.

Category	1961/71.	1971/81.	1981/91.	1991/02.	2002/11.	2011/22.	1961-2022
Natural increase	5935	7933	6418	1054	-3226	-4961	13153
Migration balance	7033	8783	1833	-6862	1626	-5318	7095
Average natural increase rate	9,44	8,01	5,76	0,85	-3,12	-4,38	2,44
Average migration balance rate	8,36	8,87	1,64	-5,53	1,57	-4,69	1,31

Source: Comparative overview of the number of inhabitants 1948-2011, Age and gender in 2022, Natural movement of the population 1961-2010, documentation tables and author's calculations;

It is interesting to note that the negative migration balance probably began ten years before the negative natural increase. This assertion is supported by the fact that almost 5% of the population was already working and living abroad in 1991 (5,523 inhabitants), while in the same year the national average was 3.5%. At the same time, natural growth in the City of Smederevo was between 20 % and 100 % higher than in the rest of the country during the observed period (excluding data for Kosovo and Metohija).

The period of the last six decades can be divided into two parts. The period up to 1991, in which the population increased naturally by more than 20,000 and by more than 17,000 due to immigration, and the period after 1991, in which the population decreased by just over 7,000 due to biological depopulation and by more than 10,000 due to immigration. Over the entire period (1961-2022), the average rate of natural increase was 2.44‰, while the average rate of net migration was about twice as low (1.31‰). However, the indirect influence of the immigrant population on fertility levels cannot be overlooked given the large number of immigrants from Kosovo and Metohia. In the last 60 years, almost 35,000 inhabitants have moved to the territory of the city of Smederevo, which, taking into account the positive balance of natural population growth of over 13,000 people, means that about 28,000 people, i.e. almost every third inhabitant, have moved away from the territory of the city in the mentioned period, with an average annual emigration rate of 4.8‰. This makes it necessary to analyse in more detail the period after 2000, which was characterised by a strong outflow of population and negative natural growth. The period after 2000 was characterised not only by extremely negative natural growth and a negative overall migration balance, but also by internal migration, as a result of which the city has lost over 3,000 inhabitants in the last 10 years alone (Table 3). On the other hand, more than 8,000 inhabitants moved into the urban area during this period, which, taking into account the negative migration balance after 2000, means the out-migration of almost 12,000 people.

In the period observed (2000-2022), two turning points can be identified in relation to the movement of natural growth and net internal migration. The first turning point in terms of the evolution of natural growth was in 2005, when negative natural growth fell from -1.66 in 2004 to -3.51 per thousand in 2005. This was due to a methodological change in the registration of live births, as live births to mothers working and living abroad for more than one year were excluded from the records of vital events. Given the high proportion of foreign population in the total population of the City of Smederevo, there was an unnatural decrease in the number of live births by almost 12% during the transition from 2004 to 2005. However, from the gradual decline in the number of live births since 1991, it can be indirectly concluded that the expected decline should have been around 2%, while the remaining 10% is due to the exclusion of the registration of life events of the population abroad.

Table 3. Natural increase and internal migration balance of the City of Smederevo

Year	Estimated population	Natural increase	Internal migration balance	Rate of natural increase	Internal migration rate
2000	110805	-205	-149	-1,85	-1,34
2001	110285	-144	-269	-1,31	-2,44
2002	109767	-145	-117	-1,32	-1,07
2003	109599	-113	67	-1,03	0,61
2004	109431	-182	322	-1,66	2,94
2005	109263	-383	187	-3,51	1,71
2006	109095	-363	76	-3,33	0,70
2007	108927	-425	-33	-3,90	-0,30
2008	108759	-537	-11	-4,94	-0,10
2009	108591	-439	72	-4,04	0,66
2010	108423	-419	-30	-3,86	-0,28
2011	108251	-535	47	-4,94	0,43
2012	107334	-364	-308	-3,39	-2,87
2013	106417	-304	-232	-2,86	-2,18
2014	105500	-374	-246	-3,55	-2,33
2015	104583	-540	-231	-5,16	-2,21
2016	103666	-588	-215	-5,67	-2,07
2017	102749	-573	-332	-5,58	-3,23
2018	101832	-597	-368	-5,86	-3,61
2019	100915	-477	-343	-4,73	-3,40
2020	99998	-762	-330	-7,62	-3,30
2021	99081	-1067	-195	-10,77	-1,97
2022	98164	-654	-302[2]	-6,66	-3,08
Sum/average	106149	-10190	-2940	-4,24	-1,26

Source: Comparative overview of the number of inhabitants 1948-2011, Age and gender in 2022, Natural population movement 1961-2010, Demographic statistics, documentation tables and author's calculations;

The second turning point relates to the balance of internal migration and can be linked to the year 2012. In the transition from 2011 to 2012, the rate of net internal migration fell from 0.4 to -2.9 per thousand. The expected internal migration balance should have been zero in that year, but amounted to -308 people. One of the main explanations or causes for this negative trend in internal migration is the almost complete cessation of operations of the steel mill in 2011 and the complete cessation of business activities by US Steel at the end of January 2012. The trend reversal in internal migration that began at that time has remained negative to this day, even after the arrival of the new owner, Hesteel Chinese Corporation, in 2016 and the start of production at full capacity, at a rate of around 300 fewer inhabitants per year.

[2] Estimated balance of internal migration

Ultimately, the last interim census period was unfortunately characterised by the highest overall negative value of the annual growth rate of over -9‰.

Analysis

Natural growth is declining in all settlements in the City of Smederevo, and until the last interim census period there was not a single settlement with positive natural growth. However, not only are there significant differences between settlements in terms of the year in which the negative natural increase began, but also the intensity of biological depopulation varies greatly, which is confirmed by the rates of natural increase (Table 4).

Table 4. Average annual rate of natural increase 1991-2022.

Settlement	1991-2002	2002-2011	2011-2022	1991-2022
Badljevica	-3,7	-12,2	-14,3	-9,4
Binovac	-12,1	-13,3	-11,8	-10,5
Vodanj	-2,2	-10,7	-11,7	-7,6
Vranovo	1,5	-1,0	-4,7	-1,3
Vrbovac	-5,3	-6,9	-10,6	-7,3
Vučak	3,1	-1,6	-2,5	-0,5
Dobri Do	-1,3	-9,8	-13,7	-7,3
Drugovac	-7,9	-10,3	-9,3	-8,8
Kolari	2,4	-7,4	-8,0	-4,0
Kulič	-6,1	-14,3	-16,4	-11,4
Landol	-6,2	-7,4	-6,3	-6,5
Lipe	-3,3	-5,8	-7,6	-5,1
Lugavčina	-0,7	-8,4	-10,5	-5,6
Lunjevac	-6,1	-9,9	-12,8	-9,9
Mala Krsna	4,0	-3,1	-4,5	-0,9
Malo Orašje	-4,7	-11,0	-12,0	-8,7
Mihajlovac	-4,5	-7,6	-11,3	-7,2
Osipaonica	1,0	-7,5	-11,1	-4,6
Petrijevo	-1,6	-3,4	-3,9	-3,0
Radinac	4,6	0,5	-2,5	0,9
Ralja	0,9	1,1	-1,5	0,2
Saraorci	-2,1	-6,8	-8,4	-5,3
Seone	-1,6	-7,1	-5,9	-4,9
Skobalj	0,8	-7,1	-12,3	-5,2
Suvodol	-7,4	-7,7	-10,4	-8,3
Udovice	2,5	-5,3	-6,7	-2,9
Šalinac	-6,1	-14,3	-16,4	-11,4
Total/average	**-1,0**	**-5,8**	**-7,8**	**-4,6**

Source: Author's calculation

No less than 13 settlements of the City of Smederevo entered the observed period with advanced biological depopulation, making up 16% of the total population of the city. In the first five-year period (1991-1995), five more settlements were added, now making up 24% of the city's total population. By the end of the 20th century, 22 settlements in the City of Smederevo had negative natural growth, and the total population of the City showed negative growth values for the first time in 1998. At that time, almost 4/5 of the settlements and almost 1/3 of the population recorded negative natural growth. In the period from 2001 to 2005, Vranovo, Vučak, Mala Krsna and the town itself joined this group, bringing 95% of the population into biological depopulation. The remaining two settlements, Radinac and Ralja, have been facing negative natural growth since 2007 and 2012, and together with 26 other settlements, they have lost 8,644 people biologically by the 2022 census (Table 5).

Table 5. Year when biological depopulation started[3]

Period	Number of settlements	Distance	Name of settlement
1990. and before	13	14,2km	Badljevica, Binovac, Vodanj, Vrbovac, Dobri Do, Drugovac, Kulič, Landol, Lipe, Lunjevac, Mihajlovac, Suvodol, Šalinac
1991-1995.	5	15,8km	Lugavčina, Malo Orašje, Petrijevo, Saraorci, Seone
1996-2000.	4	12,3km	Kolari, Osipaonica, Skobalj, Udovice
2001-2005.	4	8,3km	Vranovo, Vučak, Mala Krsna
2006. and after	2	8,0km	Radinac, Ralja

Source: Author's calculation

Although the entire urban area shows more favorable values for the natural growth rate on average than the national average, the differences between the individual settlements are considerable. In the first interim survey period (1991-2002), nine settlements had an average annual natural growth rate with positive values, two in 2002-2011 and none in 2011-2022. However, looking at the overall period 1991-2022, only two settlements (Radinac and Ralja) recorded positive average annual rates of natural growth, with only 0.9‰ and 0.2‰ respectively. Since the differences in the observed indicators between the settlements are large, they are presented on the basis of four categories.

The main result of the analysis shows that the values of natural increase are decreasing over time, with the decrease being much more intense in settlements

[3] The table does not show the year in which negative natural growth was recorded for the first time, thus empirical values were smoothed (with a linear or parabolic function) in order to avoid random oscillations due to the low frequency of the observed phenomenon.

further away from the city center (Table 6). Although fertility rates have not decreased significantly in the last 10 years, the increase in mortality due to the two and a half years of the Covid-19 crisis and the aging of the population have had a negative impact on the values of the natural increase rate. In addition, Smederevo belongs to a group of cities where life expectancy for both sexes has also decreased in the last decade, which additionally affects the deepening of the difference between the number of births and the number of deaths on an annual basis.

Table 6. Categories of settlements according to the rate of natural increase and average distance from the city center

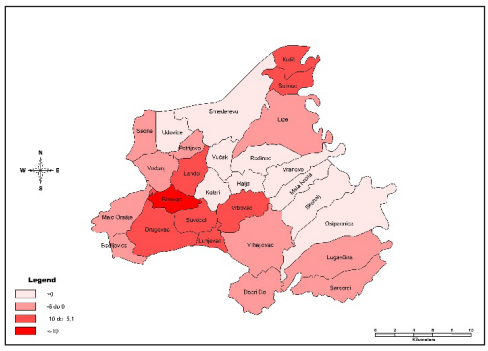
Period	> 0	-5 to 0	-10 to -5,1	< -10
1991-2002.	Vranovo, Vučak, Kolari, Mala Krsna, Osipaonica, Radinac, Ralja, Skobalj, Udovice (**10,0km**)	Badljevica, Vodanj, Dobri Do, Lipe, Lugavčina, Malo Orašje, Mihajlovac, Petrijevo, Saraorci, Seone (**16,0km**)	Vrbovac, Drugovac, Kulič, Landol, Lunjevac, Suvodol, Šalinac (**13,0km**)	Binovac (**13,0km**)
2002-2011.	Radinac, Ralja (**8,0km**)	Vranovo, Vučak, Mala Krsna, Petrijevo (**8,0km**)	Vrbovac, Dobri Do, Kolari, Landol, Lipe, Lugavčina, Lunjevac, Mihajlovac, Osipaonica, Saraorci, Seone, Skobalj, Suvodol, Udovice (**14,6**)	Badljevica, Binovac, Vodanj, Drugovac, Kulič, Malo Orašje, Šalinac (**14,6km**)
2011-2022.		Vranovo, Vučak, Mala Krsna, Petrijevo, Radinac, Ralja (**8,0km**)	Drugovac, Kolari, Landol, Lipe, Saraorci, Seone, Udovice (**12,3km**)	Badljevica, Binovac, Vodanj, Vrbovac, Dobri Do, Kulič, Lugavčina, Lunjevac, Malo Orašje, Mihajlovac, Osipaonica, Skobalj, Suvodol, Šalinac (**15,7**)
Average (1991-2022)	**8,0km**	**9,9km**	**16,1km**	**11,7km** (Binovac, Kulič, Šalinac)

Source: Author's calculation

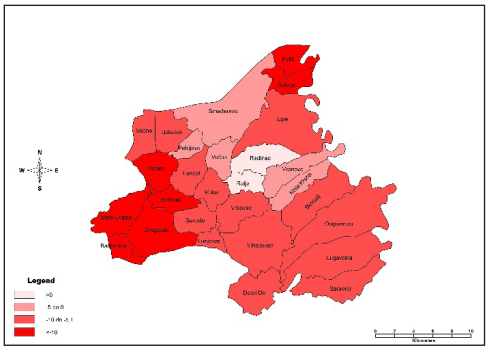
Figure 2, which shows the values of the natural growth rate, clearly shows the spatial regularity in the way its value decreases. In this sense, it seems that the

highway E-75 and the state road of the first B category No. 33 (E-75 – Požarevac) represent the limit for the value and dynamics of natural growth. North of this junction (with the exception of Šalinac and Kulič) there are settlements closer to the city center and with higher values of natural growth, while south of it there are settlements at a greater distance and in the lowest categories of natural growth. North of the mentioned junction there are 14 rural settlements with over 22,000 inhabitants (57.8% of the total rural population of Smederevo) and about half of the urban area. In the period 1991-2002, 7/10 settlements with an above-average natural growth rate were located in the northern part of the urban area. In the period 2002-2011, all 8/8 settlements with above-average natural growth and in the period from 2011 to 2022, 10/10 such settlements were located in the northern part of the urban area of Smederevo. The settlements of the mentioned northern part are in fact settlements belonging to the Danube part of the territory of the city of Smederevo.

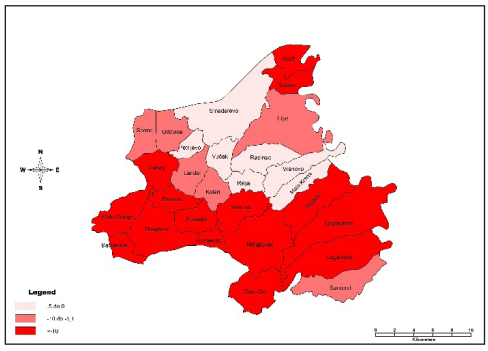
As with the analysis of the settlements according to the variability of the natural growth rate, the trends in net migration show a clear mutual differentiation. Taking into account the average annual rates of net migration, it is possible to identify categories (groups) of settlements in terms of the increase/ decrease in the number of inhabitants due to migration and the level of the rate of net migration. The period after 1991 is of particular importance, as during the crisis of the 1990s the city recorded negative



1991-2002



2002-2011



2011-2022

Figure 2. Natural increase rate

net migration for the first time since the Second World War. Moreover, as mentioned above, negative migration trends are "reactivated" after 2012, which means that the total net migration in the period 1991-2022 is -2.6‰, i.e. roughly in line with the values at the national level, which was by no means the case for the City of Smederevo in the second half of the 20th century (Table 7).

Since the average values of the annual net migration at the city level differ considerably in all periods between the censuses (-5.4‰, 1.6‰ and -3.6‰), the ranges of net migration by settlement also differ greatly. However, these differences cannot hide the fact that in the first census period, six settlements had an average net migration rate of more than 10‰, whereas in the second and third census periods, only three settlements each had an average net migration rate of more than 10‰, which obviously speaks for the considerable negative influence of socio-economic conditions on migration movements in the crisis years of the 1990s.

Table 7. Average annual rate of migration balance 1991-2022

Settlements	1991-2002	2002-2011	2011-2022	1991-2022
Badljevica	-2,7	-4,6	-1,3	**-2,9**
Binovac	-31,0	9,4	-4,6	**-10,3**
Vodanj	-5,2	1,7	2,1	**-0,8**
Vranovo	-8,2	1,3	-3,6	**-3,7**
Vrbovac	-3,4	-1,8	-5,4	**-3,5**
Vučak	14,5	15,5	-4,5	**8,1**
Dobri Do	-10,6	-5,0	-2,7	**-6,4**
Drugovac	-2,2	-10,4	-7,5	**-6,1**
Kolari	0,8	-2,5	1,5	**0,0**
Kulič	-8,7	-8,8	9,2	**-3,5**
Landol	16,4	14,3	11,7	**13,8**
Lipe	-9,9	-2,8	-3,4	**-5,5**
Lugavčina	-19,1	-1,6	-7,8	**-10,0**
Lunjevac	-7,4	2,0	-12,0	**-5,8**
Mala Krsna	-7,9	-9,7	4,4	**-4,2**
Malo Orašje	-5,2	-3,3	-5,8	**-4,7**
Mihajlovac	-8,5	-8,4	-3,9	**-6,8**
Osipaonica	-27,0	-6,6	-8,3	**-14,4**
Petrijevo	2,2	33,0	-1,8	**10,0**
Radinac	-6,0	9,9	-10,3	**-2,6**
Ralja	10,3	-26,2	-5,9	**-6,3**
Saraorci	-7,7	-7,4	-10,9	**-8,4**
Seone	11,5	2,8	-1,5	**4,5**
Skobalj	-14,7	-9,0	-0,8	**-8,4**
Suvodol	1,1	-0,1	-1,7	**-0,1**
Udovice	0,2	-4,5	3,0	**-0,3**
Šalinac	-8,7	-8,8	9,2	**-3,5**
City of Smederevo	**-5,4**	**1,6**	**-3,6**	**-2,6**

Positive rate of migration balance
Source: Author's calculation

Four categories were formed to facilitate the analysis of net migration. The first category consists of settlements with an average annual net migration of over 5‰. There are only a few of these settlements, but three suburban settlements (Vučak, Landol and Petrijevo) are particularly noteworthy, with an average annual rate of over 8‰ since the 1991 census. The second category consists of settlements with a positive migration balance, but with values below 5‰. These settlements are also rare, and only two settlements end the entire period in this category (Kolari and Seone). The third and fourth categories include all remaining settlements (22), of which nine settlements have a negative average rate of up to -5‰ and as many as thirteen settlements fall into the above -5‰ category (Table 8). However, the last category is not only the most numerous, but also has a value of over -14‰ and includes almost half of the total population of rural settlements (47.1 %).

Table 8. Categories of settlements according to the rate of migration balance

Period	**> 5**	**0 to 5**	**-5 to < 0**	**< -5**
1991-2002.	Vučak, Landol, Ralja, Seone (**8,5km**)	Kolari, Petrijevo, Suvodol, Udovice (**9,3km**)	Badljevica, Vrbovac, Drugovac (**18,0km**)	Binovac, Vodanj, Vranovo, Dobri Do, Kulič, Lipe, Lugavčina, Lunjevac, Mala Krsna, Malo Orašje, Mihajlovac, Osipaonica, Radinac, Saraorci, Skobalj, Šalinac (**14,3km**)
2002-2011.	Binovac, Vučak, Landol, Petrijevo, Radinac (**7,8km**)	Vodanj, Vranovo, Lunjevac, Seone, Šalinac (**11,4km**)	Badljevica, Vrbovac, Dobri Do, Kolari, Lipe, Lugavčina, Malo Orašje, Suvodol, Udovice (**15,1km**)	Drugovac, Kulič, Mala Krsna, Mihajlovac, Osipaonica, Ralja, Saraorci, Skobalj (**15,3km**)
2011-2022.	Kulič, Landol, Šalinac (**10,0km**)	Vodanj, Kolari, Mala Krsna, Udovice (**9,3km**)	Badljevica, Binovac, Vranovo, Vučak, Dobri Do, Lipe, Mihajlovac, Petrijevo, Seone, Skobalj, Suvodol (**13,1km**)	Vrbovac, Drugovac, Lugavčina, Lunjevac, Malo Orašje, Osipaonica, Radinac, Ralja, Saraorci (**15,9km**)
Prosek (1991-2022)	Vučak, Landol, Petrijevo (**6,7km**)	Kolari, Seone (**10,5km**)	Badljevica, Vodanj, Vranovo, Vrbovac, Mala Krsna, Malo Orašje, Radinac, Suvodol, Udovice (**12,0km**)	Binovac, Dobri Do, Drugovac, Kulič, Lipe, Lugavčina, Lunjevac, Mihajlovac, Osipaonica, Ralja, Saraorci, Skobalj, Šalinac (**15,8km**)

Source: Author's calculation

In any case, most settlements are characterized by an unfavorable migration flow, and the settlements in the immediate vicinity of the city center have the most positive values of net migration. In contrast, the most negative values of net migration are recorded in the most distant settlements and in the settlements outside the main transport axes.

The aforementioned components of population change influenced the dynamics of population growth in such a way that the settlements (according to population size categories) were increasingly concentrated in the lower categories. The essence of this change can be seen in the fact that the share of population in settlements with more than 3,000 inhabitants decreased by more than 30 percentage points, the share of population in settlements between two and three thousand inhabitants increased from 1/5 to 1/3, in settlements with 1,000 to 2,000 inhabitants increased by 12 percentage points, while in settlements with 500 to 1,000 inhabitants the increase amounted to 2 percentage points, as well as in the smallest settlements (Table 9).

The settlement size depicted in Figure 3 shows the trend in population dynamics over the last 30 years, which can be briefly described by stating that the settlements in the eastern part of the urban area are most responsible for the overall negative trends in the demographic development of the area under consideration. However, a closer look at the map shows that the greatest population decline is to be found in settlements at a greater distance from the city center, as well as in settlements that are not characterized by traffic permeability, regardless of their relative proximity to the city center.

Table 9. Categories of settlements according to population size

Year	> 3000	2000 to 3000	1000 to 2000	500 to 1000	< 500
1991.	Lipe, Lugavčina, Mihajlovac, Osipaonica, Radinac (42,6%)	Vranovo, Drugovac, Saraorci, Skobalj (19,1%)	Vodanj, Vrbovac, Vučak, Dobri Do, Kolari, Mala Krsna, Malo Orašje, Petrijevo, Ralja, Udovice (27,0%)	Binovac, Landol, Lunjevac, Seone, Suvodol, Šalinac (9,7%)	Badljevica, Kulič (1,6%)
2002.	Lipe, Lugavčina, Mihajlovac, Osipaonica, Radinac (40,0%)	Vranovo, Saraorci, Udovice (15,1%)	Vodanj, Vrbovac, Vučak, Dobri Do, Drugovac, Kolari, Landol, Mala Krsna, Malo Orašje, Petrijevo, Ralja, Skobalj, (35,8%)	Lunjevac, Seone, Suvodol, Šalinac (6,6%)	Badljevica, Binovac, Kulič (2,5%)
2011.	Lipe, Lugavčina, Osipaonica, Radinac (34,4%)	Vranovo, Mihajlovac, Saraorci (16,9%)	Vodanj, Vrbovac, Vučak, Drugovac, Kolari, Landol, Lunjevac, Mala Krsna, Petrijevo, Ralja, Skobalj, Udovice(35,4%)	Dobri Do, Malo Orašje, Seone, Suvodol, Šalinac (11,0%)	Badljevica, Binovac, Kulič (2,3%)
2022.	Radinac (12,2%)	Vranovo, Lipe, Lugavčina, Mihajlovac, Osipaonica (33,2%)	Vodanj, Vučak, Drugovac, Kolari, Landol, Mala Krsna, Petrijevo, Ralja, Saraorci, Skobalj, Udovice, (39,4%)	Vrbovac, Dobri Do, Malo Orašje, Šalinac, Seone, Suvodol (11,8%)	Badljevica, Binovac, Kulič, Lunjevac (3,4%)

Source: Author's calculation

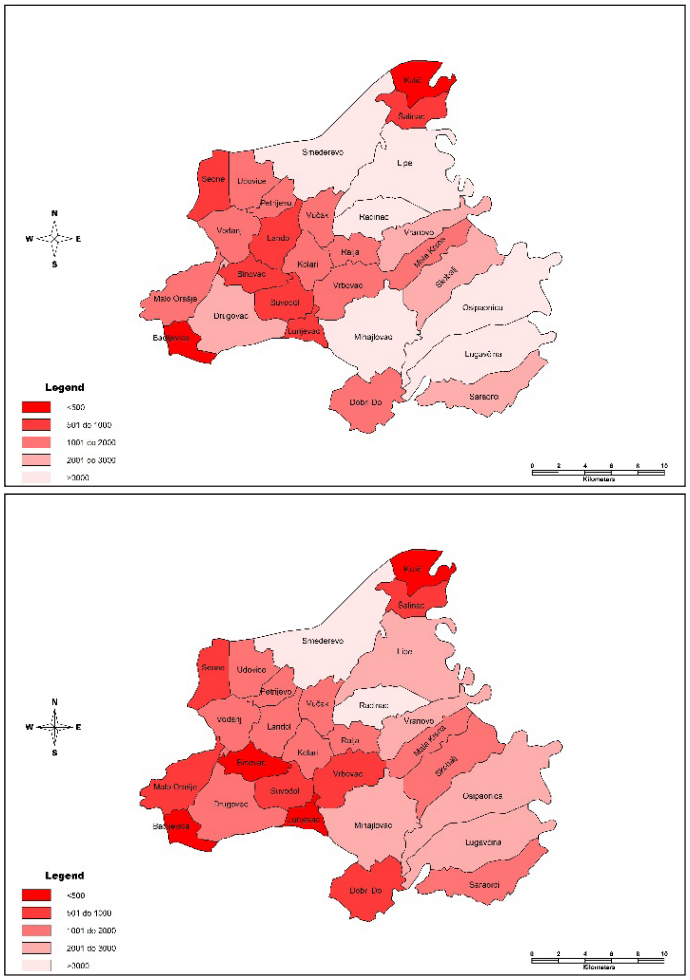


Figure 3. Population size of settlements of the City of Smederevo in 1991 and 2022

Results

As it was stated in the previous text that the initial hypothesis of the work is that the level of the natural increase rate and net migration depends on the geographical location of the settlement, i.e. the distance from the urban settlement, in the following text we will analyze the change of the mentioned rates depending on the distance from the urban settlement of Smederevo. We will divide the settlements of the City of Smederevo, 27 of them without an urban settlement, into four categories according to the distance from the city center.

The largest number of settlements is located in the immediate vicinity of the city center, i.e. there are up to ten settlements at a distance of up to 10 km. The next category of settlements at a distance of more than 10 and less than 15 kilometers consists of eight settlements, the category of distances of more than 15 to less than 20 kilometers consists of five settlements and the last category of settlements at a distance of 20 or more kilometers consists of only four settlements. Although the number of settlements decreases with the distance from the city center, the distribution of the total number of inhabitants of the settlement according to the distance from the city center is much more significant. Although the population of rural settlements has decreased since 1991 from 51,773 to 38,669 in 2022 (a decrease of 25.3%), this decline has not been uniform and has increased with distance from the city center. The first category of settlements decreased by 8.7%, increasing their share of the total population of rural settlements from 40.6% in 1991 to almost half (49.6%) in 2022. The second category of settlements recorded a decline close to the average, so that their share did not change significantly (17.2% and 16.7% respectively). In the third category, the decline in the number of inhabitants was the sharpest (-41.5%), and the share of the population of these settlements fell from over a quarter in 1991 to less than a fifth in 2022. Finally, the group of the most remote settlements also recorded a very sharp decline in the number of inhabitants by -38.6 %, and the share of the total rural population fell from 1/6 in 1991 to 1/7 in 2022 (Table 10).

Table 10. Distance from the city center and share in the total population of rural settlements

Distance	Settlement	1991.	2002.	2011.	2022.	2022/1991.	Cumulative depopulation 1991-2022[4]
Up to 10 km	Vodanj, Vranovo, Vučak, Kolari, Landol, Lipe, Petrijevo, Radinac, Ralja, Udovice	40,6%	44,3%	47,7%	49,6%	-8,7%	7,5
> 10 to 15km	Binovac, Vrbovac, Kulič, Mala Krsna, Seone, Skobalj, Suvodol, Šalinac	17,2%	17,0%	16,2%	16,7%	-27,5%	31,3
> 15 to < 20km	Drugovac, Lunjevac, Malo Orašje, Mihajlovac, Osipaonica	25,3%	23,0%	21,2%	19,8%	-41,5%	66,8
≥ 20km	Badljevica, Dobri Do, Lugavčina, Saraorci	16,9%	15,7%	14,9%	13,9%	-38,6%	100,0

Source: Author's calculation

The population dynamics analyzed are such that if we calculate the cumulant of the change in the number of inhabitants between 1991 and 2022 and express it as 1, we can say that only 1/13 of the decrease in the number of inhabitants occurred at a distance of up to 10 kilometers, almost 1/3 at a distance of up to 15 kilometers

[4] Cumulative population decrease from 1991 to 2022 calculated per 100.

and a 2/3 decrease at a distance of up to 20 kilometers from the city center. The remaining third of the decline in the number of inhabitants took place at a distance of more than 20 kilometers. In this sense, Figure 4 clearly shows the differences in the intensity of depopulation depending on the distance of the settlement from the city center.

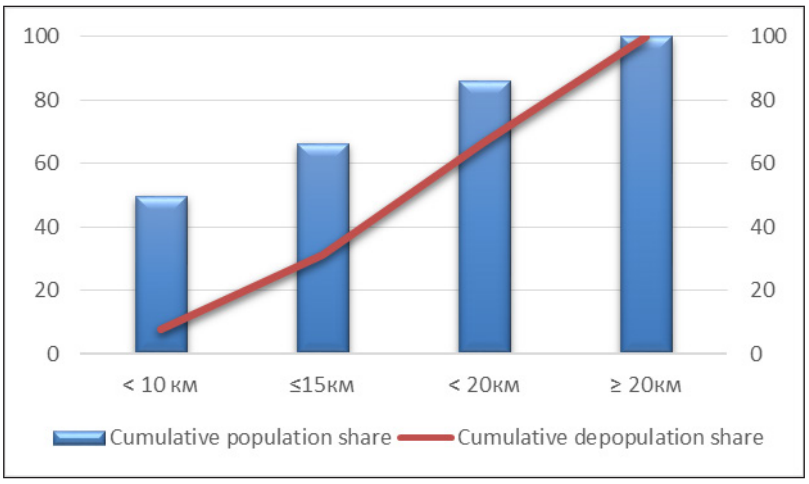


Figure 4. The relation of the share in the population and the share in depopulation

However, since population dynamics depend on the natural and migration components, in the following text we will analyze the change in these components separately depending on the distance to the urban settlement. The downward trend in natural increase is recognizable in all the settlements observed, but not only is the intensity of the change different, but the starting values from which we observe the change are also very different. For example, the range of values for the natural growth rate in 1991 ranged from -12.1‰ in Binovac (13 km away) to 4.6‰ in Radinac (6 km away). The first group of settlements (up to 10 km away) is the only one to record positive values of natural increase, and only during the first interim survey period (1991-2002). Regardless of how we interpret the change in natural growth as a function of distance, the regularity of natural growth, which decreases with increasing distance, is undoubtedly present (Table 11), with the only deviation in the period 1991-2002 being in the group of the most distant settlements, whose natural growth was higher compared to the settlements 10 to 20 km from the city center. Already in the next two intermediate census periods, a regularity increasingly emerges, deepening the difference between closer and more distant settlements. In the period 1991-2002, this difference was 4.0‰, in the period 2002-2011 5.4‰ and in the period 2011-2022 6.1‰. On average, the rate of negative natural growth of the most distant settlements is almost three times higher than that of the closest

settlements over the entire observation period. In addition, the natural growth rate of the group of closest settlements decreased by 5.9‰ during the observation period, the second group by 7.4‰, the third group by 8‰ and the group of furthest settlements by as much as 9.1‰.

The differences in the period in which the negative natural growth occurred can be seen in a slightly different way. Due to a more favorable age structure of the population and somewhat less influenced by differences in the level of fertility rates, the settlements up to 10 km away from the city center managed to maintain positive natural growth for a whole decade longer than the settlements further away.

Table 11. Distance from the city center and average rate of natural increase

Distance	Settlement	1991-2002	2002-2011	2011-2022	2022/1991	Year
Up to 10 km	Vodanj, Vranovo, Vučak, Kolari, Landol, Lipe, Petrijevo, Radinac, Ralja, Udovice	0,9	-3,1	-5,0	-2,3	1997
> 10 to 15km	Binovac, Vrbovac, Kulič, Mala Krsna, Seone, Skobalj, Suvodol, Šalinac	-2,2	-7,5	-9,6	-6,1	1989
> 15 to < 20km	Drugovac, Lunjevac, Malo Orašje, Mihajlovac, Osipaonica	-3,1	-8,5	-11,1	-7,0	1988
≥ 20km	Badljevica, Dobri Do, Lugavčina, Saraorci	-1,4	-8,3	-10,5	-6,2	1988

Source: Author's calculation

If we graph the data on the dynamics of the natural growth rate as a function of the distance of the settlement from the city center, where the distance can be considered as an independent variable and the natural growth rate as a dependent variable, the regularities in the movement of natural growth become clearer (Figure 5). Namely, the graph shows three time periods (periods) and the fourth, which represents the average annual rates of natural growth for the entire observation period (1991-2022). Using the least squares method, the empirical data was smoothed on the basis of a linear function for the dependent variable, while the independent variable was smoothed on the basis of a parabolic function (quadratic parabola). The point at which the two functions intersect represents the "critical distance" above which the values of the natural growth rate are below the average and, conversely, below which they are higher than the average. The aforementioned "critical distance" is around 12 kilometers from the city center.

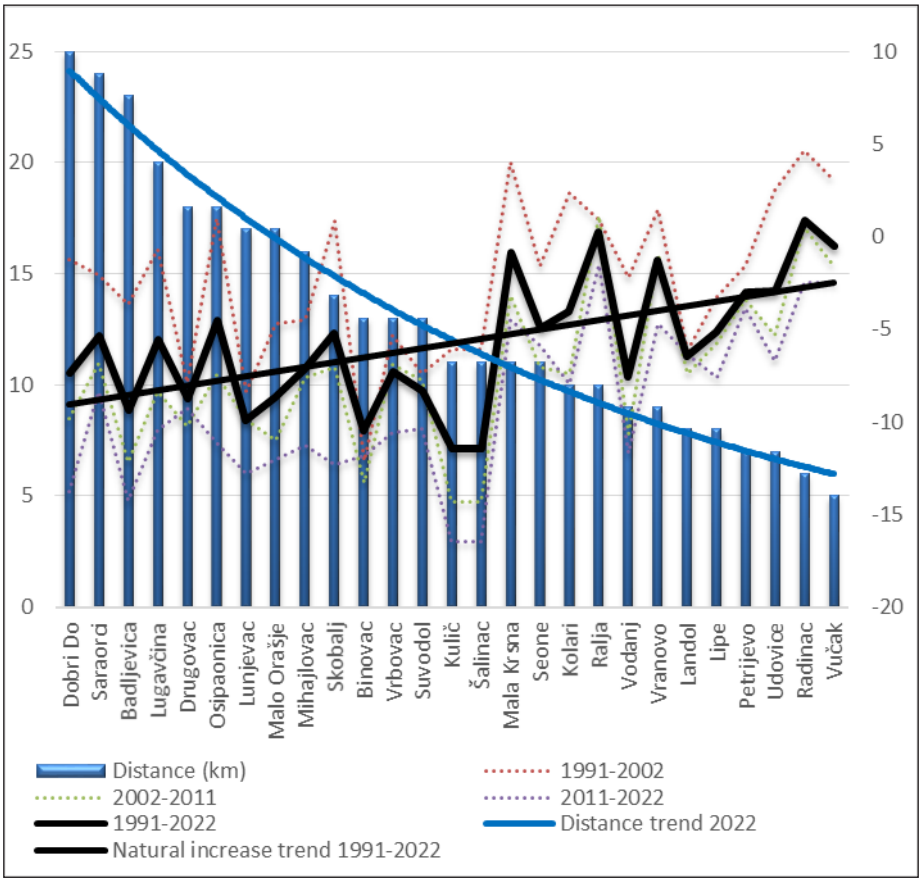


Figure 5. Distance from the urban settlement and rate of natural increase 1991-2022

The coefficient of determination and the correlation coefficient were calculated for a more detailed analysis and to check the linear matching between the two variables. The coefficient of determination indicates what proportion of the empirical data (rate of natural increase) can be directly explained by the change in the independent variable, i.e. the greater the dispersion of the empirical data, the lower the coefficient of determination and vice versa. In this case, the coefficient of determination is 0.365. In other words, 36.5 % of all empirical values of the natural growth rate can be directly explained by the distance of the settlement from the city center. On the other hand, the correlation coefficient indicates the degree of linear quantitative agreement between two variables and can take values from -1 to 1, where the value -1 stands for an ideal inverse (negative) relationship and the value 1 for an ideal direct (positive) relationship. In our case, the correlation coefficient has a value of -0.604, which can be considered a moderate to strong inverse correlation

(Evans, 1996; Hinkle, Wiersma, & Jurs, 2003). Therefore, one can speak of a high degree of agreement between the two observed variables, with a negative correlation between the distance of the settlement from the city center and the value of the natural growth rate. The quantitative analysis of the dynamics of the natural growth rate in relation to the distance of the settlement from the city center acquires its full meaning through the cartographic representation. Figure 6, which shows the value of the natural growth rate by settlement, clearly shows the spatial distribution of the observed phenomenon.

When analyzing the change in net migration as a function of the distance of the settlement from the city center, similar trends are observed, as expected. The value of negative net migration increases with the distance from the city center. In this sense, only 5.2 % of the out-migration of the population took place at a distance of up to 10 km from the city center, 20.6 % at a distance of up to 15 km and 70 % at a distance of up to 20 km. The remaining 30 % took place in settlements that were 20 or more kilometers from the city center (Table 12).

Table 12. Distance from the city center and average rate of migration balance

Distance	Settlement	1991-2002	2002-2011	2011-2022	2022/1991
Up to 10 km	Vodanj, Vranovo, Vučak, Lipe, Kolari, Landol, Petrijevo, Radinac, Ralja, Udovice	-1,8	4,1	-3,3	-0,5
> 10 to 15km	Binovac, Vrbovac, Kulič, Mala Krsna, Skobalj,Seone, Suvodol, Šalinac	-7,5	-4,6	0,5	-4,1
> 15 to < 20km	Drugovac, Lunjevac, Malo Orašje, Mihajlovac, Osipaonica	-14,4	-6,6	-6,8	-10,0
≥ 20km	Badljevica, Dobri Do, Lugavčina, Saraorci	-13,3	-4,2	-7,6	-8,9

Source: Author's calculation

A graphical representation of the data of net migration as a function of the distance of the settlement from the city center (in the same way as for the natural growth rate) reveals regularities in the development (Figure 6). In this case, the "critical distance", above which the values of net migration are below the average and vice versa, below which they are above the average, is around 14 km from the city center. The coefficient of determination in this case is 0.369, i.e. 36.9 % of all empirical values of the net migration rate can be directly explained by the distance of the settlement from the city center. In addition, the correlation coefficient has a value of -0.608, i.e. it stands for a moderate to strong inverse correlation. We can therefore speak of a high degree of agreement between the two observed variables, with a negative correlation between the distance of the settlement from the city center and the level of net migration.

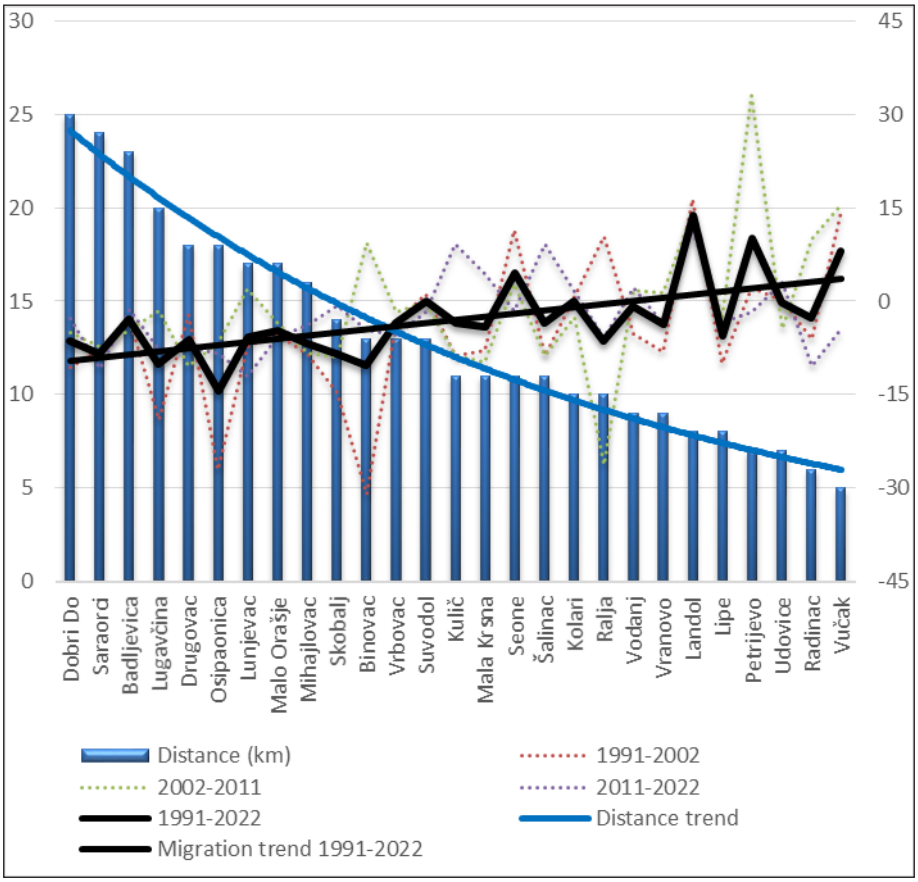


Figure 6. Distance from the urban settlement and rate of migration balance 1991-2022

Discussion

The territorial grouping of economic activities, capital and people is a logical expression of greater economic effects and higher economic growth rates achieved in this way, so that economic growth ultimately implies demographic polarization, as is also the case in Serbia (Vojković, Živanović & Magdalenić, 2018). Such spatial-demographic disparities can also be seen in the example of the lower territorial levels. The example of the City of Smederevo confirms the nature of the relationship between the components of demographic growth and the distance from the municipality/city center. In the conditions of economic and demographic boom after the Second World War, the factor of distance from the city center did not have a negative impact on the increase in the number of inhabitants, and the distance of the settlement from

the city center gained importance only with the construction of modern transport infrastructure, which created more favorable conditions for the gradual migration of the population of remote peripheral settlements (Lović Obradović, 2019). The population dynamics of the settlements of the town of Smederevo can be interpreted in the same way, with transport links to the urban settlement becoming increasingly important over time. Thus, according to Lović Obradović (2019), the average distance of settlements from the city center in the group of developed municipalities and towns where the number of inhabitants decreased in the interim census period 2011/2002 was 16 km, and the average distance of settlements where the number of inhabitants remained the same in the same period increased and amounted to 14.3 km. The result we reached in the previous analysis, notwithstanding the fact that the majority of settlements (24/27) experienced a decrease in population, similarly separates the area of positive influence of the city center at a distance of 12 km when it comes to natural growth and 14 km when it comes to migration.

In a more detailed analysis of the relationship between geographical factors and demographic trends, it was shown that the different geographical factors change the population dynamics, but since the area of the City of Smederevo is characterized by a fairly geographical uniformity, the distance and transport connections are imposed as dominant geographical factors of differentiation of population dynamics between settlements. Settlements in relative proximity to the city center (and the center of economic activity) and settlements with a favorable transport and geographical location to the city center show a more favorable development of natural increase and net migration. On the other hand, the settlements of Binovac, Kulič and Šalinac are characterized by a high degree of negative demographic trends despite their short distance from the city center and good transport connections. In a way, the settlements mentioned can be considered peripheral, as they are not characterized by traffic permeability or functional integration into the urban/municipal system. In colloquial language, such settlements are referred to as “dead ends”.

Although various studies have found regularities in the strength of the polarizing effect of urban settlements on the development of the environment (Tošić & Krunić, 2007; Živanović, 2016), there is still a lack of research on the consequences of the polarizing effect of the city on the components of the demographic dynamics of the surrounding settlements. The results we have obtained using the example of the settlements of the City of Smederevo clearly confirm the positive effect of proximity to the city center on the demographic development of the surrounding settlements. Although it is known that the spatial range of the gravitational effect of the city on the surrounding area is proportional to the strength of its influence, this fact must be “supplemented” by the importance of transport transitivity for the demographic development of the settlement, and not only by the simple distance

from the city center. The exceptions in the observed example are settlements with certain characteristics of the periphery, although they are located within the identified distance zone below 12 km, i.e. below 14 km when it comes to the values of natural growth rate and net migration.

Although the urban settlement of Smederevo plays the role of the center of urban agglomeration, the pole of concentration of population and economic activities, under whose direct and indirect influences the demographic, functional, socio-economic and physiognomic transformation of the surrounding settlements takes place (Tošić and Obradović, 2003), the aforementioned influences do not show linear spatial patterns when it comes to the demographic development of the settlements. The pursuit of uniform demographic development of the settlement raises the question of at what point of its growth the city center begins to violate the threshold of demographic sustainability of the settlement system within its functional area, i.e. how far does the reach of its influence extend (Vojković, Živanović & Magdalenić, 2018). To what extent does it contribute to the demographic vitality of its administrative area? Although the scope of analysis in this article is limited only to the area of the city of Smederevo, it is certain that the positive influences of the urban settlement of Smederevo extend beyond its administrative area, just as they do not reach all parts of the City area. The strength of the "positive demographic influence" of the urban settlement of Smederevo is significantly lower than the entire urban area, it decreases over time and is strongly dependent on the transport accessibility and permeability of the observed settlements. Roughly speaking, the area of positive demographic influence of the urban settlement coincides with the area of the Danube villages, while the Šumadija villages and then the Pomoravlje villages (due to better transport connections and permeability) remain outside this influence.

Since the urban area is divided into three larger natural geographic units (the Danube belt, the Pomoravlje belt and the Šumadija beam), it is possible to distinguish the settlements of the City of Smederevo in almost the same way when it comes to the change in natural growth and migration, with the highway corridor, with some deviations, representing the "magic border" of separation. The exceptions mentioned refer to the villages of Kulič, Šalinac, Lipe, Vranovo and Mala Krsna. Their deviation from the regularity can be explained by the fact that all five villages are located on the left bank of Velika Morava, while Kulič, Šalinac and Lipe are characterized by a certain peripheral location despite their proximity to the city center. Kulič and Šalinac objectively show a more negative demographic development than the group of settlements to which they belong (up to 13 km away). On the other hand, the villages of Vranovo and Mala Krsna, although classified as Pomoravlje villages, are characterized by their proximity to the center of the city's economic activities (Železara), as well as a special traffic transitivity towards the Braničevska region

(Požarevac) and the "Constantinople Road" (towards Velika Plana, Svilajnac, Kragujevac and Jagodina), which partly contributes to the demographic and general "vitality" of these settlements.

The problem of marginalization is noticeable at all regional levels, not only in the border areas, considering the relationship between the urban/municipal center and the periphery, where a large number of settlements that are far from the central places "remain "forgotten in space and time" and are not integrated into the urban/municipal systems. This is the situation in almost all Serbian municipalities, especially those outside the main transportation and development corridors (Vojković, Živanović, Magdalenić, 2018). In terms of demographic development, this case can be observed in the spatially distant, but also in the socio-economically and transport-marginalized settlements of the City of Smederevo. In the last interim census period, in our example, these are all villages along the Constantinople road from Skobalj to Saraorci and all Šumadija villages south and southwest of the highway. It is very surprising that Radinac, which represents a unique urban fabric with an urban settlement, has recently joined this group of settlements characterized by a significant population decline of over 12‰ per year. A significant part of the explanation lies in the fact that Radinac recorded a negative annual migration balance of over -10‰ in the period 2011-2022. The negative migration balance of this settlement even accounted for 1/3 of the total migration balance of all rural settlements in the urban area. It is obvious that the unfavorable circumstances related to the work and air pollution of the steel mill have triggered a significant wave of emigration from this settlement since 2012. Regardless of this exception, Figure 7 shows the distribution of settlements according to the values of the natural increase rate and net migration in the period 2011-2022, where it can be observed that no less than I4 settlements show a decline above the average (11.8‰), of which 12 belong to type I4 and the remaining two to type E4. The mentioned 14 settlements are on average 16.9 km away from the city center (17.8 km without Radinac), and all of them except Radinac (black square in the graph) are located at a distance of 13 or more kilometers, which is classified as "critical".

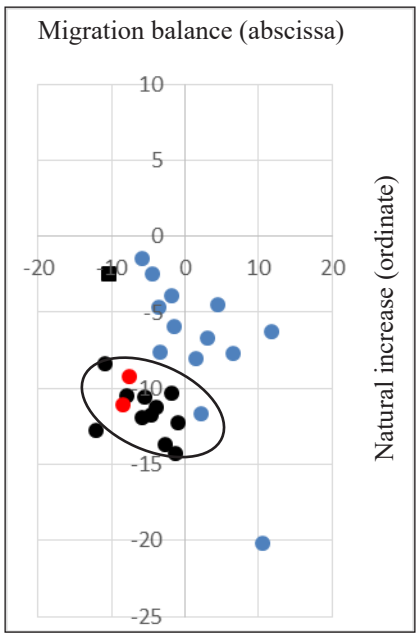


Figure 7. Natural and migration component 2011-2022 (annual rates)

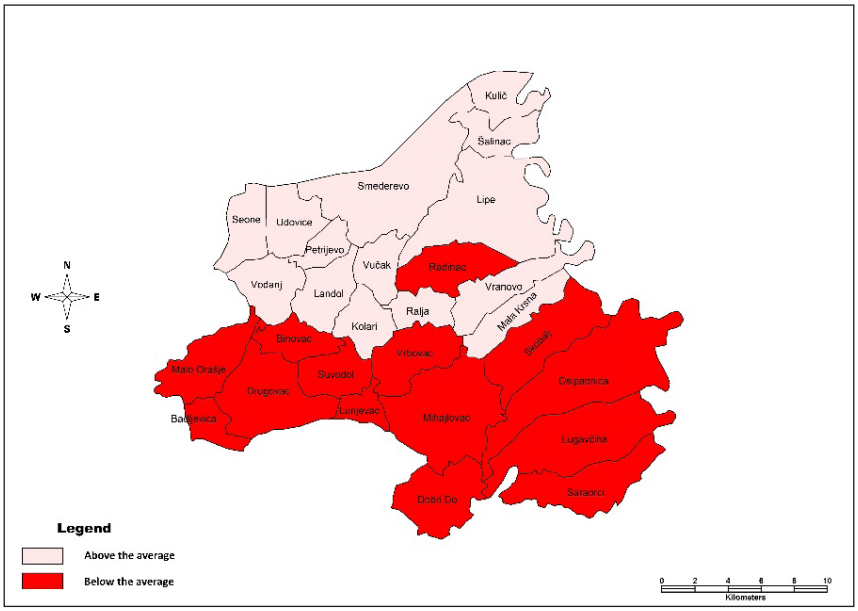


Figure 8. Annual population change rate related to the average value for the observed settlements (without city of Smederevo) 2011-2022

Although the relationship between natural growth and migration on the one hand and distance on the other have the same sign, i.e. the negative values of natural growth and migration increase with distance from the city center, the trends of these dependencies are completely opposite. The significance of distance for the level of the natural growth rate increases over time, while the significance of distance for the level of the migration rate decreases. From 1991 to 2022 (three survey periods), the value of the natural growth rate fell by 1‰ per 3.7 km distance in the first, 2.6 km in the second and 2.2 km in the third survey period. At the same time, net migration decreased by 1‰ per 1.1 km in the first, 1.3 km in the second and 2.8 km in the third census period.

It is interesting to note that the settlements of Osipaonica and Drugovac (red dots in Figure 7, which Tošić and Obradović (2003) recognized as potential micro-development cores, today, 20 years later, show one of the most intense demographic declines, ranking second and sixth, respectively, among the 27 rural settlements in the town of Smederevo. The question arises as to whether this "demographic fate" of part of the settlements of Smederevo could have been prevented or at least mitigated by a timely planning upgrade that would have promoted the functional transformation of the predominantly agricultural rural settlements with the establishment of light industry and service activities, which, together with the improvement of transport links (public and private transport), would have encouraged daily migration rather than out-migration?

Conclusion

Geographical theory and practice know and confirm the negative relationship between the spatial distribution of population and population dynamics on the one hand and the distance of urban settlements on the other. The contribution of this text to a more precise understanding of this relationship lies in the identification of spatial patterns in the movement of natural growth and net migration using the example of the settlements of the City of Smederevo. The importance of spatial distance for the components of population growth as well as socio-economic peripherality and "extrinsic" transport location, which cannot be neutralized by mere proximity to the city center, was confirmed. The positive "demographic influence" of the urban settlement of Smederevo on the surrounding settlements is significantly lower than its administrative area and continues to weaken over time. On the other hand, the disturbed age structure (which has a dominant influence on the natural growth rate) increasingly affects the growing importance of distance from the city center on the natural growth rate, while the reduced migration potential causes the decrease in the importance of distance on the net migration rate. In other words, the long-term

depopulation of the more distant settlements (naturally and through out-migration) led to a high concentration of population in the Danube area of the City.

The uneven (and often opposite) socio-economic development acted as a catalyst for negative demographic trends in more distant settlements, some of which were not integrated into the functional system of the city, forgotten and left to their fate. However, the City of Smederevo as a whole is characterized by less favorable socio-economic trends compared to other medium-sized cities in Serbia with a similar level of development (Antonić, 2022). Of the 24 medium-sized cities to which it belongs, the City of Smederevo ranked sixth in 2019 in terms of average salary (3% below the national average), eighth in terms of per capita investment (twice the national average) and twelfth in terms of per capita household inflow (19% below the national average).

Further neglect of the importance of the spatial dimension in the formulation of local public policy, especially population policy, will lead to demographic polarization of the Smederevo city area towards the more developed Danube coastal zone and the underdeveloped and demographically devastated hinterland of Pomoravlje and Šumadija. Regardless of the spatial-demographic differences, however, some of the most important causes of problems in the demographic development of Smederevo in the future will certainly be the weak diversification of the secondary and higher sectors of economic activity with a dominant link to a single factory and the lack of higher education institutions. There are 42 higher education institutions in the above-mentioned 24 medium-sized towns, and Smederevo is the only town apart from Loznica that does not have a single higher education institution. The predominant supply of low-skilled jobs in the ferrous metallurgy and heavy industry sectors and the lack of higher education institutions must guarantee high youth emigration rates, a further decline in the optimal birth rate and a shortfall in human capital in the future. In this sense, even a locally specific demographic policy could bring hardly any tangible results.

Acknowledgements

This article is the result of a research work done as a part of SRO (University of Belgrade – Faculty of Geography) which was financed by the Ministry of Sciences, Technological Development, and Innovations for the year 2023 under the number 451-03-47/2023-01/200091

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Original scientific article
Received: 14.02.2024;
Received in revised form: 23.03.2024:
Accepted: 26.03.2024;
Available online: 14.10.2024.

UDC: 338.48:616.98(497.11)
doi: 10.5937/zrgfub2472057D

INTERNATIONAL AND DOMESTIC TOURISM IN POST COVID CONDITIONES, WITH REFERENCE TO RURAL TOURISM IN SERBIA DURING THE COVID PERIOD

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Abstract: The Covid-19 pandemic was the biggest challenge the world has faced in the 21st century. It left the biggest negative impression on health, social and economic aspects. The negative impact was reflected in the tourism economy, dealing a major blow to the global economy and the movement of tourists. The pandemic affected the existing tourism, but it also changed the habits of tourists and thus influenced the choice of destination. The aim of this paper is to show the impact of the Covid-19 virus in the world as well as in the Republic of Serbia, with a focus on the selection of tourist destinations during and after the pandemic, as well as a comparison of tourists during 2022 and 2023 on the territory of the Republic of Serbia. Qualitative-quantitative, analytical and comparative methods were used during the research. Based on all relevant collected data, it is important to emphasize that the international tourism industry ended 2023 at 88% of pre-pandemic levels**,** with an estimated 1.3 billion international arrivals. A full recovery is expected by the end of 2024, driven by pent-up demand, improved connectivity and resilient Asian markets. According to the latest UN tourism barometer data, from January 2024, the Republic of Serbia has the largest increase of 79% compared to 2019 in the category of income from foreign tourists.

Keywords: Covid-19 pandemic, tourism industry, choice of destination, tourist movement

Introduction

Covid-19, a global pandemic, was declared on March 11, 2020. Many call it the pandemic of the 21st century. It represents the greatest challenge the world has faced since World War II. The World Health Organization gave the new virus the name Sars-cov-2 and the disease caused by Covid-19, which is an acute respiratory disease that spreads when an infected person coughs or sneezes. The virus can live up to

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72 hours. The Covid virus has unfathomable consequences, which at the beginning were catastrophic only in the source of China in Wuhan and its surroundings, and then in Europe, especially in Bergamo in the north of Italy, before it spread to the whole world (Abu Bakar & Rosbi, 2020; Geić at al., 2021). The consequences of this virus, which spread at an enormous speed, are reflected in the number of sick 771,820,937 cases and the number of deaths 6,978,175 according to the report of the World Health Organization (WHO). It is a worrying fact that with the constant effort of the health epidemiology profession, along with the development of vaccines and the invention of medicines, the appearance of new strains and mutations of the virus is not abating. In addition to the health crisis, the Corona virus pandemic has left the biggest negative impact on the social and economic aspects. The negative impact was reflected in the tourism industry, dealing a big blow to the global tourism economy and the movement of tourists.

The tourism industry has faced unprecedented threats. This topic is very important considering the number of tourists in the world. Authors Abu Bakar & Rosbi (2020) estimated the impact of Covid on the tourism industry using the supply and demand curve. They came to the result that the price of the tourism sector continues to decline in parallel with the decline in demand. In this period, households spent only for basic needs, such as food, medicine and protective equipment, and on the other hand, economic entities reduced or completely stopped their work due to the requirement to maintain social distance and reduce contacts (Praščević, 2020). Tourist demand has fallen worldwide, affecting flight cancellations, sales and revenue of airlines, cruise ships, hotels, restaurants and the transportation industry. In 2020, airlines and travel agencies recorded a sharp decline in the number of tourists, their existence and business depends solely on tourism. Air transport, as a branch of transport, has the largest share in international tourist movements, 58% in 2018 (ICAO, 2020). Due to the suspension of international flights, the losses of airline companies were huge (IATA, 2020). All this led to the bankruptcy and shutdown of a number of small airline companies, as well as their acquisition by large airlines that, due to their national and economic importance, can count on extensive financial assistance from national governments such as the governments of Germany, the United Kingdom and France (Jovičić, 2020). While the operation of hotels and restaurants continued, however, their business results were significantly reduced. Restaurants have limited their operations to take-out only, leading to a decrease in revenue.

The pandemic affected the existing tourism, but it also changed the habits of tourists and thus influenced the choice of destination. The measures taken by the governments of a number of countries to prevent the spread of the virus, such as social distancing, complete “lock down”, self-isolation, the introduction of negative

PCR-test measures, antigen tests or vaccination, wearing masks indoors, while in some countries the entry of tourists was forbidden. All this led to an economic collapse, to mass unemployment, which contributed to a decrease in demand in the tourism industry (Abu Bakar & Rosbi, 2020; Praščević, 2020). The travel restriction had major consequences for tourism on a global level and the world economy as a whole (Milošević & Marjanović, 2022; Jovičić, 2020; Popović, 2021; Jović-Bogdanović et al., 2021; Gejić et al., 2021). The negative impact of the pandemic on tourism hit the developed economies of Asia, Europe and North America the most, as the key emitting and receiving areas in global tourism trends. Particularly affected were countries that base their economic development on tourism, where the participation of tourism plays a large role in GDP, whose tourism economy is based on foreign demand, for example Croatia, Montenegro, Greece, Malta, Cyprus, Albania, Portugal, Spain.

Tourism is the third largest export category of the global economy, and one of the fastest growing industries in the world. Tourism contributes 10% of global GDP and in 2019 accounted for 7% of global trade and accounts for one in every 10 jobs worldwide (unep.org). This is evidenced by data from the World Tourism Organization, which confirmed that in 2018, 1.4 billion international arrivals were generated in the world, which was expected only two years later. International travel has dropped by 74% since the pandemic was declared in March 2020. This year is considered the worst year in the history of tourism, resulting in 1.1 billion fewer international tourists (overnight visitors) worldwide, bringing the number of travellers back to the level of 30 years ago. Tourism needs open borders, stable political, socio-economic as well as health and safety conditions (Jovičić, 2020).

The Covid-19 pandemic affected tourism in Serbia in such a way that the awareness of tourists when choosing tourist destinations changed. The increasing diversification of tourist destinations of a mass character (overtourism) with undiscovered tourist destinations and selective forms of tourism (green tourism, ecotourism, mountain tourism) was noticeable. Certain destinations (Stara planina, Sokobanja, Ribarska banja, Dvčibare) saw an increase in the total number of tourists in 2020 compared to 2019, due to the increase in the number of domestic tourists who did not travel abroad due to the closure of borders (Vassileva et al, 2020). However, according to the author's survey (Petrović & Kokanov, 2021), when asked where respondents work and choose to travel, which referred to the choice of place, whether it is their own country, abroad, destinations or none of the above in 2021, most of them chose abroad as a tourist destination for their trip (53%), while a few of them preferred not to travel anywhere (1%). Only 6% of respondents chose their own country as a tourist destination, while 40% of respondents chose the destination. From the above, we conclude that due to the insufficient level of development of

tourism in Serbia, changes in the quality of services and the satisfaction of tourists can be expected. The Covid pandemic in Serbia has led to some new patterns in the tourism sector regarding:

- management of tourist space (redefining the management of the flow of accommodation capacities in particularly attractive and busy destinations, prohibition of construction in protected areas outside the boundaries of the urban plan),
- health safety of tourists (the presence of even the smallest risk is crucial whether tourists will visit a certain destination) (Alkier et al. 2021),
- environmental protection (e.g. reducing energy consumption and using alternative energy sources, increasing recycling),
- development of domestic tourism (affirmation of undiscovered tourist destinations that are suitable for the development of sustainable tourism)
- the importance of digitization (during the pandemic in lock-down conditions, the internet, internet browsers, social networks enabled people's lives to continue as normal),
- achieving competitiveness in tourist market, etc.

The aim of this paper is to show the impact of the Covid-19 virus in the world as well as in the Republic of Serbia, with reference to the selection of tourist destinations during and after the pandemic, as well as a comparison of tourists during 2022 and 2023 on the territory of the Republic of Serbia. The work was based on the hypothesis that tourists choose destinations that are closer to them and that they stay shorter in the destination itself during and after the Covid-19 pandemic. That tourism is an adaptable system that adapts to the given situation in the environment.

Methods and materials

In this paper, secondary data, reports of the World Tourism Organization, reports of the Republic Institute of Statistics, a review of scientific and professional literature on the impact of the Covid-19 pandemic in tourism studies from 2020 to 2023 were used for analysis. Qualitative-quantitative, analytical and comparative methods were used during the research. The task of this work refers to obtaining results on the movement of the number of domestic and foreign tourists in the Republic of Serbia during 2022 and 2023, as well as on the presentation of tourist movements in the world that were realized during and after the pandemic, with special reference to the choice of tourist destinations. Also, using the available data, a descriptive analysis of the current state of the tourism industry was performed.

Results and discussion

The impact of the Covid virus pandemic on the development of tourism in the world

Asia and the Pacific – Considering that the largest industrial production in the world is realized in Asia, income from tourism is less dependent on other continents. However, international tourist arrivals have a positive relationship with gross domestic product per capita. Martin Oliver Pedak (2018) states that an increase in the number of international tourists will increase the economic level in the country. The first country affected by the Covid virus, China, had serious consequences in the tourism industry, considering that at the beginning of the 21st century, China recorded high tourism growth as well as the participation of the service sector. In the first place, the consequences were in social contact with the Chinese population. Because of the threat of the virus, people avoided any contact with the Chinese population. Many domestic and foreign airlines have cancelled their flights to China due to insufficient number of passengers. In the period January-October 2020, they recorded a drop in arrivals by 82%. China has opted for a "zero tolerance" approach in the fight against the pandemic. Given such a policy, in 2022, China's GDP growth will slow down to around 3%. South Korea and Australia opted for a "zero tolerance" policy (Jović-Bogdanović et al., 2021). The countries where the tourism industry has the largest contribution to GDP are Thailand, Hong Kong and Singapore, and Indonesia suffered the biggest economic shock (ADB, 2023). South Asian countries faced a more challenging situation due to their large population. These countries have weaker health systems, high poverty rates, low socio-economic conditions, poor social protection systems, and limited access to water and sanitation. To contain the spread of the virus, South Asian countries have imposed strict lockdown measures, affecting the lives of millions of people in the region, home to a third of the world's poor. Economies in Asia and the Pacific continued to recover from the pandemic as the effects of the virus eased and lockdowns eased. In 2022, Asia and the Pacific reached only 23% of international tourist arrivals, due to stronger pandemic restrictions (Figure 1) (UNWTO, 2023). In the period 2023, Asia and the Pacific reached 65% of pre-pandemic levels following the reopening of several markets and destinations. However, performance is mixed, with South Asia already recovering 87% of 2019 levels and North-East Asia around 55% (UWTO Tourism barometer, 2024).

International tourist arrivals in the **Americas** in 2022 reached about 65% of pre-pandemic visitors. By sub-region, Central America continued to exceed the pre-

pandemic level in the period January-September 2023 by +4% (UNWTO Tourism barometer, 2023). America has recovered 90% of pre-pandemic visitors according to data January 2024. Due to the spread of the pandemic, the number of passengers dropped almost to zero by mid-March 2020. Large cities on the East Coast (New York, Boston) were particularly affected due to the large number of infected people. America's healthcare system has shown major flaws. The private health insurance model corresponds to the market (entrepreneurial) model in which health insurance is organized by private insurance companies whose contributions are paid by those who want it (Praščević, 2020). In it, health care is not available to everyone because it does not ensure the availability of health services to the entire population. The poor sections of the population were the most affected.

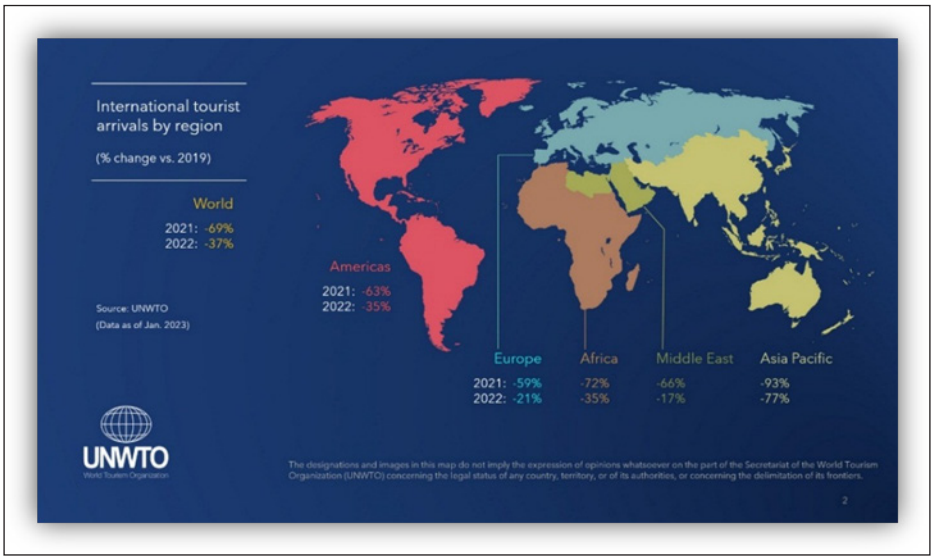

Figure 1. Arrivals of international tourists by region (January 2023)

International tourist arrivals in **Africa** in 2022 reached around 65% of pre-pandemic visitors while the Middle East had the largest relative increase among regions in 2022 with tourist arrivals rising to 83% of pre-pandemic numbers (UNWTO, 2023). International tourist arrivals in 2023 reached 96% of pre-pandemic visitors while the **Middle East** continued to lead the regional recovery in relative terms, with arrivals 22% above pre-pandemic levels 2019 (UNWTO Tourism barometer, 2024). Visa facilitation measures, the development of new destinations, investments in new tourism-related projects and the hosting of large events, help underpin this remarkable performance. The main impact on the economy of African countries during the pandemic is the reduction of foreign income. Countries such as Gambia, South Africa, Egypt, Kenya and many others that are heavily dependent on tourism

have been forced to close down many tourism businesses. The economies of African countries, since they depend for the most part on tourism, were forced to increase their borrowing, thus potentially producing their cycle of poverty. Africa has become a favourite destination for international tourists as it offers some different tourist experiences like safaris and national parks, exotic culture and food. The Republic of South Africa, a country with a significant tourism sector, was the first in its history to receive a loan from the IMF of US$ 4.3 billion (Issahaku, 2020).

Europe is the biggest destination in the world. The rebound was supported by robust intra-regional demand as well as strong demand from the United States. Intraregional tourist movements are specific in the European Union. This is supported by the fact that around 70% of foreign overnight stays in the EU are made by tourists from member countries of this organization (Eurostat, 2023). Due to the Covid-19 pandemic, the borders of the European Union remained closed to residents outside the Union, but borders were also established between member countries, which was not supported by the European Commission because it called into question the basic principles on which the Union rests, which refers to free flow people and goods, as well as solidarity between members. Tourism contributes 10% to the GDP of the European Union, includes 2.4 million economic entities, 90% of which are small and medium-sized enterprises, and accounts for 12% of employees in the community of European countries. Considering the large drop in income from tourism in 2020, hotels, tour operators, travel and train transport recorded a drop of 85%, cruise ship trips and air travel even 90% (Praščević, 2020). Europe, reached 94% of 2019 levels, supported by intra-regional demand and travel from the United States (UNWTO Tourism barometer, 2024). The highest percentage of tourism in GDP in European countries is Spain 14.3%, Italy 13%, Germany 9.1%, France 8.5%, Netherlands 5.7% (Visual Capitalist, 2020).

The recovery of tourism from Covid-19 was very gradual. The rise in demand has been fuelled by increased traveller confidence due to rapid progress in vaccinations and the easing of entry restrictions in many destinations. International tourism receipts reached USD 1.4 trillion in 2023 according to preliminary estimates, about 93% of the USD 1.5 trillion earned by destinations in 2019. Preliminary estimates on the economic contribution of tourism, measured in tourism direct gross domestic product (TDGDP) point to USD 3.3 trillion in 2023, or 3% of global GDP. This indicates a recovery of pre-pandemic TDGDP driven by strong domestic and international tourism. Several destinations reported strong growth in international tourism receipts during the first ten to twelve months of 2023, exceeding in some cases growth in arrivals. Strong demand for outbound travel was also reported by several large source markets this period, with many exceeding 2019 levels. Looking Ahead to 2024 International tourism is expected to fully recover pre-pandemic

levels in 2024, with initial estimates pointing to 2% growth above 2019 levels. This central forecast by UNWTO remains subject to the pace of recovery in Asia and to the evolution of existing economic and geopolitical downside risks. The positive outlook is reflected in better expectations for 2024 compared to 2023. Key considerations include: There is still significant room for recovery across Asia. The reopening of several source markets and destinations will boost recovery in the region and globally. Chinese outbound and inbound tourism is expected to accelerate in 2024, due to visa facilitation and improved air capacity. China is applying visa-free travel for citizens of France, Germany, Italy, the Netherlands, Spain and Malaysia for a year to 30 November 2024. Visa and travel facilitation measures will promote travel to and around the Middle East and Africa with the Gulf Cooperation Council (GCC) countries to implement a unified tourist visa, similar to the Schengen visa, and measures to facilitate intra-African travel in Kenya and Rwanda. Europe is expected to drive results again in 2024. In March, Romania and Bulgaria will join the Schengen area of free movement, and Paris will host the Summer Olympics in July and August. Strong travel from the United States, backed by a strong US dollar, will continue to benefit destinations in the Americas and beyond. As in 2023, robust source markets in Europe, the Americas and the Middle East, will continue to fuel tourism flows and spending around the world (UNWTO Tourism barometer, 2024).

The impact of the Covid virus pandemic on the development of tourism in the Republic of Serbia

With the declaration of a pandemic on March 11, 2020, tourism in Serbia faced huge losses. The World Health Organization declared the end of the emergency situation on May 5, 2023, which does not mean that the pandemic is over (WHO, 2023). However, on the territory of the Republic of Serbia, the epidemic has not been officially declared as finished. Health, social, economic crisis are just some of the consequences that the world was facing. Service activities such as tourism, trade stopped their operations due to a series of restrictive measures that were adopted to stop the pandemic. However, the government of the Republic of Serbia adopted a series of short-term measures to mitigate the negative economic and social consequences of the impact of the Covid-19 virus. According to the latest UN tourism barometer data from January 2024, the Republic of Serbia has the largest increase of 79% compared to 2019 in the category of income from foreign tourists (UNWTO Tourism barometer January, 2024)

Table 1. The number of tourists and their overnight stays in the period from 1985 to 2023

Year	Number of tourist arrivals			Overnight stays		
	Total	Domestic	Foreign	Total	Domestic	Foreign
1985.	4.605.915	3.820.263	785.652	13.129.419	11.602.158	1.527.261
1990.	3.939.867	3.059.742	880.125	11.669.782	10.201.605	1.468.177
1995.	2.432.107	2.341.078	91.029	8.124.460	7.870.220	254.240
2000.	2.169.225	2.003.549	165.676	7.696.290	7.265.197	431.093
2005.	1.988.469	1.535.790	452.679	6.499.352	5.507.604	991.748
2010.	2.000.597	1.317.916	682.681	6.413.515	4.961.359	1.452.156
2015.	2.437.165	1.304.944.	1.132.221	6.651.852	4.242.172	2.409.680
2019.	3.689.983	1.843.432	1.846.551	10.073.299	6.062.921	4.010.378
2020.	1.820.021	1.374.310	445.711	6.201.290	4.936.732	1.264.558
2021.	2.591.293	1.720.054	871.239	8.162.430	5.732.833	2.429.597
2022.	3.869.235	2.096.472	1.772.763	12.245.613	7.306.219	4.939.394
2023.	4.192.797	2.058.492	2.134.305	12.440.935	6.858.331	5.582.604

Source: Statistical Office of the Republic of Serbia (SORS), 2023.

Based on table 1, it can be concluded that in 2022, 12.2 million overnight stays were registered, which is 50% more compared to 2020, when the pandemic was declared, and 21.57% more compared to 2019, when tourism took place under normal conditions. The number of tourist arrivals of domestic and foreign tourists in 2019 is almost identical, however, with the emergence of the covid-19 virus and restrictive measures to suppress it, we can conclude a decrease in the number of foreign tourists. The number of domestic tourists since 2020 is higher than foreign tourists. Also, the number of overnight stays by domestic tourists in the period from 2020 to 2022 is higher than that of foreign tourists. Domestic tourism, during and after the Covid-19 pandemic, has shown positive signs in many markets as people tend to travel closer to each other to minimize health risks. Based on research, the United Nations World Tourism Organization (UNWTO, 2023) points out that travellers go on "staycations" or vacations close to home because they feel safe when traveling within the borders of their own country, or during visits to nearby and familiar countries. Travelers believe in the importance of creating a positive impact on local communities, increasingly seeking authenticity. Nature, rural tourism and short-haul travel have become popular travel choices due to travel restrictions and the pursuit of outdoor experiences. After the Covid-19 pandemic, there was a significant increase in spending per trip and longer stays that is, staying in a certain place.

The pandemic affected the existing tourism, but it also changed the habits of tourists and thus influenced the choice of destination. During 2022, tourists were most interested in spa, village and mountain tourism. In this year, 3,054,744 overnight

stays by tourists were realized in spas, of which 88.4% were overnight stays by domestic tourists (2,701,335) and 2,800,358 overnight stays were registered in mountain centres, of which 84.7% were domestic tourist overnight stays (2,372,790) (SORS, 2023).

Table 2. Number of foreign tourists by country of origin in 2022 and 2023.

Number of foreign tourists by country of origin	2023	2022
Turkey	201.440	125.602
Russia	170.884	123.425
Germany	123.058	105.792
Romania	100.055	74.590
China	92.125	32.591
Bosnia and Herzegovina	158.824	148.773
Bulgaria	110.419	81.661
North Macedonia	109.738	92.046
Croatia	108.161	89.860
Montenegro	96.019	80.656
Slovenia	85.051	78.532
Greece	70.388	56.564
Poland	58.458	44.513
Hungary	54.383	49.878
Italy	49.609	38.387
SAD	47.909	37.929
Austria	45.554	40.867
France	37.238	32.816
India	8.787	44.192
Israel	15.584	14.156
Ukraine	21.974	19.275

Source: Statistical Office of the Republic of Serbia (SORS), 2023/2024

The report of the Republic Institute of Statistics for the year 2023 shows that the total number of tourist arrivals is 4,192,797, which is an increase of 8.3% compared to the year 2022. The number of domestic tourists compared to the year 2022 is even, but we notice a difference in the number of foreign tourists, where we have a record number of foreign tourists compared to all previous years. It is also evident that the number of overnight stays by foreign tourists is 643,210 more than in 2022. The number of foreign tourists based on the structure of foreign tourists in 2023 shows that the largest number of tourists based on the country of origin is from Turkey, Russia, Germany and China as well as the neighbouring countries of Bosnia

and Herzegovina, North Macedonia, Croatia, Bulgaria, Romania and Montenegro. The number of tourists originating from Turkey is about 60% higher than in 2022, Russian tourists by 38.5%, and the biggest increase is among tourists from China by 59,534 compared to 2022. In the period from January to June 2023, our country was visited by foreign tourists from about 50 different countries, over 80% of overnight stays were made by tourists from Europe, so the number of foreign tourists increased by more than 32.6%. The largest number of overnight stays in 2023 was achieved by Russian tourists 665,819, tourists from Turkey 521,288, followed by Bosnians 351,542, Germans 282,252 and Chinese 282,069. One of the reasons for the large number of tourists from Russia is that there is a direct flight to Serbia, given that only Turkey and Serbia have direct flights to Russia. Also, considering the Russian-Ukrainian crisis, the number of Russian nationals who represent migrants has increased. As such, they are recorded statistically as tourists even though they do not represent tourists. Also, recording problems occur when there are tourists in transit, people who often cross the state border, students, patients, as well as business visitors (Business expediency audit report, 2023).

In the first six months of this year, the number of overnight stays in rural households in Serbia increased by 21.8% compared to the same period in 2022, while visits by foreign tourists increased by more than 32.6%. In the Republic of Serbia in October 2023, compared to October 2022, the number of tourist arrivals is lower by 1.5%, and the number of overnight stays is lower by 13.0%, the number of overnight stays by domestic tourists is lower by 21.4% , and the number of overnight stays by foreign tourists is lower by 0.5% (RZZS). 758 rural households with slightly more than 2,400 accommodation units are registered in the e-tourist database. Tourist services provided by business entities such as: restaurants, hotels, which serve both tourists and the resident population, have suffered serious consequences due to the resulting pandemic. Forecasts by the World Tourism Organization predicted a faster recovery of domestic travel compared to travel to distant destinations. All this had a great incentive for hoteliers, carriers, travel agencies and tour operators. Rural tourism in Serbia experienced a revival. The Republic of Serbia has significant natural and anthropogenic resources, rich cultural and historical diversity. In addition to popular mountain, spa and city destinations, the pandemic contributed to the discovery of new, until then little-visited tourist destinations throughout Serbia, which have a preserved and healthy environment. Even today, even after the pandemic, rural areas are at the very top of the tourist market, given the attractiveness offered by the untouched natural environment, traditional way of life and customs that are manifested in local areas. The rural area, which makes up more than 85% of the territory of the republic with about 43% of the population of Serbia, has great potential for the development of rural tourism and other alternative forms of tourism: ecotourism

(green tourism), sustainable tourism (Vesić&Bogdanović, 2023; Vesić at al., 2021) . With the strategy of the future development of the sustainable tourism sector, the authors Ilić & Šimčević (2022) highlighted the most important factors that influence the shaping of sustainable tourism, namely: the reactive role of the government in creating a sustainable and resilient tourism sector, further development of domestic tourism and strengthening of small businesses, moving away from mass tourism and adapting to the specific needs of travellers, digitizing the sector, developing eco-tourism, and highlighting efforts in the area of hygiene and health.

The authors Škorić & Jovanovnić (2021) predicted that rural tourism under the influence of the covid pandemic will move on an upward trajectory, which has come true. Considering the current situation, the Republic of Serbia will have to work a lot on improving the quality of the tourist offer in order to attract foreign demand in addition to the domestic population. The state offers incentives to those who want to engage in rural tourism or who want to do so. In addition to rural tourist households, accommodation services are also offered in home-made facilities (houses, apartments and rooms), lodgings, hostels, camps, as well as in ethnic villages and ethnic parks (Ministry of Tourism and Youth).

Conclusion

Looking back on the previous three years, we come to the conclusion that the tourism industry is slowly recovering. The introduction of measures, the advent of vaccines, which contributed to the opening of the borders of many countries, the world slowly returned to normal and the pandemic was kept under control, which therefore led to the abolition of the pandemic with the responsibility to comply with the measures, not to relax and take the situation lightly. The ability of tourism to recover from a series of natural and man-made events (avian flu threat, Indian Ocean tsunami in 2004, global economic crisis in 2008, swine flu outbreak in 2009, and the occurrence of the coronavirus 2020), shows us that the tourism industry is a resilient and adaptable system. In the last 70 years, world tourism has been characterized by continuous growth despite all the unexpected problems. International tourist arrivals in the world amounted to 25 million in the 1950s, and in the 2000s they increased to almost 700 million and in 2018 to 1.4 billion (UNWTO, 2023). Data from the Republic's Statistical Office show that there was an increase in the number of tourists on the territory of the Republic of Serbia, especially the number of foreign tourists in 2023. However, tourism in Serbia did not progress statistically due to the improvement of the tourist offer, but due to the recognition of immigrants as tourists. Given the deficiencies in the registration of foreign tourists, extensive research is needed on this issue.

In 2022/2023, the severity of the pandemic decreased. While all countries were moving from the Covid-19 pandemic, the world was gripped by new economic crises and long-term geopolitical problems such as war conflicts, Russian invasion of Ukraine, Israeli aggression on Palestine, high inflation and the jump in the price of oil on the world market, as well as the fear of global recession, still represent the main factors influencing the recovery of tourism. Extreme weather events such as floods, droughts, cyclones, heat waves that indicated the vulnerability of the entire Earth. All these extreme impacts have caused a food crisis, the displacement of millions of people and put the poor and vulnerable in danger above all (ADB, 2023). Higher food and energy prices result in lower purchasing power and weaker consumer confidence, which could affect travel demand in 2024. All these problems represent negative facts for tourism and create a feeling of general insecurity throughout the world.

The negative impact of tourism activity on the environment has led many countries' governments to encourage sustainable international tourism with a minimal impact on the environment. The pandemic affected the change in the social way of life of people all over the world, so tourism trends have transformed from mass tourism to destinations that place people's health as a primary factor. As a result, the number of tourists who are ready to pay a very high price to stay in a destination with a preserved and attractive environment has increased. All actors involved in the development of tourism with the support of the government must cooperate with each other, considering the increase in domestic tourist travel in the previous period. With its development policy, the Republic of Serbia will have to work on improving the quality of the tourist offer in order to attract additional tourist clientele.

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Original scientific article
Received: 09.03.2024;
Received in revised form: 30.03.2024;
Accepted: 01.04.2024;
Available online: 14.10.2024.

UDC: 502.1+338.48(497.16)
doi: 10.5937/zrgfub2472073B

GEOHERITAGE AND GEOTOURISM POTENTIAL OF THE MUNICIPALITY OF ROŽAJE (NORTHEASTERN MONTENEGRO)

Eldin Brđanin[1]

Abstract: Rožaje is a municipality in the north-eastern part of Montenegro. The municipality covers an area of 432 km^2. According to the data of the last census, which was conducted in 2023. 25.247 inhabitants live in this Montenegrin municipality. There are a large number of geolocations in Rožaje that have great potential for the development of geotourism. The aim of this work is to make an inventory of geoheritage objects and their possible valorisation and geoconservation for the development of geotourism in this area. In addition, one of the objectives is to assess various geolocations in the municipality of Rožaje using the GAM (Geosite Assessment Model) and determine whether this area has the potential for geotourism development in the future. The paper proposes representative geolocations of this area that can form an excellent basis for the development of geotourism. The geolocations selected for this study are Musas Pit, Ćirko Cave, Grlja Waterfall, meanders with looping arches in the Ibar River canyon, Grope Cauldron on Hajla Mountain, limestone ridges in the Ganića Karst, Bukovica River canyon, Prvotunelska Cave, Vrelo Ibra Spring and Rujište Marshes. The GAM model will be used to determine which geolocations are suitable for the development of geotourism. In addition, measures for the preservation of geolocations and their geoconservation will be proposed. In other words, it will discuss how the development of tourism in the area can be successfully managed and sustainably planned. Natural resources are the main motive for tourist flows in the area.

Keywords: geosites, geoheritage, geotourism, GAM, Rožaje, Montenegro.

Introduction

Geotourism as a special interest tourism in the era of contemporary tourist trends is based on geodiversity and geoheritage. Another definition states that geotourism is the promotion and protection of geological heritage through tourism

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with the help of education and interpretation (Tomić, 2014). Geotourism has become an increasingly popular form of tourism worldwide (Ruban, 2015). Essentially, geotourism represents the process of recognising and enhancing the significance of geosites, which should lead to better and more efficient conservation of geological heritage and geosites (Hose, 2005).

Montenegro has significant natural and cultural values, some of which are recognised not only nationally but also internationally. In a relatively small area, there is a great variety of geographical diversity and heritage, which is very important for the development of tourism, which plays an important role in the economy of this country, which also applies to the municipality of Rožaje. Tourism, as one of the strategic branches of the development of the Municipality of Rožaje, represents a very important segment in the overall system of economic sectors. When talking about tourism in the municipality of Rožaje in the past period, it can be said that it is a segment that is at a very low level of development, although there were some facilities such as the Hotel Turjak with its accommodation facilities and two ski slopes, the Hotel Rožaje. Currently, the tourist offer is limited to private hotels and guesthouses with a modest offer. Considering the fact that, according to the Rožaje Tourist Organisation, the number of tourists visiting the municipality of Rožaje has increased in recent years, and with it the number of overnight stays, it is clear that the need for new accommodation and new facilities is very pronounced and will be a limiting factor for further development. It is necessary to work on an appropriate categorisation of accommodation capacity, as there are legal regulations and standards that accommodation establishments must meet. According to the 2019-2021 Development Index, Montenegrin LGUs are categorised into five groups. Above the average are 5 LGUs (four coastal municipalities and Podgorica). Below the Montenegrin development average are 19 of the 24 municipalities for which the development index was measured, which indicates a significant development gap between the regions of Montenegro. All municipalities in the northern region are in this category, with the municipality of Rožaje below 50 % (Ministry of Economic Development and Tourism, 2023).

Geotourism depends on the geological heritage of a particular area, which is very important for the further development of geotourism due to its content. Geotourism as tourism encompasses all geological attractions and destinations (Dowling, 2006). The natural and socio-cultural values of protected areas are extremely important in attracting tourists. Geoheritage represents an important potential for the success of tourism (Huayhuaca, Cottrell, Raadik and Gradl, 2010; Brđanin and Sedlak, 2021), such as scientific research, ecotourism, schools in nature and educational tourism. Socio-cultural factors of the destination directly contribute to the development of cultural forms of tourism, which can significantly contribute to the attractiveness of the destination (Stojanović et al., 2024).

Geodiversity is an essential component of geoheritage. The overall geological-pedological and even geomorphological values of geodiversity represent a potential area for geotourism development (Grey, 2018). Geodiversity represents the natural diversity of the geoecological environment (Nikolić, 2018). For this study, the municipality of Rožaje was selected as an area with a large diversity of geoheritage with recognisable geosites for the development of geotourism in Montenegro.

According to the Law on Nature Protection of Montenegro ("Official Gazette of Montenegro", No. 054/16 of 15 August 2016), the term geo-heritage is defined as all geological, geomorphological, pedological and special archaeological values that were created during the formation of the lithosphere, its morphological formation and the interdependence of nature and human cultures (Article 6, paragraph 20). Geoheritage represents a respectable example of geodiversity, while its abundance and representation is only a small part of the total geodiversity (Đurović and Mijović, 2006). One of the main tasks of this research is the geoconservation of geo-heritage objects in the municipality of Rožaje. The aim of geoconservation is also to eliminate and minimise potential threats to geodiversity (Vasiljević, 2015; Lukić and Petrović, 2020). Geoconservation can be described as an "action taken with the intention of preserving and enhancing geological and geomorphological features, processes, sites and specimens" (Burek and Prosser, 2008).

For the future promotion of geotourism, it is necessary to assess the current condition and values of geosites in the area, which can be achieved using the GAM model, i.e. geosite assessment. The GAM model is used to assess which objects are suitable for geotourism development and how their geoconservation can be carried out. Namely, it evaluates how to manage and create a sustainable plan for the development of tourism in the area.

This methodology has already been successfully applied in research on the assessment of various geolocations in neighbouring Serbia (Vasiljević, 2015; Grujičić-Tešić, 2017; Antić, Tomić, 2017; Boškov et al, 2015; Božić et al, 2014; Božić, Tomić, 2015; Tomić et al, 2019; Tomić et al, 2020; the USA (Tomić et al, 2015; Jonić, 2018), Slovenia (Tičar et al, 2018), Iran (Tomić et al, 2021) and Hungary (Pál and Albert, 2018).

Research Area

Rožaje is a municipality in the north-eastern and eastern part of Montenegro. It is one of the municipalities bordering Serbia. The area of the municipality of Rožaje is 432 km^2 with 25,247 inhabitants and 6,595 households (according to the 2023 census). It borders the municipality of Berane and the municipality of Petnjica. The remarkable location of the municipality of Rožaje makes it important for the

development of tourism in this region. From an orographic point of view, the entire area of this municipality on the right side of the river Ibar belongs to the northern range of Prokletije Mt. and on the left side of the Ibar to the highlands Starovlaška-Raška (Skenderović, 2022).

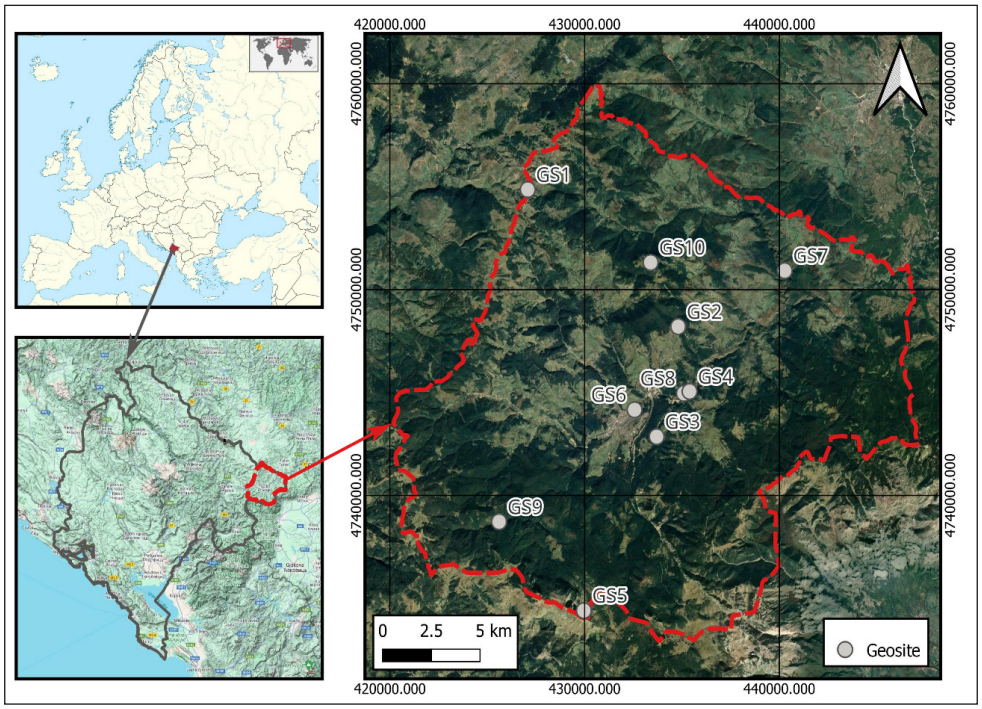

Figure 1. Analyzed localities in the municipality of Rožaje (Montenegro)
Source: Brđanin & Vujović 2024.

The border with the municipalities of Petnjica and Berane runs through the confluence of the Lim and Ibar rivers (Mokra 1,926 m, Cmiljevica 1,963 m, Krš 1,573 m, Turjak 1,409 m, Vlahovi 1,599 m). The border runs along the high mountains of Žljeb (2,352 m) and Hajla (2,403 m), the Republic of Serbia, the Pešter Plateau, Krstač (1,758 m), Gradina (1,691 m) and Vranjača (1,545 m), Petka (1,432 m), Karaula (1,306 m) and others. (Radojičić, 1996, 2008, 2015).

In the municipality of Rožaje, which has a large number of geolocations, the following geolocations were selected for this study and assessment: Musas Pit, Grlja Waterfall, Ibar Gorge, Ćirko Cave, Grope Cirque on Hajla Mountain, limestone ridges in Ganić Karst, Bukovica River Gorge, Prvotunelska Cave, Vrelo Ibra Spring and Rujište Marsh.

altitude of the municipality of Rožaje ranges from 760 metres above sea level (mouth of the Ibar River) to 2,403 metres above sea level (altitude of Mount Hajla) (Radojičić, 2008). At an altitude of 1,643 metres, there are many landforms: vertical rocks, stožine (Ahmica) high mountain passes, ridges and plains, gentle valleys, rough canyons (Ibar Canyon and Bukovica Canyon, as the most prominent geolocations for the development of geotourism), a pond and "Blato" near the village of Biševo (Martinović and Markišić, 2002). Due to its geographical location and altitude, the municipality of Rožaje belongs to the humid continental climate zone, where cold winters and cool summers prevail (Brđanin and Sedlak, 2021).

Materials and Methods

The Geolocation Assessment Model (GAM) was created based on existing methodological assessments. In addition, most of the criteria proposed for the numerical assessment were taken from the existing literature (Vujičić et al., 2011). The complete structure of the GAM is shown in Table 1.

The model is based on geolocation estimation methods used by various authors (e.g. Hose 1997, Pralong 2005, Reynard et al., 2008, Pereira et al., 2007, Zouros 2007).

According to Reynard et al. (2007), most of the existing models can be categorised into several groups that differ in their objectives and purpose. One group refers to the assessment of environmental impacts and spatial planning with a focus on scientific values (e.g. Grandgirard, 1999, Rivas et al., 1997, Bonachea et al., 2005, Coratza and Giusti, 2005), while others mainly assess not only scientific but also so-called "additional values" such as ecological, aesthetic, cultural and economic qualities (Reynard et al., 2007).

Table 1. Structure of the GAM geolocation evaluation models

Indicators/Subindicators	Description
Main values (MV)	
Scientific/Educational value (VSE)	
Rarity	Number of closest identical sites
Representativeness	Didactic and exemplary characteristics of the site due to its own quality and general configuration
Knowledge on geoscientific issues	Number of written papers in acknowledged journals, thesis, presentations and other publications
Level of interpretation	Level of interpretive possibilities on geological and geomorphologic processes, phenomena and shapes and level of scientific knowledge
Scenic/Aesthetic (VSA)	
Viewpoints	Number of viewpoints accessible by a pedestrian pathway. Each must present a particular angle of view and be situated less than 1 km from the site.
Surface	Whole surface of the site. Each site is considered in quantitative relation to other sites
Surrounding landscape and nature	Panoramic view quality, presence of water and vegetation, absence of human-induced deterioration, vicinity of urban area, etc
Environmental fitting of sites	Level of contrast to the nature, contrast of colours, appearance of shapes, etc
Protection (VPr)	
Current condition	Current state of geosite
Protection level	Protection by local or regional groups, national government, international organizations, etc.
Vulnerability	Vulnerability level of geosite
Suitable number of visitors	Proposed number of visitors on the site at the same time, according to surface area, vulnerability and current state of geosite
Additional values (AV)	
Functional values (VFn)	
Accessibility	Possibilities of approaching to the site
Additional natural values	Number of additional natural values in the radius of 5 km (geosites also included)
Additional anthropogenic values	Number of additional anthropogenic values in the radius of 5 km
Vicinity of emissive centers	Closeness of emissive centres
Vicinity of important road network	Closeness of important road networks in the in radius of 20 km
Additional functional values	Parking lots, gas stations, mechanics, etc.
Touristic values (VTr)	
Promotion	Level and number of promotional resources
Organized visits	Annual number of organized visits to the geosite
Vicinity of visitors centers	Closeness of visitor centre to the geosite

Interpretative panels	Interpretative characteristics of text and graphics, material quality, size, fitting to surroundings, etc
Number of visitors	Annual number of visitors
Tourism infrastructure	Level of additional infrastructure for tourist (pedestrian pathways, resting places, garbage cans, toilets etc.)
Tour guide service	If exists, expertise level, knowledge of foreign language(s), interpretative skills, etc.
Hostelry service	Hostelry service close to geosite
Restaurant service	Restaurant service close to geosite

Grades (0.00–1.00)					
	0.00	**0.25**	**0.50**	**0.75**	**1.00**
1.	Common	Regional	National	International	The only occurrence
2.	None	Low	Moderate	Moderate	Utmost
3.	None	Local publications	Regional publications	National publications	International
4.	None	Moderate level of processes but hard to explain to non experts	Good example of processes but hard to explain to non experts	Moderate level of processes but easy to explain to common visitor	Good example of processes and easy to explain to common visitor
5.	None	1	2 to 3	4 to 6	More than 6
6.	Small	-	Medium	-	Large
7.	-	Low	Medium	High	Utmost
8.	Unfitting	-	Neutral	-	Fitting
9.	Totally damaged (as a result of human activities	Highly damaged (as a result of natural processes)	Medium damaged (with essential geomorphologic features preserved)	Slightly damaged	No damage
10.	None	Local	Regional	National	International
11.	Irreversible (with possibility of total loss)	High (could be easily damaged)	Medium (could be damaged by natural processes or human activities)	Low (could be damaged only by human activities)	None
12.	0	0 to 10	10 to 20	20 to 50	More than 50
13.	Inaccessible	Low (on foot with special equipment and expert guide tours)	Medium (by bicycle and other means of manpowered transport)	High (by car)	Utmost (by bus)
14.	None	1	2 to 3	4 to 6	More than 6
15.	None	1	2 to 3	4 to 6	More than 6

16.	More than 100 km	100 to 50 km	50 to 25 km	25 to 5 km	Less than 5 km
17.	None	Local	Regional	National	International
18.	None	Low	Medium	High	Utmost
19.	None	Local	Regional	National	International
20.	None	Less than 12 per year	12 to 24 per year	24 to 48 per year	More than 48 per year
21.	More than 50 km	50 to 20	20 to 5 km	5 to 1 km	Less than 1 km
22.	None	Low quality	Medium quality	High quality	Utmost quality
23.	None	Low (less than 5000)	Medium (5001 to 10 000)	High (10 001 to 100 000)	Utmost (more than 100 000)
24.	None	Low	Medium	High	Utmost
25.	None	Low	Medium	High	Utmost
26.	More than 50 km	25–50 km	10–25 km	5–10 km	Less than 5km
27.	More than 25 km	10–25 km	10–5 km	1–5 km	Less than 1 km

Source: Vujičić et al, 2011.

The first group of indicators, called **main values (MV - Main Values)**, consists of three indicators: scientific or so-called educational values (VSE - scientific and educational values), scenic or aesthetic values (VSA - scenic and aesthetic values), and level of protection (VPr - protection level). The second group of GAM indicators, **additional values (AV - Additional Values)**, is further divided into two indicators, functional (VFn - Functional Values) and tourism values (VTr - Tourism Values), as shown in Table 1. (Vujičić et al., 2011).

In total, there are 12 sub-indicators of main values and 15 sub-indicators of additional values, which vary from 0.00 to 1.00, which can be analyzed by using the following GAM equation:

$$M - GAM = MV + AV \quad (1)$$

MV (Main Values) represent the main values, defined on the basis of 3 subindicators. **AV (Additional Values)** represent additional values, defined on the basis of 2 subindicators. These values consist of many sub-values and are derived from the following formulas:

$$MV = VSE + VSA + VPr \quad (2)$$

$$AV = VFn + VTr \quad (3)$$

VSE – scientific and educational values
VSA – scenic and aesthetic values
VPr – protection level
VFn – functional values
VTr – tourism values

Now that we know that each group of sub-indicators consists of several other sub-indicators, equations (2) and (3) can be written in the following form:

$$MV = VSE + VSA + VPr \equiv \sum_{i=1}^{12} SIMV_i, \text{ leading to } \quad 0 \le SIMV_i \le 1 \ , \quad (4)$$

$$AV = VFn + VTr \equiv \sum_{j=1}^{15} SIAV_i, \text{ leading to } \quad 0 \le SIAV_j \le 1 \ . \quad (5)$$

In the presented equations, SIMVi and SIAVj represent 12 sub-indicators of the main values (i = 1,...,12) and 15 sub-indicators of additional values (j = 1,...,15) shown in Table 1. (Vujičić et al., 2011).

In the GAM model, the values for each sub-indicator are determined only by experts, while M-GAM includes not only the opinion of experts but also the opinion of visitors and tourists regarding the importance of each indicator in the evaluation process. The involvement of visitors in the evaluation process is done through a survey where each respondent is asked to determine/judge the importance (Im) of each of the 27 indicators (from 0.00 to 1.00) using a questionnaire.

The main values are shown on the X-coordinate line and the additional values on the Y-coordinate line. The matrix consists of nine fields, each of which has 4 units on the X-axis and 5 units on the Y-axis. According to the score related to the geolocation value, all locations are displayed in the matrix of the GAM model shown above. For example, if a place has a sum of three additional values and six main values, this means that it has a low level of additional values and a medium level of main values. The results obtained can be used to estimate the value of a particular geographic location. Furthermore, the results can show what tourists value and to what extent these values are present in that area (Vujičić, et al., 2011; Tomić, 2014).

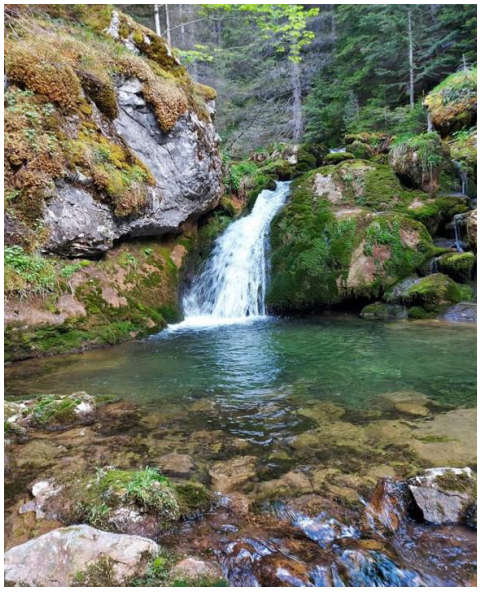

Figure 2. Geolocality Musas pit (GS_1)

Figure 3. Geolocality Waterfall "Grlja" (GS_3)

Figure 4."Bukovica" River Gorge (GS7)

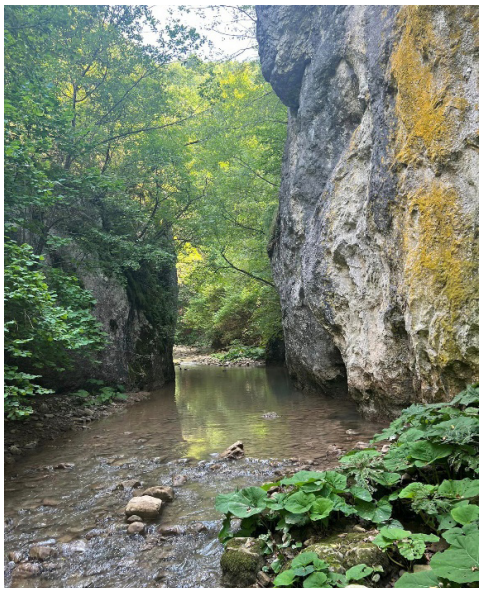

Figure 5. Limestone Ridges on "Ganića" Karst (GS6)

Figure 6. Spring "Vrelo Ibra" Rožaje (GS9)

Figure 7. Bogland Rujište (GS10)

Results and Discussion

In this research study, ten geolocalities in the municipality of Rožaje were evaluated using GAM methods. One of the goals of the paper is to compare the current state of those geolocalities and their potential for the development of geotourism. Furthermore, the goal of this paper is to find out which geolocalities in this researched area have the greatest tourist potential for the development of geotourism in the coming period, as well as their conservation for sustainable tourism. The final evaluation results are shown in Table 2, Table 3, and Figure 8.

Table 2. Sub-indicators and their values are given by experts for geolocalities of the municipality of Rožaje.

Main Indicators/ Subindicators	**Geosites Total value**									
	GS_1	GS_2	GS_3	GS_4	GS_5	GS_6	GS_7	GS_8	GS_9	GS_{10}
Scientific/Educational value (VSE)										
Rarity	0.50	0.25	0.50	0.50	0.25	0.25	0.50	0.25	0.75	0.25
Representativeness	0.25	0.25	0.50	1.00	0.75	0.75	0.75	0.25	1.00	0.50
Knowledge on geoscientific issues	0.50	0.25	0.00	0.50	0.00	0.25	0.50	0.25	1.00	0.25
Level of interpretation	0.50	0.50	0.50	1.00	1.00	1.00	0.75	0.75	0.50	0.50
Scenic/Aesthetic (VSA)										
Viewpoints	0.25	0.00	0.25	1.00	0.75	0.50	1.00	0.50	0.25	0.25
Surface	0.00	0.25	0.00	0.50	0.25	0.00	0.50	0.00	0.50	0.25
Surrounding landscape and nature	0.25	0.25	0.75	0.75	0.75	0.50	0.75	0.25	0.75	0.50
Environmental fitting of sites	0.50	0.50	1.00	0.75	0.75	0.50	0.75	0.25	0.50	0.50
Protection (VPr)										
Current condition	0.50	0.75	1.00	0.50	0.75	1.00	1.00	0.50	0.75	0.50
Protection level	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25	0.00
Vulnerability	0.50	0.50	0.75	0.75	1.00	0.50	0.75	0.50	0.50	0.25
Suitable number of visitors	0.25	0.25	0.50	1.00	1.00	1.00	0.25	0.50	0.75	1.00
Additional values (AV)										
Functional values (VFn)										
Accessibility	0.50	0.25	0.25	1.00	0.25	0.50	0.25	0.75	0.75	0.75
Additional natural values	0.00	0.25	0.50	0.50	0.75	0.50	0.50	0.25	0.50	0.25

Additional anthropogenic values	0.00	0.00	0.00	0.25	0.00	1.00	0.00	0.25	0.00	0.25
Vicinity of emissive centers	0.25	0.25	0.25	1.00	0.25	1.00	0.50	1.00	0.75	0.50
Vicinity of important road network	0.25	0.50	0.50	1.00	0.00	1.00	0.75	1.00	0.25	0.50
Additional functional values	0.00	0.00	0.00	0.75	0.00	0.50	0.50	0.50	0.00	0.25
Touristic values (VTr)										
Promotion	0.00	0.00	0.25	0.50	0.75	0.25	0.25	0.00	0.75	0.25
Organized visits	0.00	0.00	0.00	0.25	0.75	0.25	0.00	0.00	0.50	0.25
Vicinity of visitors centers	0.00	0.25	0.50	0.75	0.50	0.75	0.25	0.50	0.50	0.25
Interpretative panels	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.50	0.25
Number of visitors	0.00	0.00	0.25	0.25	0.25	0.25	0.00	0.00	0.25	0.25
Tourism infrastructure	0.00	0.00	0.50	0.25	0.25	0.50	0.00	0.00	0.50	0.50
Tour guide service	0.00	0.00	0.00	0.00	0.75	0.25	0.00	0.00	0.50	0.25
Hostelry service	0.25	0.25	0.50	0.75	0.75	1.00	0.25	0.75	0.75	0.50
Restaurant service	0.50	0.50	0.50	1.00	0.75	1.00	0.25	1.00	0.75	0.50

Table 3. Overall ranking of geolocalities of the municipality of Rožaje - using the GAM model

Geosite	Main Values	Σ	Additional Values	Σ	Total	Field
	VSE + VSA + VPr		VFn + VTr			
GS_1 – Musas pit	1.75+1.00+1.25	**4.00**	1.00+0.75	**1.75**	5.75	Z_{11}
GS_2 – Ćirko's cave	1.25+1.00+1.50	**3.75**	1.25+1.00	**1.25**	5.00	Z_{11}
GS_3 – Waterfall Grlja	1.50+2.00+2.50	**6.00**	1.50+2.75	**2.75**	8.75	Z_{21}
GS_4 – Meanders with Looping Arches in the canyon Ibar	3.00+3.00+2.25	**8.25**	4.50+4.00	**8.50**	16.75	Z_{32}
GS_5 – Grope Cirque on Hajla Mountain	2.00+2.50+2.75	**7.25**	1.25+5.00	**6.25**	13.50	Z_{22}
GS_6 – Limestone Ridges on Ganića Karst	2.25+1.50+2.50	**6.25**	4.50+4.25	**8.75**	15.00	Z_{22}
GS_7 – Bukovica River Gorge	2.50+3.00+2.00	**7.50**	2.50+1.00	**3.50**	11.00	Z_{21}
GS_8 – the Prvotunelska Cave	1.50+1.00+1.50	**4.00**	3.75+2.25	**6.00**	10.00	Z_{22}
GS_9 – Spring Vrelo Ibra	3.25+2.00+2.25	**7.50**	2.25+5.00	**7.25**	14.75	Z_{22}
GS_{10} – Bogland Rujište	1.50+1.50+1.75	**4.75**	2.50+3.00	**5.50**	10.25	Z_{22}

The results of the GAM model study are shown in Table 2 with all values for 27 sub-indicators and the final results for the main and additional values in Table 3. Tables 2 and 3 show that the sum of the main values is significantly greater than that of the

additional values. This indicates that the selected geolocations in the municipality of Rožaje have great tourist potential for the development of geotourism, but that this potential is not yet fully utilised.

Geolocations with the highest main values according to the GAM model assessment are meanders with bends in the Ibar river canyon (8.25), the Bukovica river canyon (7.50), the Vrelo Ibra spring (7.00) and the Grlja waterfall (6.00). The geolocations with the greatest scientific or educational value are the Vrelo Ibra spring (3.25), the meanders of the Ibar canyon (3.00) and the Bukovica canyon (2.50). In terms of rarity and representativeness, the meanders of the Ibar River and the Vrelo Ibra spring are the most outstanding geographical sites with extremely high values. In terms of landscape and aesthetic values, in addition to the above-mentioned geolocations, the Grlja waterfall (2.00) and the Grope Cirque on Mount Hajla (2.50) stand out with extremely high values in terms of viewpoints, surrounding landscapes and environmental adaptation. The rated geolocations with the largest area are the meanders with bends in the Ibar river canyon and the Bukovica river canyon with values (0.50), while the other geolocations fall into the category of small or medium-sized localities by area.

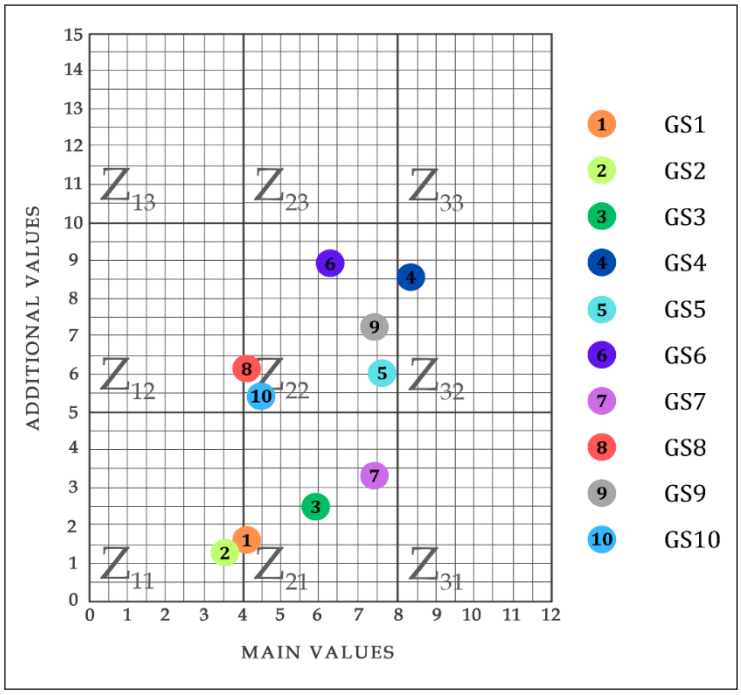

Figure 8. Position of the analyzed geolocalities in the GAM matrix.

The level of protection for all geolocations assessed has low values, especially for the localities: Musas Pit (1.25), Ćirkos Cave (1.50) and Rujište Marsh (1.75). It is particularly worrying that none of the geolocations assessed have any protection status. The current state of the geotopes falls into the "slightly damaged" or "well preserved" category. It is essential that these geolocations are protected by local or state authorities in the future, as they are likely to be endangered, i.e. damage to certain geosites may occur. It is necessary to start protection at the local level, then continue through the regional level and continue with the national or international level of protection for those objects that have been evaluated with high marks for the development of geotourism in the area, since without the transformation of these objects there will be no sustainable tourism in the future. A first protection could be done at the source of Vrela Ibra as a site of international importance for tourism development. Currently, this place is without any protection.

In terms of the most important values, Musas Pit (4.00), Ćirko Cave (3.75) and Prvotunelska Cave (4.00) are rated the lowest, as these sites are not yet fully explored and have only small areas. Knowledge about the geological and geomorphological phenomena and processes of these facilities has not yet been published and is unknown to the population and tourists. Initial valorisation of these areas has also not yet taken place.

Tables 2 and 3 show the assessed added value of all the geolocations analysed. The Limestone Ridge on the Ganića Karst geolocation (8.75) has the highest added value because it is easily accessible by car, is located near the centre of Rožaje, which suggests that there are numerous restaurants nearby, and because it is close to important transport routes. Geolocations wedged in meanders of the "Ibar" and "Vrelo Ibra" gorges are also highly rated because they are close to important regional roads and have additional natural and anthropogenic values.

The geolocations with the lowest ratings are the Musas Pit, the Ćirko Cave, the Grlja Waterfall and the Bukovica River Canyon, as the terrain is extremely inaccessible and a long distance from major centres and important transport routes. Furthermore, there are no organised tours to these geolocations. In terms of added value for tourism, the geolocations Grope cirque (5.00) and Vrelo Ibra (5.00) should be highlighted, as there are organised tourist visits. In most cases, these are visits by mountaineers who go on a hike to the summit of Hajla (2,403 m). They usually also visit the Vrelo Ibra geolocation via Bandžo, which is why this geolocation is so important in terms of organising tourist visits. There are no organised tourist visits to most of the other geolocations.

The importance of the value of tourists should not be diminished. Tourists and their values are very important factors for the promotion and further development of sustainable geotourism. It should be mentioned that there is a tourist infrastructure

in the form of well-maintained and marked hiking trails, resorts up to Mount Hajla, as well as a guide service and information boards on these geolocations. In addition, there are a large number of organised visits to these places, which are even promoted internationally as excellent hiking destinations. With the aim of making the tourist offers more successful and attractive, the installation of display boards with high-quality texts, graphics and materials could make an important contribution to these geolocations. The size and overall external appearance of the panels should be adapted to the natural environment at all geolocations. As tourists are often people who know little about the geology and geomorphology of the places they visit, it is necessary to explain the nature of the surrounding geolocation on the panels in a way that is understandable in relation to the geology and geomorphology of the object.

When analysing the additional functional values, one could say that the biggest problem of these geo-locations is the lack of parking spaces for the development of tourist destinations near the geo-locations. None of the geolocations analysed have car or bus parking. The promotion of geolocations is visible on the official website of the Rožaje Tourist Organisation for the geolocations Cirque Grope on Hajla Mountain, Ibar Spring and Rujište Marshes, while the other seven geolocations are not on the website of the Rožaje Tourist Organisation, although the importance of media promotion of geolocations through electronic media for the development and promotion of the tourist offer in the Municipality of Rožaje should not be neglected.

After the evaluation according to the GAM model of main and additional values, the results are presented in the GAM matrix with their values. In field Z32, there is only one geolocation - meanders with loop bends in the Ibar River canyon (GS4), which indicates that this geolocation stands out from the other geolocations assessed as the geolocation with the greatest potential for the future development of geotourism. In field Z22, there are 50% of the assessed geolocations (GS5, GS6, GS8, GS9, GS10) with high ratings of the main and additional values, which characterises these geolocations as having great tourist potential for the future development of geotourism in the municipality of Rožaje. These geolocations were rated with high scores for the main values, especially for the landscape and aesthetics, which is a very important motive for tourists to visit. Therefore, it can be said that it is very important to invest in the tourist values of these geolocations in order to attract as many tourists and visitors as possible to these geolocations in the coming period.

Conclusion

The main objective of this work was the inventory of geoheritage objects and their valorisation and geoconservation for the development of geotourism in the area of the Municipality of Rožaje using the GAM model (Geosite Assessment Model), in which the assessment of ten geosites determines the degree of potential for the development of geotourism in the future. All ten geolocations assessed have significant tourism potential based on natural resources, especially considering the scenic and aesthetic values that are the most valuable features of this area.

The results of the study show that no place has tourist facilities for a more significant development of tourism in the form of promotion and organised visits, with poor tourist infrastructure in all geographical locations. A major problem is the lack of tourist guides in these places. Regarding the level of protection of these geolocations, the results obtained show that the values are very low, as the geolocations are currently not protected and the objects will be highly endangered in the future. On the positive side, the geolocations are currently undamaged. It is worth noting that additional efforts should be made to place these sites under local or national protection in the coming period.

For the future development of geotourism in the municipality of Rožaje, additional infrastructure is needed in the form of interactive panels, modern maps and brochures with mapped geolocations, possibly with the construction of a visitor centre that would provide the necessary information about the geolocations, as well as interpretation that could be presented to tourists in the form of knowledge transfer by professional staff. Currently, little is known about these geolocations. Geological and geomorphological knowledge is at a low level. Unfortunately, it can be said that the level of interpretation of the analysed geolocations is poor.

The development of geotourism in the municipality of Rožaje would enrich the tourist offer of this town. This area should focus its future development on tourism, as it has great tourist potential. The Municipality of Rožaje and the local tourism organisations of Rožaje should recognise its geotourism potential as a future form of tourism for the development of the municipality in the future. Geotourism in the municipality of Rožaje would enrich the tourist offer in the town and provide additional economic income. In the future, the exploration of the geolocality of this area should be continued, as there is a high concentration of geodiversity in this area, which offers great opportunities for the future development of geotourism.

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Original scientific article
Received: 19.03.2024;
Received in revised form: -
Accepted: 03.04.2024;
Available online: 14.10.2024.

UDC: 37:91
doi: 10.5937/zrgfub2472095V

HIGH SCHOOL STUDENTS' ATTITUDES TOWARDS GEOGRAPHY: AN INDICATOR OF THE NEED FOR INNOVATIVE APPROACHES IN GEOGRAPHY TEACHING

Jovana Vuletić[1]*, Milan Miletić**

Abstract: The importance of geography lessons lies in the fact that we learn something about the space in which we live, which is important for all people regardless of their interests. A student's interest in a subject and thus the acquisition of its content depends on the student's attitude towards the subject. For this reason, this study examines the attitudes of secondary school students towards the subject of geography, which differ in terms of their subject of study, their favourite subject and the faculty in which they would like to enrol. The data collected with the questionnaire was processed with the statistical software SPSS 26.0. The neutral attitude of the students towards geography as a subject indicates that geography teaching needs to be modernised and carried out using modern teaching methods. The application of teaching innovations in geography lessons would contribute to greater student interest in geographical content and thus to better student performance in this subject.

Keywords: Geography, students attitudes, innovative teaching approaches

Introduction

Geography has a unique object of study, the geographical environment, which consists of natural and social contents. The spatial analysis of natural and human phenomena and their interrelations distinguishes geography from other natural and social sciences and gives it a multidisciplinary character. In addition to the formation of a scientific view of the world and the development of geographical skills, which include general and subject-specific competences, the school subject of geography plays a very important role in the formation of a complete personality. Geographical

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culture implies patriotic, international and ecological education. The acquisition of geographical content contributes to the individual's responsible behaviour towards the environment and other people. Regardless of the profession that people pursue, they make decisions that have a direct and indirect impact on the environment. Therefore, it is important that during education they acquire the right attitudes and habits that contribute to the protection and improvement of the environment and the preservation of peace and tolerance between people (Hopwood, 2009; Grčić, Grčić, 2009; Kubiatko, Janko, Mrazkova, 2012; Jovanović, 2019).

The adoption of educational goals in a subject depends on students' interest in that subject. Research suggests that students are more motivated to learn when the content is interesting, related to everyday life and useful for their future development. Despite this conclusion, research on students' attitudes towards any subject is not widespread (Sack, Petersen, 1998; Osborne, 2003). Various authors have investigated primary and secondary school students' attitudes to geography in different contexts, usually using questionnaires to investigate the influence of different factors (gender, age, teacher attitude, classroom working practises) on attitudes to geography, and have attempted to identify what changes need to be introduced into geography teaching to make students' attitudes to geography more positive and therefore more successful in achieving the aims of geography teaching (Adey, Biddulph, 2001; Hopwood, 2004; Weeden, 2007; Hugh McTeer, 2007; Korkmaz, Karakuş, 2009; Tomal, 2010; Bar-Gal, Sofer, 2010; Abdullah Al-Nofli, 2010; Ozdemir, 2012; Senyurt, 2014; Ntiamoah Ntim et al., 2020; Karademir, 2020; Opoku, Serbeh, Gyampoh Amoah, 2021). Research has shown that students who do not have a good opinion of their geography teacher, find his or her teaching methods boring, do not succeed in learning geography or believe that geographical knowledge will not be useful to them in their chosen profession have a negative attitude towards geography. Students who have a positive attitude towards geography are those who like their geography teachers, who see the connection of geography lessons to everyday life, who learn geography lessons on field trips, who believe that geographical research can provide a solution to economic, political and environmental problems and who actively participate in geography lessons. To achieve students' positive attitudes towards geography, the authors suggest that teachers encourage students to engage in research activities and experiential learning on field trips, and teach students how to acquire the necessary knowledge and skills and how to use them in solving problems. In the classroom, teachers need to use a variety of methods, resources and materials such as media, internet, electronic devices, etc. and link lessons to current events and news. No work was found in the domestic literature examining the attitudes of students, both primary and secondary, towards geography.

This study investigates whether there are differences in attitudes towards geography among students of different majors in high schools, whether the favourite subject affects the student's attitude towards geography, and whether the faculty that students want to enrol in affects their attitude. In accordance with these questions, the following research hypotheses are defined:

1. Students who attend the geographical-historical major have a more positive attitude towards geography compared to students of other majors who participated in the research.
2. Students whose favourite subject belongs to the group of science subjects have a more positive attitude towards geography than students whose favourite subject does not belong to this group of subjects.
3. Students who would like to enrol in one of the faculties belonging to the Faculty of Science and Mathematics show a more positive attitude towards geography compared to students who want to study faculties that do not belong to this group of sciences.
4. There is no difference in attitude towards geography between boys and girls.

Materials and methods

Creating a questionnaire about geographical attitudes

The questionnaire was taken from the work of authors Kubiatko, Janko, Mrazkova (2012) who examined the attitudes of students who attend lower grades in secondary school in the Czech Republic about geography. The mentioned authors adapted the questionnaire to the research of attitudes about geography based on the questionnaire about biological attitudes of authors Prokop, Tuncer, Chud´a (2007).

The first part of the questionnaire consists of demographic variables such as gender, major in gymnasium, favourite subject, and faculty that students would like to enrol in. This part has been changed compared to the original questionnaire and contains variables based on which the author wanted to examine differences in students' attitudes about geography between certain groups. The second part of the questionnaire was taken in the original, translated from English to Serbian, and contains 27 items (attitudes). Students' attitudes about geography were measured using a Likert five-point scale. For each attitude, students circled the degree to which they agree with it on a scale from 1 (I do not agree at all) to 5 (I completely agree). The questionnaire contains positively and negatively formulated attitudes. Negative attitudes are inversely scored compared to positive ones.

Research sample

The sample consisted of 102 students attending two gymnasiums in Nis. The study involved 64 boys and 38 girls. In one gymnasium, third-year students of the general major, third-year students with special abilities for sports, and second-year students with special abilities for computing and informatics were surveyed. From the other gymnasium, third-year students of the scientific-mathematical major, third-year students with special abilities for geography and history, and second-year students with abilities for scenic and audio-visual art were surveyed. For each major, students of the highest grade in which they have geography were examined, except for the geographical-historical major. For this major, it is envisaged to have geography also in the fourth year, but the program (major) was accredited from the school year 2020/21, so the third year represents the highest grade of this major at the time of the survey (school year 2022/23). All classes from one gymnasium are taught by the same teacher, while in the other gymnasium two majors have the same teacher, while the third major is taught by another teacher. Geography teaching in both schools is mostly conducted in a traditional way. The lecture-based learning with the use of wall maps dominates, the activity of the students is limited to answering questions in order to link the new teaching unit with the previously acquired knowledge.

Statistical procedure

Authors Kubiatko, Janko, Mrazkova (2012) used factor analysis to distinguish four specific dimensions: (1) Geography as a school subject (five items), (2) Geography and the environment (six items), (3) The importance of geography (five items), (4) Relevance of geography lessons to students life (eleven items). The division of items into these four dimensions has been retained in this paper.

The reliability of the questionnaire was determined using Cronbach's alpha coefficient. The reliability value of the entire scale is $\alpha = 0.90$. The high value of Cronbach's alpha coefficient of the scale confirmed its reliability for further analysis.

After scoring the students' answers, the number of points was added up for each student and divided by the number of attitudes to get the average value, for easier analysis of the results, which indicates what the student's attitude towards geography is. Higher values indicate a more positive attitude, and lower ones a more negative one. These values were used when examining the existence of differences between certain groups of students who were divided according to gender, majors in gymnasium, favourite subject, and faculty they want to enrol in.

To determine the existence of a statistically significant difference in attitudes towards geography between boys and girls, a t-test was used because the existence of a normal distribution of data was determined in both categories. The existence

of differences between attitudes towards geography according to other independent variables was done using the Kruskal-Wallis test, a non-parametric substitute for Univariate One-Way Analysis of Variance (ANOVA). The Post Hoc test (Tukey) was used for a more detailed analysis, i.e., determining between which categories there are statistically significant differences, and then based on the median it was determined how much they amount to.

Results

The values of Cronbach's alpha coefficient for the separated subscales are: (1) Geography as a school subject ($\alpha = 0.81$), (2) Geography and the environment ($\alpha = 0.57$), (3) The importance of geography ($\alpha = 0.75$), (4) Relevance of geography lessons to students life ($\alpha = 0.83$). In an ideal case, Cronbach's alpha coefficient should be greater than 0.70 (DeVellis, 2003). Three subscales have values $\alpha > 0.70$ which indicates their reliability. One subscale has a value $\alpha = 0.57$, the analysis showed that by deleting certain attitudes from this subscale, Cronbach's alpha coefficient could exceed the value of 0.59 which was considered acceptable in the studies of Dhindsa and Chung (2003) and Francis and Greer (1999). However, this was not respected in this paper and the attitudes that belong to this subscale were excluded from further analyses.

Table 1. Mean value, standard deviation, minimum and maximum value of the score describing students' attitudes towards geography for the entire questionnaire and specific dimensions

	x	SD	min	max
Whole questionnaire	3.12	0.70	1.33	4.76
Geography as a school subject	2.86	0.95	1.00	5.00
The importance of geography	2.87	0.82	1.00	4.60
Relevance of geography lessons to student life	3.36	0.73	1.18	5.00

x -mean value, SD - standard deviation, min - minimum value, max - maximum value

The t-test did not show that there is a significant difference between boys and girls in their attitude towards geography ($p > 0.05$). The Kruskal-Wallis test showed that there is a statistically significant difference between students who attend different majors in gymnasium and based on the faculty they would like to enrol in ($p < 0.05$), while in relation to the students' favourite subjects, no statistically significant difference was obtained ($p > 0.05$). By analysing the answers to the question of what their favourite subject is, students were divided into five groups between which the existence of differences in attitudes about geography was examined: (1)

science subjects (biology, geography, chemistry, and physics), (2) technical subjects (mathematics, informatics, programming), (3) humanities subjects (Serbian, English, German, history, audio-visual art, scenic art), (4) health and physical education subjects (physical education, sport and training, sport and health) and (5) students who do not have a favourite subject.

Table 2. Results of the Post Hoc test for the independent variable educational major

		p*
general	geographical-historical	0.001
	scenic and audio-visual	0.008
informatics	geographical-historical	0.000
	scenic and audio-visual	0.000
scientific-mathematics	geographical-historical	0.001
	scenic and audio-visual	0.004

*p < 0,05 – there is a statistically significant difference

The Post Hoc Tukey test determined that there is a significant difference between the geographical-historical major and the major for scenic and audio-visual art in relation to the general, informatics, and scientific-mathematical major (Table 2), while in the sports major, no significant difference was noted in relation to any other major.

According to the faculty they would like to enrol in, students are divided into seven groups: (1) scientific-mathematical (mathematical, biological, chemical, geographical, physical) faculties, (2) social-humanistic (law, economics, political, teacher, philosophical, philological, security faculty and faculty of sports and physical education), (3) medical (medical, dental, pharmaceutical, veterinary) faculties, (4) technical-technological (architectural, civil, electrical, mechanical, faculty of organizational sciences), (5) faculties belonging to the University of Arts (faculty of dramatic arts, faculty of applied sciences), (6) University of Defence and (7) students who still do not know which faculty they want to enrol in or do not want to enrol in it. Between these groups, the existence of statistically significant differences was determined. Subsequent tests singled out statistically significant differences between students who would like to enrol in one of the faculties belonging to the University of Arts and students who would like to enrol in medical and technical-technological faculties. Also, a significant difference was observed between students who have opted for one of the social-humanistic faculties and technical-technological faculties (Table 3).

Table 3. Results of the Post Hoc test for the independent variable of the faculty that students want to enroll in

		p*
technical-technological	social-humanistic	0.042
	University of Arts	0.002
medical	University of Arts	0.011

*p < 0,05 – there is a statistically significant difference

Statistical analysis of specific dimensions

The impact of independent variables on specific dimensions was analysed for all four categorical variables (gender, major, favourite subject, and faculty that students want to enrol in). In no specific dimension (Geography as a school subject, Importance of geography, Relevance of geography lessons to students life) was a statistically significant difference confirmed between boys and girls ($p > 0.05$).

When we look at the independent variable of major in high school in all three dimensions, the existence of statistically significant differences ($p < 0.05$) was determined. Detailed analysis showed that in the dimension "Geography as a school subject" a significant difference exists between the major for scenic and audio-visual art compared to informatics ($p = 0.02$) and scientific-mathematical ($p = 0.01$) major. In the dimension "Importance of geography" significant differences exist between the geographical-historical major and general ($p = 0.04$), informatics ($p = 0.03$) and scientific-mathematical ($p = 0.004$) major, major for scenic and audio-visual art compared to informatics ($p = 0.000$) and scientific-mathematical ($p = 0.01$) major and between sports and informatics major ($p = 0.03$). In the dimension "Relevance of geography lessons to students life" a significant difference exists between the geographical-historical major and general ($p = 0.000$), informatics ($p = 0.005$) and scientific-mathematical ($p = 0.001$) major, as well as between the major for scenic and audio-visual art and general ($p = 0.003$) and scientific-mathematical ($p = 0.04$) major.

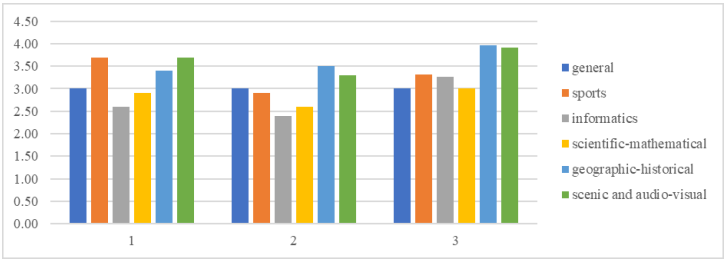

Figure 1. The value of the median rating of students' attitudes towards geography in specific dimensions in relation to the major they attend in gymnasium. f1 = Geography as a school subject, f2 = Importance of geography, f3 = Relevance of geography lessons to students life

For the independent variable favourite subject, the existence of significant differences was determined only in two specific dimensions "Geography as a school subject" and "Importance of geography" ($p < 0.05$). In both specific dimensions, "Geography as a school subject" ($p = 0.030$), "Importance of geography" ($p = 0.015$), a significant difference exists only between groups of students who have chosen one of the humanities subjects as their favourite subject and students whose favourite subject belongs to the technical group of subjects.

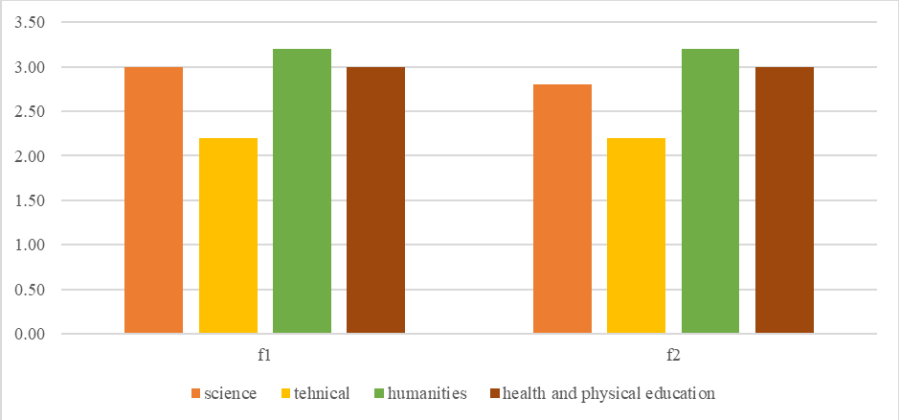

Figure 2. The value of the median rating of students' attitudes towards geography in specific dimensions in relation to the student's favorite subject. f1 = Geography as a school subject, f2 = Importance of geography

In all three specific dimensions, the existence of a statistically significant difference was determined between the categories of the independent variable of the faculty that students want to enrol in. In the dimension "Geography as a school subject", a significant difference exists between students who want to enrol in one of the faculties belonging to the University of Arts compared to students who want to enrol in a medical ($p = 0.019$) and technical-technological ($p = 0.044$) faculty. In the dimension "Importance of geography", significant differences exist between students who want to enrol in one of the faculties belonging to the technical-technological group compared to students who want to enrol in one of the faculties of the University of Arts ($p = 0.000$), social-humanistic faculties ($p = 0.000$) and those students who do not know which faculty they want to enrol in or do not want to enrol in a faculty ($p = 0.005$), as well as between students who want to enrol in one of the art faculties compared to those who want to enrol in one of the medical faculties ($p = 0.018$). In the dimension "Relevance of geography lessons to students life", a significant difference exists between students who want to enrol in one of the faculties belonging to the University of Arts compared to students who want to enrol in one from the group of technical-technological ($p = 0.033$) faculties."

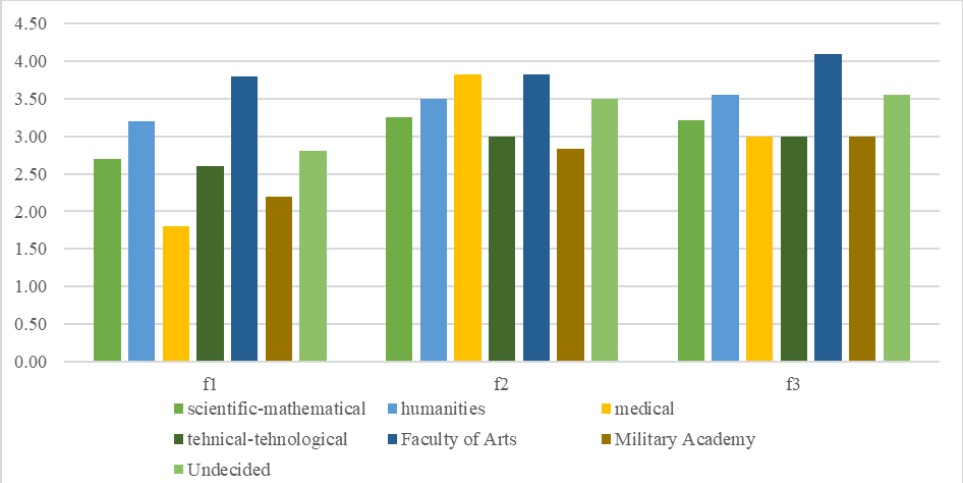

Figure 3. The value of the median rating of students' attitudes towards geography in specific dimensions in relation to the faculty that students want to enroll in. f1 = Geography as a school subject, f2 = Importance of geography, f3 = Relevance of geography lessons to students life

Discussion

The average grade that describes the attitude of students who participated in the research (x = 3.12) can be characterized as neutral. This may indicate that students do not consider geography difficult, but neither interesting due to the classical way of teaching which implies passivity of students who are expected to memorizes a large number of information without research activities. According to Weeden's research (2007), students enjoy learning when they do it through activities such as watching video recordings, excursions, drawing maps and diagrams, working on a project, discussion, making posters, etc. When we look at the average grade of students for each of the specific dimensions, the highest result and the only one above the total average grade is the dimension "Relevance of geography lessons to students life" (x = 3.36), while the remaining two dimensions "Geography as a school subject" (x = 2.86) and "Importance of geography" (x = 2.87) have a lower value of the average grade compared to the total average grade. Students in their daily life notice contents related to geography, but still do not give it greater importance as a science that studies natural and social phenomena on Earth. Tandarić and Tekić (2013) in their research examined the attitude of the Croatian public towards geography as a science and a school subject and got positive results. However, during the research, they noticed that the understanding of the subject of study of geography is incomplete

and that the conclusions about the subject of study of geography are mostly based on the contents studied in school. A similar lack of knowledge of the subject of study of geography was also obtained by King (2007) in her research. There is a possibility that for similar reasons students do not see the importance of geography as a science that can provide solutions for local, national and global growing economic, social and ecological problems. Therefore, it is necessary to put geography teaching in the function of education for sustainable development which implies active participation of students in the learning process and the local community by which students could see the importance of possessing geographical knowledge and skills (Anđelković, 2018).

The analysis of the results has shown that there is a statistically significant difference in attitudes towards geography between students who attend different subjects at grammar school. Further analysis revealed between which subjects, and by comparing the scores of attitude towards geography, it was found that the geographical-historical and scenic and audiovisual arts majors have the same value of the median, so the first hypothesis of the work is partially confirmed because the first place in the most positive attitude towards geography with the geographical-historical major shares the scenic and audiovisual arts major. It is also interesting to note that the students of the scientific-mathematical major have the most negative attitude towards geography, although this major belongs to the same grammar school as the major that has the most positive attitude towards geography (Figure 4). However, the scenic and audiovisual arts subject is taught by a different teacher than the other two subjects, so the more negative attitude of the science and maths subject may be a result of the students' opinion of the teacher. Attitudes towards a subject depend largely on the students' opinion of the subject teacher. The teacher's working style, behaviour towards students outside the classroom, attitude to work and subject knowledge all influence the students' opinion of the teacher. A positive attitude towards the teacher increases the students' interest in the subject and vice versa. The inclusion of new factors in the study, such as the students' opinion of the geography teacher, could explain why such results were obtained (Tomal, 2010).

The second hypothesis of this study could not be confirmed, as no statistically significant difference was found between the groups of students who were divided according to their favourite subjects. The authors Kubiatko, Janko, Mrazkova (2012) put forward the same hypothesis in their study and obtained results that confirmed it. Lower secondary school students in the Czech Republic who named a subject from the group of natural science subjects as their favourite subject had a more positive attitude towards geography than students with a favourite subject from another subject group.

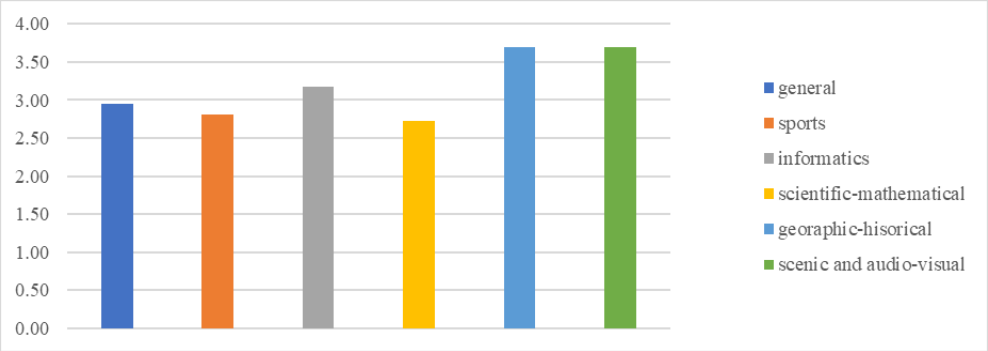

Figure 4. Median values of students' attitude rating according to the categories of the independent variable educational major.

Interesting results were obtained when testing the third hypothesis. The existence of a statistically significant difference between the groups of students categorised according to the faculty in which they intend to enrol was confirmed. The group of students wishing to enrol in one of the faculties of the University of the Arts has the highest median attitude towards geography, while the group of students wishing to enrol in one of the medical faculties has the lowest (Figure 5), thus disproving the third hypothesis that the group of students wishing to enrol in one of the science and mathematics faculties has the most positive attitude towards geography. In some studies (Adey, Biddulph, 2001; Hopwood, 2004; Norman, Harrison, 2004), the authors state that students' attitudes towards a subject also depend on their perception of the potential of the subject, i.e. the extent to which the knowledge and skills acquired in the teaching of a particular subject will be useful in their future careers. Geography belongs to the group of general education subjects, so the recognition of its importance for people's lives and work by "artists" is optimistic, but further research is needed to investigate why other groups do not have more positive attitudes towards the importance of geographical content.

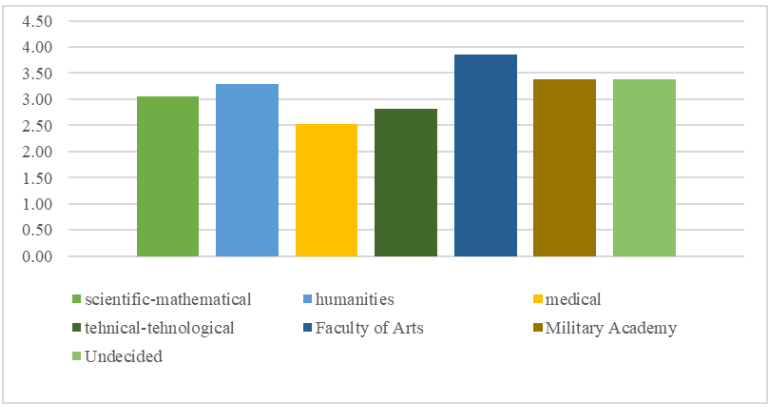

Figure 5. Median values of students' attitude rating according to the categories of the independent variable faculty that students want to enroll in

Weinburgh (1998) notes that gender has a consistent influence on attitudes towards science among all variables, that research is frequently conducted examining the difference in men's and women's attitudes towards science, and that several studies have shown that men have more positive attitudes than women. In the studies by authors Ozdemir (2012), Kubiatko, Janko, Mrazkova (2012), Senyurt (2014) and Ntiamoah Ntim et al. (2020), males have a slightly more positive attitude towards geography than females, while in this study the opposite result was obtained, girls have a slightly more positive attitude than boys, but there is no statistically significant difference between them, so the fourth hypothesis of this paper is confirmed. In England and Wales, geography is an optional subject which, according to Wedeen (2007), is more popular with boys than girls, even though girls achieve better in geography, but the reason for this is not known and requires further research.

Pupils' attitudes towards a subject are influenced by a variety of factors. It was analysed in this study on the basis of independent variables selected to express which sciences students are interested in and whether and how this influences their attitude to geography. The shortcoming of the study is that not all subjects that participated in the research are taught by the same teacher, because as mentioned before, the attitude towards a subject also depends on the students' opinion about the teacher who teaches them that subject, so a more positive attitude towards geography can be a consequence of a good opinion about the geography teacher, even if there are no internal interests in geography, and vice versa. Compared to the student population, the sample is very small, so extending it to students from other high schools, secondary schools and primary schools, who may also come from other cities or villages, could add new variables to the study and provide a more complete picture of the popularity of geography as a science and school subject among students.

Conclusion

The results regarding students' attitudes towards geography are not optimistic. As mentioned above, geography is a general education subject and the acquisition of real geographical knowledge, thinking and geographical skills is important for all students, regardless of their interests and the profession they wish to pursue. It is necessary for geography teachers to work together with curriculum designers to popularise geography as a science and school subject, and various companies and geography experts could support them in this. By actively involving students in the process of geography teaching, contextual and constructive learning, environmental teaching, playful teaching, research and projects, students would be more motivated to learn and have a more positive attitude towards geography, which would lead to more successful achievement of the educational goals of geography teaching.

Survey questionnaire

Dear students,

In front of you is a survey questionnaire, which is intended to research the attitudes of students about geography as a subject.

It will take you 10-15 minutes to fill out the survey.

The survey is completely anonymous. The data collected by the survey will be used exclusively for the purposes of writing a scientific paper.

Sex: M F

Educational profile (major): _____

What is your favorite subject? _____

Which faculty would you like to enroll? _____

Below are 27 statements related to geography as a subject. For each mark the statement with a number from 1 to 5 that corresponds to your degree of agreement with it.

1 – I do not agree at all

2 – I do not agree

3 – I partially agree

4 – I agree

5 – I completely agre

Ordinary number	Claim	Degree of agreement				
1	I like geography more than other subjects	1	2	3	4	5
2	We do not use teaching aids in geography classes	1	2	3	4	5
3	Geography and nature are not close to me	1	2	3	4	5
4	Geography lessons are difficult for me to learn	1	2	3	4	5
5	Geography lessons developed my knowledge and skills	1	2	3	4	5

6	I wish we had geography lessons more often	1	2	3	4	5
7	Geographical knowledge is essential for understanding other subjects	1	2	3	4	5
8	I'm bored in geography class	1	2	3	4	5
9	The teacher's explanations in geography classes are interesting to me	1	2	3	4	5
10	Geographical knowledge can help solve problems related to the environment	1	2	3	4	5
11	I use geographical knowledge in my everyday life	1	2	3	4	5
12	Geographical knowledge is necessary for the job I want to do	1	2	3	4	5
13	Geography is interesting to me because it is taught by an expert teacher	1	2	3	4	5
14	Maps, atlases and globes used in geography classes are interesting to me	1	2	3	4	5
15	Geography in not an important subject compared to other subjects	1	2	3	4	5
16	More effort is needed to understand geography material	1	2	3	4	5
17	Nature is integral part of human life	1	2	3	4	5
18	When I finish my studies, I would like to work in science	1	2	3	4	5
19	Geographical knowledge is not useful in everyday life	1	2	3	4	5
20	I don't like geographies	1	2	3	4	5

21	I don't like the way my geography teacher works	1	2	3	4	5
22	In geography lessons, we use different teaching ads	1	2	3	4	5
23	The processes that take place in the environment are very interesting to me	1	2	3	4	5
24	Geography as a subject is able to explain the impact of man on nature Teaching materials	1	2	3	4	5
25	Teaching materials (books, magazines, videos, souvenirs, etc.) related to geography are interesting to me	1	2	3	4	5
26	Geography as a subject allows us to understand the thinking and behavior of people from other countries	1	2	3	4	5
27	Geography is one of the easiest subjects for me	1	2	3	4	5

Thank you for your cooperation!

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Original scientific article
Received: 20.03.2024;
Received in revised form: 10.04.2024;
Accepted: 09.05.2024;
Available online: 14.10.2024.

UDC: 528.8(1-751.2)(497.11)
doi: 10.5937/zrgfub2472113J

APPLICATION OF MULTISPECTRAL IMAGING IN FOREST MONITORING – A CASE STUDY OF NATIONAL PARKS IN REPUBLIC OF SERBIA

Tijana Jakovljević[1]*, Snežana Đurđić**

Abstract: Deforestation and forest degradation are one of the most complex ecological challenges worldwide. Multispectral imaging and remote sensing help researchers and forest managers to quantify forest loss and degradation. By combining multiple bands of satellite data, multispectral indices can highlight changes in forest structure and reduce the cost and time required for field research. In this research multispectral indices and remote sensing are used in different areas of forestry (such as deforestation, wildfires, phenology) and five examples of remote sensing in forest monitoring are presented. The Normalized Difference Vegetation Index (NDVI) is used to quantify deforestation in ski center in Kopaonik National park. The Normalized Burn Ration (NBR) is used to assess forest fire damage in Šar planina National Park. The Soil Adjusted Vegetation Index (SAVI) is used to monitor some phenological events in Fruška gora National Park. The moisture content of vegetation in Djerdap National Park is analyzed with the Normalized Difference Moisture Index (NDMI) and pest damage is monitored with the NDVI and the Normalized Difference Red-edge Vegetation Index (NDRE) in Tara National Park. The results of these five case study analyses show that multispectral imaging provides the most evident results in monitoring deforestation, while pest and disease damage is difficult to detect.

Keywords: multispectral indices, remote sensing, forest, Kopaonik, Tara, Šar planina, Fruška gora, Djerdap

Introduction

The Food and Agriculture Organisation and the United Nations Environment Programme (2020) announced that 420 million hectares of forest have been lost

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since 1990. Three quarters of the forest loss is due to agriculture, which cuts down forests to grow crops, raise livestock and manufacture products such as paper (Ritchie, 2021).

In addition to deforestation, i.e. the loss of forests, forest degradation has also become increasingly common in recent decades. According to the International Union of Conservation of Nature, the conversion of forest to uses other than forestry is defined as deforestation, while degradation "occurs when forest ecosystems lose their capacity to provide important goods and services to people and nature" (https://www.iucn.org/resources/issues-brief/deforestation-and-forest-degradation). It refers to a reduction in forest growth or forest fruits or an imbalance in forest ecosystems. The indicators of forest degradation are diverse, such as canopy thinning, decrease in structural diversity, decrease in growth, increase in individual mortality, decrease in biodiversity (loss of important species, spread of invasive species), decrease in protective functions (e.g. increase in soil loss), decrease in production function, loss of regenerative capacity (Vásquez-Grandón, Donoso, & Gerding, 2018; Stanturf et al., 2014).

According to the European Commission's final report (2020) "Monitoring of Forests through Remote Sensing", remote sensing is used in the following areas of forestry: phenology, illegal logging, pests and diseases, forest fires, storm damage, forest drought and water content monitoring. There are numerous research papers that use remote sensing to analyse forests in the Republic of Serbia (Todorović & Gajović, 2013; Potić et al, 2017; Potić, Bugarski & Matić-Varenica, 2017; Šurjanc et al, 2019; Brovkina et al, 2020; Jovanović & Milanović 2021; Potić et al, 2022; Simović et al, 2022; Potić et al, 2023). This paper analyses the application of multispectral imaging in the research areas of deforestation, phenological events, pest monitoring, forest fires and water content monitoring using the example of five national parks in Serbia. The most valuable natural forest vegetation is found in the protected areas of national parks.

Deforestation

Remote sensing methods to detect illegal logging are mainly used in rough and large forest areas due to obstacles and difficulties in monitoring on the ground. There are numerous research works (Torres et al., 2021; De Bem et al., 2020; Cabral et al., 2018; Ortega Adarme et al., 2020) that use satellite data and different methods to detect and quantify illegal and legal deforestation in the Amazon forest, which is of great importance due to its large area and high deforestation rate, but also in terms of biodiversity conservation. The Brazilian National Institute for Space Research (INPE) has developed the DETER (Deforestation Detection in Real Time) system to monitor and control deforestation in the Amazon region since 2004. It uses the

MODIS instruments - Spectrum Radiometer of Moderate Image Resolution (http://www.inpe.br/amazonia1/en/uses_applications.php),

In the Republic of Serbia, there is no specific platform or service that provides data on legal or illegal deforestation, but there are several studies that have used remote sensing to estimate deforestation in some regions most affected by illegal deforestation, e.g. in southern Serbia (Potić et al., 2022), south-eastern Serbia (Potić et al., 2023) and Kursumlija municipality (Jovanović & Milanović 2021).

Wildfires

The European Commission (2020) recognizes three phases of forest fire monitoring:

1. Pre-fire phase (fuel mapping, fire risk assessment, etc.)
2. Active phase (fire detection, fire temperature retrieval etc.)
3. Post-fire phase (map burned areas, fire severity assessment, vegetation recovery mapping, forest restoration).

The European Forest Fire Information System (EFFIS) is one of the most developed services providing information on fire risk prediction, active fire detection, rapid damage assessment, fire damage assessment, fire emissions, forest fire risk assessment, seasonal forecast, monthly forecast, European Fire Database, fuels, etc. (https://effis.jrc.ec.europa.eu/). It is mainly based on data collected with the MODIS and VIIRS tools (European Commission, 2020).

Szpakowski and Jensen (2019) provided a comprehensive overview of remote sensing applications in different phases of fire management (fire risk mapping, fuels mapping, active fire detection, burnt area estimation, fire severity assessment and post-fire vegetation recovery monitoring). In terms of fire risk assessment and mapping, two primary methods are mentioned: point-based operational systems based on meteorological data and the use of remote sensing technologies and geographic information systems (GIS) that incorporate different variables (e.g. land cover classification, multispectral indices, altitude, slope, aspect, distance from roads and proximity to settlements). Perezo-Cabello, Montorio and Borini (2021) examined the most commonly used indices, techniques and algorithms to quantify post-fire vegetation recovery and concluded that vegetation recovery is primarily analysed using multispectral optical satellite imagery.

The information on forest fires on the territory of the Republic of Serbia is included in the European Forest Fire System. There are also numerous research works that use remote sensing to analyse and map the risk (Gigović et al., 2019; Novkovic et al., 2021) or the consequences of forest fires (Todorović & Gajović, 2013; Potic et al., 2017; Brovkina et al., 2020).

Phenological events

Bajocco et. al (2019) used text mining to analyse the number and structure of publications on remote sensing phenology between 1979 and 2018 and found 2315 scientific publications in the Scopus archive and concluded that research in the field of remote sensing phenology has increased significantly. Berra and Gaulton (2020) concluded in their review that 'at best, the timing of satellite-based phenological events on the land surface can be detected with a confidence of about half a week for spring metrics and about a week for autumn metrics".

Remote sensing for monitoring phenological events is more commonly used in the agricultural sector in the Republic of Serbia (Ljubičić et al. 2018; Pandžić et al., 2020; Ranđelović et al., 2023). There are only a few studies that analyse the phenophase of forests in the Republic of Serbia or in the region using remote sensing (Kern et al., 2017; Simović et al., 2022).

Pest and disease

There are three stages of invasion of pests and diseases in forests (European Commission, 2020; Huo, Persson & Lindberg, 2021; Luo, Huang & Roques, 2023):

1. Green attack (early stage with no visible change in the crown or tree)
2. Red attack (second stage, leaves and needles turn red or yellow)
3. Grey attack (last stage, leaves and needles lose their color and the trees die).

The European Commission's final report on forest monitoring by remote sensing states that the impact of pests and diseases can be recognised, but that there is no specific 'spectral fingerprint' to distinguish a particular pest from another health problem. Forest protection is all about early detection of pests and diseases, which is quite difficult due to the lack of visible signs of the problem. The need for very high spatial resolution data may still be the biggest obstacle for most researchers and forest managers to use remote sensing more often for pest and disease detection and control.

Remote sensing is used to detect and monitor pests and diseases in the forests of the Republic of Serbia. Simović et al. (2022) successfully used NDVI and NDRE to detect leaf miner infestation in urban forests. Šurjanc et al. (2019) used unmanned aerial systems to detect physical stress and pest infestation in forests in the Kopaonik Mountains.

Drought and water content monitoring

According to the European Commission's final report "Monitoring forests by remote sensing", most studies focus on drought and water content in relation to forest disturbance, but do not distinguish between forest and other vegetation

types. Not only multispectral data are used, but also microwave satellite sensors. Most commonly, the NDVI is used to monitor the effects of drought, but there are also numerous studies using other indices (e.g. improved vegetation index, forest vulnerability index, vegetation condition index, etc.). Le, Harper and Dell (2023) identified 28 indices used to detect and monitor water stress in forests and categorised them into four groups (typical vegetation indices, water, pigment and temperature vegetation indices). They concluded that most indices use visible and infrared spectral bands and most research uses data collected by MODIS, Landsat or Sentinel satellites.

Multispectral imaging is used to monitor soil and vegetation moisture of crops rather than forests in the Republic of Serbia or the region (Potić, Bugarski & Matić-Varenica, 2017; Crocetti et al. 2020; Kostić et al., 2021, Varghese et al., 2021). Mimić et al. (2022) used the normalised differential moisture index from Sentinel-2 data to monitor moisture fluxes in several plots in the Bačka region in the province of Vojvodina and introduced a new moisture stress index for crops.

Methods and materials

Geospatial data and remote sensing are valuable resources and tools for detecting deforestation or land use change, but also for monitoring of the degradation of forest ecosystem. Lechner, Foody and Boyd (2020) recognize the scope of remote sensing application in forestry (land use/land cover, cover, vegetation structure, vegetation chemistry and moisture, biodiversity, soil, disturbance), variables (tree density, foliage projective cover, above-ground biomass, leaf area index, moisture content, individual species identification, fire scare type mapping, soil type, etc.) and technologies (multispectral fine, medium and coarse spatial resolution, hyperspectral, synthetic aperture radar, light detection and ranging).

Areas of five national parks of Serbia with emphasized study areas are shown in Figure 1. An application of remote sensing to monitor phonological events is shown using the entire area of the Fruška gora National Park as an example, while the entire area of the Djerdap National Park is used to illustrate an application of remote sensing to monitor water content. Deforestation is analyzed in a specific part of the Kopaonik National Park, and the coordinates of the studied area are 43.29182130°N and 43.27281061°N and 20.80005949°E and 20.8376076°E. An application of remote sensing in the monitoring of pests and diseases is shown using the example of a part of the Tara National Park, and the studied area has the coordinates: 43.9422111°N and 43.90346656°N and 19.41601546°E and 19.47813055°E. The forest fire in the Šar planina National Park in an area with the coordinates 42.18321116°N and 42.20527626°N and 20.83957532°E and 20.87918155°E is analyzed. All coordinates are given in the WGS84 coordinate system.

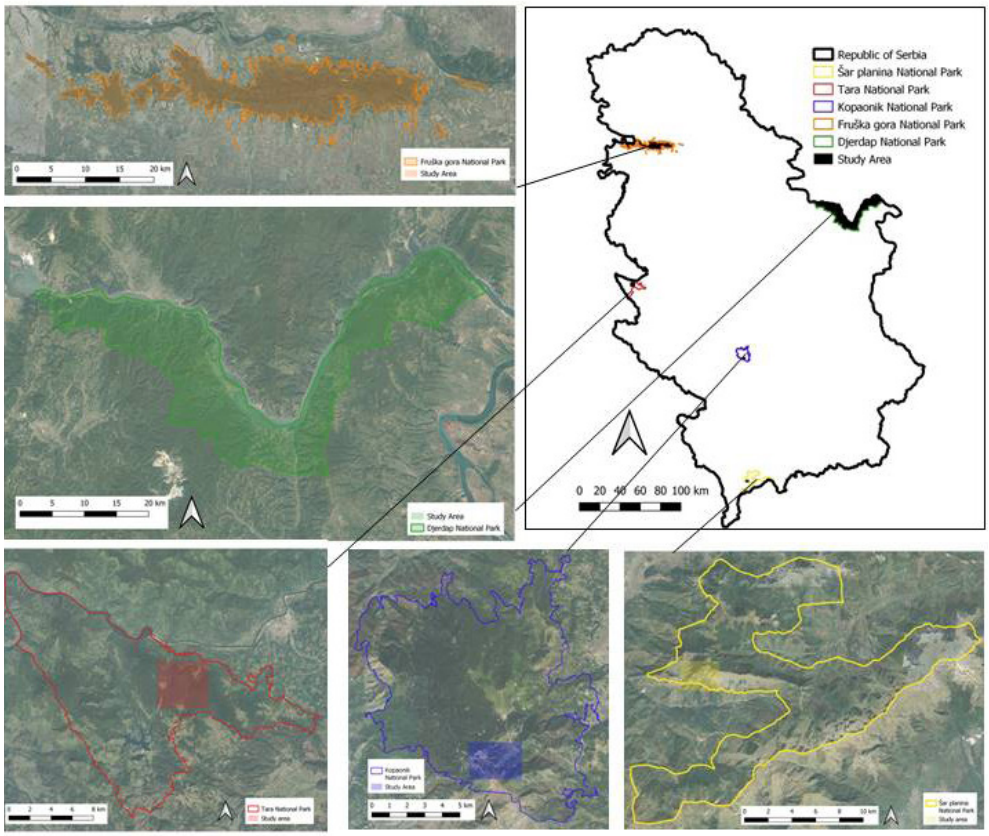

Figure 1. Geographical position of the Serbian national parks with emphasized study area
Source of basemap: Google Map Satellite activated in QGIS Hanover 3.16
Source of national parks borders : UNEP-WCMC and IUCN (2024)
Source of map: authors

The multispectral data from Sentinel 2A and Landsat 8 from the USGS Earth Explorer and Copernicus Data Space Ecosystem platforms were downloaded (https://dataspace.copernicus.eu/explore-data, https://earthexplorer.usgs.gov/). The Sentinel 2A data used in this research have a spatial resolution of 10 and 20 meters (https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-2-msi/resolutions/spatial), while Landsat 8 data have a spatial resolution of 30 meters (https://landsat.gsfc.nasa.gov/satellites/landsat-8/). All data are analyzed with the software QGIS 3.16 Hanover (QGIS.org, 2024).

Deforestation

In most studies using remote sensing to detect and quantify deforestation in the Republic of Serbia (Potić et al., 2022; Potić et al., 2023, Jovanović & Milanović 2021), the Normalized Difference Vegetation Index (NDVI) was used as an index indicating the change in land use/land cover. It combines the near-infrared (NIR) and the red (RED) spectrum (Rouse et al. 1974):

$$NDVI= (NIR – RED) / (NIR+RED) \quad (1)$$

In this case study, the changes in NDVI values were analyzed for an area with deforestation and vegetation loss in the ski center in Kopaonik National Park in the period between August 2015 and July 2023. Band 8 in the near infrared and band 4 in the red spectrum of the Sentinel-2A data were used. First, the True Color Composite (TCC) was created from the data of bands 2, 3 and 4 of Sentinel 2A, which represent the visible spectrum (https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-2-msi/resolutions/spatial). All bands used have a spatial resolution of 10 meters. Certain dates (01/08/2015 and 20/07/2023) were selected according to cloud cover and season. To avoid or reduce the influence of phenological events and weather conditions, images without clouds and images from summer were used. After creating the TCC for 01.08.2015 and 20.07.2023, vegetation loss and deforestation were digitized and a new vector layer was created (Figure 2c). The NDVI was calculated only for the area of vegetation loss, and the changes in pixel values are presented in histograms (Figure 3).

Wildfires

The risk of wildfires in summer in the Republic of Serbia has increased due to climate change (Živanović et al., 2020) and extreme weather conditions. To present the application of multispectral data and remote sensing in the post-fire phase, the burned area in the Šar planina National Park in August 2021 is analyzed. The exact location of the forest fire was determined by the European Forest Fire Information System based on MODIS instrument data. Using the Sentinel-2 data, the Normalized Burn Ratio (NBR) for a specific area before the forest fire (30 July 2021) and after the forest fire (09 August 2021) was calculated. There was no cloud over the area on these days.

Lopez Garcia and Caselles (1991) used Landsat 5 Thematic Mapper band 4 (near-infrared) and band 7 (mid-infrared) to map the burn areas in the province of Valencia affected by the April 22, 1984 fire. Key and Benson (1999) used the same Landsat 5 Thematic Mapper bands as Lopez Garcia and Caselles (1991) and defined the Normalized Burn Ration (NBR). Key and Benson (2005) explained ordering

the data (Landsat 5 Thematic Mapper), steps for processing NBR and dNBR, NBR responses, and interpretation of results. Based on the research of Key and Benson (2005), Delcourt et al. (2021) use the near/infrared and short-wave infrared spectrum of Sentinel 2 and the following equation to calculate the NBR:

$$NBR = (NIR - SWIR)/(NIR+SWIR) \quad (2)$$

$$dNBR = NBR_{pre\text{-}fire} - NBR_{post\text{-}fire} \quad (3)$$

Key and Benson (2005) emphasized that the dNBR has a theoretical range of –2.0 to +2.0, or when scaled by 10^3, –2,000 to +2,000, but in reality it is rare for valid data to vary much beyond –550 to +1,350. Declcourt et al. (2021) concluded that values of dNBR close to 0 indicating no burning, while values close to 1 indicate severely burned area (Delcourt et al., 2021). In this research band 8A as the near-infrared and band 12 as the short-wave infrared spectrum with spatial resolution of 20 meters are used.

Phenological events

The broad-leaved communities of xerophile and mesophile trees are situated in the forestland of Fruška gora National Park. Altitudes over 300 m are dominated by mountain beech forests with lime (Tilia-fagetum submontanum) (Dragićević et al., 2013). Monitoring phenology through remote sensing can help forest managers to protect trees and increase increment. In this study, we use the Soil Adjusted Vegetation Index (SAVI) to determine the difference in vegetation reflectance due to structural changes in different seasons. The influence of clouds and shadows is avoided by selecting days with little or no cloud cover and excluding all pixels in the area affected by clouds and shadows at the time of observation. In this research SAVI for the area of Fruška gora National Park on March 13, 2023, July 11, 2023 and October 23, 2023 is calculated.

Heute (1988) used SAVI to minimize the influence of soil brightness and the following equation:

$$SAVI = ((NIR-RED)/(NIR+RED+L))* (1+L) (3) \quad (4)$$

In the equation, NIR stands for the near infrared, RED for the red spectrum, while L is a constant that depends on the density of vegetation. Bands 4 (red spectrum) and 5 (near-infrared spectrum) of the Landsat 8 data with a spatial resolution of 30 meters are used. In this case study, the Landsat 8 data was used instead of the Sentinel 2 data because the cloud cover was lower on the observation days of the Landsat 8 mission.

Pest and disease

Bark beetles caused a forest dieback in Tara National Park in 2013, where upon pheromone traps were set up to catch the insects and control future damage (Tomic & Bezarevic., 2015). Milosavljevic et al. (2022) conducted further research on mites associated with the European spurred bark beetle (*Ips typographus)* at six sites in 2016. The locations of these pheromone traps and the number of insects caught are used to delineate the area of interest for this research. The NDVI and the Normalized Difference Red Edge Index (NDRE) for the second half of August from 2017 to 2023 are calculated. By choosing the same annual period, the influence of the phenophase on the values of the indices is avoided.The specific days without clouds and shadows over the study area are selected. The Sentinel-2 data, band 4 (red) , band 5 (near-infrared) and band 8 (near-infrared) are used and the same equation for the NDVI as in the case study of deforestation in the ski center in Kopaonik National Park.

Several equations for the NDRE can be found in the literature using similar spectral ranges, e.g. 720 nm and 790 nm (Barnes et al., 2000). In this case study, we used the equation from the study by Fernandez-Manso, Fernández-Manso and Quintano (2016), which is based on the study by Gitelson and Merzlyak (1994):

NDRE= (NIR-RED EDGE)/(NIR+RED EDGE) (5)

NIR stands for near-infrared or Sentinel 2 band 8 and RED EDGE for the spectrum of the red edge or band 5. Band 8 and band 4 correspond to a spatial resolution of 10 meters and band 5 to a spatial resolution of 20 meters. The data of both resolutions are used in the calculation, but results are only in 20 meters spatial resolution.

Drought and water content monitoring

Water deficit stress and drought in forests could create perfect conditions for wildfires and outbreaks of pests and diseases. Monitoring water content through multispectral imaging could help the forest manager to prevent damage. In this case study, we calculated the Normalized Difference Moisture Index (NDMI) for Djerdap National Park. We chose 2018 as a year with more precipitation in May, June and July and less in August, September and October to test the correlation between NDMI and monthly precipitation. To minimize the effects of cloud cover, we chose a cloud-free or low-cloud day in each month.

According to Jin and Sader (2005), the equation of the Normalized Difference Moisture Index is:

NDMI = (NIR-SWIR)/(NIR+SWIR) (6)

Where NIR stands for near infrared and SWIR for shortwave infrared. The Sentinel-2 data, band 8 as NIR and band 11 as SWIR are used. Band 8 has a spatial resolution of 10 meters, while band 11 has a resolution of 20 meters. Data of both resolutions are used, while the final result is in 20 metre resolution.

To calculate the NDMI, six (one per month) days with satellite observations with no or fewer clouds were selected. The highest values of the index were measured on May 2, 2018, the lowest on October 14 and August 20. Higher values (above 0.4) of the index indicate vegetation without water stress, while values between -0.2 and 0.4 indicate a tree canopy with water stress (https://custom-scripts.sentinel-hub.com/sentinel-2/ndmi/). There is a slight correlation between the NDMI of certain days and the monthly correlation. In further studies, dry periods or daily precipitation could be taken into account.

Results

Deforestation

Deforestation in the ski center of the Kopaonik National Park is a consequence of the development of infrastructure due to the increase in tourist activities in the winter season. Figure 2a shows the true color composite (TCC) on August 1, 2015 and Figure 1b shows the TCC on July 20, 2023. Deforestation and vegetation loss are evident. In Figure 2c, the deforested areas and the areas with vegetation loss are highlighted by a new vector layer. Figure 2d and 2e show the NDVI values of the area with vegetation loss, while the histograms (Figure 3) show that on August 1, 2015; most of the values in the highlighted area were between 0.6 and 0.8, while on July 20, 2023, the same pixels have values between 0.1 and 0.5. The values of the NDVI decreased significantly, which shows that the NDVI is suitable for detecting and quantifying deforestation and vegetation loss.

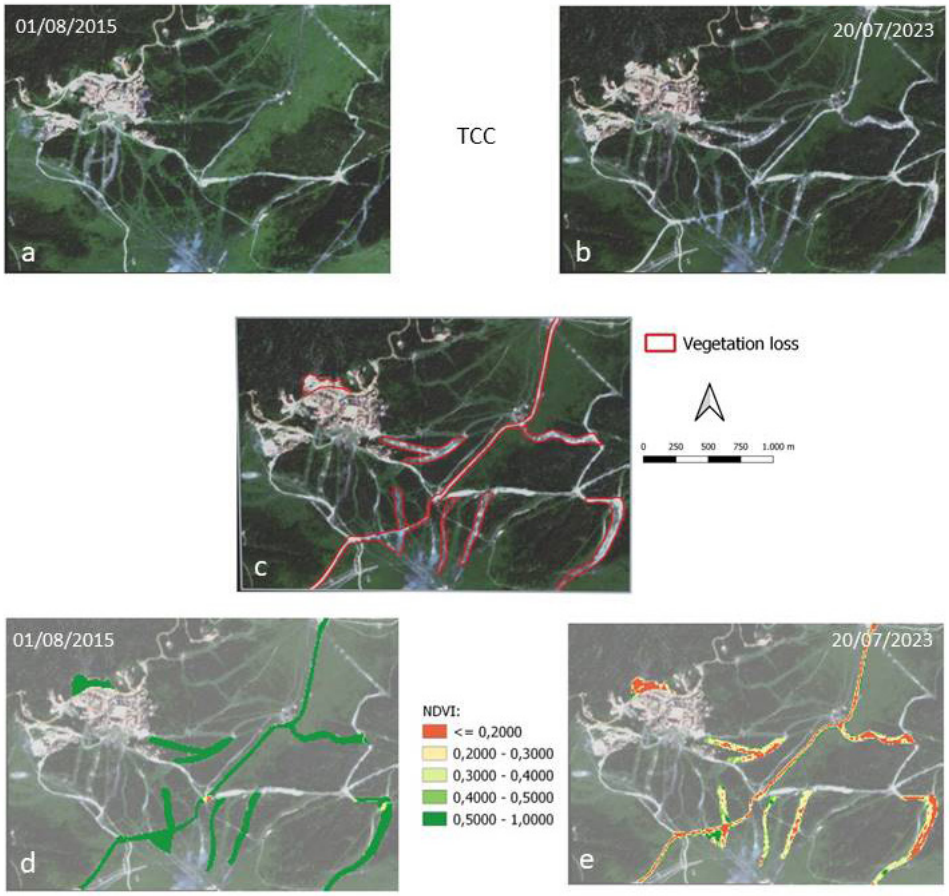

Figure 2. Ski center in Kopaonik National Park (a, b – True Color Composite, c – Digitalized Vegetation Loss, d,e – NDVI of the area of vegetation loss)
Source: authors

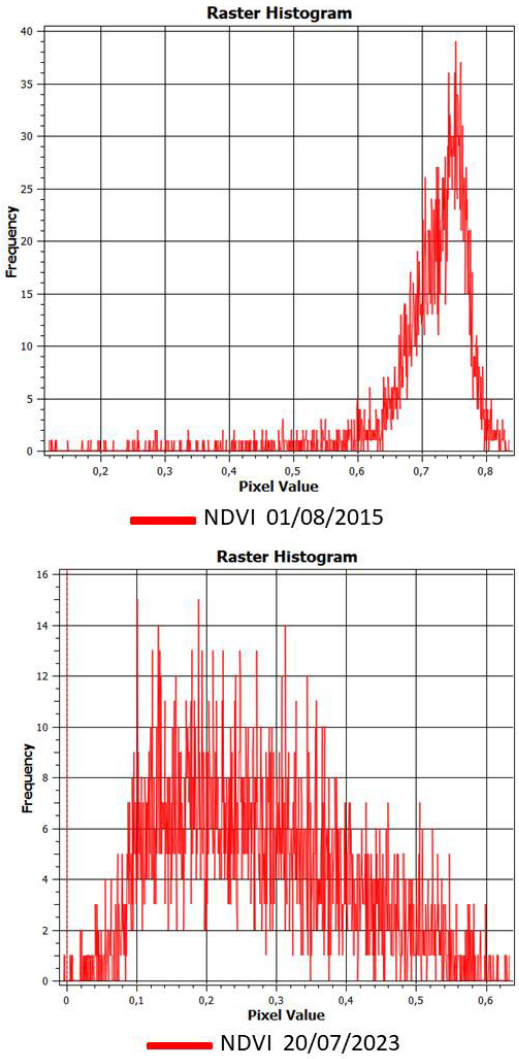

Figure 3. Raster Histograms of area of vegetation loss of ski center in Kopaonik National Park
Source: authors

Wildfires

Wildfires are a major threat to the forest ecosystem, especially in protected areas such as national parks. Mapping the burned areas is the first step in restoration management. Here the damage caused by forest fires in the western part of the Šar planina National Park has been analyzed. According to the European Forest Fire

Information System, 57 ha were affected by forest fire in August 2021, and the NBR for this area and its surroundings was calculated in this reasearch. The results are shown in Figure 4. In the analyzed area (804 ha), the values of the index after the fire were between -0.24 and 0.56, while before the fire they were between 0.02 and 0.57. Negative values of NBR (Figure 4d) indicate burnt areas. Calculating the difference (dNBR) between the NBR after and before the fire is a simple method to identify burned forest ecosystems. Positive values of dNBR (Figure 4g) indicate burnt areas.

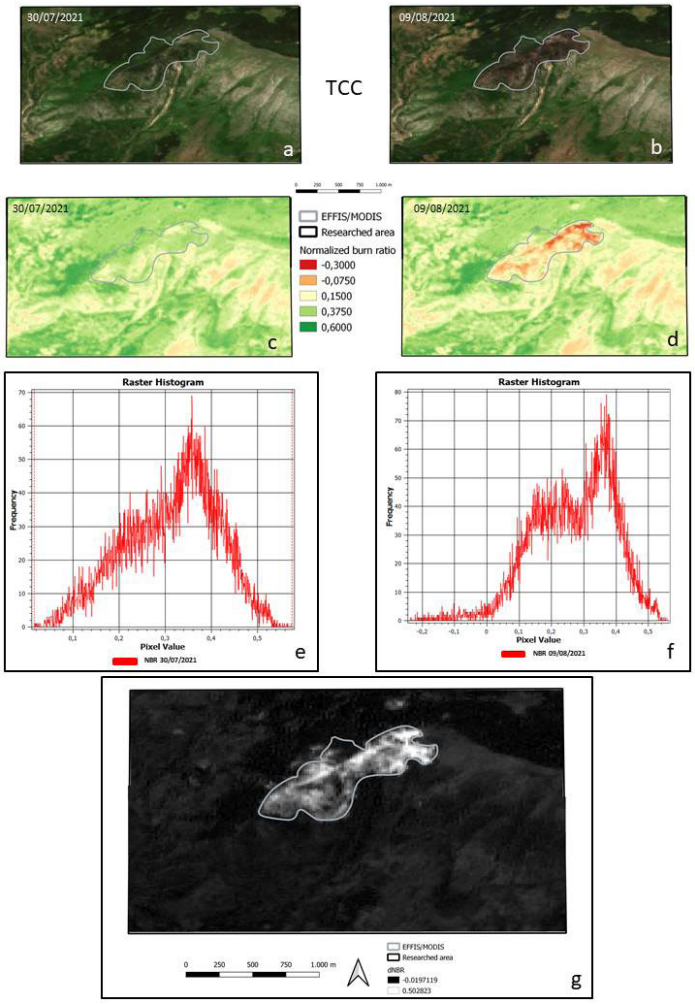

Figure 4. Wildfire in Šar planina National Park (a, b – True Color Composite, c,d – Normalized Burn Ratio, e,f – Pixel values of NBR histograms, g -dNBR)
Source: authors

Phenological events

Values of the SAVI in different seasons vary greatly due to changes in vegetation structure and cover. Figure 5 shows that SAVI values ranged from -0.08 to 0.74 on March 13, 2023, while they ranged from 0.03 to 0.78 on July 11, 2023 and from -0.11 to 0.96 on October 23, 2023 in the Fruška gora National Park. In March, however, most values were between 0 and 0.5. In the summer season they were between 0.5 and 0.75 and in the fall between 0.25 and 0.75. Further investigation could reveal more details, e.g. SAVI values in the area of dominance of certain species at the time of foliage, flowering, leaf fall, etc. The fluctuations in the index values would probably be less obvious, but valuable for forest management.

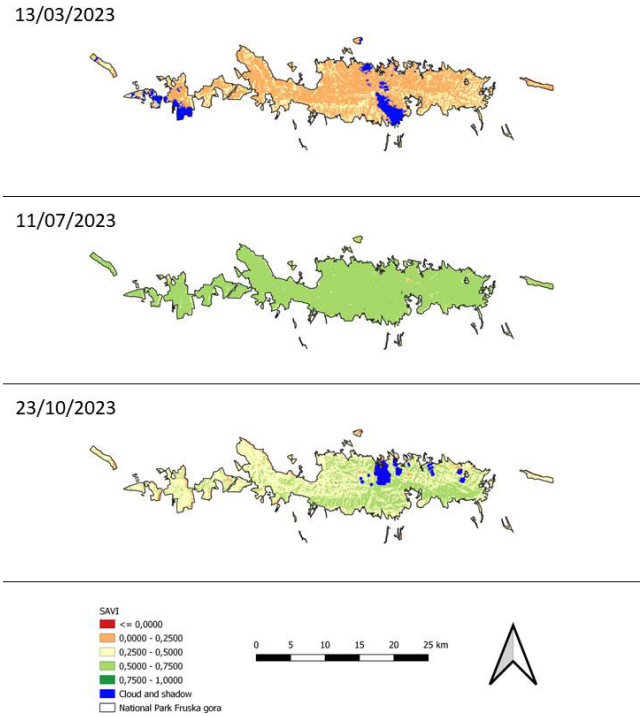

Figure 5. Soil Adjusted Vegetation Index in Fruška gora National Park
Source of Fruška gora National Park border: UNEP-WCMC and IUCN (2024)
Source of SAVI: authors

Pest and disease

Monitoring the effects of pests and diseases in the early stages requires high-resolution data as the trees partially dry out. We are trying to determine the impact of

pests and diseases in the research area in Tara National Park with medium resolution data. To draw precise conclusions about drought or other damage, more detailed studies or field work are needed.

The results shown in Figure 6 show that the NDRE index reacts more sensitively to changes than the NDVI index. Figures 6a and 6b, created in QGIS Hannover 3.16, show the boundaries of the Tara National Park and the study area. The satellite base map activated in the software (Layer/Add Layer/Add XYZ layer/Satellite) contains different brightness levels in some parts of the area shown, without specific reasons, which becomes clearer at a higher zoom level (Figures 6b, 6c and 6d).

As can be seen in Figure 6c and 6d, the values of both indices were highest on August 25, 2017, while they were lowest on August 29, 2022. Higher values of both indices indicate better vegetation condition. Lower values indicate drier vegetation. Dryness could be a result of pest infestation, drought or other stress. For pest and disease infestations, low scores should appear as patches and spread over time if forest managers do not respond. In this case study, field work or more detailed analyses are needed to clarify the reasons for the low NDVI and NDRE values in the last two years of the observation period.

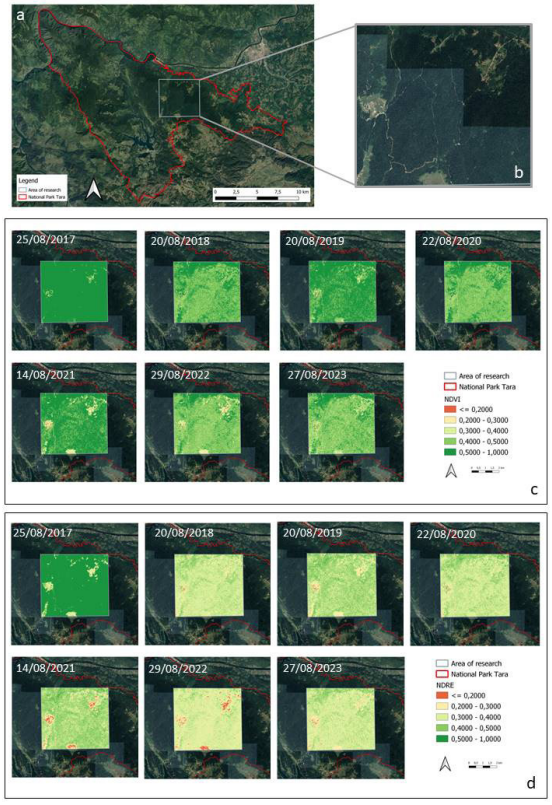

Figure 6. NDVI and NDRE in Tara National Park (a,b – borders of area of research, c – Normalized Difference Vegetation Index, d – Normalized Difference Vegetation Index Red Edge)

Source of basemap: Google Map Satellite activated in QGIS Hanover 3.16
Source of Tara National Park border: UNEP-WCMC and IUCN (2024)
Source of NDVI and NDRE: authors

Drought and water content monitoring

The territory of Djerdap National Park is covered with more than 50 phytocenoses, among them communities with *Quercus frainetto* and *Q.cerris* on silicates and *Q.cerris* with *Carpinus orientalis* on limestone, are dominant (Dragićević et al., 2013). Water deficits could destroy the trees or reduce their natural ability to cope with pests and diseases. In 2018, the Veliko Gradište meteorological station recorded the most precipitation in June (205.9 mm) and the least in October (12.7 mm). Less precipitation fell in September (20.1 mm) and August (27.2 mm), while 106 mm (41 mm) was recorded in May (Republički hidrometeorološki zavod, 2019). Figure 7 shows the climate diagram and the NDMI values on certain days. The lowest NDMI values were calculated on August 20, 2018 and October 14, 2018.

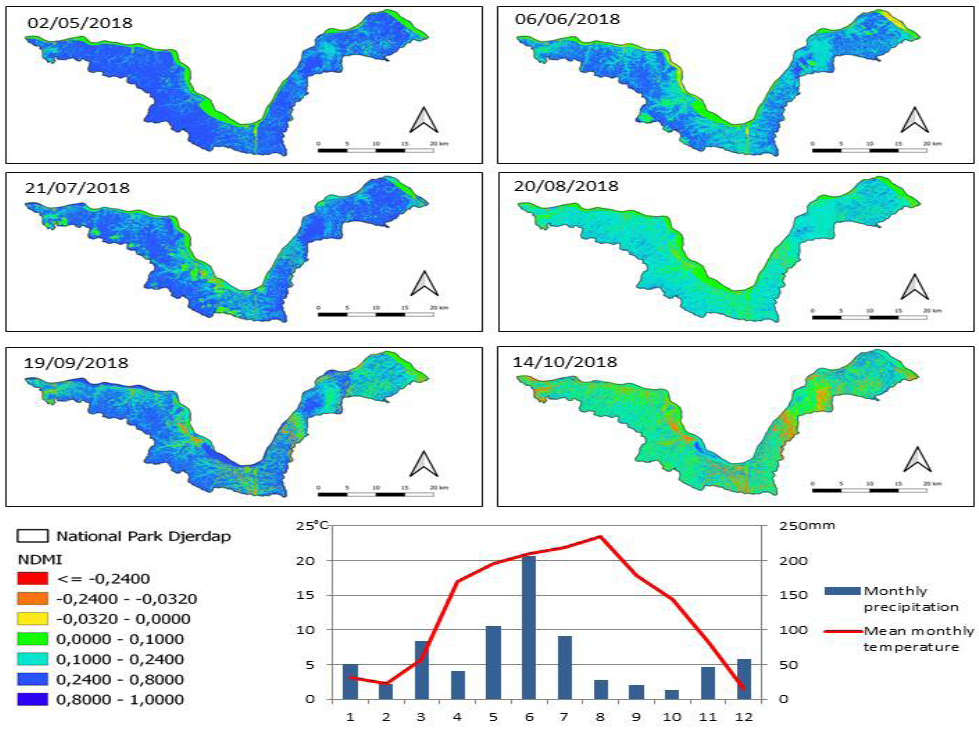

Figure 7. Normalized Difference Moisture Index and Climate diagram (Veliko Gradište, 2018)
Source of Djerdap National Park border: UNEP-WCMC and IUCN (2024)
Source of precipitation and temperature data: Republički hidrometeorološki zavod (2019)
Source of NDMI: authors

Discussion and conclusions

The most visible changes in the forest are those that can best be detected and monitored by remote sensing and multispectral imaging. Deforestation and wildfires change the values of light reflected by vegetation in such a way that medium-resolution satellite images and the most common indices (e.g. NDVI) are sufficient to quantify the damage. More specific indices (e.g. NDRE, NDMI) are required to monitor water stress and phenological events. Remote sensing and multispectral imaging are suitable tools for monitoring seasonal changes in vegetation.The biggest challenge is to detect pest and disease infestations, and these changes are usually only visible with high-resolution satellite imagery or at a time when the damage has already had a major impact.

Continuous remote sensing of forests can help managers to protect the ecosystem, preserve biodiversity and increase vegetation growth. It requires fewer resources and less time than traditional on-site monitoring. Commercial satellites that take very high resolution images or unmanned aerial vehicles are better suited for more detailed analysis. In the future, combining the results of monitored changes with machine learning and artificial intelligence may lead to the development of accurate models that help forest managers to prevent drought, wildfires or pest and disease infestations.

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Satellite data used in case study analysis were downloaded from Copernicus Data Space Ecosystem and USGS Earth Explorer:

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Original scientific article
Received: 20.03.2024;
Received in revised form: 08.05.2024;
Accepted: 20.05.2024;
Available online: 14.10.2024.

UDC: 338.48:7/8(497.11)
doi: 10.5937/zrgfub2472135N

TOURIST VALORIZATION OF THE CULTURAL POTENTIAL OF THE HOMOLJE REGION

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Abstract: The valorization of the cultural potential of the Homolje region is a key process for the preservation and promotion of its rich cultural heritage. This involves recognizing, respecting and enhancing the value of various cultural elements such as traditions, customs, architecture, art and language. Research in this area shows how it promotes tourism and economic development while preserving cultural identities by using qualitative-quantitative methods and Hilary du Cross' cultural motif valorization methods.The problem of the study of Homolje lies in recognizing and valuing the cultural motifs of the region for the purposes of tourism development. The objectives of valorizing the cultural potential in tourism are reflected in the preservation and promotion of the cultural heritage of Homolje in order to attract tourists, support the local economy and strengthen the identity of the community. The results of the qualitative-quantitative analysis conducted confirm that the cultural motifs of Homolje are characterized as sites of good quality and moderate touristic value. The Hilary du Cros analysis shows a moderate value of the indicators of cultural significance and market attractiveness of the cultural assets. These results indicate favorable conditions for the development of cultural tourism in Homolje, with appropriate monitoring, planning, promotion and protection of the area from possible damage during tourist visits.
In addition, the valorization of cultural motifs promotes social cohesion and intercultural understanding. Engaging with the different facets of Homolje's cultural heritage helps individuals realize the importance of intercultural dialog and respect for diversity. Despite important steps, challenges such as limited financial resources and preserving authenticity in tourism remain. Collaboration with local institutions and community involvement are crucial to the success of this process. In essence, enhancing the cultural motifs of Homolje plays a central role in preserving identity, promoting economic growth and improving intercultural understanding.

Keywords: tourism, Homolje, valorization, cultural values, region

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Introduction

The focus of this article is on the enhancement of cultural heritage through sustainable tourism. The concept of sustainable tourism usually encompasses three aspects of sustainability: economic sustainability, i.e. the valuation of natural, social and human capital in accounting processes at the corporate, regional or national level, as well as the internalization of negative externalities; social sustainability, i.e. the creation of conditions for sustainable tourism. i.e. the creation of conditions for the growth of social capital through social cohesion, social justice, respect for cultural identity, honesty, ethics, etc. and environmental sustainability, i.e. the responsible use of natural resources and environmental protection (Afrić-Rakitovac & Urošević, 2017). The importance of valorizing cultural motifs in tourism goes beyond economic benefits and enriches the cultural fabric of the destination and the visitor experience. It promotes sustainable practices, community empowerment and a deeper appreciation for the diverse cultural heritage in destinations (Sivac et al., 2023). The main problem of this thesis is to investigate the lack of tourism infrastructure in the Homolje region and the need to improve the tourism offer in order to attract as many people as possible to visit this region. Possible solutions include building new accommodation capacities, improving the quality of services and content, and making better use of natural and cultural resources. The aim of this work is to define the main problems in the tourism sector in the municipality of Žagubica, i.e. in the area of Homolja, to evaluate the strategies relevant for their solution and to elaborate recommendations for the continuous development of tourism. The main assumption is based on the fact that the implementation of the proposed measures will contribute to an increase in tourist visits, economic benefits for the local community and the preservation of natural and cultural heritage, which would enable sustainable development of tourism in this region. The representation of territorial identity means the identification of the social system that includes the people, the traditions, the culture and the landscape, not forgetting the emotional ties and connections between the inhabitants and the territory (Carta, 2002; Bizzari & Micera, 2021).

Today, the concept of landscape is linked to the various areas and aspects of cultural assets. It is, in fact, a kind of basic concept that gives a new value and character to the relationships between nature and history, man and territory (Antić, Tomić, 2017). The regions in the Republic of Serbia have natural, cultural and historical values that define various tourist offers. However, in Homolje, these potentials and types of tourism products are still underutilized, partly due to the differences in existing conditions (nature, cultural and historical heritage) and partly due to the created conditions such as accessibility, infrastructure, service sector, sports and

recreational facilities and tourism organizations. Homolje is still an underdeveloped but resource-rich and beautiful region of Serbia.

Table 1. Budget income per capita, RSD

Year/area	2019	2020	2021	2022
The Republic of Serbia	47.400	45.970	56.521	65.314
Braničevski district	45.290	43.485	49.930	53.658
Municipality of Žagubica	44.602	45.676	50.055	56.968

Source: Municipalities and regions in the Republic of Serbia, 2020, Statistical Office of the Republic of Serbia, Belgrade., Municipalities and regions in the Republic of Serbia, 2021, Statistical Office of the Republic of Serbia, Belgrade., Municipalities and regions in the Republic of Serbia, 2022, Statistical Office of the Republic of Serbia, Belgrade., Municipalities and regions in the Republic of Serbia, 2023, Statistical Office of the Republic of Serbia, Belgrade

The municipality of Žagubica is one of the most underdeveloped municipalities in the Republic of Serbia. The economic development and the state of the local economy at the current level of development is characterized by inadequate use of development resources, which is reflected in the constant and pronounced economic backwardness of this municipality. The existing resources (mountains, rivers, forests, pastures, etc.) represent the main municipal development potential, which largely coincides with the strategic determinations of the Republic's economic development directions (tourism, agriculture, forestry and wood processing). Therefore, it is necessary to change the policy of regional development towards greater support of underdeveloped areas, especially the most underdeveloped ones that have development opportunities (Spatial Plan of the Municipality of Žagubica, 2010).

Table 1 shows that in the Municipality of Žagubica, household revenues per inhabitant are constantly increasing and are in line with the national and district average. However, the municipality's tax capacity in the period 2018 - 2020 is relatively low and amounts to 24 - 30 %. Most of the revenue is generated by taxes (wages, real estate, motor vehicles, etc.), municipal equalization payments and municipal fees. The Municipality of Žagubica belongs to Group IV, i.e. to the underdeveloped units of local self-government, whose level of development is below 60% of the national average (Municipality of Žagubica Development Plan 2021-2031).

The fact that the situation on the territory of the Municipality of Žagubica has not changed in terms of economic development is also evidenced by the data on the website of the Ministry, i.e. the Cabinet of the Minister for the Development of Underdeveloped Municipalities (https://rnro.gov.rs/projekti/). According to the latest data on the website, the Municipality of Žagubica is one of the 44 municipalities that fall into Group IV in terms of development level (development level below 60% of the

republican average). On this basis, the Law on the Budget of the Republic of Serbia for 2024 issued the Regulation on the Establishment of the Support Program for the Improvement of the Development of Extremely Underdeveloped Municipalities (local self-government units of the fourth group) for the year 2024 (https://pravno-informacioni-sistem.rs/eli/rep/sgrs/vlada/uredba/2023/112/1/reg). This Ordinance entered into force on the eighth day after its publication in the "Official Gazette of the Republic of Serbia" of December 15, 2023 ("Official Gazette of the Republic of Serbia", number 112/2023-3) and is valid from January 1, 2024. The aim of the program is to implement projects and support measures aimed at increasing capacities in the field of construction, reconstruction and equipping of buildings, procurement of equipment relevant to extremely underdeveloped municipalities and implementation of poverty reduction measures relevant to extremely underdeveloped municipalities. Areas such as the Municipality of Žagubica require financial support from the Republic of Serbia. This mainly concerns the provision of basic requirements and necessary conditions for attracting capital. This includes, above all, the transport infrastructure, which does not even meet the current needs of the local population.

Figure 1. Homolje region
Source: http://beljanica.nanetu.rs/Homolje

Tourism valorization is still insufficiently used in current research activities to create development plans, programs and strategies (Risteski, 2020; Sivac et al.,2023).

At the same time, the synergy effects of integrating the cultural and tourism sectors contribute to cultural tourism being a real catalyst for the growth and development of tourism as a whole (Sančanin et al., 2022; Sivac et al.,2023). The combination of cultural and tourism development measures could act as a catalyst and promote the local destination as the most desirable and attractive place to live, work, visit and invest. Investing in cultural heritage can significantly improve the quality of life of residents and their guests, revitalize neglected urban areas and increase the value of real estate (Afrić-Rakitovac & Urošević, 2017).

Materials and methodology

Study area

Homolje is an area in eastern Serbia that territorially coincides with the area of the Municipality of Žagubica. The area of Homolje has the shape of an irregular rectangle in the direction east - southeast - west - northwest, with a length of about 35 km, while the widest point is about 26 km (Živković, 2011; Prentović et al, 2016). The territory is surrounded by mountain ranges on all sides. It is separated from Zvižd by the Homoljske Mountains (940 m) to the north, from Resava by Beljanica Mountain (1339 m) to the south, from the Crna Reka Basin by the Crni Vrh Massif (1043 m) to the east and from the lower plains of Mlava by the Gornjak Mountains (825 m) to the west (Miljković, 1992; Prentović et al, 2016). It is naturally divided into two parts of the basin: the hilly and the mountainous. The main and central part is the Žagubica basin, the lower part of which lies at an average altitude of 300 metres. The second, smaller and lower part is the Krepoljin-krupaj basin with an average altitude of 220 metres. There is a hilly area between these basins (Mekić, Novaković, 2018). The municipality of Žagubica belongs territorially to the southeastern part of Braničevo County. It is 170 km away from Belgrade, while it is 83 km away from Požarevac. It is surrounded by the municipalities of Petrovac, Bor, Majdanpek, Despotovac and Kučevo. Most of the villages in Homolje are located on the banks of the Mlava tributaries. Despite its rugged terrain, Homolje has a relatively dense road network.

The main traffic corridor is the regional road R 105 Pozarevac − Petrovac − Žagubica − Bor. Two other regional roads pass through the territory of Homolje, namely R 104 Žagubica – Majdanpek and R 216 Krepoljin – Despotovac, which are of much lower quality than the above-mentioned R 105 road. All villages in the municipality of Žagubica are connected by the local road network. The main roads in the Homolje area are only 14 km long, while the length of the local road network is

102 km (Prentovic et al, 2016). All regional roads are paved with a modern surface, and in recent years more extensive rehabilitation works have been carried out on state road No. 161 on the section from Žagubica to Salakovac (Municipality of Malo Crniće) and on state road No. 186 on the section from Krepoljin to Despotovac - to Milanovac (Municipality of Žagubica). The remaining sections of state roads are in poor condition, especially state road 164 towards Majdanpek. The local road network connects all settlements in the municipality, but is in an unsatisfactory condition. Some of the local roads do not have a modern surface, while the roads with a modern surface are poorly maintained. Railroad traffic does not pass through the municipality (Žagubica Municipality Development Plan 2021-2031).

Serbia is a country with a great history. Many conquerors ruled over this territory in the past, which was very popular due to its favourable location at the crossroads of East and West. Each of them left behind a small part of their culture, and today Serbia is a country with a large and diverse cultural heritage (Marjanović et al., 2023). Homolje is not only one of the few ecologically diverse destinations in Serbia known for its breathtaking natural beauty, but also has numerous potentials for anthropogenic tourism. It is important to point out that on the list of cultural monuments of the Republic of Serbia, three of the mentioned cultural potentials are located in the Homolje area (Blagovestenje Monastery, Gornjak Monastery and Trška Church). They belong to the category of cultural assets of great importance and are under the protection of the Regional Institute for the Protection of Cultural Monuments in Smederevo.

Among the significant anthropogenic tourism values that are not only important for this region, but also have a broader significance, the following should be emphasised:

- archaeological values,
- Monumental values (Gornjak and Trška churches),
- ethnographic values (the oldest forms of spirituality in Europe),- artistic values (in the context of traditional folk crafts and creativity) (Miljković, & Stojanjelović, 2002).

Cultural heritage is an important source of creativity and innovation, generating new ideas and solutions to problems and creating innovative services – from the digitization of cultural assets to the use of cutting-edge virtual reality technologies – with the aim of interpreting historic environments and buildings and making them accessible to citizens and visitors. Cultural heritage has been proven to offer a good return on investment and generates significant tax revenues for the public sector through spillover effects from heritage-oriented projects, leading to further investment (Urošević, 2017). The cultural and historical heritage plays a decisive role in the touristic valorization of Homolje. It is characterized by its diversity and

uniqueness, which is shaped by a combination of historical events and the special social, geographical and transport significance of the region, both in the past and in the present (Jovičić, Nikolić, 2005). These were the anthropogenic values considered during the valorization process.

Figure 2. Blagoveštenje (Annunciation) Monastery
Source: http://www.tozagubica.rs/manastiri-i-ckrve/manastir-blagovestenje

Archeological sites from the Roman period include fortifications with watchtowers and rest areas. These structures were part of the defense system along the critical Roman road "Via Militaris"," which led through the Mlava Gorge. During the reign of Emperor Dušan, the town of Ždrelo was located here, which was ruled by the Lords of Rastistolići. The region was also home to the seat of the metropolitanate, the Blagoveštenje monastery, as well as several smaller churches and hermitages (Jovičić, Nikolić, 2005).

Gradac Fortress has been located on the Roman road since the Middle Ages. The fortress is located on a hill called Đula near Krepoljin.

The medieval Gornjak Monastery stands on one of the terraces above the Mlava River in the Gornjačka Gorge. This monastery, founded by Prince Lazar, was built between 1379 and 1381 and is recognized as a cultural monument of great importance (Jovičić, Nikolić, 2005). According to the local museum in Žagubica, today's Gornjak Monastery only partially resembles its original structure, as it was built on old foundations. What sets this monastery apart from others is the richness of its interior walls, which are decorated with masterpieces of wood carving and frescoes

from the 17th and 18th centuries, making it one of the few of its kind in Serbia. In addition, a modern guest house on the premises offers overnight accommodation and increases the value of this valuable cultural and historical monument in Homolje.

The Blagoveštenje Monastery is located near the Gornjak Monastery, on the Žagubica - Petrovac road on the Mlava River, one kilometer away and above the right bank of the Mlava. The church of the Blagoveštenje monastery with its outbuildings was built on a flat plateau with a cascading retaining wall. It dates back to the 14th century. Century. The entire complex was archeologically investigated between 1979 and 1981, and conservation and restoration work was carried out at the same time (http://spomenicikulture.mi.sanu.ac.rs).

Trška church is the second most important cultural monument in Homolje. It is located in the Žagubička Valley next to the main road. It is considered part of the Raška school and is the oldest church in Homolje. The church was restored in 1985 and is protected as a cultural monument (Jovičić, Nikolić, 2005). The Trška Church Monastery is the youngest monastery in the Braničevo Eparchy and is home to the oldest church in the eparchy (Ljubisavljević, Đokić, 2013).

The Church of the Holy Trinity, built between 1873 and 1875, is located in the heart of the Žagubica settlement. The church is decorated with nineteen icons by the painter Nikola Marković from 1874 and also houses twenty-three figures of saints on the north and south walls, which were painted at the end of the 20th century. The church also houses valuable examples of movable icons, liturgical books, objects of applied art and various pieces of church furniture. Inside the gate, to the east of the altar apse, there is a large gravestone commemorating a street monument from 1826. Due to its central location, the church attracts a large number of worshippers on important holidays and during regular services (http://muzejzagubica.org).

The Šupljaja church is located in the village of Ribare and is also a cultural and historical monument of Homolje. It is 1.5 km away from the center of the village and is reached by an excellent macadam road. It is believed that the church was donated by Princess Milica, as evidenced by a legend that says that the princess passed through this area after the battle in Kosovo and realized that her grieving heart was hollow, hence the name of this church. The new Šupljaja Church was built on the remains of an older church that was destroyed during the Ottoman period and has a wooden iconostasis that is considered one of the most beautiful in Homolje. It is a popular excursion destination for the inhabitants of the region and offers the potential for excursion tourism due to its breathtaking natural surroundings.

A fascinating cultural monument is undoubtedly the house of Nenad Stojanović, which is located in the settlement of Milatovac and was built at the beginning of the 20th century. This building is an example of folk architecture and belongs to the

progressive type of Moravian houses built at the end of the 19th and beginning of the 20th century.

The Homolje Local History Museum is located in the heart of Žagubica and is a relatively new institution founded in 2017. Visitors can view a permanent exhibition of sculptures by Svetomir Arsić Basara. In addition, archeological exhibits about the "Early Byzantine period in the Žagubica area" and a historical-ethnological exhibition entitled "Homolje – remains of the past" can be viewed.

Handicrafts, especially in the artistic field, souvenir making, traditional costumes and folklore are integral parts of the cultural heritage of the people of the Homolje region. The people of Homolje have a rich tradition of organizing numerous events, which should be fully developed and enhanced to meet the needs of tourism. Among the most important are the well-organized tourist and cultural events: "Vrela Homolja" (Homolje Springs), "Spasovdanski susreti" (Spasovdan Gatherings) and "Hajka na Homoljskog kurjaka" (Hunting for the Homolje Wolf). These events have become a tradition and have gained importance at the state level and make an important contribution to the tourism development of the municipality of Žagubica (Jovičić & Nikolić, 2005).

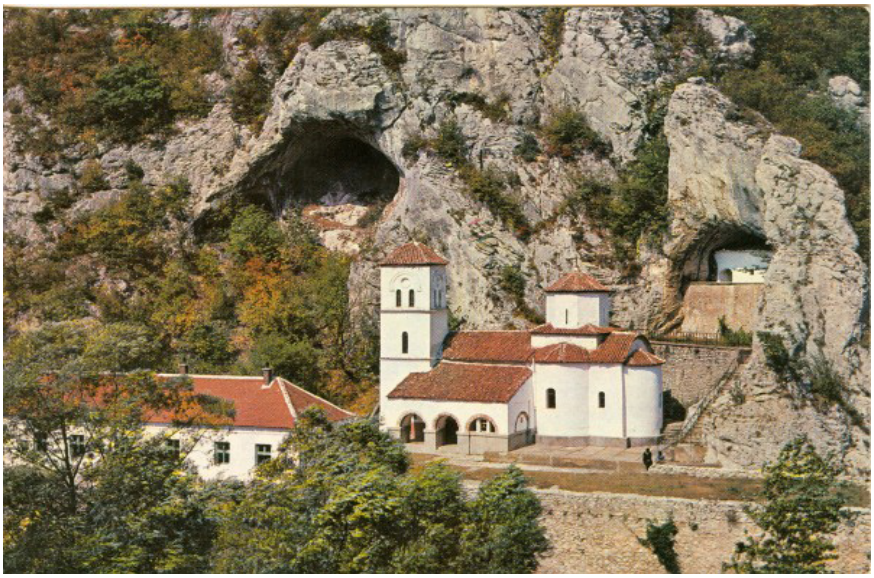

Figure 3. Gornjak Monastery
Source: http://manastiriusrbiji.com/manastir-gornjak

Table 2. Arrivals and overnight stays of tourists in the municipality of Žagubica in the period from 2018 to 2022

The sequence number	Description	2018	2019	2020	2021	2022
1.	Arrivals of domestic tourists	716	1.019	1.471	1760	881
	Arrivals of foreign tourists	148	154	79	81	16
	Total tourist arrivals	**864**	**1.173**	**1.550**	**1841**	**897**
2.	Overnights of domestic tourists	2.056	2.508	4.267	6936	2933
	Overnight stays of foreign tourists	446	540	386	532	192
	Total overnight stays of tourists	**2.502**	**3.048**	**4.653**	**7468**	**3125**

Source: Development plan of the municipality of Žagubica 2021-2031; Statistical Office of the Republic of Serbia, Municipalities and Regions, Belgrade, 2022; Statistical Office of the Republic of Serbia, Municipalities and regions in the Republic of Serbia, 2023, Belgrade.

A detailed assessment of the data (Table 2) on tourist arrivals and overnight stays of tourists in the municipality of Žagubica, in the Homolje area, during the period from 2018 to 2022 provides an insight into the dynamics of tourist visits to this region. The strongest growth was recorded in 2021, when the number of arrivals and overnight stays increased significantly, doubling compared to the previous year. The sudden increase is due to various influences, in particular the health conditions caused by the spread of coronavirus and people's restricted mobility. The corona disease known as COVID-19, which is present everywhere in Serbia, has increased the number of tourists in local destinations. Already in 2022, the same destinations were forgotten by domestic tourists. In 2022, Homolje also recorded a sharp decline in arrivals and overnight stays of more than 50 % compared to the previous year. This decline is worrying and indicates that further studies and measures are needed. Some of the reasons for this decline could be the global health crisis or changing tourist preferences. In terms of preserving the cultural heritage of Homolje, this drastic decline in tourist visits can be worrying. The cultural heritage of Homolje, which includes a rich history, tradition and architecture, is the most important part of the identity of this region. A decrease in the number of tourist visits can have a positive impact on the preservation and promotion of this heritage. For all these reasons, it is important to take appropriate measures to promote the sustainable development of tourism and the preservation of Homolje's cultural heritage. Additional measures related to the promotion of tourism resources, the improvement of tourism

infrastructure and offer, as well as the development of events and cultural events that would attract visitors and arouse their curiosity for this unique destination.

Methodology

Two methods were used in researching the Homolje area to assess its cultural tourism motives: the quantitative-qualitative approach and the Hilary du Cross tourism valorization method. This method was applied to the archaeological sites, the site of the Gornjak Monastery, the remains of the Blagoveštenje Monastery, the Trška Church, the Church of the Holy Trinity, the Šupljaja Church and other cultural monuments and artistic values in the Homolje region. At present, it has a relatively homogeneous structure that naturally reflects the different historical stages, which are emphasised by specific authentic cultural elements (Vasilita-Craciun, 2023). These sites represent the cultural and historical richness of the area, so this method is crucial for evaluating the tourist attractiveness of these places and serves as a first step in planning the tourist development of Homolje.

Quantitative-qualitative method

Due to its flexibility, this approach is one of the most frequently used methods in research and evaluations (Čomić, Pjevač, 1997). Within the quantitative-qualitative model, six elements require to be examined, namely:

- The geographical location of tourist tourist (accessibility of resources),
- tourist services and facilities (available accommodation facilities, information),
- artistic value,
- Ambience,
- Special nature of the resource,
- Importance of the resource (attractiveness and market recognition).

The respondents were domestic tourists. The concept of a questionnaire was used for the study. The questionnaire was created based on a literature review (Park et al., 2019; Zhang et al., 2021) and adapted to the specific characteristics of the heritage tourism under study (Pantović et al., 2023). The assessment of the survey provides information on the demographic characteristics and experiences of the respondents in relation to Homolje. Based on the total number of respondents, it can be seen that men form the majority with a share of 82.35%, while the share of women is significantly lower at 17.65%. In terms of education, the majority of respondents have a university degree, namely 58.82%, while 41.18% of respondents

have a secondary school degree. The majority of respondents, namely 64.71%, live in the Homolje area, while 35.29% are only visitors to Homolje. Based on the responses and the ratings of the tourism enhancement indicators, average values were calculated for each indicator, which finally resulted in an overall average rating.

Table 3. The methodology applied in the research

Applied methodology	Description of methodologies
Survey questionnaire	The application of the survey as the basic mechanism for collecting data from the research participants.
Analysis and synthesis	The combination of data from different sources in order to obtain adequate conclusions relevant for research through analysis and synthesis.
Application of statistical data	Use of statistical data obtained from publications of the Statistical Office of the Republic of Serbia
Using available literature	Using available literature, which includes professional literature, scientific research, strategic documents and other appropriate sources, in order to gather information.
Use of the relevant sites	Use of relevant and official websites that are an additional source of information and research support.

The tabular presentation gives a clearer insight into all the important methodological procedures that were applied in the study, including the mechanisms for data accumulation, analytical methods and sources of information that were applied.

Tourist valorization of the cultural potentials of Homolje according to Hilary du Cross

Hilary du Cross' model is a scientifically recognized and comprehensive approach to the valuation of cultural assets in tourism. Its main objective is to explore how cultural assets can be integrated into sustainable tourism development (Lakićević, Srđević, 2011; Milenković, 2018).

The model comprises two main sectors: the tourism sector and the cultural heritage management sector. Within the tourism sector, there are two sub-indicators: the market attractiveness of cultural goods and the factors influencing the design of a tourism product. The sub-indicators are scored on a scale of 0 to 5, with some having a narrower range. The total score for the tourism sector is calculated by adding the scores of all sub-indicators from both groups. The resulting score is then interpreted as follows: 0–20 (low attractiveness), 21–40 (medium attractiveness) and 41–60 (high attractiveness).

The cultural property management sector comprises two sub-indicators: cultural significance and robustness. The overall score for this sector is calculated by adding these two values together. The resulting score is interpreted on a scale of 0–20 (high sensitivity/low cultural value), 21–40 (moderate sensitivity and cultural value) and 41–60 (low sensitivity/high cultural value) (Stanojlović, Ćurčić & Pavlović, 2010; Marković & Petrović, 2012; Milenković, 2018).

Based on the analysis, a market attractiveness/robustness matrix is created, comprising nine cells labeled M (i, j) (i, j=1, 2, 3), as shown in Table 2 (Du Cros, 2000; Milenković, 2018). These cells are defined as follows:

- M (1, 1) high value of the indicators of cultural significance/robustness and low market attractiveness;
- M (1, 2) high value of the indicators of cultural significance/robustness and moderate market attractiveness;
- M (1, 3) high value of the indicators of cultural significance/robustness and high market attractiveness;
- M (2, 1) moderate value of indicators of cultural significance/robustness and low market attractiveness;
- M (2, 2) moderate value of indicators of cultural significance/robustness and moderate market attractiveness;
- M (2, 3) moderate value of indicators of cultural significance/robustness and high market attractiveness;
- M (3, 1) low value of the indicators of cultural significance/robustness and low market attractiveness;
- M (3. 2) low value of the indicators of cultural significance/robustness and moderate market attractiveness;
- M (3, 3) low value of the indicators of cultural significance/robustness and high market attractiveness.

Cultural assets have the greatest potential for the development of a tourism product, especially those classified in cells M (2, 3) and M (1, 3) after valorization. These assets have moderate to high market attractiveness but low robustness. Although they can be used for tourism purposes, it is important to create conditions that prevent damage during tourist visits.

Cultural assets with low market attractiveness, such as those in cell M (3, 1), are unlikely to attract many tourists. However, cultural assets with high or moderate value as an indicator of cultural significance/robustness and moderate tourist appeal should be effectively promoted. In addition, they need to be protected, including the determination of the optimal number of visitors to ensure sustainable development of cultural tourism (Stamenković, 2005; Marković and Petrović, 2012; Milenković, 2018).

Table 4. Market attractiveness and robustness matrix

Robustness	41–60	M (1, 1)	M (1, 2)	M (1, 3)
	21–40	M (2, 1)	M (2, 2)	M (2, 3)
	0–20	M (3, 1)	M (3, 2)	M (3, 3)
		0–20	21–40	41–60
Indicator	Market attractiveness			

Source: Hilary du Cros, 2000; Milenković, 2018

Figure 4. Šupljaja Church
Source: http://muzejzagubica.org

Results and discussion

When applying the questionnaire, respondents were allowed to rate each parameter separately in grades from 1 to 5. One indicates insufficient quality, grade two indicates the importance of local tourism, grade three represents the sound quality of resources in the region, while five indicates excellent, high quality with international importance.

Table 5. Evaluation of cultural values of Homolje, quantitative-qualitative method

Indicators	**Grade**
Tourist-geographic position	2.9
Artistic merit	3.1
Tourist value of the environment	2.7
Tourist attractiveness and recognition	2.8
Construction and equipment of the space	2.3
Integration into tourist wealth	3
Overall score	**2.8**

Source: Author's survey

Based on the applied quantitative-qualitative method of tourism valorization, a conclusion can be drawn about the value of the cultural motifs in Homolje. The overall rating of the touristic value of the sights, including archaeological sites, monasteries and churches, is 2.8, which classifies them as high-quality sites of regional importance and moderate touristic attractiveness.

Tourism sector

Market attractiveness includes the following sub-indicators (grades from 0 to 5).

Market attractiveness of cultural goods:

- **Ambience** – Homolje is a geographical region located in eastern Serbia. It is situated between the surrounding mountain ranges in an arc, namely the Gornjačka Planina (825 m) in the west, the Homoljska Planina (940 m) in the north to the northeast, the Crni vrh massif (1043 m) in the east, while the Beljanica mountain extends to the south (1339 m). These mountain massifs contribute to the specific geographical landscape of Homolje and represent an important part of its natural environment. It also includes the upper course of the Mlava river, as well as two basins: Žagubička and Krepoljinsko-krupajska. This region's cultural assets are situated in an ecologically preserved environment, contributing to an ambience rating of 4.
- **Site known outside the local area** – Homolje is a significant symbol recognized locally and regionally. Its unique cultural events make it a promising destination for cultural tourism, with the potential to gain national significance through effective promotion. The grade for this criterion is 2.
- **National symbol** – While Homolje holds significance locally and regionally, it has yet to establish itself as a destination that attracts tourists from across the country. Despite its potential for development, limited traffic connections and inadequate infrastructure hinder its appeal. The grade for this criterion is 3.
- **Evocative character** – Altering historical contexts, unique social, geographical, and transportation positions have the potential to draw a significant number of tourists to this region. The abundance of legends, myths, intriguing historical facts, and remnants of cultural artefacts that reflect the customs and inhabitants from Roman times through the Middle Ages, the Nemanjić dynasty, the Battle of Kosovo (1389), and subsequent eras are crucial for the cultural and touristic advancement of this area. Grade 4.
- **Clear differentiation** – The Homolja area, with its unique natural and anthropogenic characteristics, stands out from surrounding areas. While the

underdevelopment lowers the rating due to low attendance, it does not diminish the significance of its numerous cultural assets that distinguish it from other regions. Grade 3.

- **Attractions for special needs** – Homolje is an area suitable for various forms of tourism development. Its abundant cultural tourism assets favour the growth of cultural-historical, event-based, and other forms of tourism. Additionally, Homolje's natural beauty increasingly draws tourists interested in hiking, mountain biking, skiing, hunting, and fishing. The grade is 3.
- **Complementarity with other tourist products** – Given that areas with prominent cultural motifs surround Homolje, it can be said that there is a low degree of complementarity with tourist offers in the near and far surroundings (event tourism, religious tourism, transit tourism). Grade 2.
- **Tourist activity in the region** – Tourist activity in the region of Homolje does not boast a high level of tourism development. Despite its central location in Eastern Serbia, inadequate transportation links and contemporary issues related to demographic decline in Homolje and surrounding areas diminish this value. Grade 2.
- **Associated with culture** – Numerous objects of cultural and historical heritage and certain manifestations characteristic of Homolje can confirm that this area is associated with culture. Grade 3.

Table 6. Sub-indicators of market attractiveness

Sub-indicators	Grade
Ambience	4
Site known outside the local area	2
National symbol	3
Evocative character	4
Clear differentiation	3
Special needs appeal	3
Complementarity with other tourist products	2
Tourist activity in the regions	2
Associated with culture	3
Overall score	**26**

Source: Author's survey

Factors of importance when designing a tourist product are:

- ***Access to the destination*** (grades from 0 to 4) – The spatial relationship of Homolje to larger urban and industrial centres is more favourable. In the first dispersive zone of a distance of 100 km, there are Bor and Zaječar in

the east, Požarevac and Smederevo in the northwest, Kragujevac, Jagodina, Paraćin, Ćuprija, Smederevska Palanka and Velika Plana in the west. The second group of tourist destinations 200 km away are Belgrade, Pančevo, Kruševac, Niš, Pirot, and others. (Mirković, 2003). The existing tourism potentials are insufficiently used. One of the reasons is the worse geographical position of the municipality, considering that the municipality is located outside the most important traffic corridors in the Republic. In addition, the municipality has not developed both traffic and tourist infrastructure. Accommodation facilities generally have a low degree of utilization, but nevertheless the number of tourist arrivals and overnight stays in the municipality of Žagubica in the period from 2018 to 2020 recorded an increase, which is encouraging data (Development plan of the municipality of Žagubica 2021-2031). The biggest jump in the growth of the number of arrivals and overnight stays occurred in 2021, due to the action of various factors. After that, the downward trend in the number continued, which indicates the need for further investments in the development of tourism and raising awareness among future visitors. The grade is 2.

- ***Transport to the destination*** (grades 0 to 3) – Homolje is just 30 kilometres from the Belgrade-Niš freeway, near Svilajnac or Paraćin. The tourist route of Đerdap and Timok is of peripheral importance compared to Homolje. However, if Donji Milanovac-Majdanpek-Žagubica road were modernized, it would establish a faster and more efficient connection between the Đerdap region and the south of Serbia. In the Homolje territory, road traffic is of the greatest importance, as the railway infrastructure is underdeveloped. Grade 2.
- ***Cultural attractions in the immediate vicinity*** (grades from 0 to 3) – In the vicinity of Homolje, there are numerous cultural monuments and notable attractions. The Bor area boasts intriguing caves like Zlotska and Lazareva caves. Nearby Požarevac is home to several state-protected cultural monuments. Additionally, the proximity of the ancient site of Viminacium near Kostolac attracts a certain number of tourists. Grade 2.
- ***Hospitability facilities*** (ratings from 0 to 5) – Accommodation options in Homolje are insufficient to accommodate many tourists, especially during events. The entire region has only one motel, "Vrelo", in Žagubica, offering 80 beds for accommodation. The restaurant at the motel can seat 400 guests. There are six other restaurants in Homolje, with capacities ranging from 30 to 100 seats. With proper rehabilitation and reconstruction, abandoned agricultural farms in the area, which currently have untapped potential, could be adapted to cater to nature enthusiasts, anglers, and hunters (Prentović et al., 2016). Grade 2.

Table 7. Sub-indicators of importance when designing a tourist product

Sub-indicators	Grade
Access to the destination	2
Transport to the destination	2
Cultural attractions in the immediate vicinity	2
Hospitability facilities	2
Overall score	**8**

Source: Author's survey

The total score is calculated by summing up the scores within the tourism sector. The score for sub-indicators crucial in designing a tourist product is 8, while the score for market attractiveness is 26. Adding these scores together, we get a total score for the tourism sector of 34, indicating moderate attractiveness.

The sector of cultural property management

Cultural significance can be evaluated using the following sub-indicators, each rated from 0 to 4.

- ***Aesthetic value*** (from 0 to 2) is high. Homolje boasts beautiful ambient settings and numerous cultural and historical monuments spanning various periods, from antiquity to modern times. These sites are legally protected as cultural assets. The grade for this criterion is 2.
- ***Historical value*** (from 0 to 2) is also high, as the area of Homolje contains remnants of cultural and historical heritage, including archaeological sites, numerous religious buildings from various periods, and objects that reflect the area's diverse cultures and customs over time. Grade 2.
- ***Educational value*** (from 0 to 2) – Homolje somewhat lags behind other regions in the Republic of Serbia. While the educational aspect can be seen in organized visits to cultural and historical sites, the fact that young people from this region often relocate to larger cities for education impacts the grade, which is 1.
- ***Scientific and research value*** (from 0 to 2) – is at a very low level. Homolje has been insufficiently researched from a scientific point of view. Homolje is rich in various resources, natural and cultural, rich in history above all, and has potential for scientific and research activities that have not yet taken root in this area. Grade 1.
- ***Social value*** (0 to 2) – It is highly developed despite experiencing demographic decline. Locally and regionally, numerous events are held that attract tourists and are increasingly gaining national significance ("Vrela Homolja," "Spasovdanski susreti," and "Hajka na Homoljskog kurjaka"). Grade 2.

- ***Representative site*** (from 1 to 4) – Several representative localities can be singled out in the area of Homolje. First, Gornjak Monastery, characterized by the gorge of the same name, then Trška Church, which is still interesting for historical studies, and many others. The grade is 3.

Table 8. Sub-indicators of cultural significance

Sub-indicators	Grade
Aesthetic value	2
Historical value	2
Educational value	1
Scientific and research value	1
Social value	2
Representative site	3
Overall score	**11**

Source: Author's survey

The robustness, i.e., the degree of acceptance of tourists, can be assessed using the following sub-indicators (from 0 to 5):

- ***Sensitivity of the cultural property*** (grade 0 to 4) – Tourist traffic in the Homolje area is extremely low and has been declining in recent years. However, this situation has not resulted in negative consequences for the cultural and historical sites, as the number of visitors to this area has not reached its maximum capacity. Grade 2.
- ***State of reparation*** (grades from 0 to 4) – This region's cultural and historical values require repair, restoration, and preservation, as most buildings were renovated in the 1980s (Trška Church, Blagoveštenje Monastery). An exception is the Local Museum of Homolje, which opened in 2017, where the museum display is at an admirable level and does not need revitalization. Grade 3.
- ***Existence of a management plan*** (grade 0 to 5) – Several projects and plans were adopted to develop tourism within the Development plan of the municipality of Žagubica 2021-2031 (https://www.zagubica.ls.gov.rs). The priority plans regarding the development of tourism include the improvement of the tourist offer and tourist potential in the area of the municipality of Žagubica. This includes increasing accommodation capacity, improving the quality of hospitality/tourist services, strengthening the capacity of event tourism, infrastructural arrangement of tourist destinations, and development of tourist

content. Most of these plans and projects have not been implemented, so it is necessary to improve and implement them as soon as possible or create new strategic plans to develop tourism. Grade 2.

- ***Regulatory monitoring and maintenance*** (grades from 0 to 5) – The cultural monuments in the area of Homolje fall under the jurisdiction of the Regional Institute for the Protection of Cultural Monuments in Smederevo. There have been issues with the inadequate maintenance of cultural assets. Grade 3.
- ***Current investment potential*** (grades from 0 to 5) – The investment potential in Homolje has not yet been clearly defined. There are opportunities exist for investment in both the public and private sectors. However, there has been a lack of investment in the development of tourism, which could prove to be a profitable venture in Homolje. Grade 2.
- ***The possibility of a negative impact of visitors*** (grades from 1 to 5) – Homolje, in particular the municipality of Žagubica, was visited by 897 tourists in 2022, with 3.125 overnight stays recorded (Statistical Office of the Republic of Serbia, 2023). The number of visitors has not yet peaked and remains below a satisfactory level. Consequently, there is no immediate concern regarding a negative impact on cultural assets. The grade is 4.
- ***Possibility of modification as part of product development*** (grades from 1 to 5) – So far, modifications to the area have not adversely affected the condition of cultural assets. However, unplanned construction to enhance tourism development could impact the physical state of cultural and historical buildings. Failure to implement modifications according to plan and in harmony with natural conditions may damage the whole of Homolje's ambiance. Grade 3.

Table 9. Robustness sub-indicators

Sub-indicators	Grade
Sensitivity	2
State of reparation	3
Management plan	2
Regulatory monitoring and maintenance	3
Current investment potential	2
The possibility of a negative impact of visitors	4
Possibility of modification as part of product development	3
Overall score	**19**

Source: Author's survey

By adding the overall scores within the management sector, the sub-indicator of cultural importance, which is 11, and the sub-indicator of robustness, which is 19, the total score is obtained, which in this case is 30. Based on the results, it can be seen that it is about the average sensitivity of cultural assets and the average cultural values. A "matrix of market attractiveness/robustness" has been developed based on the obtained results.

Table 10. Matrix of market attractiveness and robustness of cultural motifs of Homolje

Indicator	Market attractiveness			
Robustness	Overall grade	0–20	**21–40**	41–60
	0–20	M (3, 1)	M (3, 2)	M (3, 3)
	21–40	M (2, 1)	M (2, **2**)	M (2, 3)
	41–60	M (1, 1)	M (1, 2)	M (1, 3)

Source: Author's survey

Based on the matrix, it's apparent that the combined assessment of all sub-indicators has placed Homolje's cultural aspects in cell M (2, 2), indicating a moderate level of cultural significance and market appeal of its cultural offerings. These findings suggest that Homolje has favourable conditions for cultural tourism development, provided there is appropriate monitoring, thoughtful planning regulations, and effective promotion and preservation efforts to safeguard the area from potential harm during tourist visits.

Conclusion

The analysis of the moderate values of the indicators of cultural significance and market appeal of cultural assets shows that Homolje has exceptional potential for tourism development. The region is rich in cultural heritage, which is a valuable asset for attracting visitors from all over the world. However, exploiting this potential requires concrete measures to improve the tourism offer and effectively promote the area.

Firstly, better heritage management is needed. This includes the implementation of detailed plans and programs for the restoration, preservation and revitalization of cultural assets. These efforts not only serve to preserve Homolje's cultural heritage, but also help to create an authentic and engaging tourist experience.

Secondly, improving the promotion of tourism in the region is crucial. Previous marketing efforts have been inadequate, resulting in limited awareness of Homolje as a tourist destination. To overcome this challenge, a coordinated approach to promotion is needed that involves all stakeholders, from local authorities and entrepreneurs to civil society organizations and the local population.

Developing a coherent and enticing marketing package that highlights key events, attractions, tours and offers is crucial to attract the attention and interest of potential tourists. It is important to emphasize the lasting benefits of investing in Homolje's tourism growth. In addition to the economic benefits, such as job creation and boosting the local economy, tourism also plays an important role in preserving cultural identity and fostering a sense of community. Sustainable tourism practices promote the preservation of traditions, strengthen local pride and improve the overall quality of life in the region. The development of tourism in Homolje requires a comprehensive strategy that involves all relevant stakeholders and aspects of the tourism sector. Through joint efforts, commitment and strategic planning, we can achieve sustainable cultural development and exploit the rich tourism potential of the region.

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Original scientific article
Received: 13.05.2024;
Received in revised form: 08.06.2024.;
Accepted: 08.06.2024;
Available online: 14.10.2024.

UDC: 338.48(497.113)
doi: 10.5937/zrgfub2472159V

ATTITUDES OF OWNERS AND PERSPECTIVES OF SUSTAINABLE TOURIST BUSINESS IN VOJVODINA FARMS

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Abstract. Thinking sustainably and "green" through the activities of almost all organizations and companies, but also through personal attitudes and actions, has become an imperative of socially responsible business for those who deal with tourism and hospitality. There is an entrenched view that tourism should be viewed more broadly, i.e. as a system that, in addition to tourists and the economy, also includes the environment and society as a whole. Taking care of sustainable tourism development has become everyone's obligation ‒both supply and demand. For the purposes of this research, the opinions of owners of Vojvodina salaš farms engaged in tourism and providing hospitality services were examined through a survey. The goal of the work is to determine, based on the presentation of various contents and activities on salaš farms (representation of ethnic complexes and accommodation facilities, organic food products, ecotourism activities, additional contents...) whether they respect the concept of sustainable development and whether they strive for it. Also, to answer the question whether traditional, but also "increasingly numerous" modern facilities on salaš farms contribute to the concept of sustainability? The analysis of the collected data was performed using the SPSS.26.00 statistical program, descriptive statistics were presented and One-way ANOVA was performed. The results of the research indicate a positive attitude of the respondents regarding the sustainable development of tourism, but also differences in their attitudes regarding the enrichment of the tourist offer on salaš farms with modern amenities.

Keywords: tourism, hospitality, sustainable development, attitude research, offer holders, salaš farms, Vojvodina.

Introduction

The development of society is largely determined by the relationship between man and nature. The environment has always been an object of interest and admiration,

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but the lack of environmental awareness of the majority has meant that the adaptation of nature to human needs has become a strong anthropogenic influence, leading to inevitable destruction. The first wave of environmental awareness began in the 1970s with the emergence of public concern about the deteriorating state of the earth. The Brundtland Commission defined sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their needs (Agbedahin, 2019; Halisçelik, Soytas, 2019). Originally, tourism was not the focus of the Brundtland Report's discussion of sustainability principles, but it soon became the predominant activity under which sustainable development is promoted (Zhang, Chan, 2020). Holden, Linnerud & Banister (2017) argue that sustainable development is a moral imperative to meet needs, ensure equity and respect environmental constraints. Indeed, tourism depends more than any other activity on a quality environment, but on the other hand, the environment suffers from the consequences of uncontrolled development, i.e. mass tourism. Even small changes in tourists' behavior during the trip itself can have a positive impact on the human environment (Wut et al., 2023). It is precisely for this reason that it is necessary to refer to the concept of sustainable tourism and promote its development. Moreover, sustainable tourism not only protects important ecological resources, but also promotes the development of small and medium-sized enterprises, promotes local authentic products and stimulates economic development at the local and regional level (Waldemar, Dyer, 2024).

Farms in Vojvodina have a long tradition and are considered a special social phenomenon in the Pannonian region, symbolizing the former struggle of farmers with the wasteland (Demirović, 2018). At the end of the 17th and beginning of the 18th century, the terrain of Vojvodina was covered by loess plains and ridges, which made Vojvodina unsuitable for living. The distances between the villages were great, so only the land closer to the villages was cultivated. This situation led to the emergence of farms, where livestock farming initially dominated, and at the end of the 18th and beginning of the 19th century, the conditions for arable farming were created (amelioration works) (Angelovska Nedeljković, 2006; Radović, 2018). It is assumed that there were up to 11,000 farms before the First World War. Between the two wars, there were around 440 farms with more than 2,000 inhabitants. Most of them were located in Bačka and in northern and central Banat. Due to the agrarian reform and its physical destruction after the Second World War, urbanization and the modern lifestyle, many farms were wiped out. According to recent data, there were 237 inhabited and 27 uninhabited farms in the first decade of the 21st century (Košić et al., 2014). Today, only 53 farms are listed on the website of the Vojvodina Tourism Organization (https://vojvodina.travel/).

Compared to other buildings and structures in Vojvodina, the peculiarity of farms is reflected in their appearance, furnishings, cuisine and lifestyle. Farms are a

kind of urban and architectural unit with old traditional furniture. Each farmhouse had a residential and farm part. The residential building contained living rooms and guest rooms. There was a front parlor, the middle parlor, which served as both kitchen and dining room and from which the brick oven in the front parlor was fired, a pantry at the side and a veranda in front of the front door. The farm buildings were inseparable from the farmhouse: a grain shed, a barn, sheds for storing tools and carts, pens, chicken coops and pigsties. The original material used to construct the farm buildings was clay, later brick and more recently brick. The buildings were roofed with reeds and later with tiles. In front of the farmstead there was an obligatory deep dug well on the jeram, from which the inhabitants of the farmstead and the livestock drank healthy water and which was used to store food and cool drinks in the summer (Pajović, Pavlica, 2002).

The authors Ćurčić & Pavlović (2011) point out that over time, farms have become places where agriculture lives in harmony with nature and where rural, ecotourism and sustainable tourism have developed as new types of farmers' activities, but also so-called agritourism. According to the same authors, agritourism means a tourist offer on farms in Vojvodina, as a specific form of agricultural enterprises, and represents a specific market niche of a particular form of tourism. In recent years, however, a redefinition of the concept of a farm has taken place (Košić, Pejanović & Radović, 2013), where, in addition to the preserved traditional elements, numerous modern contents in the field of services and additional activities are introduced, which are offered to tourists as an integral package, combining "tradition and modernity".

Considering the pronounced centralization of Serbia and the orientation of attention and resources towards Belgrade (Živanović et al., 2019) as the main administrative center, the economic aspect of sustainable tourism is particularly evident in the business activities of the surveyed businesses in Vojvodina. The concept of sustainable development and green economy represents a mechanism that leads to the improvement and development of human well-being while insisting on the reduction of environmental risks. Its principles are embedded in the economic, social and environmental spheres (Đorić, 2021). In addition, they strive to create employment conditions and contribute to the reduction of inequalities between social classes (Al-Taai, 2021). Accordingly, the concept of "green tourism" developed, which Dodds & Joppe (2001) divide into four components:

- environmental stewardship - preserving and enhancing nature and the physical environment to ensure the long-term conservation of the ecosystem;
- local economic vitality – supporting the local economy, businesses and community;
- cultural diversity - respecting and valuing culture;

- experiential richness – enriching experiences through personal interest and active participation in nature, culture, people and places.

It is precisely through these components that the potential of the farm can be recognized, which thanks to the authentic tourist offer (preserved nature, accommodation in facilities that maintain the traditional style, offer of local products of organic origin, creative tourism - production of authentic items, active participation in the work of the host, etc.) contributes to the popularization of responsible tourism and forms a good basis for the integration of modern specific trends such as green economy and sustainable tourism with the traditional way of life and work.

Although farms have been much researched as a cultural and ecological feature of the Pannonian region, they are still underutilized in tourism presentation and are therefore a legitimate topic of this research. The aim of the work is to determine the possibility of uniting the tradition of farms in Vojvodina and the modern trends that guide today's tourist demand and shape the offer. Based on the answers received and the carefully considered views of the interviewees, it is possible to talk more concretely about the sustainable tourism business of farmers in Vojvodina, as well as the possibilities and limitations for the future development of this specific form of tourism, which is called agritourism.

Materials and methods

The main research instrument in this work is a questionnaire formulated as an online survey and sent to 40 official email addresses of selected farms in Vojvodina (those that, considering the offer on the website of the Vojvodina Tourism Organization and its websites, were considered to be providing or offering gastronomic and tourist services in accordance with sustainable business principles). It was assumed that all participants in this research initially participated voluntarily and then honestly answered the questions asked in the questionnaire, and the sample obtained is considered valid. The survey consisted of three parts, the first of which requested the respondents' answers on the geographical and socio-demographic characteristics of the farmers and the activities carried out on the farm. The second part of the survey contained a series of questions on agricultural and sustainable tourism, potentials and limitations, as well as questions on basic tourism characteristics (scope and structure of tourism and hospitality services offered and the main characteristics of tourists visiting them). The third part of the survey was designed in the form of a Likert scale on which respondents were asked to indicate their level of agreement with the given statements (from 1 to 5, i.e. from total disagreement to total agreement). The questionnaire was available to farm owners for three weeks (from the end of March to the first half of April 2024). Data analysis and processing was carried

out using the IBM SPSS statistical analysis computer program (version 26.00). Descriptive statistics methods were used to describe the observed phenomena (mean of respondents' answers - mean and standard deviation - df), and inferential statistics were used to test the hypothesis, i.e. a one-way ANOVA was performed to determine whether there was a statistically significant difference between respondents according to their place of residence (divided into the three categories "I live on a farm", "I live in a village", "I live in a town") when asked about the 15 Likert scale variables.

In the following text, the analysis and interpretation of the results was carried out according to the set research task, which is to examine the views of farm owners in Vojvodina and their understanding and implementation of the principles of sustainable development and agritourism. The paper presents the farm tourism offer that points to authenticity and responsible action.

In order to show the perspectives of the union of tradition and sustainability on the investigated farms of Vojvodina and modern content through contemporary trends that guide the tourist offer and characterize the demand, a general hypothesis was formulated, which is *"The tourist offer on the farms is determined by the lifestyle and mindset of their owners"*.

Results and discussion

Of the total of 40 farms to which the survey was sent, 10 responded to the survey, whose basic geographical and tourism/hospitality characteristics are listed in Table 1. The oldest establishment has been in operation since 1993, two have been open since 1996, one since 2006, two since 2008, one since 2012, one since 2013 and two since 2015. In terms of gender structure, 50% of the respondents were women and 50% men. The age structure of the business owners shows that most of them are middle-aged, i.e. over 50 years old, while two respondents belong to the younger generation and are 32 and 40 years old. 7 respondents have primary school education, 2 respondents have completed secondary school and 1 respondent has higher education. Five farms are active in tourism, agriculture and the sale of local products of organic origin, the others are only active in tourism and gastronomy. The number of farm members involved in the provision of tourism and hospitality services ranges from 3 to 15.

Table 1. Basic geographical and tourism/hospitality characteristics of the respondents

Name of the farm	Location	Year of operation	Accommodation capacity (number of beds)	Catering services	Duration of operation of farm	Number of visitors per year
Djeram Farm	Mokrin	2006.	8	yes	All year round	300-500
Buca's Farm	Temerin	2012.	/	yes	All year round	over1.000
Katai Farm	Mali Idjoš	1996.	100	yes	Seasonal (spring/ autumn)	over 1.000
Majkin's Farm	Palić	1996.	30	yes	All year round	over 1.000
Our Farm	Gradina	2015.	8	yes	All year round	over 1.000
Lujza Farm	Belo Blato	2008.	In the process of adaptation	yes	Seasonal (spring/ autumn)	over 1.000
Tandari Farm	Martonoš	2013.	26	yes	All year round	over 1.000
Isailovi	Sremska Mitrovica	2015.	6	yes	opened only when visitors are announced	100-300
Rokin Farm	Nosa, Ludaš lake	1993.	17	yes	opened only when visitors are announced	500-1.000
Blue Farm *	Čenej	2008.	9	/	opened only when visitors are announced	up to 100

*Legend: *Due to unresolved disputes and long-standing problems with electricity supply, Plavi Salaš is currently unable to operate in the hospitality and tourism sector, but successfully organizes and conducts numerous workshops that serve as a complement to the tourist stay.*

The differences between the surveyed businesses can be seen, among other things, in the services offered (almost all offer catering and accommodation services with different capacities, expressed by the number of beds), in the operating time during the year and in the number of visitors on an annual basis (Table 1). Regarding the visitor structure, 80% of the respondents stated that the farms are visited equally by domestic and foreign visitors, and 20% that domestic visitors still predominate. In terms of age structure, respondents indicated that the majority of visitors are middle-aged (70%), followed by young people (20%) and older visitors, pensioners−10%. Regarding the length of stay, respondents indicate that most guests come over the weekend (two nights) - 40%, then those who stay for one day (no overnight stay) - 30%, those who stay for a short time (come for a few hours) - 20% and finally those who stay for more than three days - 10%.

Analyzing the answers of farm owners to questions about sustainable management and tourism, we can generally speak of a positive attitude and attitude towards the sustainable development of tourism on farms. In this context, the answers with 100% agreement of all survey participants to the questions whether they know what the concept of sustainable tourism entails and whether they would invest more in their tourism offer on the farm if it would contribute to the ecological balance and the protection of the environment are to be regarded as very significant. Also when answering the question "Is it important to you that tourists contribute to ecological balance and environmental protection? "Is it important to you that tourists do not endanger nature during their stay on your farm?", where they chose the answer "very important". Out of 10 respondents, only one gave a negative answer to the question: "Would you organize educational workshops for visitors to show them the importance of preserving the natural and cultural values on your farms"?

When asked if they believe that too many tourists who do not care about the environment can threaten farm values, 60% of respondents expressed their fear, while 40% disagreed with this opinion. That there is no reason to be afraid of a larger number of tourists was expressed by one of the respondents through an additional answer that expressed his misunderstanding of this question: "In the 30 years that we have been working, no one has damaged cultural or natural values, on the contrary, that is the reason for their arrival." I do not understand why you are asking this."

In line with the views of Živković, Petrović & Ercegović (2020) that service activities and ecotourism are most exposed to the effects of competition, especially from the aspect of quality and business efficiency, Table 2 shows the differences between the participants in the survey, depending on the tourist-hotel services and activities they offer.

Table 2. Services provided on farms that took part in the survey

Name of the farm	Services provided on farm
Djeram Farm, Mokrin	accommodation services; catering services (home-made food and drinks); workshop for making objects from clay; brandy pot; children's playground; organization of cultural and artistic programs; art colonies; concerts and demonstration of folk customs; organization of seminars and festivals.
Buca's Farm, Temerin	food services (home cooking); mini-zoo; children's playground; soccer and basketball courts.
Katai Farm, Mali Idjoš	accommodation services; catering; organizing conferences and seminars; playgrounds; getting to know pets, riding horses and donkeys; carriage rides; making handicrafts using various techniques; hiking; collecting medicinal plants; possibility of organizing day trips and schools in nature for students from 1st to 4th grade; camps for primary school students (English camp, art camp, eco camp, old crafts camp); organizing a visit to the bakery museum; swimming and fishing at the lake.
Majkin's Farm, Palić	accommodation services; catering services (home cooking); outdoor swimming pool; meeting room and reception; tambourine music; carp pond; sports fields; horse stables; orchards and an acacia grove; organization of festivals; open-air museum; winery; production of home-made juice.
Our Farm, Gradina	accommodation services; catering services (home cooking); organization of festivals and weddings and business lunches; children's playground; picture gallery and ethnic collection; sale of handicrafts from old crafts; proximity to the "Pannonian Road of Peace" cycle path.
Lujza Farm, Belo Blato	food services (traditional gastronomic offer and healthy food); breeding of domestic animals.
Tandari Farm, Martonoš	accommodation services; catering services; organization of business seminars, celebrations; camping in natural environment; contents for children; orchard; sports fields; mini-zoo; sport fishing and hunting tourism.
Isailovi Farm, Sremska Mitrovica	accommodation services; catering services (home cooking); organization of meetings, weddings and celebrations; picnic area; organization of tours or lessons on local culture; children's playground.
Rokin Farm, Nosa, Ludaš lake	accommodation services; catering services (traditional Hungarian cuisine and home-made products); ethnological collection of authentic original objects; organization of farm tours; school trips; family celebrations (birthdays, anniversaries); organization of seminars, conferences, manifestations; children's camps and workshops; children's playground; table soccer, table tennis; there is accommodation, decorated rooms in the old style (currently out of service); promotion of old crafts and products of old crafts; organization of traditional festivals and events; exhibitions and fairs; promotion of healthy organic food; organization of seminars, art workshops, outdoor educational camps, organization of wine and farm evenings.
Blue Farm, **Čenej**	accommodation services; catering services (home-made food and drinks); workshop for making objects from clay; brandy pot; children's playground; organization of cultural and artistic programs; art colonies; concerts and demonstration of folk customs; organization of seminars and festivals.

Source: (The authors have researched on the basis of surveys and supplemented on the

basis of information from the following sources: www.etnokucadjeram.com; https://www.moja-delatnost.rs/salas-temerin/etno-kuca-bucin-salas/MMQxUPZ; www.katai.farm; www.majkinsalas.rs; www.nassalas.com; https://vojvodina.travel/salas-lujza-belo-blato/; www.salasi-tandari.com; https://www.booking.com/hotel/rs/salas-isailovi.sr.html; https://vojvodina.travel/plavi-salas-cenej/; https://palic.rs/sta-raditi/salas-vinarija/rokin-salas/)

The authors of the paper consider that the difference in farm owners' thinking regarding the presentation of purely traditional or the need for the presence of "modern content" (which may not be compatible with the environment and the function of the farm) and their position on sustainable development integrated into their own tourism offer depends strongly on whether they live on the farm itself, in a rural or urban environment. It is assumed that owners living on farms are more inclined to preserve purely traditional values of farms and sustainable development, as are those living in rural areas compared to owners living in urban areas (to whom the farm may have been left as a "trust" and who are therefore more oriented towards an offer that attracts and satisfies the needs of "sophisticated' tourism demand at all costs).

Although farm owners generally agree with most of the statements in the survey, namely:

- The farm should be located in a preserved natural environment (mean 4.80; pd .483);
- The farm should contribute to the development of the local community (preservation and improvement of traditional local features and values) (mean 4.70; Sd. .675);
- I would like to offer my guests only traditional gastronomic–Vojvodina specialties (mean 4.70; Sd. .483);
- The farm supports activities related to ecotourism and quality of stay in nature (mean 4.60; Sd .483);
- Agritourism is an opportunity for tourists to return to true values (mean 4.50; Sd. .455);
- The economic impact of businesses is visible and opens up opportunities for further investment (mean 4.10; Sd. .994);
- Through tourism and hospitality, I try to promote and sell local products (mean 4.00; Sd. 1.054);
- The current tourism offer on the farm is a good basis for attracting tourists (mean 4.40; Sd. .516);
- Tourism on the farm offers the opportunity to meet people with different cultures and interests (mean 4.40; Sd. .665);
- Compared to other catering businesses, farms contribute more to sustainable development because they have a balanced and positive impact on society and the environment (mean 4.20; Sd. .919);

- The farm that belongs to me can work in a sustainable and ecologically responsible way in the future (mean 4.60; pd. .516).

Nevertheless, some very important statements can be singled out where a statistically significant difference (significance level ($p<0.05$)) was found in relation to attitudes towards tourism and hospitality on farms (see Table 3), which is why the hypothesis: "The tourism offer on farms is determined by the lifestyle and mindset of their owners" should be partially accepted. Although a statistically significant difference was found between respondents for a smaller number of statements (4 out of 15), and as the difference occurred for the "most important" statements, the hypothesis should not be completely rejected as it indicates differences in the attitudes and mindsets of owners.

Table 3. Selected attitudes based on the one-factorial analysis of variance ANOVA - attitudes of farm owners according to their place of residence

Claims	Place of residence	N	M	F	p
Today, the farmhouse should be designed to meet the current trend in tourism: a combination of tradition and modernity (old architecture enhanced with modern and comfortable facilities with great capacity and innovative equipment and technology).	farm	3	2.56	4210	.006
	village	3	3.13		
	city	4	4.25		
The farm's guests should be offered accommodation and catering exclusively in the traditional style (old and authentic architecture)	farm	3	4.35	6264	.020
	village	3	4.00		
	city	4	3.07		
We exclusively maintain the traditional architectural style of this region, authentic for the Vojvodina Plain	farm	3	4.45	5964	.027
	village	3	4.15		
	city	4	3.75		
Young entrepreneurs as owners of farms should primarily influence the trend towards green economy in order to become a model of thinking for sustainable tourism development of farms	farm	3	3.78	4970	.048
	village	3	4.05		
	city	4	4.37		

Legend: N – number of respondents; M – arithmetic mean (mean value of answers), F – statistical value, p – significance level ($p <0.05$).

Based on the results obtained, it can be said that there is an awareness and a positive attitude of farm owners towards sustainable tourism development, but when it comes to the tourism offer, we can divide them into two groups: Traditionalists - those who tend towards pure traditionalism (ethnic characteristics of local values,

exclusively authentic content for accommodation and stay, organic products and food....) and the so-called "modernists"−those who, in order to increase the number of guests and satisfy the "hedonistic" and "differentiated" taste of tourist demand, are willing to add modern facilities to the traditional ones (modern and comfortable facilities with large capacity and innovative equipment and technology, swimming pools, wellness and spa centers, etc.). Demirović (2018) comes to a similar conclusion when he states that in the area of Vojvodina today there are a number of farms that have been converted into tourist services or agro-ecological facilities.

Tourism is often described as an activity that can significantly contribute to the development of a given region, as an activity that enhances various natural and anthropogenic values and thus attracts tourists and investments and creates conditions for the creation of new jobs and improvement of living standards (Počuča, Matijašević-Obradović, 2020). We can see consistency with these conclusions precisely in the attitudes of those farm owners who described themselves as "modernists", i.e. those who are willing to introduce new things and combine traditional and modern content on the farms.

Furthermore, this study, as well as the one conducted by Radović (2018), assumes that sustainable tourism and hospitality and the revitalization of farms contribute to the achievement of numerous benefits: economic (additional income through the provision of tourism services), demographic (improvement of the age and economic structure of the population in rural areas), cultural (increasing interest in preserving traditions), infrastructural and communal (improvement of roads, construction of water supply, sewerage, etc.), integrative (promoting the development of rural areas, etc.)), integrative (promotion of the development of complementary activities and revival of old crafts), but above all ecological (growing awareness of the importance of preserving the environment and the importance of local food of organic origin).

As the results of the survey show, respondents believe that the environment on farms is not threatened by tourist activities and that they are willing to organize educational workshops to inform visitors about the importance of conservation. Some have clearly marked information boards about permitted and prohibited activities on the farm.

Conclusion

Farms are a kind of guardians of the tradition and authentic lifestyle of Vojvodina. The development of sustainable tourism and related infrastructure, developed now and in the future in harmony with natural capacities, should support the regeneration and productivity of natural resources, recognize the efforts of people and communities and the customs and lifestyles that contribute to shaping the tourist

experience. It also understands the importance of sharing equally in the economic benefits of local people and host communities. Sustainable tourism is a development concept that reconciles the ecological, socio-cultural and economic components of the environment with the satisfaction of tourists. In this way, it is possible to create an optimal model of tourism development that does not lead to degradation and ensures preservation for future generations. Sustainability must be an imperative for all forms of tourism (not just nature tourism), but especially for those that lead to the development of mass tourism and pose the greatest threat to the environment, cultural heritage and identity of a area.

The results of this work, based on the answers of the respondents to the question: "In what way do you contribute to the preservation of the environment?" (where the owners could tick several answers) are considered to be very significant. The following results were obtained: 40% of respondents answered that they only grow and offer products of organic origin; 40% of respondents use solar energy on the farm and even 70% of respondents use materials from the natural environment (in terms of construction, recycling, reduced use of plastic, etc.). However, none of the respondents stated that they offer the possibility to rent bicycles as an environmentally friendly means of transportation to visit the farm, although this was offered in the survey as well as in the brochures and offers on the websites of some of them. If such an option was previously available and has been removed over time, the owners could be advised to renew or enrich their offer and support sustainability in this way. The suggestion would be to create cycle paths connecting, if not all, at least those closest to the farms (or connecting them to existing ones, e.g. the "Pannonian Road of Peace" cycle path), where fans of this type of tourism are safe and at the same time visitors and guests are welcome on the farms.

Modern society, it seems, is trying more than ever to "return to nature" and tradition, which is especially felt after major health crises such as the recent COVID 19 virus pandemic. A challenge and a risk, but it is up to the owners of the offer, i.e. the farm owners, to decide on their future business and to respect the principles of sustainability. However, caution is needed when making such decisions as there may be a revolt among tourists, especially those who are more environmentally conscious. Therefore, future research could include a survey of tourists' opinions on the inclusion of modern amenities on farms in Vojvodina.

Considering the limitations of this work, we can state that although there are a large number of farms operating on the territory of Vojvodina (53 farms according to current statistics), we encounter a problem due to insufficient engagement in cooperation with key stakeholders as well as insufficient interest in indirect promotion. Most farms have a so-called one-dimensional approach and do not show sufficient interest in collaborating with actors from complementary sectors. The

lack of cooperation with educational institutions that can indirectly participate in promotion and popularization is recognized as a problem and can also be seen as the main limitation of this work (as only 10 out of 40 contacted farm owners supported participation in this research). Involving a larger number of farms and gathering the opinions of their owners would certainly provide a different insight into their way of thinking and doing business, which would give a more complete picture of the farms' tourism offer, and it could be a continuation of some future research, which could include other research topics besides sustainable development, giving an answer to the prospects of their further business.

Acknowledgments

This work is the result of research funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia under the number 451/03/65/2024-03/200091.

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Original scientific article
Received: 14.05.2024;
Received in revised form: -
Accepted: 25.05.2025;
Available online: 14.10.2024.

UDC: 338.48:502/504
doi: 10.5937/zrgfub2472175S

TOURISM PLANNING ACCORDING TO THE MAN AND THE SPACE

Stevan M. Stanković [1]

Abstract: The current domestic and foreign tourism in our country and in the world is developing in significant natural, rural and urban areas. As such, it is of interest for numerous research endeavours, operational activities and appropriate spatial and social planning in accordance with current legislation and established views on environmental sustainability. In places, regions and countries receptive to tourism, where tourism develops on the basis of tradition and respect for local and regional characteristics, the highest possible harmonisation and planning of development with existing natural and anthropogenic values is required, with particular attention to the views of modern ecology and anthropogeography on the unity of nature, man and society. The planning of modern domestic and international tourism in all its forms must always and everywhere be based on scientifically proven foundations and realistic social reality. The planning of tourism development must always and everywhere be aimed at achieving economic and social effects, i.e. directly at the economic component, since the income from tourism as a type of activity in the sense of unmanageable exports is significant for the country's balance of payments. The need for tourism development planning in harmony with people and nature is emphasised by a number of good experts in this field. Among them, the German sociologist Jost Krippendorf stands out, whose views are often quoted as expressing the need to respect the local and traditional over the universal when it comes to planning the overall tourism activities in a given area. Also of interest are the recommendations of the World Tourism Organisation, which are addressed to the member countries of this leading organisation in the field of tourism and travel (Krippendorf, 1986).

Keywords: Planning, man, space, inbound tourism, outbound tourism, economical effects, local and traditional

Introduction

Modern tourism can be equated with the specific migration of people from their home countries to tourist destinations, both within a country (domestic tourism)

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and between different countries (international tourism). For many years and decades, the number of domestic and foreign tourists in the world has been increasing, which indicates the need for targeted spatial planning for its development. The literature states that modern tourism and human society are two closely and diversely related categories, characterised by their past, their present and their aspirations for the future. Modern tourism is characterised by numerous phenomena and processes that reflect in a particular way the economic and cultural state and development of society, its material and cultural well-being, regardless of the recipe and reception of tourists. With its mass, not only host, but also international tourism, as well as the great power of integration of numerous actions, natural, economic and social activities, tourism has no equivalent on the planet.

Due to a number of peculiarities of modern tourism, it is necessary to plan and organise it in such a way as to harmonise it as much as possible with the needs of the people and the capacities of the space. Only well-planned and organised tourism that is in line with modern positive views of ecology will bring real results in the long term. It manifests itself in the possibility of valorising those natural complexes and social objects, phenomena and processes that are not important for other activities. This is linked to the realisation that tourism expands the human field of work and contributes many times over to the realisation of the economic and social effects of the places, regions and countries in which the hosting and tourism side takes place. For this reason, special attention is paid to this activity in the various territorially and socially organised modern societies.

Tourism as a global process

There are few activities that have taken hold of almost our entire planet like tourism, from traditionally well-visited centres, regions and countries to those that are just entering the large tourism market with their offer. Due to a number of specific features, especially its economic importance, tourism is recognised in most countries directly and indirectly, traditionally and modern, in legislation, the economy, spatial planning, urban development, investment, ecology, the protection of natural and anthropogenic values, human resources training, tax policy, road and transport document regime, but also culture, art, design, general and targeted marketing, the protection and revival of archaeological sites, monumental heritage and the presentation of original traditional ethnographic values. It is also about the training and education of personnel for increasingly complex and diverse tasks in tourism initiative and reception (Stanković, 2009).

Since the first organised tourist trips and the emergence of tourist destinations and regions, tourism has been understood differently in different countries. This

makes it interesting and challenging for a comprehensive study, especially for the spatial and functional planning that contributes to development. Time has shown that many conditions are necessary for tourism to be successful and economically recognisable. The opinion of some authors that tourism will quickly and easily revitalise underdeveloped regions and countries has not been fully realised. Among the ten most developed tourism countries in the world, almost all are among the first in terms of a number of other indicators, such as the material base of tourism, the level of investment in tourism and hospitality facilities and infrastructure, the level of personal and family standards of the population, the high degree of complementarity of tourism with other activities, especially transport, food production, environmental protection, etc. We are talking about the USA, Spain, France, Italy, Switzerland, Germany, Austria, Great Britain, Hungary, but also China, Indonesia and Brazil.

It is estimated that people's spending on international tourist travel accounts for 12 to 15% of the total national product, i.e. 6 to 8% of the value of global exports or 20 to 30% of the value of all services. In addition, investment in the renovation of old and construction of new tourism and hospitality facilities exceeds 15% of total investment. Revenues from global tourism totalled 1.5 trillion dollars in 2019. Now that tourism has recovered from the Covid-19 pandemic, revenues are expected to exceed USD 1.8 trillion in 2024. This situation requires targeted tourism planning by people and spaces to avoid saturation and degradation of natural and anthropogenic tourism values, which are the drivers of tourist movements of varying intensity and duration. If we add the number and characteristics of foreign tourism, which is four to six times greater than domestic tourist flows, things become more complicated, planning becomes more responsible, the tasks more complex and the problems to be solved more numerous and varied. For the constantly growing number of tourists in the world, it is necessary to plan and upgrade existing areas and conquer new ones, to revitalise and build existing and new tourist and catering facilities and all kinds of tourist infrastructure.

Table 1. Number of foreign tourists in the world (in millions)

Year	Tourists	Year	Tourists
1970	166	2000	661
1975	222	2005	808
1980	284	2010	937
1985	238	2015	1.000
1990	456	2020	1.060
1995	534	2025. (forecast)	1.500

Planning process from local to the international level

The planning of tourism must be consistent with the generally recognised definition of this social and economic activity, which has conquered the whole world and is developing faster and more extensively than a number of other activities. It is a set of relationships, phenomena and processes resulting from people travelling from their permanent residence to a tourist location, region or country in order to satisfy one or more of life's needs, the most important of which are recreation, health and culture. Although it has a long, rich and varied tradition, tourism in the modern sense of the word, especially in terms of the frequency and scale of domestic and foreign tourist movements, is characteristic of the period between the two world wars, particularly the second half of the nineteenth century, i.e. the relatively rapid reconstruction of the economy and the rise in living standards after the Second World War. For several decades, tourism has only been able to compete with the most profitable human activities, such as some industries, electronics, banking, transport and trade, both in terms of mass and economic, social and cultural indicators.

From an anthropogeographical point of view, modern tourism represents the most massive form of occasional population migration, both from the place of origin to the tourist destination and from the regions of the countries that initiate tourism to the regions and countries of the tourist host countries. For the ever-growing number of domestic and foreign tourists in our country and in the world, as well as for their ever-increasing and diverse demand, we need more and more original and well-organised and protected rural, urban, continental, mountainous, plain and coastal areas, i.e. manifestations of various types, monuments and memorial complexes that can satisfy health, recreational, excursion, congress, demonstration, cultural, personal, sporting and other needs with their basic characteristics. Tourism planning in terms of people and space extends from the local to the regional and national level, with supra-regional and intergovernmental plans and projects to improve tourism being favoured in many places in recent times. The planning of tourism in terms of people and space differs in some ways from the planning of other activities. This is because the development of tourism requires a lot of original or well-protected space, while tourism is not a constant consumer of it, on the contrary, if it is well planned and organised, it improves the state of the environment, enriches the space with specific objects and, more than other activities, can serve culture, tradition, improvement of the local environment, raising awareness of the need to protect and improve nature and its monumental heritage, as well as improving the economic and social standards of the population of receptive places, regions and countries (Stanković, 2022).

The fact is that tourism is a distinct spatial phenomenon and takes place in almost all climate zones, on all continents, high mountains, warm seas and deserted

islands. Numerous natural and anthropogenic objects, phenomena, processes and events contribute to the development of tourism. Where the appropriate material basis for tourism has been created (accommodation and catering facilities, transport infrastructure and where cultural heritage is well protected, researched and presented or attractive sporting, ethnographic, culinary, musical and other events take place), tourism contributes in many ways to the well-being of the local population, i.e. to the reception of tourists. Planning the development and improvement of tourism is a complex and responsible scientific research and application task. It follows a good knowledge and functional design of the type and scope of accommodation and catering facilities, transport infrastructure and transport, the richness of the content of tourist stays, the problem of year-round operation, as an integral part of tourist movements and the economically and socially justified operation of tourism and catering facilities.

Table 2. Tourists and overnights in Serbia

Year	Tourists			Overnights		
	Domestic	Foreign	Total	Domestic	Foreign	Total
1955	988,000	60,000	1,048,000	2,805,000	175,000	2,980,000
1965	2,147,000	477,000	2,624,000	6,844,000	1,303,000	8,187,000
1970	2,636,000	687,000	3,323,000	6,540,000	1,136,000	7,676,000
1975	3,179,000	842,000	4,021,000	8,586,000	1,381,000	9,967,000
1980	3,460,000	868,000	5,328,000	10,562,000	1,468,000	12,030,000
1985	3,899,000	847,000	4,746,000	12,424,000	1,473,000	13,897,000
1990	3,060,000	881,000	3,941,000	10,202,000	1,468,000	11,6670,00
1995	2,228,000	204,000	2,432,000	7,481,000	644,000	8,125,000
2000	2,003,000	165,398	2,168,398	7,265,000	430,000	7,695,000
2005	1,536,000	452,679	1,988,679	5,507,000	991,748	6,498,748
2010	1,317,916	682,681	2,000,597	4,961,359	1,452,156	6,413,515
2015	1,304,944	1,132,221	2,437,165	4,242,172	2,409,680	6,651,852
2020	1,374,310	445,711	1,820,021	4,936,732	1,264,558	6,202,290
2022	2,096,472	1,772,763	3,869,235	7,306,219	4,939,394	12,245,613

Figure 1. Palić lake and the shore – an example of well-organized tourist area

Tourism planning and space valorisation

On the basis of the natural sciences of the area under study (geography, biology, ecology, geology, hydrology, climatology, pedology), the development of tourism can be planned on smaller and larger natural or administrative units, regions, states and interstate levels. . The tasks of spatial and functional tourism planning are numerous, diverse and specific. One of the reasons for this is that some objects, phenomena and processes in space that are not of interest for a number of other activities can be valorised through the development of tourism. Only through tourism do they acquire their true value (caves, beaches, snow-covered mountain slopes, swamps, and sunsets), i.e. they expand the sphere of human labour, economy and employment. In planning the enhancement of natural and anthropogenic values, events and phenomena that correspond to production capacities, it is necessary to harmonise and coordinate, always and wherever possible, the existing complementary tourist values of the territory within the limits of an optimal circulation that does not jeopardise the ecological relationships and processes that have been established in the environment over time.

The area as a territorial unit of the municipality, the district and the state can be valorised in an exemplary way through tourism. “In this limited spatial framework,

an all-round spread of all particles of animate and inanimate matter takes place. But in a way that is tangible and controllable. Such an entanglement leads to various spiritual events. In addition to space, time also plays its specific and decisive role in every human action. Time is therefore inseparable from space. It is philosophically inseparable, it is inseparable for every theory and it is inseparable for every practical activity" (Dobrović, 2017). This means that it is inseparable from tourism, i.e. its planning for the present and the future.

Tourism planning differs in some ways from the planning of a number of other activities. This is because tourism aims to create an original, well-preserved or revitalised environment with objects, phenomena and processes that have one or more attributes of tourist attraction. It is the organised activity of the social community to enable economically profitable and socially beneficial operation of the tourist reception based on the existing tourist values. Tourism planning must be based on the fact that processes and phenomena in space that emphasise tourism values are natural and social. They are stimulating and constraining and can be immediate, occasional, periodic, short-term, long-term, permanent, local, regional, controlled and uncontrolled, creative and destructive, historically conditioned but also contemporary, easier and harder to predict and solve. This situation shows the complexity of tourism planning. The environment, i.e. the space based on the direct, indirect and feedback connections of numerous factors with the environment that have developed over time, and in which tourism also develops, is a specific category based on a series of indicators, with elements of zonal and azonal, organised and disorganised, centre and periphery, proactive and receptive.

Tourism, as one of the increasingly important economic and social functions in the territory, is the content of spatial and urban plans of various territorial inventories, basic and special purposes, e.g. for national parks, nature reserves, health resorts, mountain and seaside resorts, islands, monument complexes, as well as for corresponding administrative units such as municipalities, communes, districts, etc. The organisation, design and functional equipment of the tourist area on a human scale are three important tasks that geographers, spatial planners, urban planners, architects, tourism scientists, ecologists and economists have to deal with, taking into account existing facilities and the state of tourism as well as knowledge of contemporary trends in developed countries. of tourism and a positive tourism balance in terms of the amount of income from tourism services for domestic and foreign tourists and the volume and structure of employment in tourism and hospitality.

Tourism as a spatial phenomenon

Due to the constant growth of mass tourism, both domestic and foreign, and the importance of this activity, appropriate attention must be paid to tourism from a planning perspective, bearing in mind that the scientific and practical foundations of the approach to the overall planning of tourism are based on the scale of people and space, and the tasks involved are numerous, varied, often complementary, but also conflicting with a number of activities that have an interest in the area of value for tourism. This is of particular importance, because regardless of the large area of our planet or individual countries and regions, the space cannot be expanded to include almost everything, especially that which has the appropriate attributes of tourist attractiveness, is originally preserved or well protected and improved and as such has tourist value. Of course, only legally protected areas (reserves, national parks, nature parks, memorial sites) are not acceptable for a diverse and economically justified tourism. Tourism seeks wide areas in different geographical longitudes and latitudes, altitudes, islands, seas and continents as well as climatic zones (Stanković, 2023)

Knowledge of space, i.e. the environment in which human society lives, is one of the oldest human endeavours, which has changed and improved with the development of techniques, technology, production forces, human needs and general social relations. For several centuries, scientists, especially philosophers, have been dealing with the problems of coping with the forces of nature and their effects on material and spiritual life. "With the development of society, questions about the sufficiency of the earth's natural resources to meet the suddenly increased demand for energy and natural materials and in connection with population growth and scientific and technological progress have become increasingly topical. Finally, the problem of the fundamental characteristics of the natural environment under the influence of the sharp increase in production has recently become the centre of attention. In a relatively short time, this problem has gone beyond the scope of nature conservation, i.e. the preservation of certain natural systems (geosystems). The task of environmental protection and the activities of human society itself have taken centre stage, both in the present and in the interests of future generations. The character and speed of natural geographic and ecological processes (including the different characteristics of natural systems in terms of their self-regulating capabilities) and the process of demographic, social and economic development." (Radovanović, 1977).

Responsible and sustainable tourism development

In the context of modern trends in tourism, the Agenda 21 for the tourism industry and the General Code of Ethics for Tourism, specific documents of the

World Tourism Organisation based in Madrid, are of interest. Some measures in the positions are of interest for development planning and benefit the member countries. It is about the contribution of tourism to understanding and respect between peoples, about tourism as a means of individual and collective satisfaction, about tourism spatial planning activities based on sustainable development. As a widely accepted international agreement, Agenda 21 has a special significance for tourism, which has been recognised as the most important economic sector at global level for some years now. It is about the actions that the tourism industry must take. Although the recommended activities may seem unrealistic, the consequences of failing to take appropriate action can lead to an increase in the economic damage to tourism reception. (Group of Authors, 2000). This is followed by the positions of the General Code of Ethics for Tourism, which pays special attention to tourism as a factor of sustainable development and as a user of natural and cultural heritage, its conservation and enhancement, the freedom of movement of tourists and the rights and duties of tourism workers. (Group of Authors, 2001). Tourism development planning can be based on the recommendations of the World Tourism Organisation, which has elaborated five main and 27 additional elements for planning and proposed different types of tourism facilities, namely coastal and mountain areas, national parks and reserves, archaeological sites, historically significant places and health resorts, in the short term (1 to 3 years), medium term (4 to 10 years) and long term (11 to 25 years).

The planning of tourism development requires a careful approach and a good knowledge of natural processes, zonal and azonal elements, occasional and permanent processes, connections, conditioning, direct and feedback loops of spatial elements. Although there are universal methods for analysing spatial planning for the needs of tourism, they should not always and everywhere be applied literally. Each space intended for tourism requires the application of appropriate research methods and the communication of the results obtained, because in the tourism market the local and regional, the endemic, the exemplary, has a higher price than the universal. Tourism planning by man and space can be defined as a planned, scientifically based, continuous and practically verifiable activity of man and society, which endeavours to achieve the targeted and proven orientation of tourist-historical and transport facilities, with the help of which tourist traffic in a certain area can be optimised. The facilities and their location are selected according to the tourist values of the area, the type of tourism and the ability of the municipality to invest in the planned facilities to meet the needs of current and potential domestic and foreign tourists.

Succession in tourism planning

The planning of tourism development is approached analytically, with a clear definition of the desired objectives. It is based on an inventory of tourism values, the possibility of enhancing, protecting and improving them, as well as complementarity and competition with the environment. It also involves research into existing and future demand on the domestic and foreign markets, the placement of facilities and activities in the area and the best possible selection of locations for certain tourist activities, which must be suitably equipped. The identification and definition of the desired objectives and the definition of alternative and acceptable methods to achieve them seem to be particularly important. It is also necessary to prioritise the construction and design of the tourist area and its zoning in accordance with ecological principles and local natural and social conditions. Put simply, the best results are achieved by comparing with the existing situation, by analysing priorities and exemplary examples from the country and the world, by properly evaluating investments and their importance for economic and social development, the time, type and extent of use of tourist and hospitality facilities and the impact of tourism on both natural and anthropogenic tourist values, i.e. on living nature and monumental heritage (Stanković, 2021).

All this must be subordinated to the realisation of real benefits of the tourism and hospitality industry in the area covered by the plan. In order to achieve this, planners must start from an inventory of existing assets in the area that have one or more characteristics of tourist attraction, i.e. that enable one or more types of tourism. Of interest is the actual assessment of natural and anthropogenic tourism assets in relation to current and future demand. In spatial terms, it is important to distinguish tourist places and regions from areas that have a different appearance, function and purpose. Particular attention is paid to the placement of infrastructure, equipment, accommodation, catering, health, leisure, sports and conference facilities. The selection of the best locations for specific facilities and purposes seems to be a priority, as it contributes to the extension of the tourist stay, the richness of its content and the realisation of corresponding economic and social effects.

Inventarization and valorizatio of tourism values

Competitiveness and complementarity with the environment must be respected in the full sense, because one category contributes to the improvement of tourism, while the other prevents and neutralizes it (Stanković, 2008). In the process of spatial and functional planning of tourism, in significant tasks, which analysis, synthesis, model, i.e. proven scientific and applied methods, should be solved in the

right way, among others, we include: Defining desired goals for appropriate time periods; Determining acceptable alternative ways to solve set tasks and achieve real goals; A detailed inventory of natural and anthropogenic values with appropriate attractiveness attributes for certain types of tourism; Spatial definition of tourist places, centers, zones, directions and regions affected by planning as clearly as possible; Determining the priorities of arrangement and equipment according to overall and specific tourist values in the area affected by planning; Zoning of space in order to protect rarities and the need for appropriate protection both for tourists and from tourists; Identifying possible tourist attractive, especially, unrepeatable and non-transferable, values, endemics and relics, rare species, archaeological sites and specific monuments; Defining auxiliary and supplementary activities in the area covered by the plan, emphasizing complementarity and possible collision and competition; Legal regulation of the relationship between investors, planners, builders and users; Improvements in the elements of the tourist offer for the domestic and foreign markets, education and employment of the workforce, etc.

Of particular importance are the analysis and insight into current and future tourist flows, insight into the profitability of investments and operations of tourist and hospitality facilities, the functional connection of tourist reception with the tourist initiative, i.e. tourist places and regions with places of permanent residence of people, that is, dispersive zones of native places, according to the contractive zone of tourist places; A well-designed and easily applicable tourism policy at different decision-making levels, as well as the overall effects of tourism on the area affected by the plan. In this regard, it can be stated that spatial planning of tourism, as an integral part of general and special planning, is a complex continuous research and application work, the goal of which is such arrangement, furnishing and organization of space that can achieve positive social, social and economic effects on the tourist market. based on the valorization of natural and anthropogenic potentials.

Tourism planning must be harmonized with existing proven standards and previously achieved positive effects. In the spatial planning of tourism, methods of making plans, geodetic and cartographic bases, documentation, statistics, urban, planning and tourism norms, as well as appropriate models are used. The planning of the development of tourism is temporally harmonized with the existing standards of general spatial planning of the corresponding geographical entities and administrative units. The size of the territory, as a spatial measure for the needs of tourism, is defined as local, regional and national. In addition to all that, the spatial and functional planning of tourism, always and everywhere, should be tailored to man and society, coordinated with relationships, events and objects, the basic aspirations of the social community, the state of the living environment, coordinated with complementary activities, the economy that serves man, with more decentralization than centralization of state policy, etc. (Krippendorf, 1986).

Planning the development of tourism in a certain territory must, among others, include and solve three specific tasks. It is about a precisely defined territory, purposeful furnishing of the space and purposeful arrangement of it. It is significant that tourist-geographic areas of different rank, potential and significance, through tourism planning and development, acquire a specific structure, physiognomy and functions. This means that the integrity, evaluability, systemic organization, hierarchy and overall relations, phenomena and processes with the immediate environment, i.e. tourism complementary activities, must be emphasized, and all this at the level of modern understandings of sustainable development, which we can terminologically identify with domestic, coordinated, designed, scientifically based and applicatively feasible works without violating the basic ecological laws. In addition, the positions of the existing legislation, the principles of the concept of active environmental protection, the existing postulates on water, as well as the way of spatial management must be properly respected (Stanković, 2008).

Figure 2. National and traditional heritage in the funcition of the tourism

Tourism planning and ecosystem protection

Among the most important research and application actions and works, on the issues mentioned above, the following can be classified: Analysis of ecosystems of habitats and areas of the living world and determination of direct and indirect connections and relationships with existing anthropogenic objects, especially important for tourism; Analysis of tourist demand on the domestic and foreign market, not only by volume and time, but also by social, status, economic and cultural characteristics of tourists; Realistically established and long-term designed cooperation with institutions in the field of environmental protection, i.e. of nature and the monumental heritage in it, that is, with those from the domain of traffic,

forestry, water management, meteorological service, legislation, sports, culture, etc.; Determining the goals of long-term revitalization, reconstruction and protection of nature and monumental heritage, along with defining priorities, zones and operational procedures; Defining the capacity of the tourist area in terms of the maximum load at different times during the year, so that saturation and degradation do not occur; Defining the right proportions between mass and elite tourism, that is, summer and winter tourism, recreational and health, domestic and foreign, commercial and subsidized, stationary and weekend tourism, etc.; Realistic design and appropriate construction of tourist-hospitality and infrastructure capacities, according to existing and possible tourist demand; Designing the contents of the tourist stay in order to extend the tourist season and achieve better economic effects; Maximization of positive and minimization of negative social, economic and social effects of tourism in the planned tourist place or tourist region (Stanković M. S. 2002).

Tourism planning, more than the planning of some other activities in the area, must be in accordance with the views on active environmental protection, i.e. with ideas of sustainable development. Planning, protection, maintenance, revitalization and improvement of the environment, as a tourist value and the basis of its development, is the basis of what the work of the tourist reception rests on. Management of a touristic area is the basis of maintaining it at the level of originality or good protection, as a basis for valorisation. Degradation of the environment in some places, regions and countries causes a decline in its quality and is a limiting factor in valorisation, spatial and functional planning and arrangement. Areas of high ecological value, i.e. true originality and the best possible protection, in many places it is less and less, which makes it difficult to plan, valorise and achieve real economic and social effects. The fact is that legally protected areas, which in the best case make up 5 to 10% of the national territory (Serbia 8%) are not enough for the rapidly growing needs of tourism. There is not enough quality tourism space and it must not be treated as everyone's and no one's, only for one activity and only for today (Pavić, 1987).

Problems must be posed, studied, and practically solved on the ground, according to plans of defined time periods. It starts from the analysis of habitats, areas and ecosystems of the living world and their relationship with non-living nature, that is, anthropogenic creations, which are important for tourism. The volume and structure of tourism demand, which is highly variable in time and space, are investigated. Good results can be achieved by cooperation with institutions in the fields of urban planning, architecture, nature and monument protection, forestry, agriculture, balneo-climatology, gastronomy, health, sports, etc. In many places, it is very necessary to set aside zones of varying degrees of touristic value, but also for purposeful protection, in order to preserve and improve the ecosystem. Determining

the physical capacity of the space for appropriate types of tourism in the season and out of season, in order to prevent saturation which has been current for several years in some tourist places and regions. The best results are provided by the construction of tourist and hospitality facilities adapted to the local environment, materials and traditions, which contributes to the favouring of geographical origin, which is often non-reproducible and non-transferable and therefore has a corresponding tourist attraction and value. It seems that it is extremely important to develop the awareness and improve the work skills of the staff employed in various jobs in tourism.

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CIP - Каталогизација у публикацији

Народна библиотека Србије, Београд

911

ЗБОРНИК радова / Географски факултет Универзитета у Београду = Collection of papers / Faculty of Geography University of Belgrade ; editor in chief Marko Joksimović. - 1994, бр. 44-

. -Belgrade : University of Belgrade, Faculty of Geography, 1994- (Beograd: Planeta print). - 24 cm

Godišnje. – Tekst na engl. jeziku. – Je nastavak: Зборник радова

- Природно-математички факултет Универзитета у Београду. Географски институт = ISSN 0351-465X. – Drugo izdanje na drugom medijumu: Зборник радова (Географски факултет Универзитета у Београду. Online) = ISSN 2334-9441

ISSN 1450-7552 = Зборник радова - Географски факултет Универзитета у Београду

COBISS.SR-ID 61672706

Универзитет у Београду
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ISSN 1450-7552