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ANTROPOPRESURE OF THE HEAVY VEHICLES TRANSPORT ON TOURIST ROUTES - SURFACE DESTRUCTION AND TRANSFORMATION CYCLE

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ABSTRACT

Usage of the tourist routes by the tourists causes a number of negative consequences which ranges from soil loss by rill and sheet erosion, trampling, increased compaction, and vegetation destruction to a disturbance in water retention and infiltration. In the close proximity of the cities, economic and recreational interests meet in the form of tourist routes that usually are designated on already existing roads, throughout the forests used for heavy vehicles movement that are not under active environmental protection. The main goal of this paper is to determine micro-topographical consequences of heavy vehicle passages and a tourist routes surfaces changes with in 10 year period in such area. Fruition of this goal requires monitoring procedures that allows for capturing changes over time. For that purpose, LiDAR data and the Structure-from-Motion photogrammetry technique has been applied in two separated plots on tourist routes surfaces affected by vehicles transitions in order to obtain detailed digital elevation models. Those models, in turn, allow for calculation and analysis of the changes over time with the use of digital elevation model of difference method. After two years of monitoring which includes total of twelve scans for both test fields, models were then analyzed to draw conclusions. Results of observations and scanning show destructive effects caused by the vehicles passages as well as further stages of the surface evolution including initial recovery stage and main transformation stage.

Keywords: Urban Forests, Tourist routes, Erosion, SFM, LiDAR

INTRODUCTION

The human influence on the natural environment is important from the point of view of nature protection, as well as resources and their use in the economy [1], [2], [3]. This relationship and the pressure exerted by human activity, is often the result of anthropopressure. This concept has been the subject of many studies in the past, while its importance only grew within the last years, as land conservation and resources management became dominant in decision making process [4]. Many areas around the world has been maintaining this issue by establishing protected areas, such as national parks and reserves. In such areas, human activity has been regulated in order to protect the natures order. However, many sites do not have the appropriate conditions or do not meet the criteria, which would allow establishment of protected area. Within those areas, anthropopressure is visible in many forms spanning from emission, pollution, deforestation, land alteration, loss of biodiversity to even species extinction [5], [6], [7], [8], [9]. Sites heavily exposed to such problems are often located near the cities, where urbanization and the need for resources are growing together with the number of

population. Therefore it is important to sustain such areas, while those quickly become crucial in cities development. Suburban forests that are not protected sites are often used for timber harvesting, transportation, recreational and educational activity [10]. Signs of those actions can be observed on forest unpaved roads, which often serve as tourist routes. Many scientists have presented a negative impact of human use of forested roads. Those range from road-related problems, such as soil degradation, sediment transportation and plant trampling [11], [12], [13], [14], [15], to larger-scale issues such as deforestation, forest fragmentation, and loss of animals habitat [16], [17], [18], [19], [20]. While most of the road-related issues in regards to tourist routes are usually studied in protected areas, there is a much smaller number of studies that take up this subject in suburban forests. Among the main problems of forested areas is the use of heavy vehicles in timber transportation and the devastation they leave behind. Heavy vehicles movement over forested roads, is limited or even forbidden in protected areas, while in unprotected sites their activity often is not regulated [21], [4]. Prone to degradation, tourist routes in suburban forests shows signs of heavy vehicles passages many years after their occurrence. With such repeated use road gullies are created, which are not able to return to their natural state. Instead, their development is dependent on a heavy vehicle passage cycle. Because of this cycle, such forms retains their microtopography over the years [22], [23], [24]. The key issue taken by this study is the assessment of the ability of road gullies, to develop a resistance to the heavy vehicle passages over the years of use. Understanding this environmental ability, might bring new information on how such roads develop under continuous use, and if recovery actions are required in order to return the road gully to a state similar to natural. Therefore the goal of this paper is to asses the microtopographic changes, before and after the passage of the heavy vehicle over the forested road, which serves both as a transportation and tourist route in urban forest. With it, derive a stages of the devastation cycle and potential recovery.

METHODS

Study area

Fieldwork has been conducted in the city of Kielce, located in the western part of the Holy Cross Mountains in central-eastern Poland. The mentioned urban area is located between forested mountain ranges, whose highest peak is Mount Telegraf (407 m. a.s.l.). In Kielce, there is a dense network of tourist routes, many of which are overlapping with logging routes used for timber harvesting [25]. Development of tourism and recreation infrastructure is relatively slow in comparison to protected areas such as national parks, however, the potential for further development can be seen in the addition of the Świętokorzyskie Geopark to the UNESCO Global Geoparks Network in April 2021. Forests around Kielce are managed by Polish State Forests which controls timber supply, performs environment conservation, and provides access to the forest for the population, for recreation or minor gathering needs. Forested roads usually have unpaved surfaces, and were never purposely designed for tourism. Most of the routes are over 200 years old, as similar to today's forest roads patterns can be seen in historical military maps, such as the map of Western Galicia (1804) or the map of Military Geographical Institute (MGI) from 1929. Such legacy routes often are in a degraded state, which is a result of many years of diverse usage. In order to perform monitoring of the microtopographical changes over the forested routes, which are caused by the heavy vehicle movement, two separated

testing sites have been selected (Tab. 1). The first one is in the southern area of the city while the second is located in the northern reach.

Table 1. Characteristics of test fields

Characteristics	Test field 1	Test field 2
Location of the test field	50.8352°N, 20.6269°S	50.9074°N, 20.6069°S
Age of the road	Over 220 years old (present on	Less then 80 years old (absent
Area of the measurement	32.5 m^2	30.7 m^2
Altitude	307 m a.s.l.	277 m a.s.l.
Maximum exposed route width	304 cm	334 cm
Route maximum depth	67 cm	50 cm
Slope	1,72°	3,60°
Aspect of the road	S	W
Road to slope alignment angle	43°	48°
Soils texture	Sand	Loamy Sand
Soil density	1,76 g/cm^3	1,48 g/cm^3
Forested area	441,45 ha	127,21 ha
Geology	Upper Cambrian - sandstones	Pleistocene - till

Test field 1 is located near the Telegraf Mountain (southern Kielce) on the road, which serves as a tourist route as well for wood transportation. It is a 10-meter segment, deeply incised by the wheels of the vehicles. The road, where this area is located, served its purpose for many years. Historical maps of Western Galicia from the 1804 year show a road in the similar position, as the one that is present today. In addition, aerial LiDAR scanning data showed multiple legacy roads, which are currently overtaken by the forests vegetation. In the last decade test field 1, has gone through major vehicle passages, which resulted in a very devastated state at the beginning of 2020. Test field 2 is also a 10-meter route segment, which is located in the northern part of the Kielce urban area. Similar to Test field 1 it also serves as a tourist route, however only recently tree felling and timber harvesting have started in this area. Although this test field presents a similar level of devastation in comparison to Test field 1, its area is much less disturbed, this can be confirmed by the lack of the current road of test field 2 on historical maps from before 1939, and much smoother LiDAR elevation model.

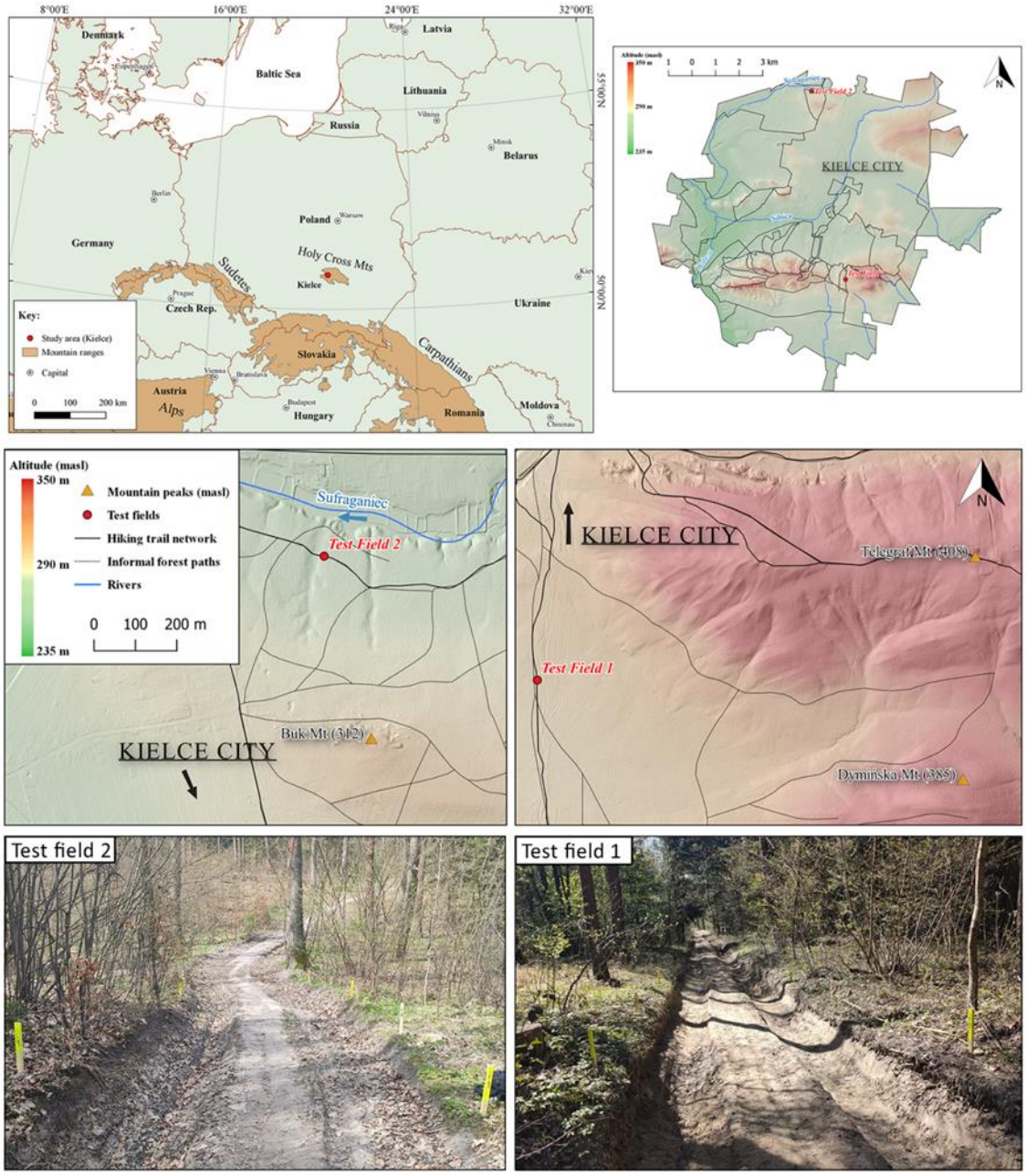

Figure 1. Study area and pictures of both test fields with LiDAR relief, yellow wooden sticks represents GCPs locations. Test field 1 LiDAR data reveals a network of legacy roads currently overtaken by the vegetation

Field procedure and data processing

To assess the microtopographic changes before and after the passage of the heavy vehicles on the surface of the route, a DEM of difference method has been applied [26], [27], [28], [25] and it was a final element of comparison procedure (Fig. 2). This approach allows for direct comparison between digital elevation models, to asses the changes between them. In order to conduct such comparisons, a series of fieldwork has been done on both test fields from March 2020 to November 2021 which was supported by data gathering stage. Gathered data includes - historical and thematic maps such as: the map of Western Galicia 1: 28800 (1804), map of the Eastern Mining District of the Kingdom of Poland 1:

42000 (1868) or the topographic maps of Military Geographical Institute 1:100000 (1929-1939) as well as maps of Kielce city 1:10 000 (1959 and 1982). Scans of maps were obtained from https://fotopolska.eu/ which are available for public use. In this research, aerial LiDAR point clouds were used, which were produced in 2011, 2016 and 2019 year (with point density equal to 24 points per meter square). This data was provided by the Kielce City Hall to Jan Kochanowski University for scientific purposes. Test fields have been located in the LiDAR point cloud data and segmented from the original cloud, based on the area of the study site and provided classification (ground points only). This preparation allowed for better accuracy than achieved in previous studies [25]. Horizontal and vertical errors have been assessed to be close to 5 cm, however, after the process of clouds registration, the root mean square error (RMSE) has been decreased to the range of +-2 cm. Segmented data has been then imported into CloudCompare (version 2.10). Where comparison can be carried out. During the fieldwork Structure-from-Motion (SfM) photogrammetry technique has been applied to obtain the detailed point clouds of both test fields in their current state, six times, every 3 to 6 months. Test fields have been divided into three rectangular areas which were marked by wooden sticks with painted signs, those served as ground control points. Singular SfM scan was performed with a 48 Mpix smartphone camera placed on a tripod (Xiomi Mi 9T pro) with settings as follows: shutter speed 1/500, ISO 1600, lens set to wide, and focus of the camera set to manual. Each SfM scan for the test field was composed of 250 to 300 pictures. SfM photogrammetry scans were supported by 8 ground control points (GCP), which were located on each test field. Their location has been measured by GPS receiver (Trimble GeoXH 2008 series) and then corrected by manual measurements of distance and azimuth to the nearest trees, with the use of a laser measuring tool. Obtained measurements in the field and 2019 LiDAR reference data were then used, to correct the GPS position with the use of QGIS (version 3.4) GIS software. A procedure that was applied to SfM point cloud creation was similar to those performed by the series of previous studies [26], [27], [25]. Firstly, pictures were imported into Agisoft Metashape (ver. 1.7) and their quality has been assessed by the software. Those that have had lower sharpness and lowest quality were removed. After that, each picture had from 3 to 8 markers placed with coordinates of GCPs measured in the field. Camera alignment was performed with settings: quality - highest, reference preselection - subsequential, key point limit: 60000, tie point limit: 6000, Adaptive camera model filtering option - on. Newly created tie point clouds, spanning from 280 to 410 thousand points were then filtered, with the use of a gradual selection tool. Tie points that originate from 2 pictures or less were removed, the same has been applied to other filtering criteria such as projection accuracy: higher than 10 pixels, reprojection error: higher than 0.5 pix, reconstruction uncertainty: higher than 50. Points that matched those criteria were removed. After the filtering, dense point cloud has been created with the setting set to: quality - medium, depth filtering - aggressive, with the option „calculate point confidence - on”. Such point clouds have tens of millions of points, calculated confidence criteria, have been used to filter points with a confidence lower than 10.

Data obtained this way undergo RMSE assessment based on the scale bars prepared in the field and compared with the SfM clouds. RMSE for test field 1 ranges from 0.6 to 1.2 cm while for test field 2 from 0.7 to 1.4 cm. Point clouds of the test fields have been exported then into las 1.3 format, for further comparison with the LiDAR data. After the preparation of all of the point cloud, data has been imported into CloudCompare software where the comparison has been carried out.

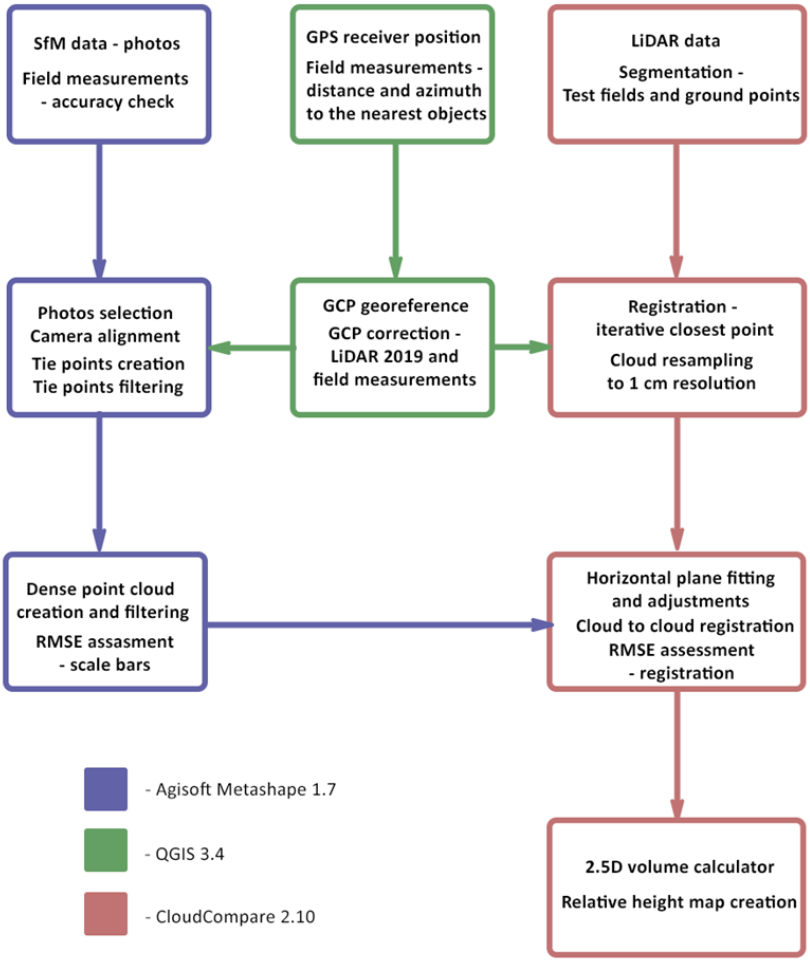

Figure 2. Flow chart of the procedure and software used to prepare and compare point clouds of LiDAR and SfM

Each point cloud has been registered to the proper georeferenced position based on the 8 GCPs (ETRS89 / Poland CS2000 zone 7 - EPSG:2178). After that, each cloud could be compared. The total number of periods that have been taken into account is 9. Those are LiDAR: 2011, 2016, 2019, and SfM: March 2020, July 2020, November 2020, March 2021, July 2021, and November 2021. In order to assess the changes before 2011, a plane surface has been fit on top of the 2011 road gully, which resembled the original surface before the road was created. For assessment of the changes between point clouds 2.5D volume calculator tool has been used, to obtain the volume values of the changes between periods as well as a digital model of relative height changes. Dynamic of each periods changes has been calculated from the equation.

$$TFd = \frac{|Va + Vr|}{Lp} \times Sd$$

Where:
TFd - Test field changes dynamic [g/day], Va - Volume added in the given period in [cm3],
Vr - Volume removed in the given period in [cm3], Lp - length of the period [days], Sd - soil density [g/cm3].

RESULTS

Analysis of over 10-year changes has revealed multiple events of destruction (heavy vehicles movement) and recovery stages where the dynamic of erosion and deposition stayed on a lower and stable level. Although precise events before 2011 are unknown, the overall result of the road usage can be derived from the first period (horizontal even plane compared to LiDAR form 2011). The first comparison shows larger damage done to the route of test field 1, where the entire surface of the road has been turned into a road gully. While second test field shows the greatest incision in the upper area of the field between points P1 and L1 (Fig. 3). Calculated soil loss up to 2011 is equal to 11 m3 for test field 1 and 6.75 m3 for the second test field. With soil density taken into account, those values correspond to 19.36 tons for test field 1 and 9,99 tons for test field 2. After 2011 the next scan available is aerial LiDAR data from 2016 and 2019 up to the first SfM photogrammetry scan in March 2020. Their comparison with the 2011 data shows characteristics of the changes as well as differences between test fields (Fig. 4). The comparison shows that in the 5 year period, from 2011 to 2016 both test fields were not as similar in shape as today. The first test field showed mostly erosion on road edges which might be evidence of the establishment of the road gully and a major incision before 2011. On the other hand, the second test field represents ruts that were created in the 2011 to 2016 period, at the same time edges together with the central area were uplifted from 5 to 20 cm up in comparison to 2011.

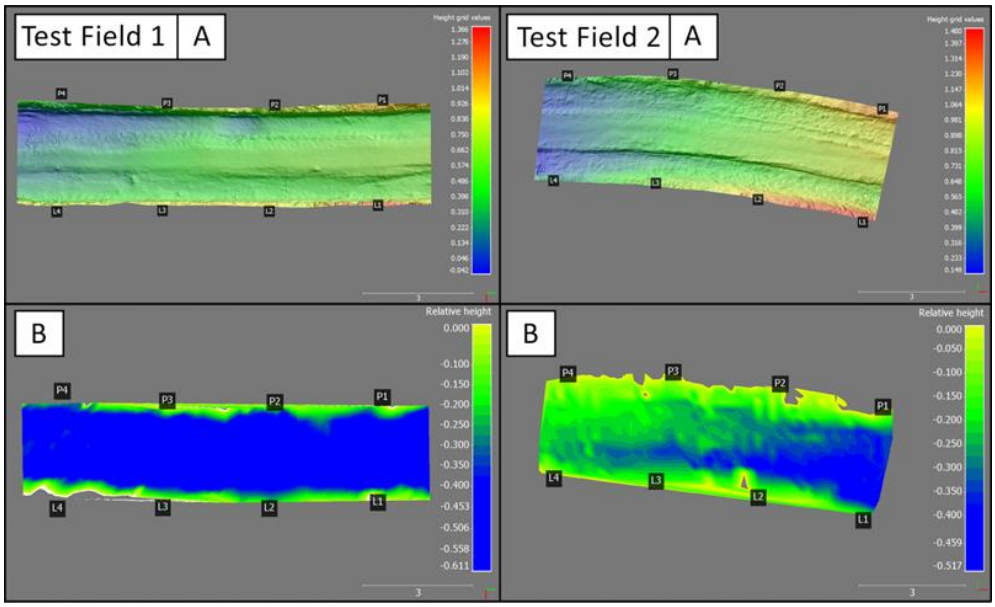

Figure 3. A) Colored hilshade of each test field. B) Relative height change between a horizontal even plane and 2011 LiDAR point cloud for the test field 1 and 2. Blue color represents the highest damage reaching from 30 to 60 cm of negative height change

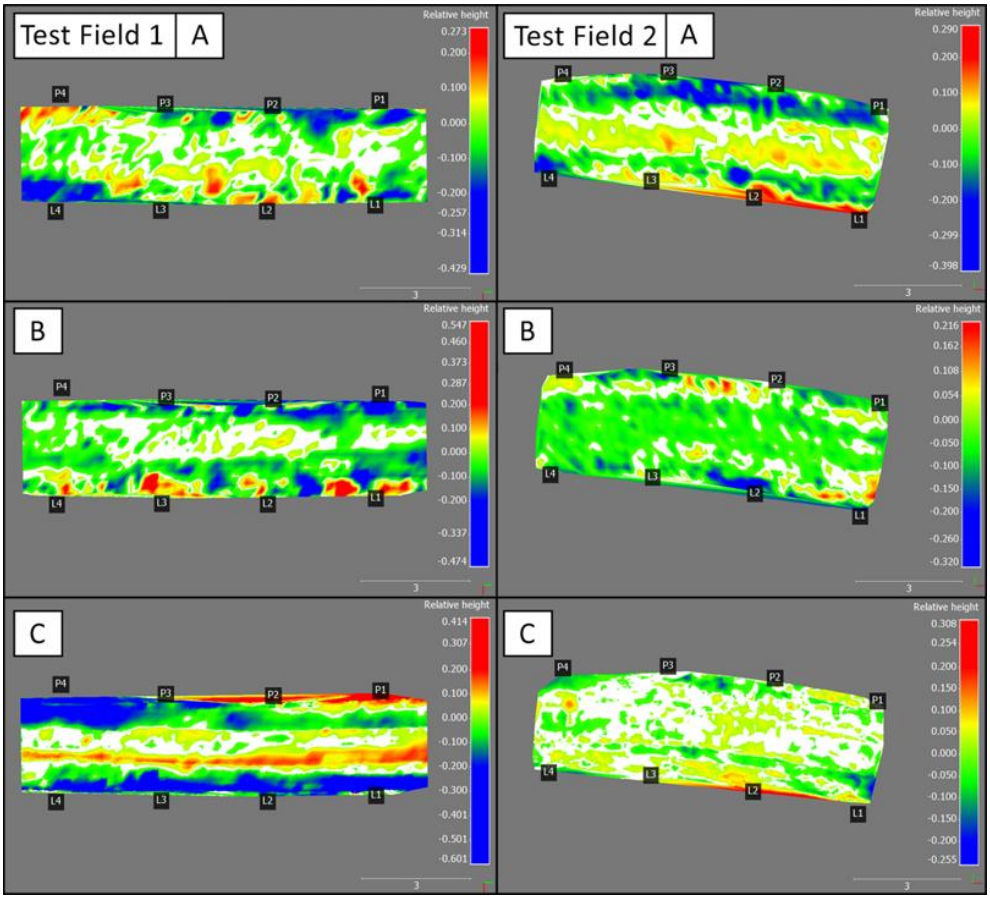

Figure 4. Changes in the test fields in the 2011-2016 (A), 2016-2019 (B), and 2019 - 2020 (march) (C) periods

In the next period from 2016 to 2019 test field 1, has had its ruts deepened in a similar fashion to the second test field. In addition, in the first case, a larger widening can be observed, as the route was already deep while its edges are very sharp. In this period, signs of the vehicle's movement can be seen on both sites. Both test fields uphold a similar magnitude of changes dynamics. The period that showed the largest differences between the test fields was one from the year 2019 to march 2020. In this period in the area of test field 1, areal tree felling has had its place, which resulted in multiple heavy vehicles passages. In test field 2 such activity was not carried out until 2021, this is why very small changes in comparison to the first field were recorded. In test field 1, ruts were lowered in comparison to the year 2019 from 10 to 40 cm. At the same time, the right edge and a central area have been uplifted up to 10 cm. Overall volumetric changes for test field 1, were equal to negative 1.5 m3 which corresponds to 2.64 tons of soil loss. At the same time test field 2, recorded minimal changes where timber harvesting was not conducted. Although the change was still negative its represented only 89 thousand cm3 or loss of 131.72 kg of soil (Tab. 2). This main difference sets up a stage for direct comparison between those fields in 2020 and 2021 where test field 1 has been freshly devastated by the vehicles, while test field 2 has had its time to recover since the last major devastation to the surface, which took place before the 2019. In the first SfM period, initial recovery in the form of denudation can be observed for test field 1. Central area and sides of the road, which were uplifted during the initial devastative event now erodes its most sharpest edges. Some of sediment eroded this way from route sides as well as from the center is deposited in the ruts left out by the passing vehicle.

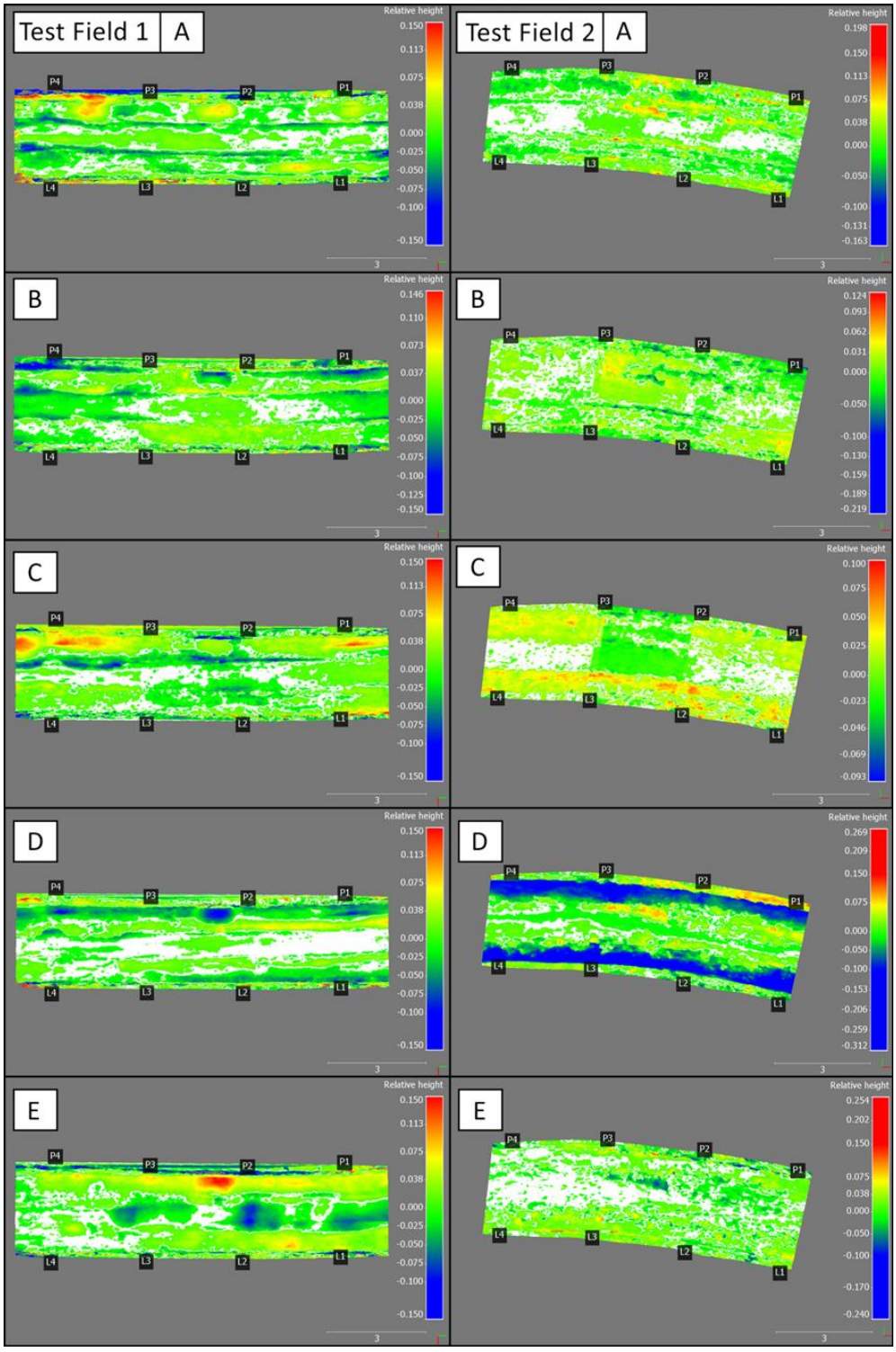

Figure 5. Differences between each SfM photogrammetry scan in 2020 and 2021. Test field 2 (D) shows road devastation event

Test field 1, has kept the high dynamic of the changes until the last SfM scanning. At first, erosion dominated only to be replaced by the strong deposition, especially after the winter 2020 and fall of 2021 where deposition record was the highest. The second test field in the same period has had different behavior. Very few signs of vehicle movement have been spotted up to spring of 2021, where route devastating events in the form of

areal tree felling have occurred. Before that, signs of the final recovery phase could be observed in March - July 2020 period on test field 2, where vegetation overtook the surface. Plants represent positive height change values, while very small negative change has been recorded along the axis of pedestrians walking path. Besides the addition of plants, the dynamic of changes was much smaller than in test field 2. During the devastation event on test field 2, which happened from March 2021 to July 2021 ruts have been deepened by an additional 10 to 25 cm. The large weight of the vehicle uplifted the right side and central area while the left side, which was already uplifted by the previous passages remained mostly undisturbed. Volumetric balance for test field 2 in this period was negative and reached -0.819 m3 or 1.21 tons of soil loss. Dynamic of that period changes in comparison to the ones that were recorded previously grew by 300%. In 2021 after the destructive event, vegetation cover retreated to the sides of the route. In the last period for test field 2, the initial recovery phase started, where uplifted soil material in the central area and on the right side started to erode, while newly deposited sediment can be observed in the ruts left out by the vehicle's wheels (Figure 5).

Table 2. Changes and their dynamic in each test field during each period

Period	Added volume [m^3]	Removed volume [m^3]	Volume balance [m^3] (soil balance [kg])	Test field changes dynamic (g/day)
TF1 - Horizontal plane - 2011	0.036	11.843	-11.807 (-20780)	-
TF2 - Horizontal plane - 2011	0.064	6.814	-6.750 (-9990)	-
TF1 - 2011 - 2016 (1820 days)	0.452	1.285	-0.833 (-1466)	1 664,19
TF2 - 2011 - 2016 (1820 days)	0.619	1.410	-0.792 (-1172)	1 634,68
TF1 - 2016 - 2019 (1041 days)	0.371	1.724	-1.354 (-2383)	3 565,96
TF2 - 2016 - 2019(1041 days)	0.160	1.508	-1.349 (-1996)	2 387,46
TF1 - 2019 - 03.2020 (325 days)	0.868	2.367	-1.500 (-2640)	19 365,9*
TF2 - 2019 - 03.2020 (325 days)	0.391	0.480	-0.089 (-131.72)	4 384,62
TF1 - 03.2020 - 07.2020 (122 days)	0.398	0.412	-0.014 (-24.64)	11 540,96
TF2 - 03.2020 - 07.2020 (122 days)	0.240	0.168	0.073 (108,04)	4 949,50
TF1 - 07.2020 - 11.2020 (118 days)	0.307	0.395	-0.088 (-154.88)	10 470,5
TF2 - 07.2020 - 11.2020 (118 days)	0.163	0.235	-0.072 (-106.56)	4 991,86
TF1 - 11.2020 - 03.2021 (125 days)	0.481	0.286	0.196 (344.96)	10 799,36
TF2 - 11.2020 - 03.2021 (125 days)	0.286	0.143	0.143 (211.64)	5 079,36
TF1 - 03.2021 - 07.2021 (122 days)	0.267	0.360	-0,093 (-163.78)	9 045,24
TF2 - 03.2021 - 07.2021 (122 days)	0.249	1.068	-0.819 (-1212,12)	15 976,7*
TF1 - 07.2021- 11.2021 (114 days)	0.520	0.365	0.155 (272.80)	13 663,15
TF2 - 07.2021- 11.2021 (114 days)	0.212	0.173	0.039 (57.72)	4 998,24

*areal tree felling in the neighborhood

Observation of the mentioned events on both test fields allows for their classification based on dynamic and a character of changes for following phases, which are parts of the degradation cycle. SfM periods that have had their test field changes dynamic (TFd) from 15 to 19 kilogram per day, were classified as starting point of the cycle as a route devastation events. Both test fields have shown a behavior that leads to another phase after the devastation. It is the initial recovery phase, where sharp edges created during the vehicle's passage and uplifted areas are eroding, while new sediment is deposited in the deepest areas of the routes. This phase can last from 4 (Test field 1) to 8 (Test field 2) months depending on the amount o degradation caused by the route devastation event. With the initial phase completed, the route then transitions towards the main denudation phase where deposition usually is larger then erosion and compaction of the soil’s surface

is getting smaller. Test field 2 in 2020 shows signs of this final phase as plants started taking roots in route surface, effectively overtaking a portion of the area in the central and upper part of the field. Potentially, this denudation process can take from just a few years up to decades depending on the overall level of use, sharpness of the edges, type of plants, and their growing conditions. Alternatively, the cycle can be repeated again by a new route devastation event, such as heavy vehicle passage over the route which returns the cycle to the beginning, as was the case on Test field 2 (Fig. 6).

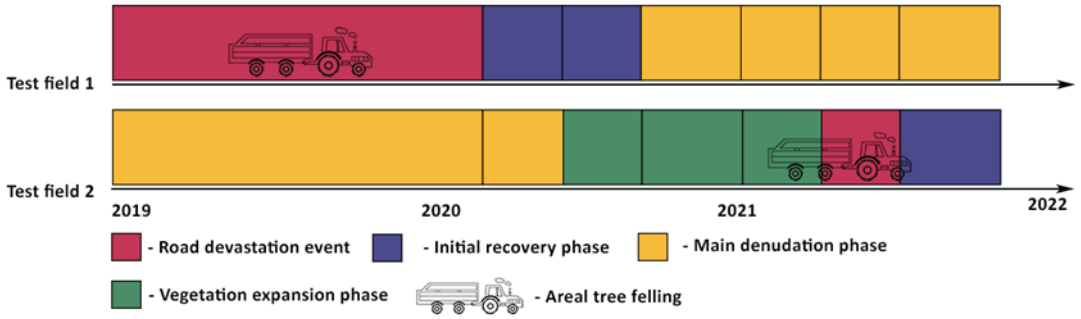

Figure 6. Timeline of the SfM monitoring periods from 2019 to 2022 with their classification to phases in degradation cycle

DISCUSSION

Concerning the impact of the vehicles in different environments has been found in multiple research [29], [30], [31], [32], [33]. In those studies, results point out similar degradation cycles with the main difference in speed of the recovery phase. Areas such as dunes or grasslands have a much larger susceptibility to devastation, while urban areas are more prone to chemical pollution and heat island effect [4]. The main goal of this research was to assess the microtopographic changes before and after the passages of the heavy vehicle over the forested road which serves both as a transportation and tourist route in an urban forest. With the use of aerial LiDAR and SfM point clouds data, such changes have been assessed and results show a clear cycle of degradation where the path is destroyed by route destruction events such as the passage of the heavy vehicles, followed by the long period of recovery up to another devastation. Both test fields have shown the signs of the degradation cycle, all though the first one has the larger dynamic of changes. Both test fields also show much larger changes than the one reported by other studies conducted in protected areas, where the use of heavy vehicles has been restricted, and shows the significantly slower dynamic of changes compared to the one found in this research [34], [11], [21], [14], [35]. Route devastation events caused by the heavy vehicles recorded in this study were responsible for the loss of 2640 kg of soil (25-40 cm deeper ruts) from the test field 1 and 1212,12 kg (15-25 cm deeper ruts) for test field 2. This damage is larger than the one caused by the most extreme cases of heavy rainfall events, responsible for an increase in path incision from 15 to 21 cm [36]. All this points out the human impact caused by the use of heavy vehicles as a most destructive form of forest routes, which is why it is heavily limited and even forbidden in protected areas. Findings of this research show that urban areas such as Kielce where timber harvesting and transport through the forest is important from the economic point of view, have to deal with the issue of overlapping tourist route networks and routes used by the vehicles. By overlapping these two, a loop of creation and abandonment of the roads is in motion

(Fig. 7). With the damage caused by the vehicles passages, tourists tend to search for an alternative path around the damaged segment, effectively starting a new route. Once the vegetation is trampled on a new path it widens to the point of being usable by vehicles which leads to another main devastation event and repeat of the loop. Test field 1 can be evidence of such loop as aerial LiDAR shows multiple abandoned legacy roads, which are parallel to the current route.

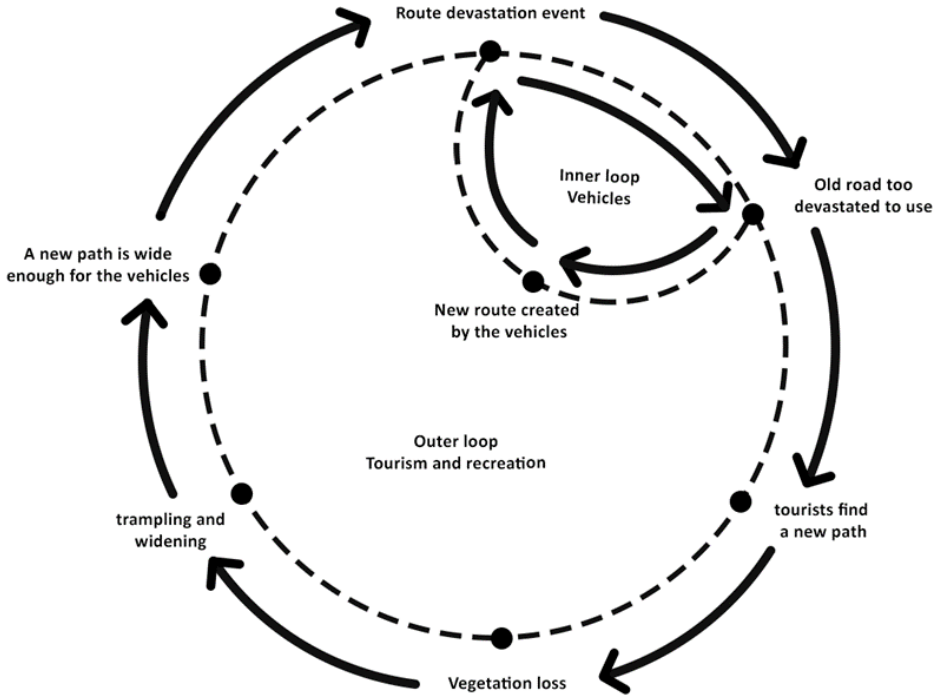

Figure 7. Simplified model of the human impact caused by the vehicles and tourists and their relation in the creation of the new forested paths

Findings also show an interesting behavior of the vegetation cover on test field 2 where, after at least 2 years without or with minor disturbance, plants started taking roots in the central area of the field marking the final part of the recovery phase. The topic of plant's resilience to trampling and vehicle movement was a topic of other studies [37], [38], [39], where it was confirmed their importance in the ability of the natural route restoration. As it currently stands, results of both test fields show that the route natural restoration ability is not enough as the devastation cycle is too often repeated on the forested roads in Kielce. The degradation cycle can not be prevented unless heavy vehicles are not used for several years, which is unlikely due to the economic losses. With the constant passages of the vehicles, the vegetation expansion phase can not be completed. Although results have been presented and discussed this study has had its limitations which were mainly connected to the intensity of route use. Since the start of the monitoring program in 2019 a situation over the road was monitored, however before this period there a no information available about areal tree felling or intensified periods of heavy vehicles usages. Therefore interpreting LiDAR data from 2011 and 2016 is much more difficult and has larger uncertainty. The intensity of use is hard to interpret over such a road because there a no records of illegal passages of the vehicles such as off-road vehicles or all-terrain vehicles (ATV) which do not belong to the Polish State Forests service. The amount of

tourists has been assumed as small (in the range of 10 to 20 thousand annually) based on other studies performed in the area, and hiking trail activity monitoring which is currently conducted by the author on other forested routes within Kielce hiking trail network. Future studies will include more precise data on the amount of use for those routes.

CONCLUSION

Urban forested roads on the example of Kielce receive large antropopressure resulting from the constant use of heavy vehicles for timber harvesting. Moreover, no restoration activities are performed in order to fix the route surface after the main areal tree felling is completed. In order to minimalize human impact on the environment and slow down the degradation cycle presented in this study, state of the road should be included in planning before such work is done. It would be advised to perform simple restoration procedures to the used roads. It is also important for the drivers of the vehicles to avoid creating new paths which are parallel to the ones already created, this way the areal effect of human use can be smaller while the land around the route is less disturbed. An increase in the tourism potential of Kielce by the addition of this area to a UNESCO Geopark Network might spark increased pressure on the tourist routes, which are available in the city. Therefore it is important not to overlook the issue of overlapping the trails with a transportation routes used by the heavy vehicles. Tourist movement is largely known for the avoidance of muddy surfaces, which in turn widens the already existing roads or even creates new paths. In Kielce, a re-planning of the tourist route network should be considered in order to avoid the issue of overlapping and optimizing traffic on forested roads..

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INTRA-ANNUAL DYNAMICS DISSOLVED SOLIDS AND SUSPENDED SEDIMENT IN THE EXTREME HIDROLOGICAL EVENTS – CASE STUDY NIŠAVA RIVER

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ABSTRACT

Dynamics of totall dissolved solids (TDS) and suspended sediment concentrations (SSC) were monitored on the river Nišava at the hydrological station Dimitrovgrad. Water samples were collected each day in the period from 01.01.2010–31.12.2010. TDS concentration followed a seasonal pattern imposed by the availability of water, with higher concentrations recorded in low-flow periods and lower concentration in the high-flow period. SSC was extremely variable and dominate mainly with specific high-flow events. Mean annual discharge (Q=6.68 m3/s, q=13.9 l/s/km2) over the year was 3.3 times higher than the average for the period of 50 years. In the study period, the annual transport dissolved load (Qd) was 36962.8 t (specific load Qds=76.7 t/km2/yr) and suspended sediment load (Qs) was 98861.9 t (specific load Qss=205.1 t/km2/yr). The transport of dissolved load and suspended sediment load shows temporal variations in different seasons. The analysis revealed that the maximum loads was transferred during the winter (Qd=43.3% and Qs=56.8% of the annual transport) and spring season (Qd=37.9% and Qs=38.9% of the annual transport). A comparative analysis of Q, Qd, and Qs show that the suspended sediment shows greater variability and exponential pattern of transport. For instance, 90% of the time was required to export 65% of the total water and transported 77% of the total dissolved load and only 22% total suspended sediment load. The most extreme precipitation episodes and extreme temperatures events was recorded in February 2010. The floods in February contributed by 44.8% of the total Qs transport over the study period. These findings have important implications for water resource management in the context of sediments mobilization, erosion, channel management, water quality and ecological functions.

Keywords: dissolved load, sediment load, extreme precipitation, floods, Nišava river

INTRODUCTION

Suspended and dissolved matters in rivers are considered relevant ecological problems. They are related to a wide range of on-site and off-site impacts, such as soil erosion or salinisation [1]. Suspended sediment has several impacts in water courses, such as siltation of reservoirs, desorption of nutrients, various biological impacts. Dissolved solids is being recognized as a major source of surface water quality deterioration. The estimation of the dissolved and sediment load and the transport rate governs the geomorphological, hydrological, sedimentological and ecological processes of river

basins. Understanding the relationship between dissolved load and sediment load, i.e. chemical weathering and physical erosion rates is an important issue for environmental science; both processes affect studies of soil and landscape evolution, water quality, or the Earth's climatic evolution [2]. Therefore, research interests pertaining to fluvial transport loads in the river systems have attracted much attention in recent times worldwide [3,4,5,6,7]. In general, comparative studies of the dynamics and transport of both dissolved and sediment loads in Serbia are represented in several papers [8,9,10,11]. In the last few decades, the extremes of meteorological-hydrological events in Europe have been particularly important for the occurrence of natural hazards [12]. Tošić and Unikašević (2014) showed that wet and dry periods become more frequent at the territory of Serbia after 1970 [13], pointing also to more frequent rainfall extremes and consequently torrential flood events [14,15]. Particularly during 2010 Central and Eastern Europe were affected by extreme climate events which had strong consequences on the environment and impact on human society [16]. Several episodes of extreme precipitation leading to dramatic and high-impact floods occurred in Serbia [17,18,19]. In this study, dissolved and sediment loads on the Nišava River (Eastern Serbia) in the period 01.01.2010–01.12.2010. The main objectives were to analyse the dynamics and transport of dissolved load and suspended sediment load at annual and seasonal scales, and to analyse during extreme daily climatic-hydrological condition. This research can serve as a basis for integrated basin management [20]. In the initial phase of implementation of this concept, it is necessary to identify and quantify specific problems in the basin and to enable reliable and timely action of the population.

METHODS AND DATA

Monitoring dissolved solids and suspended sediment concentration on the river Nišava at the hydrological station Dimitrovgrad (φ=43o 01’; λ=22o 45’; A=482 km2) was in the period 01.01.2010–31.12.2010. Analyses of the water samples were performed in the Laboratory for Physical Geography of the Faculty of Geography, University of Belgrade. Here we report the results of the research with the frequency of daily samples. Physic-chemical analyses (titration method, potentiometric method and spectrophotometric method) determined the concentration of dissolved solids (TDS=Ca2++Mg2++Na++K++HCO3-+Cl-+SO42-+SiO2). The hydrotehnical method was used to obtain the suspended sediment concentration (SSC) [21]. The data for water discharge (Q), precipitation (T) and temperature (T) are provided by the Hydrometeorological Office of the Republic of Serbia [22]

Dissolved load (Q_d) and Sediment load (Q_s) was determined by the following equations:

$$Q_d\ (\text{t/day}) = Q\ (\text{m}^3/\text{s}) \times \text{TDS}\ (\text{mg/l}) \times 0{,}0864 \quad (1)$$

$$Q_s\ (\text{t/day}) = Q\ (\text{m}^3/\text{s}) \times \text{SSC}\ (\text{mg/l}) \times 0{,}0864 \quad (2)$$

where: Qd – dissolved load, Q – water discharge, TDS – total dissolved solids; Qs – sediment load, Q – water discharge, SSC – suspended sediment concentration. Annual and monthly loads transport was obtained by summing daily values.
Load is then normalized by dividing through the drainage area (A) for interbasin comparison, resulting in the specific dissolved yield (Qds) specific specific sediment yield (Qss) as well as runoff (q) following equations:

$$Q_{ds}\ (t/km^2/yr) = Q_h\ (t/yr) / A\ (km^2) \quad (3)$$

$$Q_{ss}\ (t/km^2/yr) = Q_s\ (t/yr) / A\ (km^2) \quad (4)$$

$$q\ (l/s/km^2/yr) = Q\ (m^3/s) \cdot 1000 / A\ (km^2) \quad (5)$$

Specific dissolved and sediment loads can be converted into denudation rates (DR). For this study, chemical (DRch), mechanical (DRme) and total denudation rates (DRt) were calculated. The denudation rates were estimated by using the equation given by [23,7]:

$$DR_{ch}\ (mm/yr) = Q_{ds}\ (t/km^2/yr) / \rho\ (t/m^3) / 10^3 \quad (6)$$

$$DR_{me}\ (mm/yr) = Q_{ss}\ (t/km^2/yr) / \rho\ (t/m^3) / 10^3 \quad (7)$$

$$DR_t\ (mm/yr) = Q_{ds}\ (t/km^2/yr) + Q_{ss}\ (t/km^2/yr) \quad (8)$$

Rock densities (ρr) vary slightly depending on the mineral composition of source rocks. We used a mean density of 2650 kg/m3 following Hay (1998) and Singh et al (2008) [24,5].
For calculating thresholds of extreme precipitation and water discharge events, the method of peaks was used [25,26]. In this study statistical method were used for calculating the thresholds of extreme precipitation following equation:

$$\phi_P = \frac{1}{n}\sum_{i=1}^{n}\phi_{P_{MD}} \quad (9)$$

$$\phi_Q = \frac{1}{n}\sum_{i=1}^{n}\phi_{Q_{MD}} \quad (10)$$

Here, the value of the threshold was defined as the average value (arithmetic mean) of maximum daily precipitation (PMD, mm) or maximum daily water discharge (QMD, m3/s) for each year (i) during n years (50 in this case) of the analysed period 1961–2010.

RESULTS AND DISCUSION

Climatic and hydrological conditions

The average annual precipitation for the period 1961–2010 is P=642.9 mm. In general, the analysis of the annual precipitation shows an insignificant incease trend of 0.413 mm/year. At the seasonal scale, insignificant trends of decreasing precipitation during the summer, as well as increasing during the autumn, were observed. The positive trend in the autumn season is attributed to short-term atmospheric instabilities that can cause heavy rain [27]. The results show that after 1980, a trend of increasing monthly precipitation in the period from December to May was detected, and a significant increase at the level of significance of 5% was detected in February [28]. According to the climate classification [29], 2010 belongs to the category of wet years [30]. The total annual amount of precipitation in 2010 was P=787.6 mm, which is 18% higher than the multi-year average. In the intra-annual distribution (Table 1), the highest amount of precipitation is in June (P=81.7 mm) and May (P=72.6 mm), and the lowest in January (P=40.8 mm) and February (P=40.5 mm).

The average annual water discharge of the Nišava river at the hydrological station Dimitrovgrad is Q=2.1 m3/s (q=4.26 l/s/km2). According hydrological classification, using the Log-Pearson III distribution, 2010 was classified as an extremely wet [30]. Namely, in the period 1961–2010, the highest average annual flow of Q=6.68 m3/s (q=13.87 l/s/km2) was recorded in 2010. The maximum average monthly water discharge occurs in March and April and has approximately the same values, Q=3.87 m3/s (q=8.02 l/s/km2) and Q=3.84 m3/s (q=7.96 l/s/km2) respectively. The minumum average monthly water discharge is in August (Q=0.98 m3/s, q=1.81 l/s/km2) and September (Q=0.87 m3/s, q=1.54 l/s/km2) (Table 1).

Table 1. Precipitation and water discharge and thresholds for extreme events on a monthly time scale (Q – monthly water discharge in 2010, Pav – average monthly water discharge (1961–2010); PMD – maximum daily water discharge in 2010; PMDav – average maximum daily water discharge 1961–2010; P – monthly precipitation in 2010, Pav – average monthly precipitation 1961–2010; PMD – maximum daily precipitation in 2010; PMDav – average maximum daily precipitation 1961–2010)

Precipitation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
P 2010	43.2	64.2	77.3	64.7	117.3	81.3	40.7	25.0	18.7	93.1	71.9	90.2
P_{av} (1961–2010)	40.8	40.5	44.1	52.3	72.6	81.7	61.2	49.6	47.8	47.2	56.5	48.7
P_{MD} 2010	8.9	9.5	22.7	20.4	35.7	21.6	12.6	12.9	6.6	18.1	29.9	29.7
P_{MD} (1961–2010)	12.5	13.2	14.7	14.8	21.0	25.5	25.3	20.0	18.4	17.3	17.7	13.8
Water discharge												
Q_{av} 2010	7.63	20.25	13.75	14.44	11.36	2.71	1.78	0.98	0.87	1.06	1.37	4.01
Q_{av} (1961–2010)	1.85	3.41	3.87	3.84	2.94	2.04	1.31	0.87	0.74	1.02	1.14	1.61
Q_{MD} 2010	17.30	77.00	20.90	32.20	39.80	5.60	4.10	1.20	0.96	1.58	4.10	35.40
Q_{MD} (1961–2010)	6.45	12.93	10.53	10.24	8.30	6.69	5.44	2.88	2.38	3.13	3.91	6.93

DYNAMICS IN TOTALL DISSOLVED SOLIDS AND SUSPENDED SEDIMENT CONCENTRATION

Selected statistics for water discharge, dissolved and suspended sediment concentration and loads are presented in Table 2. The observed dynamics in the behaviour of total dissolved solids (TDS) and suspended sediment concentration (SSC) were significantly different. The degree of variation in TDS concentration was relatively low. In the case of TDS concentration, average and median values were relatively similar (TDSav=251.8 mg/l, TDSme=255.0 mg/l), as well as values of minimum and maximum (TDSmin=78.8 mg/l, TDSmax=375.0 mg/l). In contrast, SSC concentration was extremely variable. Average and median of SSC concentrations were significantly different from TDC concentrations. The average concentration 4.6 times higher than median values (SSCav=141.5 mg/l, SSCme=30.8 mg/l). Also, the range between the minimum and maximum values is much larger (SSCmin=1.7 mg/l, SSCmax=2660.0 mg/l). Regarding the specific values, the obtained SSC concentrations have a highest inter-quartile range than the TDS concentrations (IQR from 22.1 mg/l to 170.0 mg/l and IQR from 195.4 mg/l to 313.0 mg/l respectively). In fact, SSC concentrations have a 6.8 times higher coefficient of variability compared to TDS concentrations.

Table 2. Selected statistics of daily variables in the Nišava river on hydrological station Dimitrovgrad 2010 (Q, m3/s – water discharge, TDS, mg/l – total dissolved solids, SSC, g/l – suspended sediment concentration, Qd, t/day – dissolved laod, Qs, t/day – sediment load; av – average, min – minimum, max – maximum, Quar.– quartile, me – median, IQR – Inter-Quartile Range, Perc.– percentile, Conf.SD – Confidence SD, δ – Standard deviation, CV – coefficient of variation).

Variable	Q (m^3/s)	TDS (mg/l)	SSC (mg/l)	Q_d (t/day)	Q_s (t/day)
av	6.6	251.8	141.5	101.3	270.9
min	0.8	78.8	1.7	24.3	0.7
max	77.0	375.0	2660.0	528.9	17696.4
Quar. 1	1.1	195.4	22.2	29.3	2.0
me	2.4	255.0	30.8	52.3	6.1
Quar. 3	10.2	313.0	170.0	183.1	163.9
IQR	9.1	117.6	147.8	153.8	161.9
Perc. 5	0.9	138.9	20.0	26.3	1.7
Perc. 95	20.9	362.4	560.0	244.4	858.8
Conf.SD–95%	8.3	67.5	259.6	83.7	1278.2
Conf.SD +95%	9.6	78.1	300.3	96.8	1478.4
Δ	8.9	72.4	278.5	89.7	1371.0
CV	136	29	197	89	506

TDS and SSC concentrations represent a different and characteristic seasonal pattern in relation to the same water discharge value. Monthly water discharge along with TDS and SSC concentrations are show in Figure 1. The highest TDS concentrations were observed at the end of the summer to mid-autumn, in the period August–October. In contrast, the lowest recorded TDS concentrations tend to occur in winter months, although in some occasions this period is slightly delayed, with lower concentrations in spring months. Mostly, dissolved matters depend mainly on the lithology and the duration of water circulation, surface runoff, interflow, and groundwater flow [31,32]. The seasonal pattern in TDS concentration is clearly related to the available water discharge. The relationship between monthly Q and monthly TDS is represented by a logarithmic function, with a high coefficient of determination R2=0.91 (Figure 1A). Namely, the highest TDS values were recorded during the lowest flows.

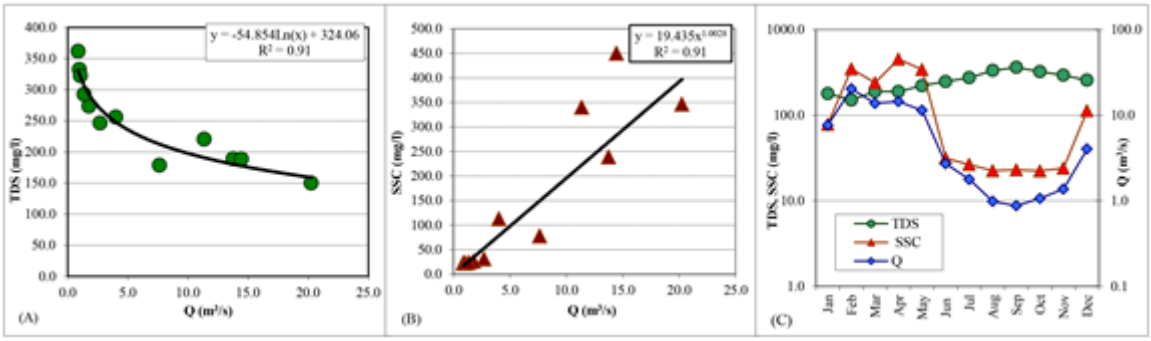

Figure 1. Logarithmic function (TDS=aLn(Q)+b) of the relationship between Q and TDS (A), power function (SSC=aQb) of the relationship between Q and SSC (B) and variability of Q, TDS and SSC (C) on a monthly time scale

In contrast, a different seasonal pattern was observed for SSC concentrations. As shown in Figure 1B, the relationship between monthly Q and monthly SSC is represented by the power function, with a coefficient of determination of R2=0.91. Visual interpretation indicates that, in general, samples with high concentration of SSC collected in months with a significant increase in water discharge. In this case, the highest monthly values of SSC are in the period February–May, when water discharge were recorded (Figure 1C).

DYNAMICS OF DISSOLVED LOAD AND SEDIMENT LOAD AT DIFFERENT TIME SCALE

During the period January–December 2010, the dissolved load and sediment load at the measuring station Dimitrovgrad amounted to Qd=36962.8 t and Qs=135824.9 t, respecively. Monthly transport of dissolved load and sediment load for 2010 are given in Table 3. The minimum transport Qd=818.0 t/month and Qs=51.9 t/month was during September. The maximum values of loads occurred in different months. So the highest monthly transport of dissolved loads was in March Qd=6822.1 t/month, which represents 18.5% of the total annual transport. On the other hand, the highest monthly transport of sediment load was in February Qs=44267.7 t/month, which represents 44.8% of the total annual sediment transport. Daily values of Qs show a much larger range compared to daily transport of Qd (Table 2). The ratio between the maximum and minimum daily transport of Qs is 1:26422, and Qd is only 1:22. The results show a very high daily coefficient of variation Qss of CV=506, as opposed to the coefficient of variation Qd which is CV=89.

Transport of dissolved and sediment loads shows a temporal variation at different seasons. The values of specific dissolved load (Qds) and specific suspended sediment load (Qss) during winter, spring, summer and autumn for the research period are given in Figure 2. Generally, characteristic of loads in the river Nišava on the hydrological profile Dimitrovgrad is the existence of two seasons in the transport of dissolved and sediment loads. The seasons are polarized into wet season (winter–spring) and dry seasons (summer–autumn), which by their characteristics represent extreme values in river loads transport. The presented seasonal distribution of sediment and dissolved transport is determined by the seasonal distribution of runoff (q). Average monthly runoff of approximately q=10 l/s/km2 can be defined as the limit value between wet and dry period. For specific runoff q<10 l/s/km2, 23.3% of annual Qd load and only 4.6% of annual Qs load were transported during the dry season. Both types of loads during the dry season have a small range of monthly values. In the period Jun–December (dry season) dissolved load was in the range of Qd=818.0–2140.5 t/month (Qds=1.7–4.4 t/km2/month) and transport sediment load in the range of Qs=51.9–254.4 t/month (Qss=0.1–0.5 t/km2/month). In contrast, during the wet season (q>10 l/s/km2), 76.7% of Qd and 95.4% of Qs of the annual load were transported. During the period January–May (wet season) sediment load has a larger range in transport compared to dissolved load, Qs=2276.9–44267.7 t/month (Qss=4.7–91.8 t/km2/month) and Qd=3465.9–6822.1 t/month (Qds=7.2–14.2 t/km2/month), respectively.

Table 3. Monthly distribution of water discharge, dissolved load and sediment load and percentage share in annual transport (Q, m3/s – water discharge, q, l/s/km2– runoff, Qd, t/month – dissolved load, Qds, t/km2/month – specific dissolved load, Qs, t/month – sediment load, Qds, t/km2/month – specific sediment load).

Paramet	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Q	7.6	20.2	13.8	14.4	11.4	2.7	1.8	1.0	0.9	1.1	1.4	4.0
q	15.8	42.0	28.5	30.0	23.6	5.6	3.7	2.0	1.8	2.2	2.8	8.3
Q_d	3465.	5719.7	6822.	6553.7	5803.3	1653.	1227.	871.	818.	912.	975.	2140.
Q_{ds}	7.19	11.87	14.15	13.60	12.04	3.43	2.55	1.81	1.70	1.89	2.02	4.44
Q_d %	9.38	15.47	18.46	17.73	15.70	4.47	3.32	2.36	2.21	2.47	2.64	5.79
Q_s	2276.	44267.	9587.	21423.	16733.	254.4	137.0	58.8	51.9	64.0	100.	3906.
Q_{ss}	4.72	91.84	19.89	44.45	34.72	0.53	0.28	0.12	0.11	0.13	0.21	8.11
Q_s %	2.30	44.78	9.70	21.67	16.93	0.26	0.14	0.06	0.05	0.06	0.10	3.95

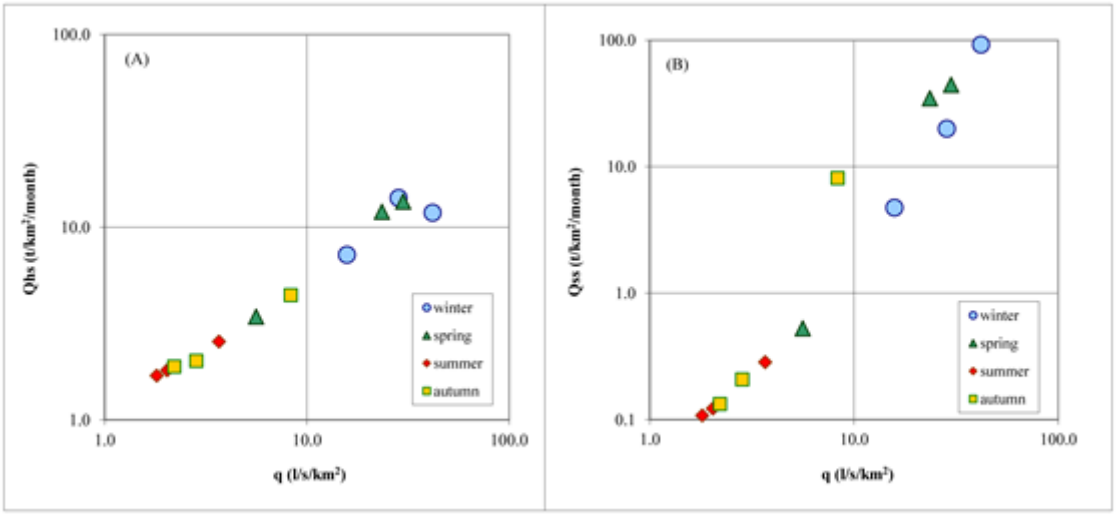

Figure 2. Relationship between average runoff (q) and specific dissolved load (Qds) and specific sediment load (Qss) at a seasonal scale (winter – January, February; March; spring – April, May, June; summer – July, August, September; autumn – October, November, December)

High values of sediment transport during the wet season are a consequence of extreme hydrological conditions during that period. As shown in Table 1, the average monthly water discharge in 2010 were higher than the monthly average water discharge for the period 1961–2010 from 60% in December to a record 83% in February. High water discharge were caused by a large amount of precipitation. Namely, monthly precipitation was higher than the average monthly precipitation for a period of 50 years from 19% to 46%. For a particular understanding of the dynamics and conditions of suspended sediment transport, sediment rating curve (SRC) will be used. The method is based on the relationship between the sediment load and water discharge and can be expressed as a power function Qs=aQb [33,34,35]. The analysis considered temporal changes in the sediment regime differentiated into monthly time scale. Sediment rating curves for each month during 2010 are shown in Figure 3, and the values of the parameters a and b are given in Table 4. Namely, the sediment rating parameters represent the soil erodibility and erosivity of the river [36]. The rating coefficient a represents availability of sediment in the basin and whether the sediment is easily eroded and transported by stream flow. Therefore, the value of the coefficient a at the station is closely related to sediment sources upstream. This coefficient, therefore, is influenced by the soil erodibility and suspended sediment input in the basin upstream of the gauging site. The rating exponent b indicates the changing rate of the suspended sediment load per change of unit water discharge [37].

Table 4. Sediment rating parameters for power function Qs = aQb for monthly time scale.

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a	0.0163	0.1958	0.0613	0.3481	0.3829	0.9119	1.7732	1.9227	2.0102	1.8992	1.7618	2.7534
b	3.7655	2.5363	3.1987	2.7260	2.7123	2.0805	1.4570	0.7021	1.1030	1.2267	1.5998	1.8923
R^2	0.80	0.94	0.95	0.93	0.96	0.96	0.94	0.81	0.52	0.86	0.99	0.94

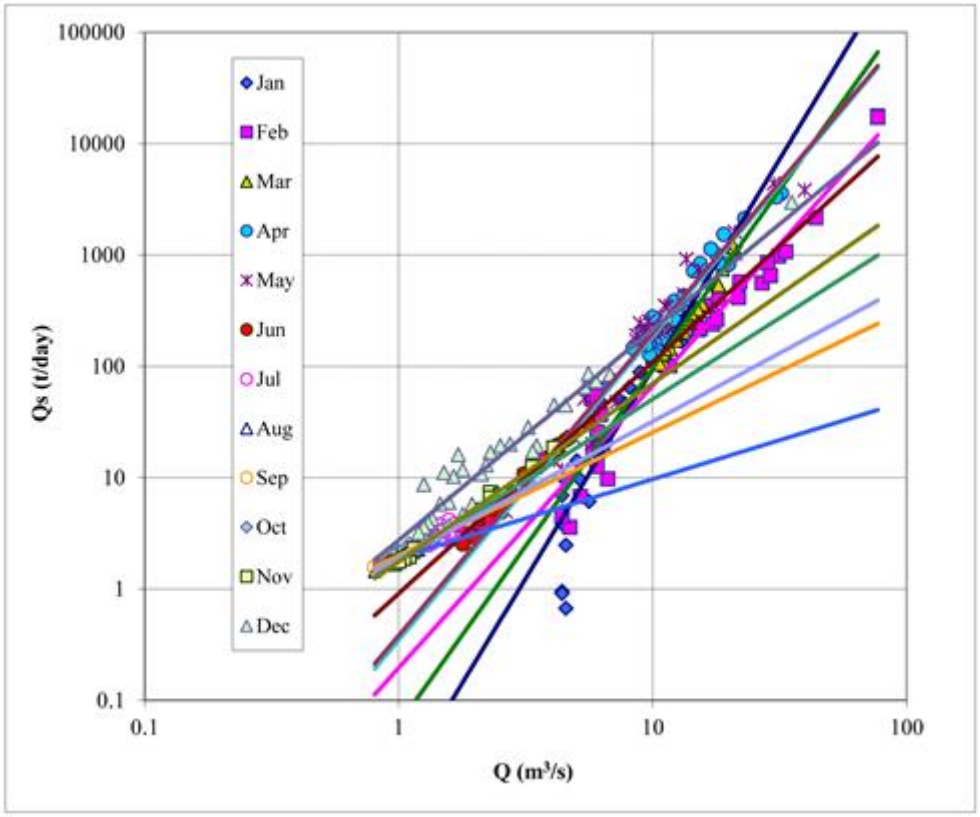

Figure 3. Sediment rating curves (SRC) for decline of sediment load
(b) for monthly time scale based on daily data

The ranges of the monthly rating coefficient a are from 0.0163 to 2.7534. Results show that the coefficient a was significantly larger (for 95%) in summer and early autumn than in winter and in early spring. This is explained by the wide availability of sediments in the area of the entire basin upstream of the measuring station during the summer months due to the intensive agricultural activity in that part of the year. Values of monthly exponent b fluctuate between 0.7021 and 3.7655. Since the exponent b>1 in all months except August, the dominant shape of SRC is convex at monthly levels of analysis. The high value exponent b indicating strong increase in erosive power of the river [36,38], that suggests a substantially increasing rate of suspended load with an increase of discharge [39]. Changing the shape and slope of the rating curve means changing the sediment transport regime. In this case, the exponent b for the monthly curve in August is b < 1, which indicates a concave shape. This means that the suspended load increases in a diminishing rate with the increase in discharge. Rivers with this type of SRC are supply-limited, which means that the amount of sediment transported is constrained by the amount of sediment available [40,41]. On the other hand, during the wet season (January–May period) the exponent b has extremely high values, so that the curve has a more pronounced convex shape. Generally, previous studies have shown that the exponent b is significantly higher in spring than in winter [42,43,44]. The spring is the time when the annual peak of the flow occurs. This coincides with the annual snowmelt period. In that conditions, the erosive potential of the stream is higher, which affects the strong increase in the transport of suspended sediment in the river flow. However, in this study the values of exponent b are also high during the winter seasons, which is not

typical. This means that some other conditions affected the high transport of Qs in this period, which will be considered on the several events.

TRANSPORT OF DISSOLVED LOAD AND SEDIMENT LOAD DURING SOME EXSTREME DAILY EPISODES

Extreme values of sediment transport in rivers occur most often in response to sudden changes in climatic conditions. Research has shown that the first, the biggest impact is the change in the amount and intensity of precipitation, while the second dominant impact is the change in temperature [45]. In fact, sediment transport is strongly focused on precipitation events and relatively few events are the key to explain the sediment export [46]. The combined impact of extreme precipitation and temperature conditions is a key factor in the occurrence of high water discharge and floods. Generally, the critical periods for floods in Serbia are the end of spring, from May to the first half of June, and the end of winter from February to the first half of March [47,48].

Previous research in Serbia [18,30] suggest that maximum daily precipitation (PMD) was considered as the key factor in excessive erosion. The impact of extreme precipitation on sediment transport will be considered on the example of the flood events in May (Figure 4A). The highest monthly precipitation during 2010 was recorded in May (P=117.3 mm) and is higher than the threshold for precipitation by 68% (Table 5). Specifically, in this case, in May, the maximum daily precipitation (PMD=35.7 mm) was 38% higher than the value of the PMD threshold was determined. Extreme precipitation events caused the occurrence of high flows and SSC concentrations. The average monthly water discharge is Q=11.4 m3/s and is higher than the average long-term by 74%. Maximum daily water discharge (QMD) was observed after the onset of maximum daily precipitation (PMD). Particular in this case, on May 15 the highest daily precipitation was registered, and five days later (May 19), the highest daily QMD = 39.8 m3/s was registered. Sediment transport in these conditions was extremely high. In fact, on May 19, when the largest daily Q was registered this month, were transported Qs=4380.5 t/day (26% total sediment load in May). The next day when the highest SSC values were registered, the daily sediment transport was Qs=4380.5 t/day. It can be concluded that 50% of the monthly sediment load was transported in only two days. On the other hand, on May 19, the highest daily dissolved transport Qd=364.8 t/day was recorded, which represents only 6% of the total monthly dissolved load.

Table 5. Extreme daily values of dissolved load (Qd) and sediment load (Qs) and percentage share in monthly transport.

Parameters	7. Janauary	18. February	7. March	22. April	19. May
Q (m^3/s)	17.3	77.0	20.9	32.2	39.8
Q_d (t/day)	190.5	528.9	257.5	315.3	364.8
%	5.5	9.2	3.8	4.8	6.3
Q_s (t/day)	538.1	17696.4	1175.5	3561.1	4380.5
%	23.6	40.0	12.3	16.6	26.2
Q_s/Q_d ratio	2.8	33.5	4.6	11.3	12.0

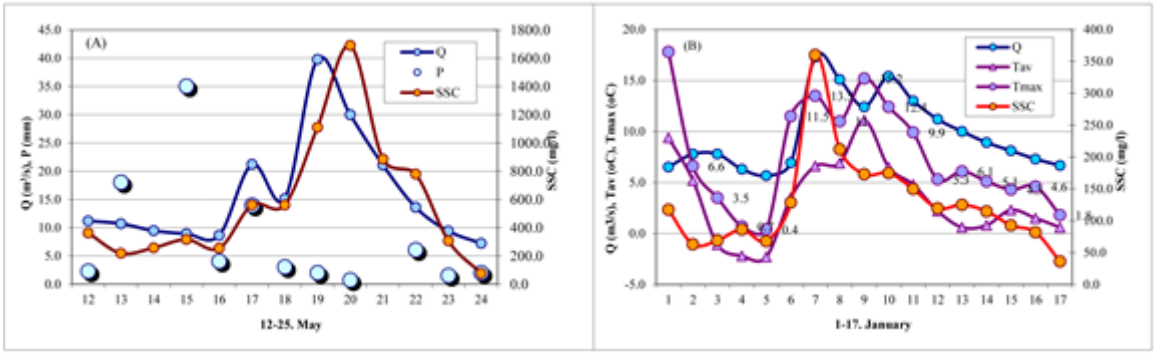

Figure 4. Daily values of water discharge (Q), precipitation (P) and suspended sediment concentration (SSC) for period 12–25. May 2010 (a) and daily values of water discharge (Q), average daily temperature (Tav), maximum daily temperature (Tmax) and suspended sediment concentration (SSC) for period 1–17. January 2010 (b).

Table 6. Correlation matrix between selected variable for January at significant level p=0.001 (Q, m3/s – water discharge; SSC, mg/l – suspended sediment concentration; TDS, mg/l – total dissolved solids; Qs, t – sediment load; Qd, t – dissolved load; Tav oC – average daily temperature; Tmax, oC – maximum daily temperature).

Parameters	Q	SSC	TDS	Q_s	Q_d	T_{av}	T_{max}
Q	1.00						
SSC	0.92	1.00					
TDS	–0.91	–0.84	1.00				
Q_s	0.92	0.96	–0.80	1.00			
Q_d	0.99	0.90	–0.87	0.87	1.00		
T_{av}	0.73	0.73	–0.72	0.62	0.74	1.00	
T_{max}	0.72	0.78	–0.70	0.68	0.72	0.93	1.00

However, precipitation is not the only factor in the excessive erosive process. As mentioned above, the major water discharge and transport of sediment load was in February 2010. In fact, the amount of precipitation in February (P=64.2 mm) was higher than the multi-year average (P=40.5 mm), but PMD was as much as 28 % lower than the threshold for precipitation (Table 1). Actually, the determining factor in the high transport of sediment load, in this case, is a combination of precipitation and temperature events of the current and previous month. The average monthly temperature in January and February was extremely high. Ten days in January and only four days in February with a Tmax>0oC were recorded. As shown in Figure 4B, in the first half of January Tmax ranged from 0.4 oC to 17.8 oC. High daily temperatures were also in February. In the last decade of February, maximum daily values of temperature higher than Tmax>6 oC, and during five days the average air temperature was higher than T>12 oC. High values of temperatures caused the snowmelt and high water discharge, which increased the erosive potential of the river flow. The correlation matrix (Table 6) between climatic parameters, sediment parameters and dissolved parameters show higs significant level (p=0.001). These climatic conditions resulted in extreme transport of sediment load in study period. On February 17, the maximum daily transport sediment load of Qs=1175.5 t/day was recorded, which is 33.5% of the total monthly sediment load. Also on this day, the maximum daily dissolved load was recorded (Qd=528.9 t/day). As presented in Table 5, it can be concluded that in extreme climatic and hydrological conditions, the suspended sediment is dominant. The Qs/Qd ratio ranges from 2.8 in January to 33.5 in February.

COMPARISON OF QD/QS LOADS AND HEMICAL/PHYSICAL EROSION

The pattern of cumulated water discharge (Q), suspended sediment load (Qs) and dissolved load (Qd) in relation with the cumulated time is represented in Figure 5. In general, the accumulated dissolved load presented a pattern similar to that of the water discharge, supporting the conservative behaviour of dissolved solids in water, which is in agreement with other research [1]. For instance, 90% of the time was required to export 65 % of the total water and transported 77% of the total dissolved load. The transport of sediment load shows greater variability and exponential pattern at the measuring station. For the same period, it was required to export 22% of the total sediment load. Regarding sediment load, its episodic character was clearly detectable in following example. More than 70% of the Qs load was discharged during the flood events, i.e. in only 5% of the time period. During the same period, only 16% of Qd load was transported.

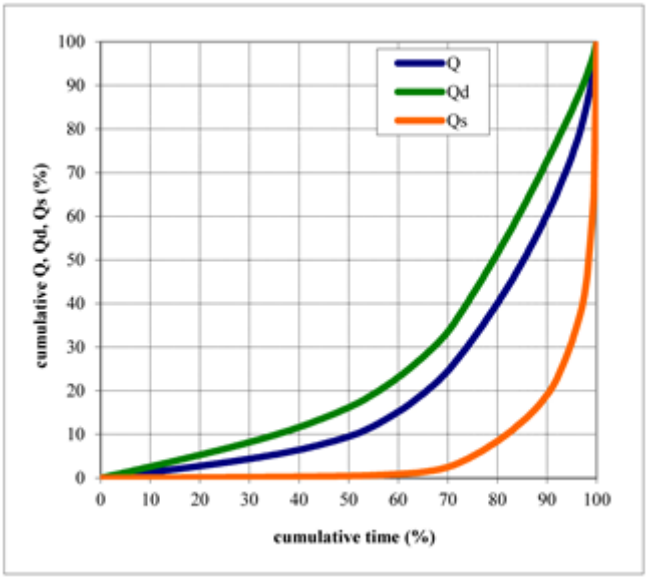

Figure 5. Cumulative water discharge (Q), dissolved loads (Qd), suspended sediment loads (Qs) versus cumulative time in Nišava river, hydrological station Dimitrovgrad

Comparative of chemical erosion and mechanical erosion are given in Table 7. The results show that the mechanical erosion (sediment load)/chemical erosion (dissolved load) ratio at the Dimitrovgrad hydrological stations on the Nišava River is higher than one, indicating overall dominance of mechanical erosion over the chemical erosion. The chemical and mechanical erosion rates during 2010 sampling period were calculated to 76.7 t/km2/yr and 205.1 t/km2/yr, respectively. In particular, during 2010 the mechanical erosion contributed by 73% in total erosion. The lowering rates based on the observations were estimated to be 0.75 mm/yr (0.20 mm/yr due to chemical erosion and 0.54 mm/yr due to mechanical erosion).

Table 7. Comparative chemical denudation rate (DRch) and mechanical denudation rate (DRmc)

Hydrological station	A (km^2)	Q_{ds}	Q_{ss} ($t/km^2/yr$)	Total erosion	P/C ratio	DR_{ch}	DR_{mc} (mm/yr)	DR_t
Dimitrovgrad	482	76.7	205.1	281.8	2.67	0.20	0.54	0.75

CONCLUSIONS

The comparison of dissolved load and sediment load provides important conclusions on the transport processes of river load and erosion rate that occur at the different time scale in the upstream of the Nišava river basin. Over the period under consideration, we observed a larger variation in the suspended sediment concentration and sediment load than in total dissolved concentration and dissolved load. For the Nišava river in hydrological station Dimitrovgrad, the data show that the water discharge (runoff) is the main factor controlling the transport of river loads intra-annual variations. Generally, the main characteristic of loads is the existence of two seasons in the transport of dissolved and sediment loads: dry season – in which 23.3% of annual Qd load and only 4.6% of annual Qs load were transported (2) wet season – in which 76.7% of Qd and 95.4% of Qs of the annual load were transported. We have obtained a more precise estimate value Qd and Qs load over period of study characterized by massive floods. The floods in February contributed by 44.8 % of the total Qs transport over the study period. The relationship between cumulative time and cumulative load suggests that more than 70% of the Qs load and 16% of the Qd load was discharged during the extreme events, i.e. in only 5% of the time period. Comparative of chemical erosion and mechanical erosion during 2010 show that the mechanical erosion contributed by 73% in total erosion. This research would help in understanding the hydrologic responses of river fluvial systems for taking up appropriate soil and water conservation measures leading to integrated river basin management.

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MICROPLASTICS IN THE SOIL PROFILE AND GROUNDWATER OF GREENHOUSE FARMLANDS OF SOUTHEAST- HUNGARY

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ABSTRACT

Soil profile and groundwater under greenhouse farming are susceptible to microplastics contamination due to high generation of plastic waste. Natural and anthropogenic processes such as, infiltration, presence of cracks and farm management practices favor the vertical penetration of contaminants from the soil surface to soil depths and groundwater aquifers. In this study, we quantify and characterized the microplastics in the soil profiles and groundwater of greenhouse farmlands from Southern Hungary. We selected six soils profiles on the plots of greenhouses in the greenhouse farmlands of two cities, which have not been in use for about 3 years and 15-20 years respectively. Six soil profiles were dug, and samples were collected at intervals of 20 and 40 cm. Groundwater samples were also collected from the same profiles at a depth of 100 cm and below 4 meters. Microplastics were extracted from the groundwater by vacuum filtration process, while, predigestion of organic matter with 30%H2O2 and density separation with ZnCl2 was used to extract microplastics in the soil profile samples. Microplastic contamination was detected in the soil profile, thought; its distribution is not uniform. However, microplastics were also recorded in five of the six drilled areas, the average microplastics concentration in the groundwater was 2.5 pieces/L, and fibers were the dominant plastic structure. Given that microplastics were found in soil profiles, and groundwater, we recommend the treatment of groundwater from such areas before it is used for human consumption or irrigation as well as careful cleaning and disposal of plastics on greenhouse farmland.

Keywords: greenhouse farming, microplastic, pollution, Soil profiles, groundwater contamination

INTRODUCTION

Greenhouse farming began in 1953–1954 at the Kentucky Agricultural Experiment Station in the United States [1]. Today, greenhouse farming contributes heavily to the production of various agricultural products. Globally, greenhouse farming covers 220,000 ha of land and consumes 250,000–350,000 tons/year of plastic film [2]. Low-density polyethylene (LDPE) is the major plastics used for greenhouse coverage [2, 3-5]. Other polymer presence in the greenhouse farming includes polyvinyl chloride (PVC), ethylene-vinyl acetate, and linear LDPE [6-8]. These plastics materials are used inform of plastic pipes, fibers for tightening and plastic containers for agrochemicals. The plastics for greenhouse coverage have short time span and can easily age as a result of weather, agrochemicals, and environmental pollution [2, 3-5].

Plastic contaminants can be small-sized particles, i.e., <5 mm, referred to as microplastics. These plastic contaminants enter agricultural soils such as greenhouse and other farming sites through mulching [9], sewage sludge [10], and organic and inorganic fertilizer application [11-12]. Microplastic waste can be transferred vertically through the soils by water, microorganisms, and leaching [13-15]. Other means of transportation include irrigation and other agricultural practices, as well as cracks on the soil surface.
Plastic contaminants in the soil ecosystem affect the quality of agricultural products and the growth and photosynthesis of plants are altered by the presence of microplastics [16-19]. Furthermore, Plastic contaminants in the soil ecosystem alter soil quality and fertility by altering its structure, bulk density, and water holding capacity [20-21]. Importantly, microplastics can adsorb and transport contaminants such as heavy metals and other pollutants in the soil environment [22-23]. Therefore, the health of soil organisms and their enzymatic activities are disturbed by microplastic contamination [24]. Lastly, direct ingestion of microplastics or consumption through contaminated food, such as fish and agricultural products, is a threat to human health [25].
Moreover, there is a knowledge gap in terms of microplastic contamination in the soil profiles and groundwater of greenhouse and general soils. The current studies available on the microplastics pollution in the soils concern on the soil surface and shallow depths. Recently, the World Health Organization [26] lamented the lack of studies on microplastics in drinking water; they emphasized that although the scant data do not reveal the threat to human health, there is a need to collect more data to draw proper conclusions. Hence, the present case study aimed (1) to quantify the level of microplastics distribution and contamination in the soil profiles and groundwater on two greenhouse farmlands; (2) to examine the morphological structures of microplastic contaminants; and (3) to measure the relationship between soil depth and microplastic availability.

MATERIALS AND METHOS

Study Case

This research was conducted on the agricultural soils of greenhouse farmlands located next to Szeged and Szarvas in the south-eastern part of Hungary. Both areas were selected based on size, history of greenhouse farming. The first study area has a climatic conditions of warm and dry (mean annual temperature: 10.5 °C; mean annual precipitation: 520 mm), with 2,080–2,090 h per annum average annual radiation. The area is 84 m above sea level, and the perched groundwater depth is 100 cm. The sample area is plain with loess bedrock, and the natural soil type is Phaeozem (according to the World Reference Base for Soil Resources) [27-28]. The greenhouse area is used for tomato cultivation. Sampling occurred in March 2021. In total, 20 soil samples were collected from the soil profiles. Additionally, three shallow groundwater samples were collected.
The second area is located in Szarvas. The climatic condition is warm and dry (mean annual temperature: 10.2 - 10.4oC; mean annual precipitation: 520 mm), with 190 - 810 h as an annual average radiation. The area is 82.6 - 92.1 m above sea level, and the perched groundwater depth is 2-4 m. The sample area is plain with infusion loess bedrock, and the natural soil type is Chernozem [29]. The greenhouse area was established in 1990s and is abandoned since 2007. The area was used for tomatoes, pepper and cucumber production. The sampling occurred in February 2022. In total, 27 soil samples were collected from the soil profile and three shallow groundwater samples were also collected.

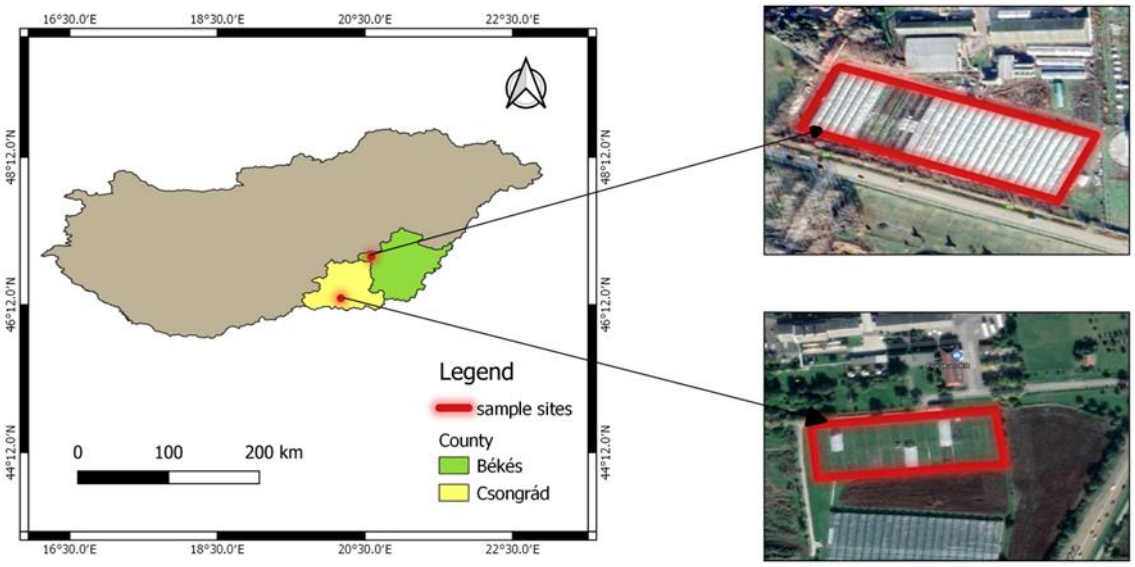

Figure 1. Map of the study area

Sampling from the soil profiles

For the first area, three boreholes were drilled in the middle of each sampling plot to collect samples from the soil profile. The samples were obtained at 20 cm intervals from the surface to where the effects of groundwater were clearly observed; the three profiles had depths of 160, 140, and 140 cm, respectively. For the second area, random sampling method was used to select three areas. Three boreholes were similarly drilled in the middle f each sampling plot. Profile 1 has a depth of 70 cm and samples were collected at the 20 cm interval. Profile 2 and 3 have depths of 4 and 5 meters respectively; thus, samples were collected at every second layers (i.e., 0-20, 40-60, 80-100, 120-140 cm).

Sampling from the groundwater

Groundwater in area 1 was reached at 160, 120, and 120 cm respectively. The perched groundwater was collected at the depth of 100 cm reach. However, Groundwater in area 2 was reached at the depths of 70 cm, 4 meters and 5 meters respectively. While the perched water level were 40, 350 and 450 cm for the respective profiles.

Microplastic sample preparation

To obtain pure plastic debris, a method developed by Li et al [30], which was modified and adjusted by Saadu and Farsang [31], was used. Briefly, the soils were oven-dried at 40°C and sieved with a 5 mm sieve. In 250 mL conical flasks, 10 g of soil was mixed with 40 mL of 30% H2O2, and 10 mL of Fenton reagent for organic matter digestion. The solutions were heated at 70°C until they had dried up. The flask containers were then immersed in cold water and a few drops of butyl alcohol were added to reduce the samples spout out. ZnCl2 [1.5g/cm3 (5mol/L)] was used as a flotation salt and 40 mL of the solution was added. The complete solutions were capped with aluminum foil and shaken for 1 h at 200 rpm in an orbital shaker, after which they were emptied into 100 mL beakers and allowed to settle for 24 h. Approximately 20mL of the upper supernatants were collected with a glass pipette, and 20mL of ZnCl2 was added to the solution, which was shaken for 30 min in the orbital shaker for a second time. The upper supernatants were again collected and combined with the first supernatants to form single microplastic extracts. These extracts were later filtered through a nylon membrane filter (20 μm) and

Whatman filter (0.45 μm), respectively, using a vacuum pump. The filters were air-dried and taken to the laboratory for microscopic microplastic identification and quantification. The suspected plastic particles were confirmed using a needle and heat method and Raman spectroscopic analysis.

Identification, classification, and quantification of plastics

The extracted microplastics were observed using an Inspex II microscope (software version: 1.06; film ware version: F001-001-011; ring light version: 1.03; Ireland) at 50× magnification. Some suspected microplastics particles were confirmed using the heat and needle method. These experiments were conducted at the analytical laboratory of the Department of Geoinformatics, Physical and Environmental Geography, University of Szeged. Pieces of different macroplastics and 5% of the suspected microplastics were later confirmed using a Raman spectrometer. Obtained Raman spectra were compared with the Raman library; thus, the compositions of plastic materials were accurately determined. Raman analysis was performed at the Department of Mineralogy, Geochemistry, and Petrology, University of Szeged.

Statistical analysis and quality control

Both descriptive and inferential statistics were used in this analysis. Descriptive statistical analysis was performed using Microsoft Excel, whereas inferential analysis was conducted using SPSS (version 22). The relationship between microplastics and soil depth was determined using Spearman's rank correlation. ANOVA was used to determine the relationships among soil profiles. A bare minimum of plastic materials was used during sampling and laboratory analysis. Contamination prevention techniques, such as rinsing the apparatus with distilled water three times, were adopted throughout the laboratory processes, during which a cotton lab coat and hand gloves were always worn by researchers. To prevent atmospheric contamination, aluminum foil was used from sampling until the final stages to cover the analyzed samples.

RESULT AND DISCUSSION

Abundance of microplastics in soil profiles and relationship with soil depth

The abundance of microplastics was extensively studied in the soil profile of two areas. One-way ANOVA revealed that in area 1 and 2, there were no significant differences among the three profiles in terms of microplastic availability in the soil horizon [$F(1, 2) = 0.59$, $P > 0.05$)]. Individual profile analysis revealed that the distribution of microplastic particles was not uniform. The individual profiles analysis in area 1 is as follows; profile 1 has the highest concentration (200 pieces/kg) of MiP in the 100-120cm layer followed by 40-60 cm, 120-140 cm and 140-160 cm where 100 pieces/kg were respectively recorded. According to Spearman's correlation analysis, there was a moderate positive correlation between depth and microplastic content in this profile, but it was not statistically significant [$r (8) = 0.626$, $P = 0.097$]. Profile 2 has the highest concentration of 300 pieces/kg in the 80-100 cm layer followed by 0-20 cm with MiP concentration of 200 pieces/kg. There was a weak negative correlation, which was not statistically significant, between depths and microplastic content [Spearman's correlation: [$r (6) = -0.235$, $P = 0.653$]. In profile 3, the highest concentration of 300 pieces/kg was recorded in 40-60 cm layer followed by 0-20 cm with 200 pieces/kg. There was a strong negative correlation between depth and microplastic content, which was not statistically significant [$r (6) = -0.759$, $P = 0.080$].

Similarly, in area 2, the individual profiles were also extensively analyzed. For profile 1, the highest concentration of 500 pieces/kg was recorded in the 20-40 cm layer, followed by 0-20 cm with 300 pieces/kg. According to Spearman's correlation analysis, there was a moderate negative correlation between depth and microplastic content in this profile, but it was not statistically significant [r(4) =-0.316, P =0.684]. Similarly, Profile 2 has the highest concentration of 300 pieces/kg in the 0-20cm layer followed by 200 pieces/kg in 20-40 cm. According to Spearman's correlation analysis, there was a moderate negative correlation between depth and microplastic content in this profile, The relationship is not statistically significant [r(10) =-0.555, P =0.096]. Also, Profile 3 has the highest concentration of 400 pieces/kg in 0-20 and 40-60 cm layers respectively, followed by 100 pieces/kg in 80-100 cm layer. According to Spearman's correlation analysis, there was a strong negative correlation between depth and microplastic content in profile 3[r(13) =-0.697, P =0.008]. The relationship is statistically significant.

These results agree with previous findings on the penetration of microplastics at different soil depths from 0 to 80cm [32]. Moreover, the vertical distribution of soil microplastics from the surface to the soil horizon occurred as a result of soil texture, the dry–wet nature of the soil, agricultural activities (e.g., plowing and harrowing), leaching of irrigation water, and transportation of microplastics by soil microorganisms through their various activities [13, 15, 20, 32-34]. Taken together, these findings imply that the presence of microplastics deep in the soil could contaminate underground and soil aquifers over time.

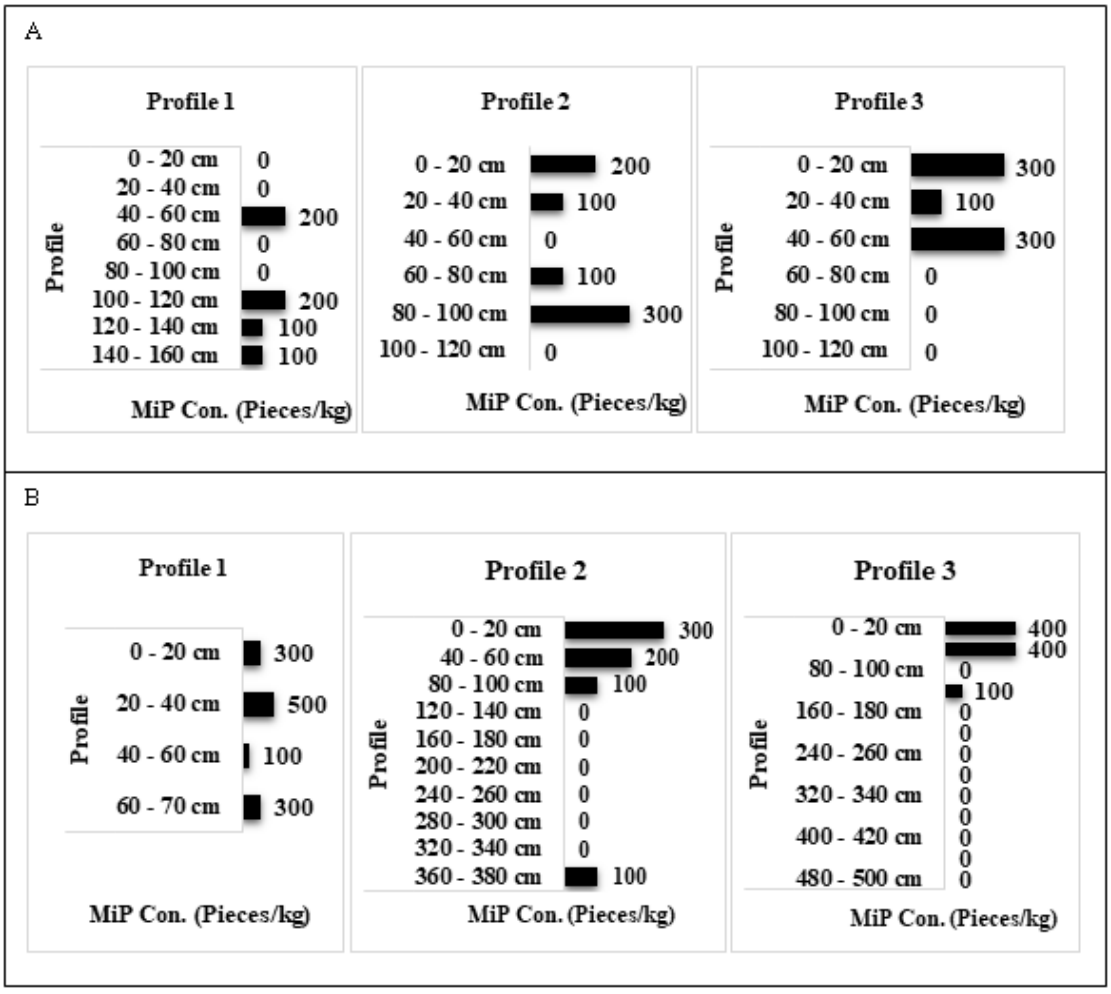

Figure 2. Abundance of microplastics in the soil profiles; A (Area 1) & B (Area 2).

Abundance of microplastics in groundwater

Figure 2 reveals the abundance of microplastics in groundwater. In area 1, microplastics were recorded in two of the three drilled areas (not in Drilling 3). The average concentration of microplastics in the groundwater was 3.3pieces/L. In Drilling 2, the highest number of microplastics recorded was five particles, whereas that in Drilling 1 was three particles. Contrarily, the average concentration in area 2 (Szarvas) is 2.6 pieces/L. In Drilling 1, the highest number of microplastics recorded was five, whereas two and three microplastics particles were respectively recorded in Drilling 2 and Drilling 3. The difference in MiP content in the areas was tested with One-way ANOVA. The result revealed that there were no significant differences among the two areas in terms of microplastic availability in the groundwater [$F(1, 4) = 0.14$, $P > 0.05$)]. The result of presence of microplastics in the groundwater are consistent with some findings on microplastics in groundwater. For example, Su et al [35] found a few microplastic fibers in the Jiaodong Peninsula, China, and Panno et al [36] reported 15.3 particles/L in karst groundwater. Our results also support the hypothesis of Wanner [37], who assumed that deposition of plastics in agricultural areas could contaminate the groundwater and soil aquifers beneath agricultural farmlands. However, our finding differs from that of Panno et al [36] in terms of the wide gap in the number of microplastics; this could be attributed to differences in soil texture and climatic conditions (amount of rainfall) as well as the openness of the surface water, which makes it prone to atmospheric surface runoff and other environmental contaminants. Our results are also in agreement with previous postulations that microplastics can penetrate the soil and contaminate the groundwater and aquifers through infiltration and other contamination sources [38, 13]. Additionally, cracks in the soil might act as pathways for microplastic contamination to the groundwater. Taken together, these result simply that groundwater is prone to microplastic contamination. Hence, microplastics could potentially be consumed directly in some areas where groundwater is used as drinking water without undergoing proper treatment.

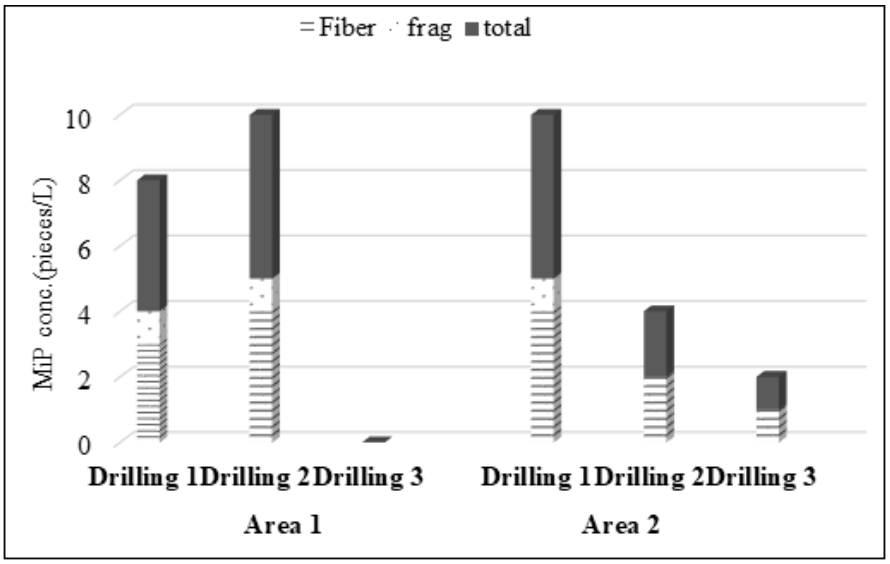

Figure 3. Microplastics abundance in groundwater of two areas

However, the result of the morphological structures of the plastics contaminants is revealed in Table 1. The table shows that fibers and fragments were found in the farmlands. Fiber microplastics are predominantly available in the areas. Panno et al. [36]

and Su et al [35] similarly reported fibrous materials to be the main contaminant structures in Illinois, USA, and in Jiaodong Peninsula, China, respectively. The availability of fibrous contaminants in the areas may occurred as a result of wide spread of fibrous materials in areas. Also, it may be as result of easiness of fibrous plastics to penetrate the soil depth through water penetration as revealed by previous researches. Furthermore, the result of two areas tally in terms of structures, as fiber and fragment were both found in the farmlands. The colors recorded in the groundwater of area 1 is black and blue while in area 2 three colors were recorded, these are; white, red, & blue, (Tble 1). The main cause of difference is attributed to the numerous varieties of macroplastics contaminants as can be observed in area 2.

Table 1: Characteristics of microplastics in the groundwater of Area 1 and 2

Sample ID	Actual Depth (cm)	Perched Depth (cm)	GPS Coord.	MiP (No.)		Total (No/L)	Color
				Fiber	Fragment		
$D_1$1	160	100	N451728.64292, E 201021.2364	3	1	4	Red & black
D_1 2	120	100	N461728.61988, E 201020.7858	4	1	5	Red & black
D_1 3	120	100	N461728.5093 E201019.8282	0	0	0	
Total						**9**	
D_2 1	70	40	767136 / 168718	4	1	5	White, blue, & Red
D_2 2	400	350	767149 / 168713	1	2	3	Blue
D_2 3	500	350	767159 / 168718	1	0	1	Blue
Total						**9**	

CONCLUSIONS

This study is among the first group of studies to quantify and characterized microplastic contamination in soil profiles and groundwater of greenhouse farmlands. Moreover, the level and distribution of microplastic contamination in the soil profiles were determined, and microplastics were found in some layers of soil profile. Microplastic particles were also found in the groundwater of greenhouse farmlands (mainly fibers). Hence, groundwater from such areas must be treated before human consumption and use in irrigation to reduce the microplastic load in the human body and agricultural soils, respectively. Additionally, farmers and stakeholders must take greater care to clean and dispose of plastics in greenhouse farming areas. Finally, this research provides insights that could lead to further research on microplastic contamination in the soil profile and groundwater.

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DETERMINATION OF DISCHARGE CYCLES OF THE SOUTH MORAVA RIVER (SERBIA)

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ABSTRACT

Possibilities of using water resources, their quality and availability in the world represent one of the most complex and very current scientific and practical topic in numerous research of the last decades. The studies on the variability and fluctuations of river discharge values are especially important due to emphasized vulnerability of rivers to climate changes. Accordingly, the aim of this paper is to determine the existence of possible cycles in changes of the values of annual and seasonal river discharges of the South Morava River in Serbia. In addition to determine the trend of changes in the values of the indicator for the period 1946-2020, statistical procedures of autocorrelation and spectral analysis, for studying the possible repetition of the time series of particular cycle, were applied. The results indicated the existence of a certain cyclicity, which was correlated with the most important factor, variation of the precipitation amount. The obtained results present the base for further research that would include examining the repeatability of extreme values, as a particularly important for forecasting the occurrence and frequency of flood and drought waves.

Keywords: river discharge, cycles, South Morava River, trend

INTRODUCTION

Research and analysis of fluctuations of the hydrological parameter values has a distinct scientific and practical significance, especially for the necessity of forecasting and understanding flood and drought waves [1]. The increasing occurrence of catastrophic floods on one side, and extremely dry periods on the other [2], confirms the requirement for more thorough research into the causes and regularity of their occurrence. The variability of the climatic element's values (precipitation and temperature) has been most often singled out as the main factor [3]. However, it is necessary to emphasize the increasingly intensive anthropogenic activities in river basins including river regulation, water use and anthropopressure [4]. One of the main challenges in this type of studies is the inability to quantify the impact of natural in relation to anthropogenic causes of discharge variations.

The values of river discharges are differently variable on certain spatial-temporal scales - on small scales, the river turbulence affects scholastic fluctuations, and on larger scales (daily to annual) fluctuations of discharge values are the result of complex nonlinear interactions between precipitation, topography, and geography [5]. Knowing the mentioned fluctuations of discharges is especially important for determine certain seasonal or annual cycles in a time series of data [6]. In that context, several scientific articles [7], [8], [9], [10] treated this topic by using various methods and techniques.

Smith et al. [11] identified certain variability of river discharges, using the method of wavelet transformation over the values of daily discharges. Chang & Yeh [12] used spectral analysis to determine the correlation between precipitation on the one and runoff on the other side, defining the basin as a "block box" with an input indicator (precipitation) and an output indicator (runoff). A similar study was conducted by Roshani et al. [9] who determined the existence of a certain water cycle of the Rudhan River (Iran), especially during the summer and autumn seasons. Some research used the same methodology to investigate the correlation between water level changes and climate changes [13], [14].

In order to determine the discharge cycles and their repetition, the first step include trend analysis and registration of changes of the hydrological parameter. However, it is important to notice that trend analysis can often lead to a wrong conclusion due to the non-stationarity of a time series, i.e., due to the existence of perennial watery and drought cycles in the series. The aim of this paper is to investigate the existence of possible cycles in the values of the mean annual and seasonal river discharges of the South Morava River (Serbia) as well as to observe the time intervals of their repetition. For that purpose, statistical methods of autocorrelation and spectral analysis were applied. In addition, general statistical trend tests (Mann-Kendall and Pettitte test) were used to observe the trend in the time series.

MATERIALS AND METHODS

Study area

Due to specific water regime, basin characteristics and river morphodynamic, the South Morava River represent adequate example for investigating the variability of river discharges. The South Morava River begins at the confluence (near Bujanovac) of the rivers Binačka Morava and Preševska Moravica at an altitude of 392 m. Near Stalać (145 m a.s.l.) West Morava River (left side tributary) and South Morava River (right side tributary) form the Great Morava River. According to data from 2019 the total length of the South Morava River is 235.5. Its river valley has composite feature in south to north direction, which indicate appearance of several gorges and valleys. The South Morava River Basin covers an area of 15,469 km2, with smaller parts in the territories of Bulgaria and Northern Macedonia [15], [16].

On the South Morava River six active hydrological stations has been registered. On each of them, the most important hydrological parameters are measured. For the analysis of the mean and seasonal discharge variations, data from four active hydrological stations were used, for which empirical data for a 75-year period (1946-2020) exists. Data were obtained from the Hydrological Yearbooks of RHSS [17] for the following stations: Mojsinje (1), Kurvingrad (2), Grdelica (3), and Vladičin Han (4) (Fig. 1). The first two stations are located in the lower course of the South Morava River, downstream (Mojsinje – 16.4 river km) and upstream (Kurvingrad – 105.7 rkm) from the confluence of its largest right tributary Nišava River, while the other two are located in the middle course (Grdelica – 155 rkm, Vladičin Han – 187.6 rkm).

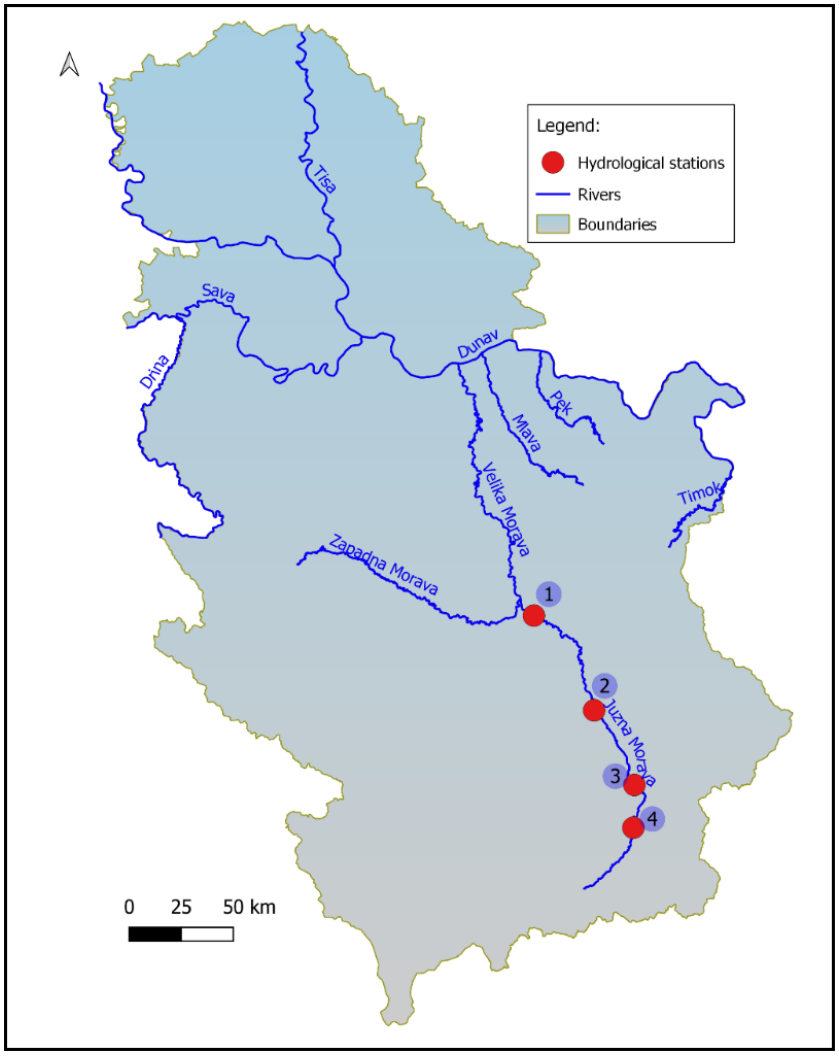

Figure 1. Geographical position of the South Morava River and four hydrological stations in Serbia

Methodology

Numerous techniques and methods have been used in academic literature in order to determine the trend changes of hydrological parameters and the occurrence of cycles of a certain discharge. For the purpose of this article, several statistical and quantitative methods, processed in different statistical programs, were used. Before the existence of certain discharge repetition was determined, trends of river discharges were analyzed by using Mann-Kendall and homogeneity tests, which are applied in many meteorological and hydrological analyzes [18], [19], [20], [16], [21].

Autocorrelation is a statistical method also known as "serial correlation". This technique is important in procedures of observing the repetition of a part of a data series (time series) with a certain time lag. One sequence correlates with itself, so that in each subsequent step, it is shifted by one time lag. The autocorrelation function is symmetric about zero [22]. Dominant "zero" autocorrelation means coincidence in time series data - while periodicities are observed if there are pronounced peaks. The aim of applied autocorrelation is to show whether there is a stationary or seasonal value of the indicator in the time series [23].

Spectral analysis encompasses many useful methods based on Fourier time series analysis. The analysis is useful in examining data within time series, and therefore can be

applied in various hydrological research as well as in the fields of paleogeography, climatology, meteorology, oceanology, geophysics, etc. [7]. Many authors used this procedure for many decades, but Kite [24] who analyzed the temporal sequence of water levels and river discharges, examined linear trends, periodicities, autoregression, and possible correlation with climate variability, and Lall & Mann [25] who investigated changes of the Great Salt Lake water level [26] can be considered as pioneers in using mentioned technique in the hydrological research. The main goal of spectral analysis is to transform the time domain (time series of data) into a frequency domain. It can be described as the decomposition of a time series into sinusoids (sine waves) of different amplitudes, phases and periods [27]. By summing all these sinusoids, initial time series would be obtained. Walega et al. [28] state that the significance of spectral analysis is that it "breaks" a complex time series (consisting of cyclic elements) into several basic functional sinusoids with specific wavelengths. Use of spectral analysis could enable describing the frequencies of time series and observing the presence of high frequency variations and cyclicity. The ultimate goal of the analysis is to assess the strength of the periodic component of all possible frequencies

RESULTS AND DISCUSSION

Determination of the existence of a certain trend in time series provide an adequate basis for identification of the cyclical repetition of a period with similar discharges. The non-parametric Mann-Kendall test was used to identify the trend of mean annual and seasonal discharge. Out of four investigated hydrological stations of the South Morava River, the decreasing trend of average annual discharge was recorded at 100% of the analyzed profiles. A decreasing trend that is not statistically significant was observed in 75% of profiles (3 stations). The other 25%, i.e., one station, is characterized by a statistically significant decreasing trend. The test results indicated that at the level of mean annual values, the discharge has a dominant decreasing trend, which is in correlation with most rivers in Serbia [19]. The average reduction rate varies from 0.014 m3/s/year on the Grdelica HS, to 0.14 m3/s/year on the Kurvingrad HS. On the Mojsinje HS, the level of significance is 0.1, which indicates existence of moderate significant decreasing trend (Z = 1.73) (Tab. 1).

Analyze of the seasonal trend of discharge values showed certain differences in the characteristics of the observed trend. However, a common feature for all seasonal trends is that there are no significant changes in the values. The main characteristic of winter seasonal discharges is decreasing trend (from -0.59 on the most upstream station of Vladičin Han, to -1.45 on the most downstream station of Mojsinje) in the limit of significance. In spring, seasonal discharges indicated certain differences depending on the profile - decreasing trend on the downstream profiles of Mojsinje and Kurvingrad (average -0.022 m3/s/year), and increasing trend on the upstream profiles of Grdelica and Vladičin Han (average 0.09 m3/s/year). On three HS in the period 1946-2020 a decreasing trend was recorded in summer season with an average value of -0.52 m3/s. A stagnant or mildly increasing trend on the largest number of profiles was noticed during the autumn (HS Kurvingrad, Z = 0.32).

Table 1. The results of the MK and homogeneity test for the period 1946-2020

HS	Period	Qsr (m^3/s)	Z	α	Year of change
Mojsinje	Spring	162.9	-0.87	-	1988
	Summer	55.59	-0.82	-	1983
	Autumn	39.06	0.05	-	1971
	Winter	107.7	-1.45	-	1981
	Annual	91.69	-1.73	+	1981
Kurvingrad	Spring	99.28	-0.51	-	1982
	Summer	32.53	-0.53	-	1983
	Autumn	23.93	0.32	-	1969
	Winter	59.78	-1.51	-	1981
	Annual	55.85	-1.45	-	1984
Grdelica	Spring	41.91	0.28	-	1953
	Summer	14.13	0.88	-	1963
	Autumn	11.98	0.03	-	1969
	Winter	30.72	-1.02	-	1986
	Annual	24.69	-0.28	-	1984
Vladičin Han	Spring	31.29	0.23	-	1953
	Summer	10.55	-0.22	-	1983
	Autumn	9.45	-0.31	-	1981
	Winter	24.21	-0.59	-	1984
	Annual	18.87	-0.44	-	1984

+ - significance of 0.1; - significance higher than 0.1 i.e., does not indicate any significance in this parameter change

Results of homogeneity test showed that, in the period of 75 years, an all stations a point of change of annual discharge occurred in the period 1981-1986 (Tab. 1) (on HS Mojsinje, from 103.95 m3/s before year of 1981 to 80.7 m3/s after). When it comes to the seasonal discharges, certain disparities regarding the point of change can be observed. Winter discharges are completely coincided with the period determined by annual values. The biggest differences regarding the point of change of seasonal discharges can be noted on the HS Grdelica, where slightly increasing trend was registered, mostly after the 1950s and 1960s (spring, summer and autumn).

The statistical method of autocorrelation was applied by using the same input data on four representative hydrological stations of the South Morava River. In Fig. 2 value of the correlation coefficient for the discharge data and their dynamics in the domain of the 95% confidence interval (black line) are presented (the value of the autocorrelation coefficient is 0.25). The deviation of the correlation value from the mentioned interval indicates that the coefficients are statistically significant, i.e., that the sequence with a certain shift (lag) correlate well with itself. In that case, the base for determination of the possible occurrence of cyclicality i.e., repeatability of a time series after a certain period, can be recorded.

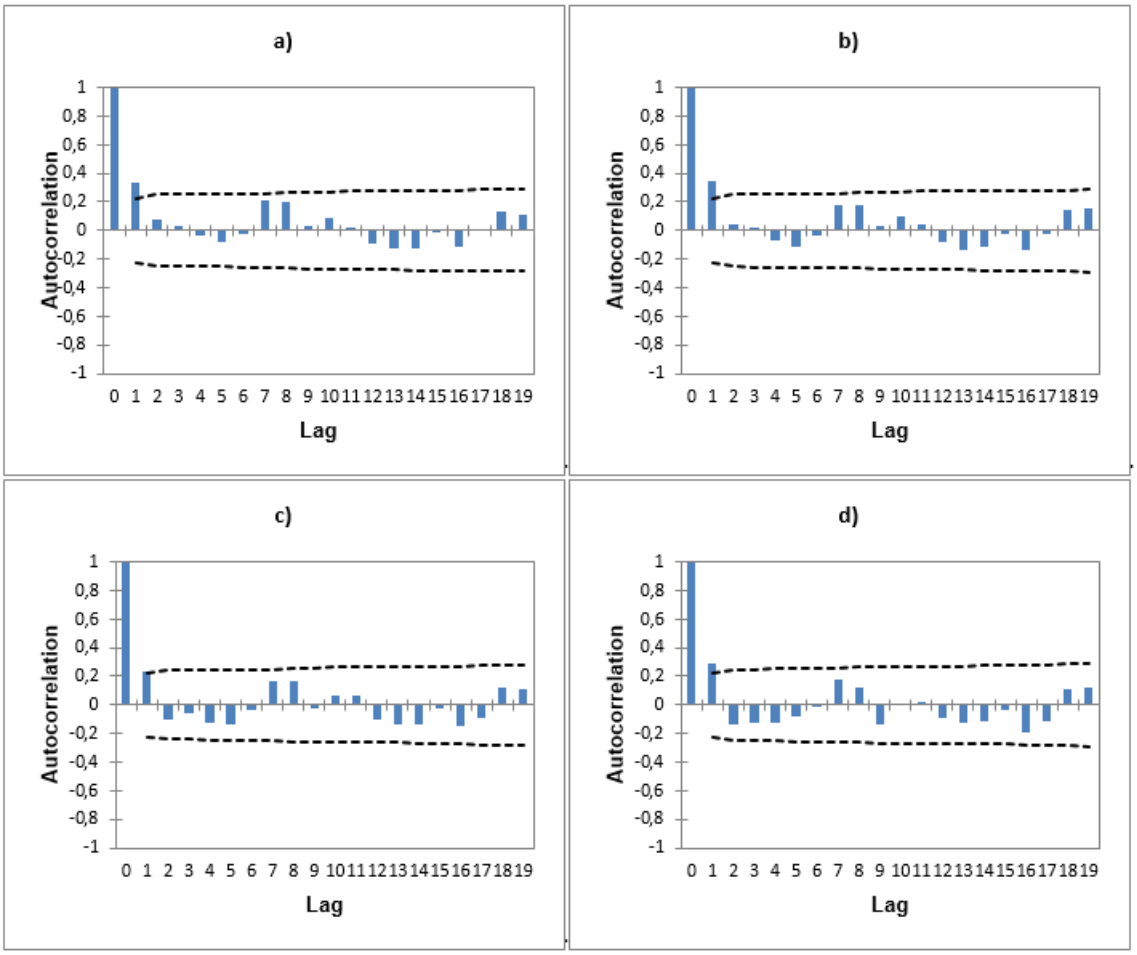

Figure 2. Autocorrelation of mean annual discharge values for the period 1946-2020 - a) Mojsinje, b) Kurvingrad, c) Grdelica, d) Vladičin Han

The graphs presented in Fig. 2 shows that none of significant autocorrelation between the data of mean annual discharge values was registered. Accordingly, obtained results can be described as random and mutually independent. It is also possible to determine the indications of a certain cyclicity within the analyzed sequence, which will be more relevant explained by using another method. Taking into account the fact that the period by definition starts with value 1, it can be noted that almost the entire autocorrelation is within the 95% confidence interval. On the stations of Mojsinje and Kurvingrad, it can be observed obvious pattern that the first 38-year period is characterized by an almost positive correlation, and the second period by an almost negative one. On the other two profiles, it is noticed the dominance of a negative correlation or one that has a value close to zero. Based on these findings it can be concluded that isn't possible to identify further dynamics of the values of indicator, i.e., adjacent observations (periods) do not "cooperate", so this case is called the case of "no autocorrelation".

However, it can be evidenced the existence of two peaks (marked with 7.5 and 8) on the HS Mojsinje (Fig. 2a) statistically close to defined confidence interval. Nevertheless, the obtained situation does not imply that there is a dependency of data in a time series. For a defined 95% confidence interval, it can be expected that about 1/20 of the period be statistically significant due to random fluctuations. In order to reject the suspicion of the existence of random fluctuations in the observed series of data, in Fig. 3 correlograms of seasonal discharges on the HS Mojsinje are presented. The results on the graphs lead to

conclusion that a deviation from the confidence interval exists on the autumn water discharges (value of 0.281, at lag 17) which represents "mildly significant autocorrelation". The types of autocorrelation charts presented on the Fig. 3 are called sinusoidal autocorrelation models.

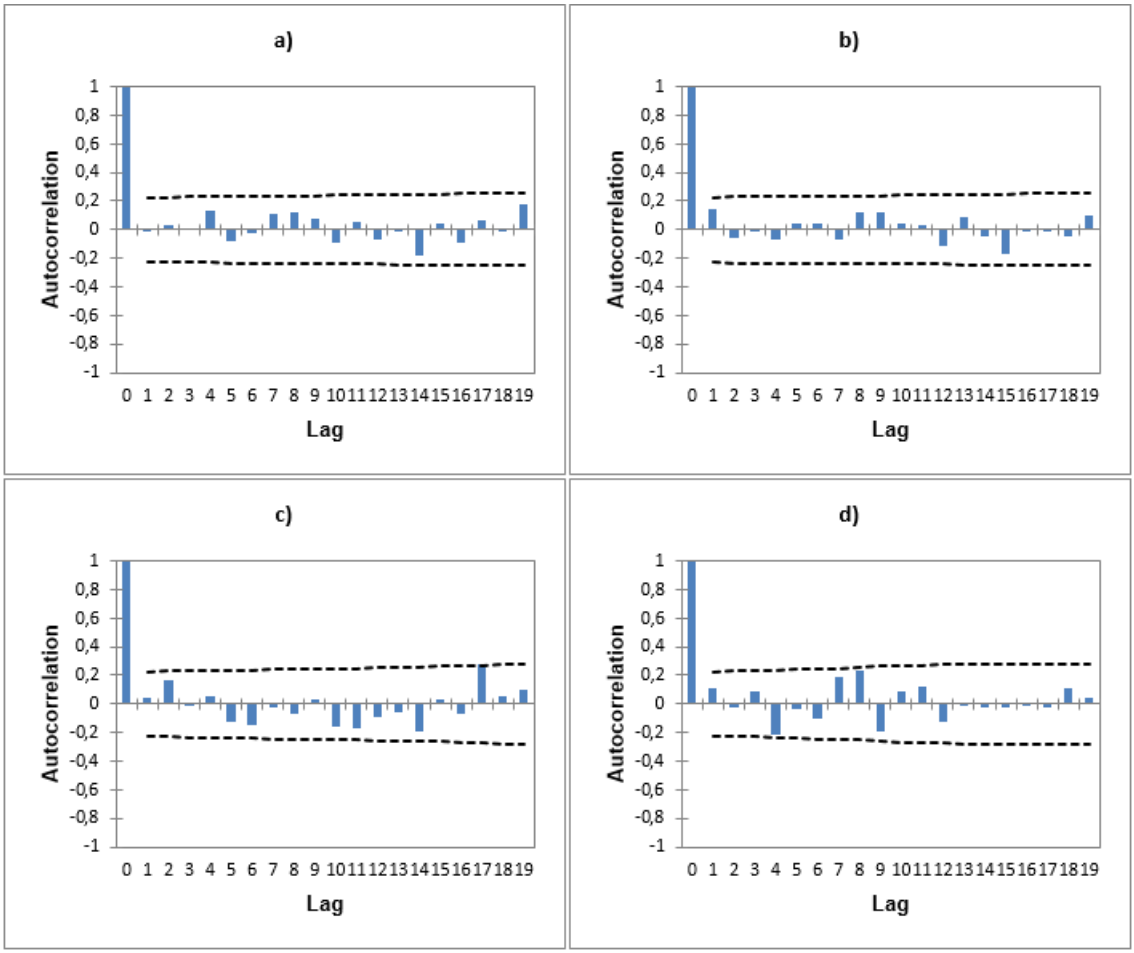

Figure 3. Autocorrelation of seasonal discharge values for the period 1946-2020 on the Mojsinje HS - a) spring, b) summer, c) autumn, d) winter.

The idea of using spectral analysis in hydrological research is based on the possibilities that procedure offers, primarily the ability to identify cycles in a particular time series. Data of the annual and seasonal discharges were used again for the spectral analysis. The graphical results of the spectral analysis are shown in Fig. 4, i.e., on four spectrograms. At all examined stations, the frequency (F) ranges from 0.01 to 0.5, which corresponds to periods from 2 to 100 years (1/F). There was no need to analyze frequencies higher than 0.5, because maximums are not expected in that frequency range, i.e., the occurrence of periodicity is not expected.

Several distinct peaks are clearly visible on all spectrograms on Fig. 4 – one or two primary and several secondary. On the Mojsinje HS (Fig. 4a), the dominant peak has the frequency of 0.097 which responds to a periodicity of 10.2 years. The next peak is distinguished by frequency of 0.27 which corresponds to a periodicity of 3.67 years. The third peak (frequency of 0.11) will repeat its maximum every nine years. In the rest of the observed spectrum, the dominant peaks are not noticeable. The results of spectral analysis indicate repeatability trend of the maximum value of the mean annual discharge

approximately every 10 years, while the other regularities of repeatability are of secondary importance. Similar results were recorded on the upstream profile of Kurvingrad (Fig. 4b). A certain difference was noticed on the last two profiles. On the Grdelica HS (Fig. 4c) two maximum peaks (power = >5), frequencies of 0.117 and 0.27 and periodicity of 8.5 and 7.1 years and two secondary peaks with a repetition of 11,1 and 6 year were recorded. The most downstream profile of Vladičin Han (Fig 4d) is characterized by two distinct peaks - one primary with a frequency of 0.28 (3.5 years) and secondary with 0.15 (6.6 years).

Low frequencies visible on presented graphs are known as "a harmonic spectrum" and are characterized by large periods of oscillation that affect the change of perennial discharge values. Group of significant low-frequency spectrum harmonics constitutes a macro-periodic component. This means that the set of continuous lower discharge values can be repeated cyclically for a certain period of time. By analyzing Fig. 4c (HS Grdelica), one can observe a whole series of low-frequency oscillations that are repeated three times over the observed time period of 75 years.

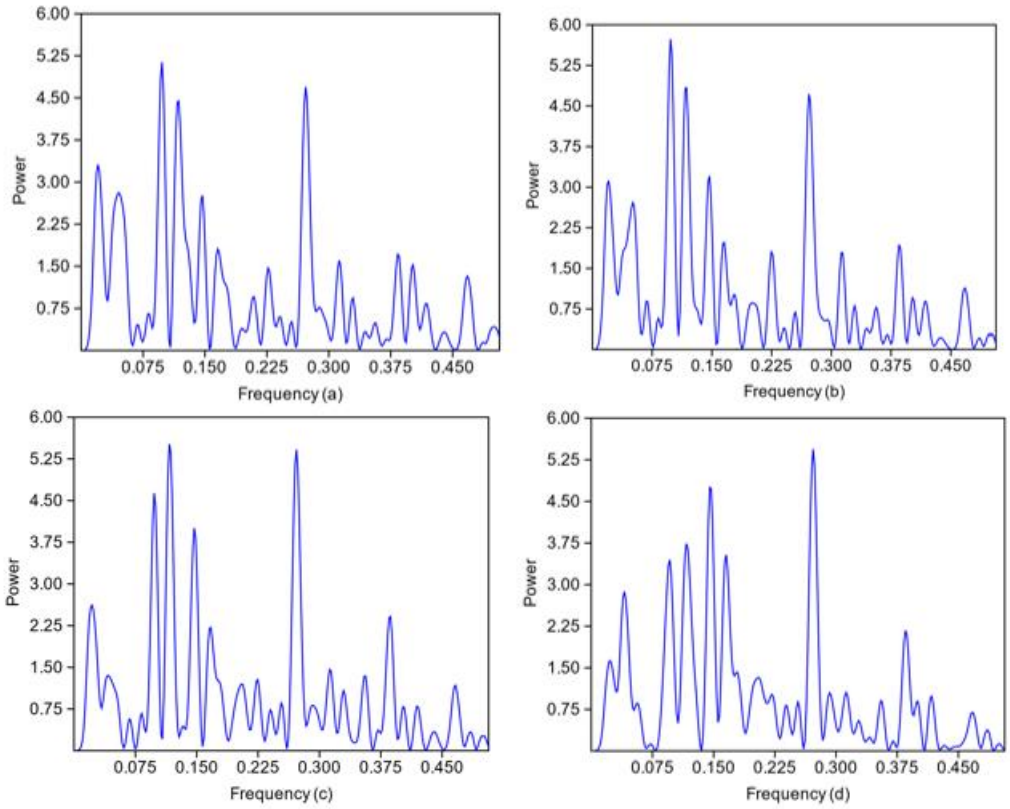

Figure. 4. Spectrograms of mean annual discharges for the period 1946-2020 - a) Mojsinje, b) Kurvingrad c) Grdelica, d)Vladičin Han

Four spectrograms of seasonal discharges of the representative HS Mojsinje, are presented on Fig 5, and by analyzing them certain regularities can be distinguished. During the warmer period of the year (Fig 5a,b), one dominant (frequency 0.458 and periodicity of 2.1 years in spring, i.e. frequencies 0.221 and periodicity of 4.5 years in summer) and one secondary peak can be distinguished. Winter discharges (Fig. 5d) are specified by one maximum peak, frequency 0.27 and periodicity of 3.6 years, as well as two secondary peaks of similar power. Based on the performed spectral analysis of autumn discharges, the existence of two peaks of similar power (3.5), frequencies of 0.04

(25 years) and 0.09 (11 years) can be noticed. By comparing the obtained spectrograms, it can be concluded that the occurrence of discharges of a certain value is uneven during the investigated period, while in the autumn and winter, regularities or cycles of higher or lower river discharges that change properly can be distinguished (especially during winter).

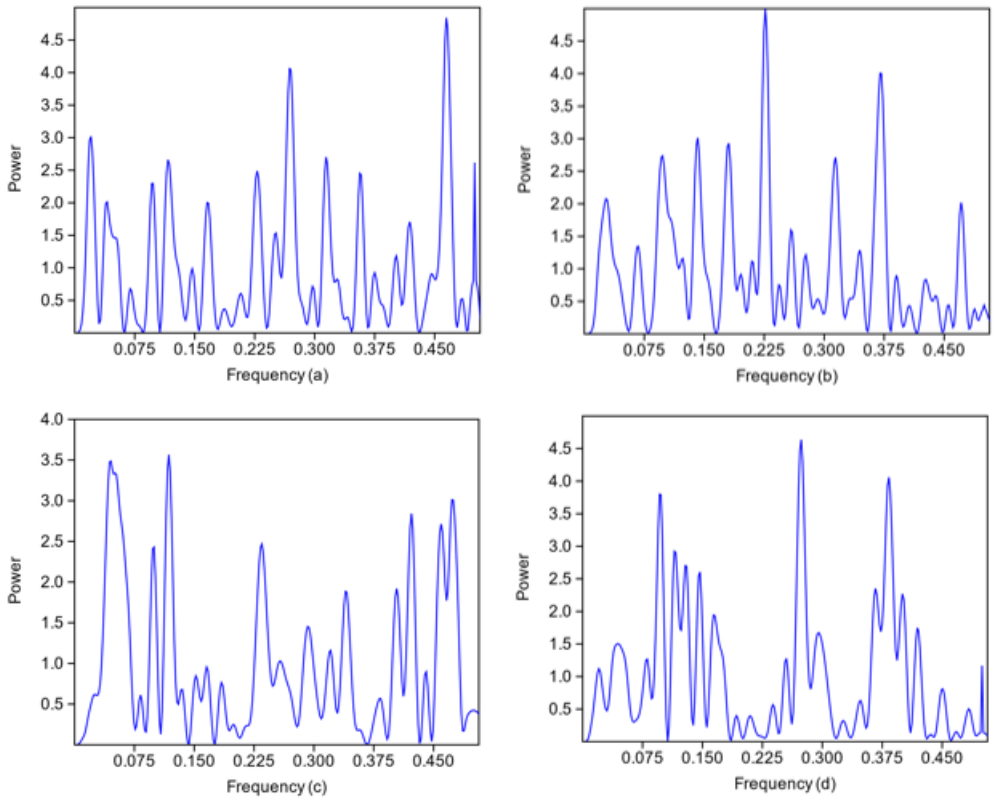

Figure. 5. Spectrograms of seasonal discharges for the period 1946-2020 on the Mojsinje HS - a) spring, b) summer c) autumn, d) winter.

The results of all the applied statistical procedures enabled comprehensively understanding of studied topic. Given that the only significant decreasing trend was registered at the Mojsinje station, as well as indications of the cyclicality occurrence, this station can be emphasized as representative for further discussion. The primary hypothesis indicates that the changes of river discharges on the Mojsinje HS are conditioned by changes in the amount of precipitation, as well as changes of the discharge values of the largest tributary of South Morava River (Nišava River).

Detailed examination has indicated that a significant decreasing change in river discharges on the Mojsinje HS in the period 1946-2020 occurred during the middle of the observed interval, i.e., within the second third of the 75-year period (1971-1996). In that time sequence, a pronounced significant decreasing trend in the discharge values was recorded (MK test results, Z = - 3.71, at the level of significance 0.001). In accordance with the formulated hypothesis, changes in the amount of precipitation were singled out as a main factor. Consequently, MK test was conducted over the precipitation amount data for the period 1971-1996 (required data were obtained from Meteorological Yearbook of HRSS [29] for nearest meteorological station of Aleksinac). The study shows existence of a decreasing trend (Z= - 0.86). For further explanation regression analysis (with independent variable - precipitation and dependent variable - annual

discharge) was used. It reveals occurrence of strong dependence because regression coefficient had value 0.71. Finally, the use of spectral analysis and autocorrelation (average annual discharge and precipitation – 1971-1996) confirmed the important influence of precipitation variations on changes in river regimes. Comparative analysis of auto-correlograms (Fig. 6) pointed out that both variables range in the 95% confidence interval, as well as those certain regularities can be identified i.e., that negative changes in precipitation are accompanied by negative changes in discharge. The intensity and dynamic of these changes are not equal in the observed period, which implies that other factors have a special impact on discharge modifications, especially due to geographical position of the HS Mojsinje (most downstream station on the South Morava River and most affected by different anthropogenic activities). The results of spectral analysis revealed the occurrence of a periodicity (13.1 years) of the highest values of annual precipitation and discharge, but unlike the precipitation spectrum, several other smaller peaks clearly stand out in the discharge spectrum. Secondary peaks that are not proportional are greatly influenced by other physical-geographical and especially anthropogenic factors (accumulation construction in the South Morava River Basin, river regulations, water use, etc.).

In accordance with the achieved decreasing trend of discharge values on the Mojsinje HS, are the results obtained by other researchers [30], [16]. Langović [16] determined occurrence of decreasing trend at three HS on the Nišava River and its tributaries Temska and Jerma (pronounced and moderate significancy). Such dynamic of discharges in the last 50 years in the Nisava River Basin inevitably stands out as an important factor of regime variations of the downstream part of the South Morava River, given that Nišava River annually provides amount of 27.3 m3/s of water to South Morava (33% of the mean annual discharge at the Mojsinje HS).

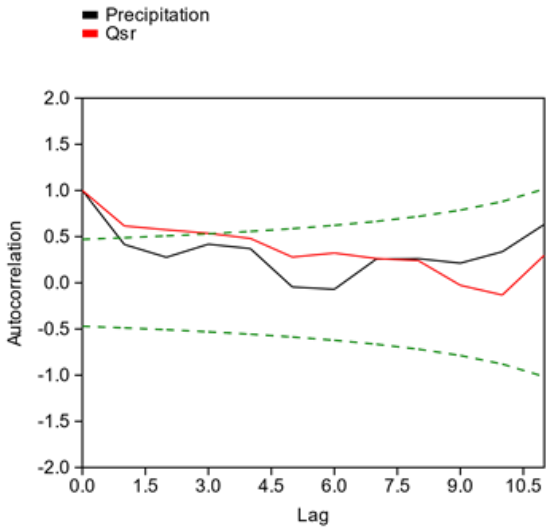

Figure. 6. Comparative autocorrelation of mean annual discharge values and precipitation for the period 1971-1996

CONCLUSION

The possibilities of using statistical programs, techniques and procedures in hydrological research are significant. Considering the current interests of hydrological studies, in addition to the quantification of hydrological phenomena and the use of mathematical and statistical methods to determine the state and prospects of their further development, it is

necessary to use the results in an applicable way. The study of changes in the series of hydrological data in longer time series, and the observation of trends are significant for understanding the river regimes. Using non-parametric tests, it was determined that all stations are characterized by a slightly decreasing trend of discharges, which is in accordance with most rivers in southern Serbia (only on the HS Mojsinje with significance for the period 1946-2020). Based on the applied spectral analysis and autocorrelation, the time (periodicity) of the occurrence of certain discharges was noted. The most downstream HS Mojsinje was singled out and its data were specially analyzed due to occurrence of autumn discharge autocreation. Finally, the analysis of causes that led to the specific river discharge variations of the South Morava River was performed, corelating it to the precipitation factor. Changes of river discharges are proportional to variations in the amount of precipitation, which is proven by calculated regression coefficient (0.71) and determined autocorrelation, but based on results of spectral analysis, the influence of other factors, primarily anthropogenic, is also emphasized.
According to the findings, it can be concluded that the knowledge of variations of annual and seasonal discharge is important as it demonstrates the state of river regimes. The obtained data can serve as a relevant basis for further scientific research in context of detailed investigation of relations between variations in discharge and the dynamics of other physical-geographical processes characterized for the South Morava River Basin (riverbank erosion, soil erosion, torrents etc.). The length of the series of empirical data of 75 years corresponds approximately to the duration of mostly two cycles, which is relatively small for obtaining a more reliable regularities of repetition. Therefore, in the future, it is necessary to repeat the entire procedure after fulfilling the next period norm of 80 years. Also, future research must include a statistical analysis of changes in extreme values and daily discharges.

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ADOPTION OF ENVIRONMENTAL CITIZENSHIP CONCEPT AMONGST UNIVERSITY STUDENTS IN CROATIA: THE EXAMPLES OF TOURISM AND TRANSPORTATION

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ABSTRACT

Environmental Citizenship is one of the leading concepts of pro-environmental actions and awareness of people in their daily lives, as well as among stakeholders who directly or indirectly deal with the environment. This concept is new in Croatia, although some postulates have been included in some school and university courses.
The main aim of this research was to investigate if Environmental Citizenship has been adopted among students of the main scientific disciplines who will make environmental decisions in the future at the local, regional and national levels, and whether future generations of students will be educated to become environmental citizens. Special attention is given to tourism and transportation as part of daily life, which have high demands on natural resources and serious environmental impacts. The main objectives were to explore the perceived environmental impacts of tourism and transportation, personal choices in tourism and transportation related to the environment, and willingness to change tourism and transportation options for the benefit of the environment.
The research was conducted using a quantitative method. The data were obtained through a questionnaire survey of 167 students of Geography and Environmental Science courses at the University of Zagreb. Data analysis showed that students have high perception of environmental problems and impacts of tourism and transportation. However, they showed indifferent or low awareness of current practices in tourism and transportation. They also showed little willingness to change their behavior in the future.

Keywords: Environmental Citizenship, geography, environmental science, transportation, tourism.

INTRODUCTION

Nowadays environmental problems are globally and locally outspreaded. At the global level, the world is facing with problems such as climate change, pollution problems, desertification, just to name a few. At the local level, environmental problems are present such as habitat loss, huge urban sprawl, problems with waste, and overconsumption of space. Considering the emergency of the environmental problems, it is necessary to develop a more sustainable and environmentally aware society which will achieve positive outcomes for the environment and will prevent the creation of new environmental problems. Such society should transform their values, beliefs, attitudes and behavior of individuals who see themselves as part of the global environmental politic [1], [2]. One of such developed possibility is a concept of Environmental Citizenship.

According to [2] "Environmental Citizenship is defined as the responsible pro-environmental behavior of citizens who act and participate in society as agents of change in the private and public sphere on a local, national and global scale, through individual and collective actions in the direction of solving contemporary environmental problems, preventing the creation of new environmental problems, achieving sustainability and developing a healthy relationship with nature. Environmental Citizenship includes the practice of environmental rights and duties, as well as the identification of the underlying structural causes of environmental degradation and environmental problems and the development of the willingness and the competences for critical and active engagement and civic participation to address those structural causes and to act individually and collectively within democratic means, taking into account inter- and intra-generational justice." It is obvious that Environmental Citizenship is related to pro-environmental public and private behavior of citizens driven by a belief in fairness of the distribution of environmental goods, in active participation and in the co-creation of sustainability policy [3], [4]. Environmental Citizenship is an important element in transition to sustainability where different citizenry is needed to achieve positive outcomes for the environment by way of personal lifestyle changes and/or citizen participation in environmental decision-making which will result in environmentally friendly actions [5], [6]. Educating individuals and communities to become Environmental Citizens is one of the challenges of our time if we want to achieve sustainable growth and preserve our natural environments [7].

Tourism and transportation are activities with markedly and visible impact on space. They have high demand for natural resources and severe environmental impacts. Although transportation could be considered as one of the fundamental life functions which connects people and areas, the impact of transportation on the environment is significant. Amongst many other impacts, transportation is one of the most abundant energy and petroleum consumers and the fastest-growing contributor to air pollution through carbon dioxide emissions, thus becoming a significant contributor to global warming [8], [9]. On the other hand, although tourism could be considered as a "clean" human activity, environmental degradation in tourism regions soon threatened tourism itself by damaging the main attraction basis [9]. Excessive growth in tourism, encouraged by its economic benefits for hosts, particularly in mass forms of tourism, very often causes high pressure on destination areas and negative impacts both on local communities and guests, within a phenomenon commonly known as overtourism [10]. The extent of tourism impacts in those areas exceeded its negative environmental impacts and becomes a social problem as well, which can be resolved only by quality tourism planning and change in behavior, attitudes and actions of both hosts and guests [11].

Youth are growing up and living in a world of prominent environmental problems resulting from the declining state of the environment, which is intensifying economic and social problems [12]. These environmental issues are interrelated and interdependent and overarch the natural and social realms [13]. Youth should be considered as key agents of Environmental Citizenship and future environmental restoration.

In line with all mentioned above, the object of this paper is a research of tourism and transportation choices within interrelated context and their perceived environmental impact based on faculty students. The main aims of the paper are to investigate: a) perceived environmental impacts of tourism and transportation, b) level of environmental awareness relevant to tourism and transportation, c) personal choices in tourism and

transportation related to environment, d) willingness to change tourism and transportation options for the benefit of the environment.

RESEARCH METHODS

The results of this research were obtained using a questionnaire survey on environmental awareness and Environmental Citizenship in tourism and transport. The survey targeted students of geography and environmental science, as future educators in school and stakeholders in the field of spatial planning, economic development and environmental protection. Therefore, the survey included occasional sample 167 students of the University of Zagreb, Faculty of Science, Department of Geography, representing 30% of all students of studies related to geography and environmental science at the Faculty. The survey was performed online in October 2019 using the web service Survey Monkey. To achieve reliability of the questionnaire and measurability of the scale, during the preparation of the research various references were consulted. Environmental awareness among students coming from the United States to Australia and New Zealand for fieldwork and experimental learning were examined by [14]. Complex research on environmental behavior at three educational faculties in Israel were performed by [15] where they emphasized the role of teachers in environmental education and sustainable development and defined environmental literacy approach. Research on online education about environment and environmental behavior and awareness were performed by [16]. Topic about recycling and waste were examined by [17], while the relationship between knowledge about environment, environmental behavior, values and actions were investigated by [18].

The questionnaire consisted of mostly forced-choice using multiple-choice answers and statements with the Likert scale, and only few were open-ended. Questions were divided into four sections: (1) sociodemographic information on respondents, (2) environmental knowledge and awareness, (3) environmental awareness in tourism and (4) environmental awareness in transportation. This paper included results of analysis of all sections, in order to get an insight into environmental awareness and behaviour when travelling.

For the purposes of this paper, responses were analysed using the descriptive statistics method in MS Excel. Multiple-choice responses were presented as proportions, while Likert scale questions were analysed as average grades of coded answers and, when necessary, as shares of different categories in the whole sample. Responses in open-ended questions were presented as proportions of the total number of responses or, were included in the original extent to explain respondents' statements. In open-ended questions in which respondents gave more than one answer (e.g. impacts of travelling); all listed responses were included into analysis.

SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

The sample of 167 respondents that participated in research consisted of 55.7% female and 44.3% male students. As the sample specifically targeted students, the research included persons in age 18-42, out of which 93.4% were aged 18-24, 6.0% were aged 25-29, while only one person was above 30. Average age of respondents was 21.5 and median age 22 years. The sample reflects the general structure of students by enrolled courses at the Department of Geography. During the research, 67.1% of participants studied the research course in Geography, 3.6% studied teaching course of Geography and History, 11.0% were in the graduate teaching course of Geography and 18.2% studied

Environmental Science. 17.4% were studied first year, 24.0% studied second, 11.4% studied third, 25.8% studied fourth (or first graduate year) and 21.6% were studied fifth year (or second graduate).

In order to investigate if the area of living had an impact on environmental awareness, respondents were asked to list the place in which they had spent their childhood and the place of living during the study. As it was expected, 96.4% respondents were from Croatia and only 3.0% came from abroad (4 from Bosnia and Herzegovina and 1 from Germany), while 1 did not specify. Out of the total number of respondents from Croatia, 28.6% have always lived in Zagreb, only Croatian city with more than 200,000 inhabitants; 3.1% came from cities with a population 100,000 – 200,000 (Split and Rijeka); 19.3% from mid-size Croatian cities (20,000 – 100,000), while 23.0% came from small towns with a population under 20,000 and 26.1% from rural areas. With 73.9% from urban or urbanized areas, the sample of respondents was above the Croatian degree of urbanization (57% in 2019) [19]. Observed by the regional structure, two-thirds (66.5%) came from the most populated Central Croatia or Zagreb Macro Region, 14.9% were from East Croatia, 8.1% from the Northern Croatian Littoral, 9.9% from Dalmatia, while only 1 person was from the Dinaric Croatia. Lower share of respondents from the Littoral Croatia reflects the general structure of students at the Department of Geography, as these regions gravitate to studies of geography at the University of Zadar. However, due to everyday tasks related to studying, most students that had resided in areas outside a 1-1.5 hours travelling to the university have moved to Zagreb and got used to living in a city. Therefore, 84.4% stays in Zagreb most of the week, 11.4% resides in the Zagreb Urban Agglomeration, and only 4.2% remained outside, mostly within 2 hours drive from the centre of Zagreb.

As environmental awareness is adopted in great part at home and from parents through earlier education, respondents gave information about the level of education of their parents, in order to determine if it had an impact on respondents' attitudes and behaviour towards the environment. Out of all acquired information, 3.9% of respondents' parents had only elementary school, 57.1% had high school, 26.9% university education (pre-graduate and graduate), and 12.1% a postgraduate study. With 39.0% with a university diploma, it turned out to be above the Croatian average.

ENVIRONMENTAL AWARENESS

The first part of the analysis focuses on the environmental awareness of the respondents. They had to assess how they perceive it, indicate where they acquired it, express their attitude towards the environment and climate change, and name the most important environmental problems. In the first two questions of this section, respondents had to rate the extent to which they consider themselves to be environmentally aware individuals and environmental citizens using a Likert scale of 1-5 (Fig. 1). They then had to choose the statement that best described them. Based on this statement, the respondents were placed in one of the categories according to [20] (Tab. 1).

A large majority (84%) believe they are environmentally aware individuals with an average grade of 3.9. Self-perception as environmental citizens was slightly lower, but still high, with an average of 3.7 and 69% positive responses. The discrepancy between these responses can be explained by the stricter definition of environmental citizenship, which includes actions for the environment, and the fact that many respondents may not have been familiar with the concept of environmental citizenship.

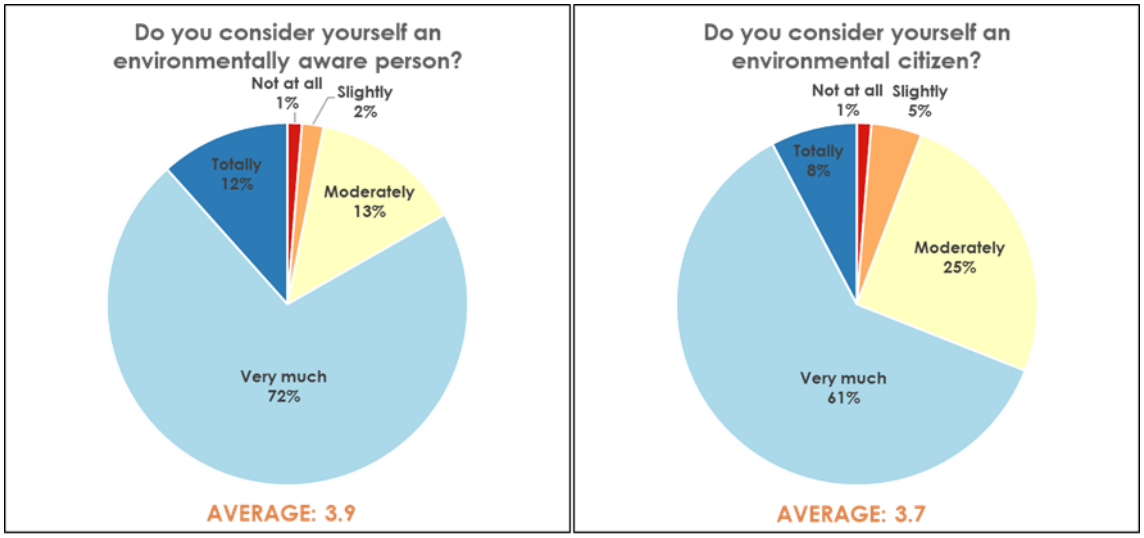

Figure 1. Perception of respondents as environmentally aware persons and environmental citizens

In reality, only one third of respondents are willing to do more for the environment. According to the classification of [20] these are wastage focused (32.9%) and green activists (1.9%) (Tab. 1). The other two-thirds admit that they do not do as much for the environment as they could – 40.7% of respondents think they give their current maximum for the environment because they are constrained by other factors (*long-term restricted and currently constrained), 16.1% do not do more because they think they cannot change much (basic contributors), while 7.1% are satisfied with their lifestyle and do not plan to change it for the benefit of the environment (consumers with conscience*). Despite the low percentage of the disinterested (1.6%), this shows that even among geography and environmental science students there are still people who are not at all aware (or ignorant) of environmental problems.

Table 1. Environmental segments of the respondents according to their attitudes towards the environmen

CATEGORIES	**STATEMENT (DESCRIPTION)**	**SHARE** (%)
Disinterested	I don't do anything for the environment and I don't see a reason to start.	1.3
Basic contributor	I do my small bit for the environment but I think people like me can't change a lot.	16.1
Long-term restricted	I do my bit for the environment but I can't do more because there are so many things I have to think about.	20.0
Currently constrained	I do as much as I can for the environment and I will do more as soon as I have more time and money.	20.7
Consumer with conscience	I do as much as I can for the environment but I don't plan to make great changes in my lifestyle for the environment.	7.1
Wastage focused	I do as much as I can to use resources carefully because I don't like waste.	32.9
Green activist	I do everything I can for the environment, even if it means I have to expose myself.	1.9

Note: categories and statements used the methodology of [20]

The discrepancy between the self-perception of environmental awareness and citizenship and the types analysed shows that there is a lack of knowledge on environmental citizenship, that environmental awareness is not sufficiently translated into action, and

that respondents overestimate themselves (they think they are better than they actually act).

Family and social background are still more important in raising environmental awareness (50%) than education (34%) (Fig. 2). One third of the respondents believe that they acquired their environmental awareness at home and 17% in the community where they grew up. The lower share of education shows that there is a real need for formal Education for Environmental Citizenship or at least some kind of environmental education in primary and/or secondary education. Schools in Croatia currently offer only one cross-curricular theme of sustainable development, which is taught in geography, biology and many other subjects. However, as this is a relatively new curriculum in Croatia, it remains to be seen how it will affect the generations currently in the education system.

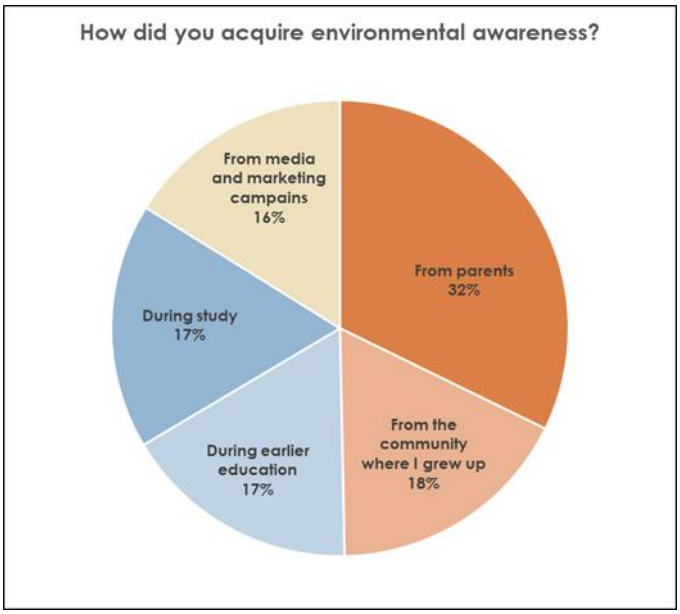

Figure 2. Background of environmental awareness of students

To explore perceptions of environmental issues, respondents were asked to list the environmental issue they found most important (Tab. 2). As some respondents gave multiple answers, all answers were included in the analysis and presented as proportions in total. The analysis showed that the three most important environmental problems are waste (44.1% of all responses), pollution (of air, water and in general) (23.5%) and emission of greenhouse gases and climate change (17.6%). Within the general waste problem, 13.0% of the responses mentioned plastic as the most important environmental problem, while other responses included large amounts of waste, improper waste disposal, throwing waste into the oceans, etc. All other environmental problems are perceived as less serious than those mentioned above - deforestation (5.9%), water use (1.8%) and loss of habitat and biodiversity (1.8%). It must be emphasized that respondents were able to choose up more options, so the number of the responses exceeds 167.

Table 2. The most important environmental issues according to respondents' responses

ISSUE	NUMBER OF RESPONSES	SHARE (%)
Waste	75	44.1
Pollution	40	23.5
GHG emission and climate change	30	17.6
Unsustainable energy sources	4	2.4
Water use	3	1.8
Deforestation	10	5.9
Loss of habitats and biodiversity	3	1.8
Other	5	2.9
Total	**170**	**100.0**

Perceptions of greenhouse gases and climate change were additionally examined in a forced-choice question in which respondents had to choose what they thought caused this problem. A large majority (85.8%) consider climate change to be the result of a combination of natural forces (part of the cyclical climate change in nature) and human activities (increase in greenhouse gases); 11.6% see it solely as a function of human activities, while only 2.6% think it is determined only by natural forces. These results were to be expected as the survey included a sample of well-informed people who were taught about climate as part of their university studies.

TRAVELLING HABITS

This chapter analyses the respondents' travel habits, the number of trips they made in the 12 months preceding the survey, the destination and the type of trip. As the survey took place before the outbreak of the COVID-19 pandemic, the results represent pre-pandemic travel habits and attitudes.

The results show a fairly high level of student mobility; 71.4% made three or more trips in the year prior to the survey, while 35.7% made five or more trips (Fig. 3).

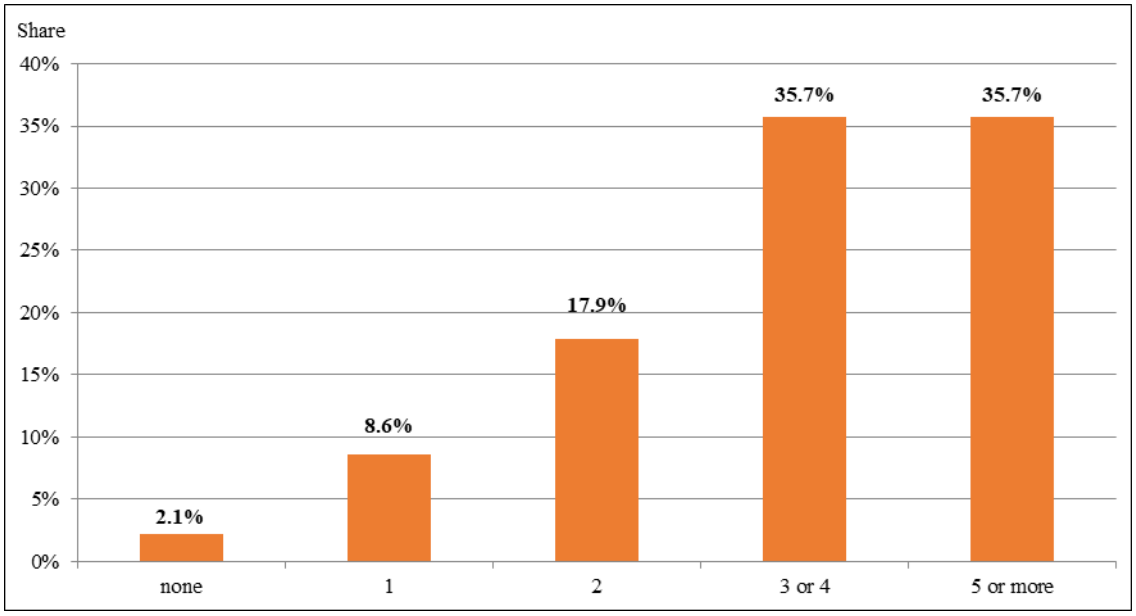

Figure 3. Number of tourist trips of respondents in recent 12 months (prior to the survey)

The higher mobility of students compared to the national average is partly related to their young age (and fewer constraints due to family commitments) and, above all, to their

great interest in travelling to visit the Earth's natural and cultural resources, which is particularly evident in their choice of courses (geography and environmental sciences). Only three of the respondents did not travel at all.
However, most of the trips were short trips, which is largely related to the limited travel budget of the respondents (students), which is also reflected in the means of travel. More than 72.1% of respondents travelled within Croatia, 25.0% travelled to neighbouring countries (Bosnia and Herzegovina, Italy, Hungary, Montenegro, Serbia, Slovenia) and 35.7% travelled to other European countries. Only three respondents travelled to countries outside Europe in the given period. It must be emphasized that respondents were asked where they had travelled most frequently during the period indicated and could choose up to two options. Therefore, the sum of the percentages exceeds 100%.
Two thirds of all trips were made by public transport – 52.1% by bus, 5.7% by train and 5.0% by plane. This confirms the previous statement about the limited budget for travel and the fact that few have or can use a private car (37.1%). The bus is the main means of public transport and is used for travel within and outside Croatia. Students also use it for travelling to some more distant destinations (e.g. Germany, Italy, Czechia, Poland) for which air travel would be more suitable. However, respondents largely avoided air travel because of the high prices, mainly because there were few low-cost airlines from Zagreb in the period before the survey. Only a few respondents use rail for their trips, as the railway in Croatia is poorly developed and not used for most tourist destinations.

PERCEPTION OF ENVIRONMENTAL IMPACTS OF TOURISM

This chapter focuses on perceptions of various aspects of travel and tourism - awareness when travelling, the main negative environmental impacts of tourism, the forms and tourist activities selected, and the extent to which respondents are willing to change their travel behaviour. Compared to self-perceived environmental awareness, respondents are less aware of the impacts of tourism - 4% answered that they are completely aware of these impacts, 44% very aware, 24% moderately aware, 22% slightly aware, while 6% are not aware at all, for an average grade of 3.2. They mentioned several main groups of impacts of their travel: (1) gas emissions (55%), (2) waste (in terms of amount of solid waste and its recycling) (20.7%), (3) pollution (7.4%), (4) resource consumption (6.3%), (5) environmental degradation (3.2%) and pressure on tourism areas (3.7%) (Tab. 3). The highest awareness of transport-related gas emissions, of which 22.1% relate specifically to greenhouse gases, may be related to the modes of transport they use most (cars and buses) and current campaigns warning people about the harmfulness of greenhouse gases to climate change, often oversimplifying the role of transport as the main polluter of the environment. It must be emphasized that respondents were able to choose up more options, so the sum of the responses exceeds 167.
Respondents' perceptions on this issue are reflected in their response to the question of which mode of transport has the highest carbon dioxide emissions per passenger – 45.0% mentioned cars, 30.7% planes, 13.6% cruise ships, 10.7% buses, while none mentioned electric trains. Although their perceptions differ from the actual data, it is evident that respondents are well aware of the carbon dioxide emissions of all fossil-fuelled modes of transport.

Table 3. The most important environmental impacts of respondents' travel

IMPACT	NUMBER OF RESPONSES	SHARE (%)
Gas emissions from transport	54	28.4
GHG emissions from transport	42	22.1
Waste issues	32	16.8
Plastic waste	7	3.7
Environmental pollution	14	7.4
Energy and fuel consumption	12	6.3
Pressure on tourism areas	7	3.7
Degradation of habitats and landscape	6	3.2
Use of natural resources	3	1.6
Noise	2	1.1
Other	11	5.8
Total	**190**	**100.0**

When respondents were asked to rate the harmfulness of each selected form of tourism and each tourism activity using Likert scale (1 - not at all; 5 - totally), they gave quite different and surprising answers (Fig. 4). The forms of tourism were rated very differently, from cruising in the Caribbean, which was considered most harmful to the environment (average grade 3.9), to wine tasting on Pelješac, which was not considered harmful at all (1.9). Although the respondents did not have to explain the reasons and it is not possible to speculate on the background of their answers, it seems that they rate selected forms of tourism according to the number of visitors staying in the same place at the same time.

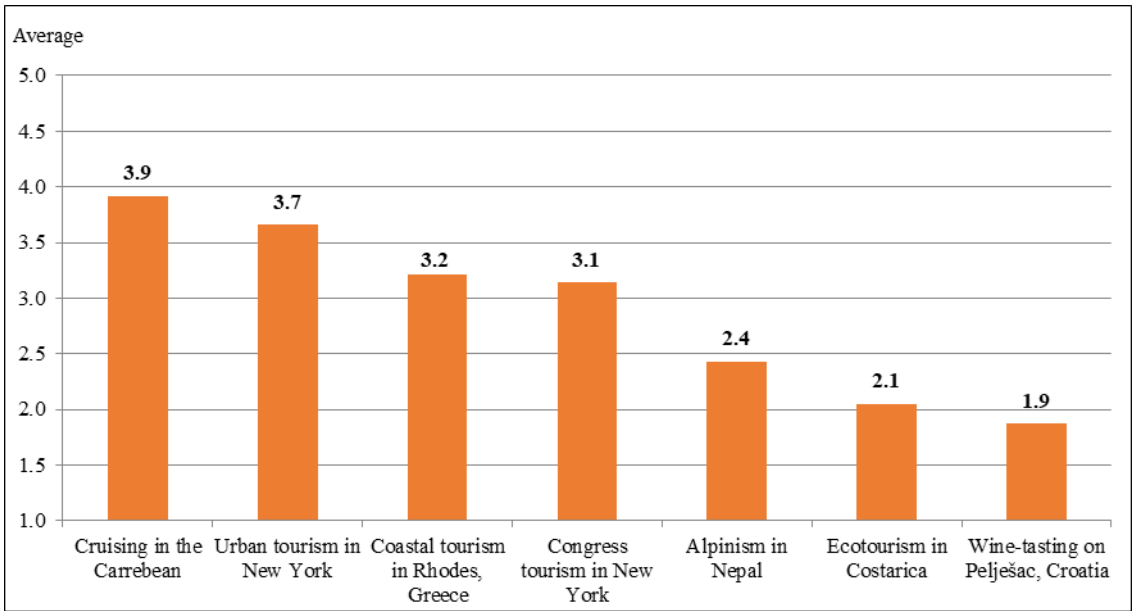

Figure 4. Respondents' perception on harmfulness of selected forms of tourism

Therefore, mass tourism is perceived as more harmful to the environment than some forms of special interest tourism (e.g. ecotourism, alpinism and wine tourism). Their perception is in line with general tourism theory, but few tourists in some forms of special interest tourism in regions with sensitive environments (e.g. alpinism in Nepal) can have more harmful impacts on the environment than much larger numbers of tourists in cities or in tourism regions with developed infrastructure that can support them without

exceeding carrying capacity (e.g. urban tourism in New York, congress tourism in Hong Kong or even coastal tourism in Rhodes, Greece).
Perceptions of potentially harmful tourism activities, investigated in this part of the research (using Likert scale (1 - not at all; 5 - totally)) vary less than forms of tourism, ranging from 4.1 for swimming in lakes in protected areas to 3.1 for off-road driving in rural areas (Fig. 5). As before, perceptions are related to the number of users of an activity, more than the activity in which they participate, and respondents may perceive protected areas as more visited than rural areas. Respondents' sensitivity towards nature and protected areas seems to be high, as activities in these areas are perceived as more harmful to the environment. The moderately high rated impacts of illegal tourism accommodation on the environment are associated with landscape degradation and increased littering, and are perceived as more harmful than driving a speedboat (which could harm marine life) or barbecuing in the Mediterranean in summer with a higher risk of fire.

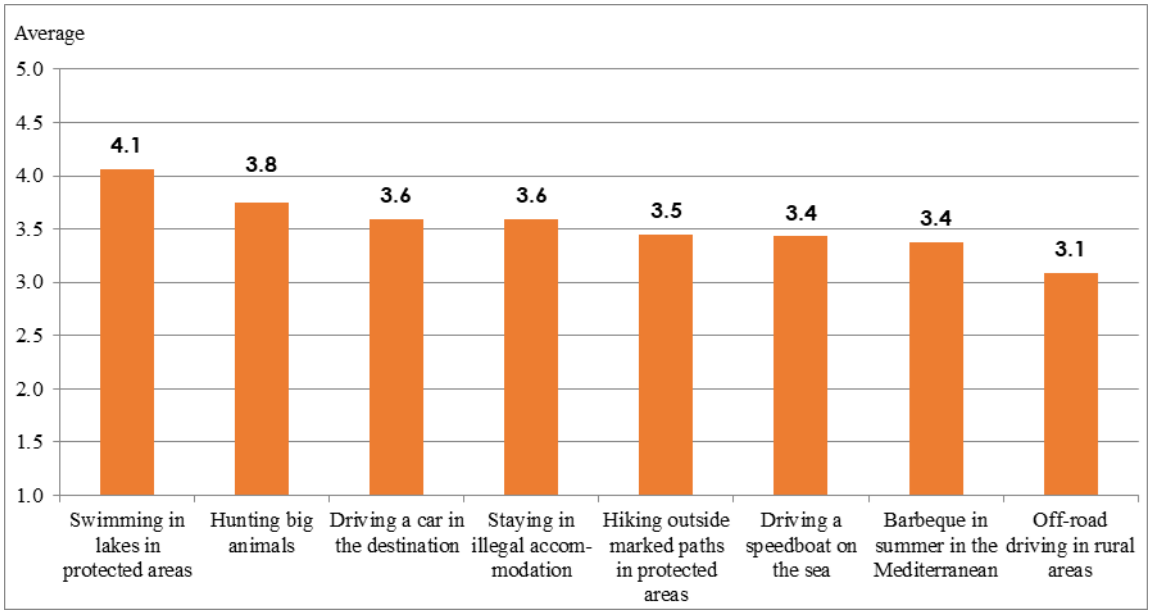

Figure 5. Respondents' perception on harmfulness of selected tourist activities

Respondents were asked how and to what extent they are willing to change their travel habits in order to reduce the negative impact on the environment using Likert scale (1 - not at all; 5 - totally) (Fig. 6). Most of them are willing to reduce their consumption (if they had to pay extra for it) (average grade 4.0) and to use another mode of transport (train) if it is available (3.7 for cars and 3.2 for planes). Many would take only a few trips with longer stays instead of multiple short trips during the year (3.4), but they would be less willing to change a destination to avoid a flight (2.8). However, there is less willingness to pay more to offset CO2 emissions when travelling (3.1), even though awareness of CO2 emissions from fossil-fuelled transport has increased. The rather high percentage of respondents who are not willing to change anything because they think they do enough throughout the year shows that there are still people who are not at all aware of the extent of the negative impacts of travel.

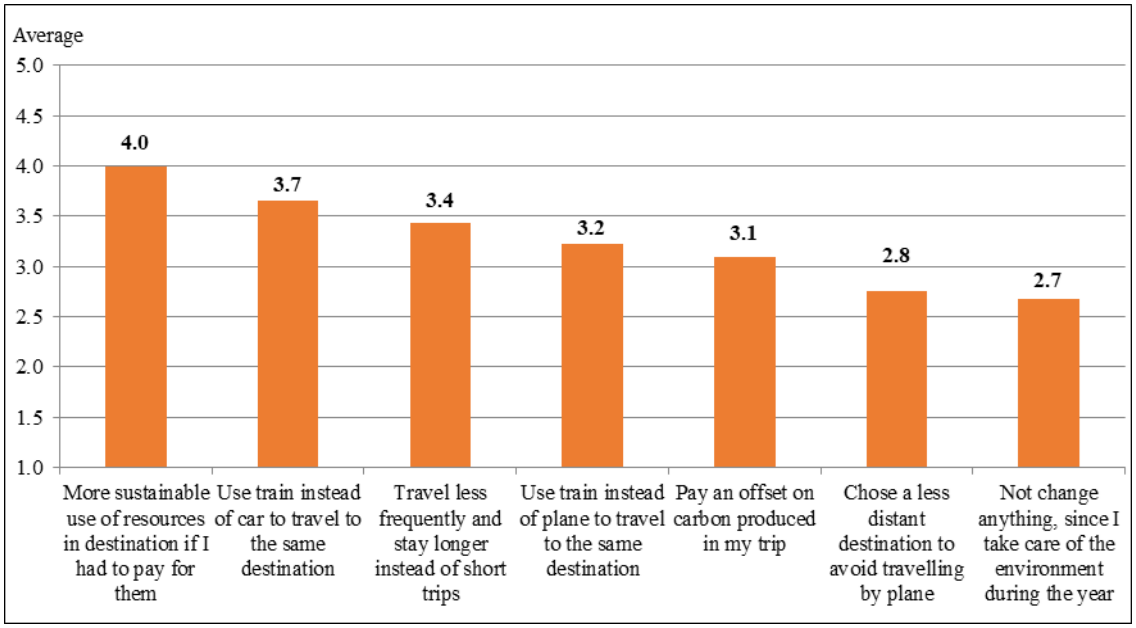

Figure 6. Respondents' willingness to change travel behaviour for the benefit of environment

The last question in the section on tourism explored who respondents hold most responsible for providing information on environmental issues and negative environmental impacts of tourism and how they explain their answer. Most respondents consider the education system most important (41%), 22% the media, 17% the government, 10% any individual and 9% international organisations. The role of the education system is explained by the fact that pupils and students learn about the environment and it is easiest to acquire different behaviours, values, habits and knowledge at a young age. Those who prefer the media claim that they can reach everyone in an easy and ubiquitous way and therefore should also have the task of informing about the impact of tourism. Respondents who consider everyone responsible believe that each individual has an impact with their choices and behaviour and that the only way to reduce the negative impacts of travel is through their own choices. Those who call for government intervention, on the other hand, believe that behavioural change can only be enforced from the outside, through legislation, and that it is their job to inform. The results show once again the importance of education about the environment as well as education about tourism and its impacts, which has already been recognised in important documents on global tourism. In particular, the Global Code for Ethics in Tourism in Article 2. Tourism as a vehicle for individual and collective fulfilment calls for the inclusion of the value of tourism exchange, its social, cultural and economic benefits as well as its risks in school curricula [21].

ENVIRONMENTAL CITIZENSHIP AND TRANSPORTATION

Since the transportation is one of the key life activities, perception of students on relation between environment and transportation were investigated in this chapter. Students were asked about environmental impacts of transportation, transportation in their everyday lives and making holidays and their future plans regarding transportation options.
Firstly, students expressed their attitudes about environmental impacts of transportation using Likert scale (1 - completely disagree, 5 - completely agree) and the average grades of their answers were calculated (Fig. 7). Students gave relatively high grades to proposed

statements, which implies their high perception of positive and negative environmental impacts of transportation. Students were aware of positive impact of sustainable transportation modes (e.g. public transportation, 4.1), i.e. of negative impact of car transportation on environment (4.1). According to their opinion, electric energy has real potential to represent a future in transportation sector. However, they are somewhat sceptic regarding the environment friendliness of transportation modes fuelled by batteries (3.6). From the political aspect, students expressed their opinion that government should have a key role in promoting or limiting different transport options, but with a higher grade for promoting, and a bit lower grade for limiting.

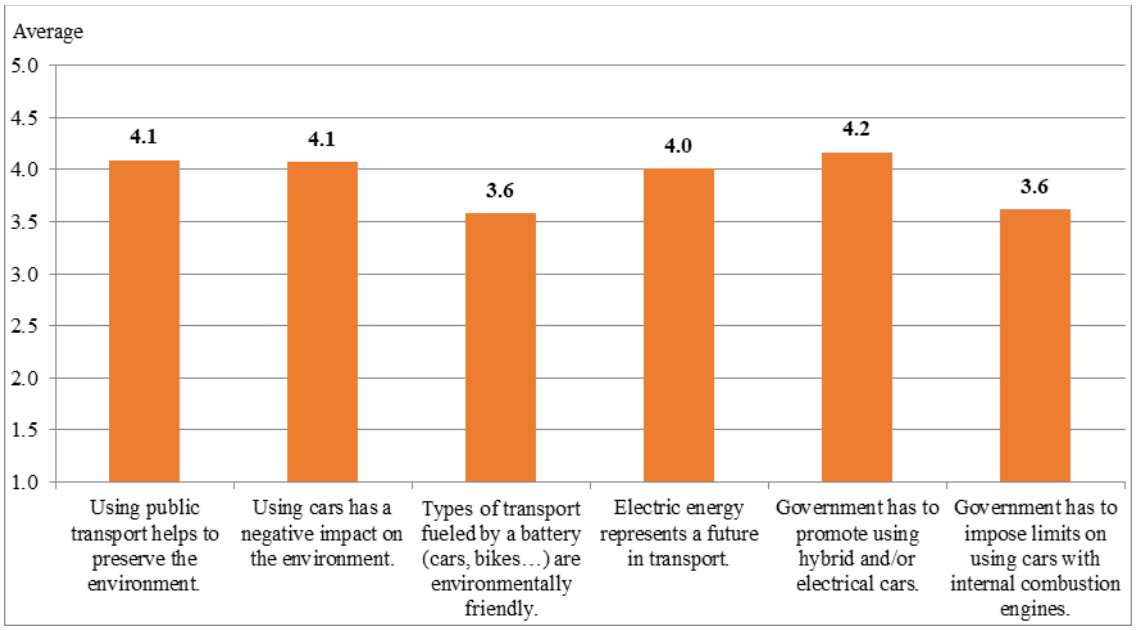

Figure 7. Respondents' perception of environmental impacts of transportation.

Any kind of travelling requires certain transportation mode (walking is also transportation mode, e.g. [22]). Here students were asked about attitudes towards transportation used in everyday life and for holiday purposes, again using Likert scale (1 - completely disagree, 5 - completely agree) (Fig. 8). It could be seen that students' personal choices and habits are less environmentally aware, it could be even characterised as indifference. It is obvious that lots of students walk or ride a bike (or skate) on shorter distance, but the reason for that is less likely environmentally awareness. Their moral obligation to take care of the environment when using transportation options is not so high (3.1). Related to that attitude, environmentally friendly transport in everyday travelling is even less important for students (3.0), and the usage of transportation options best for the environment in everyday travelling is even less prominent (2.9). Most probably students use transportation mode which is more suitable for them considering financial options, and other reasons (time travelling, schedule, etc.). This is more prominent when discussing holiday issue, because environmental awareness is even lower. Environmentally friendly transport in travelling on a holiday is less important for students (2.6) than everyday travelling, and the usage of transportation options best for the environment when traveling on a holiday is even lower (2.4).

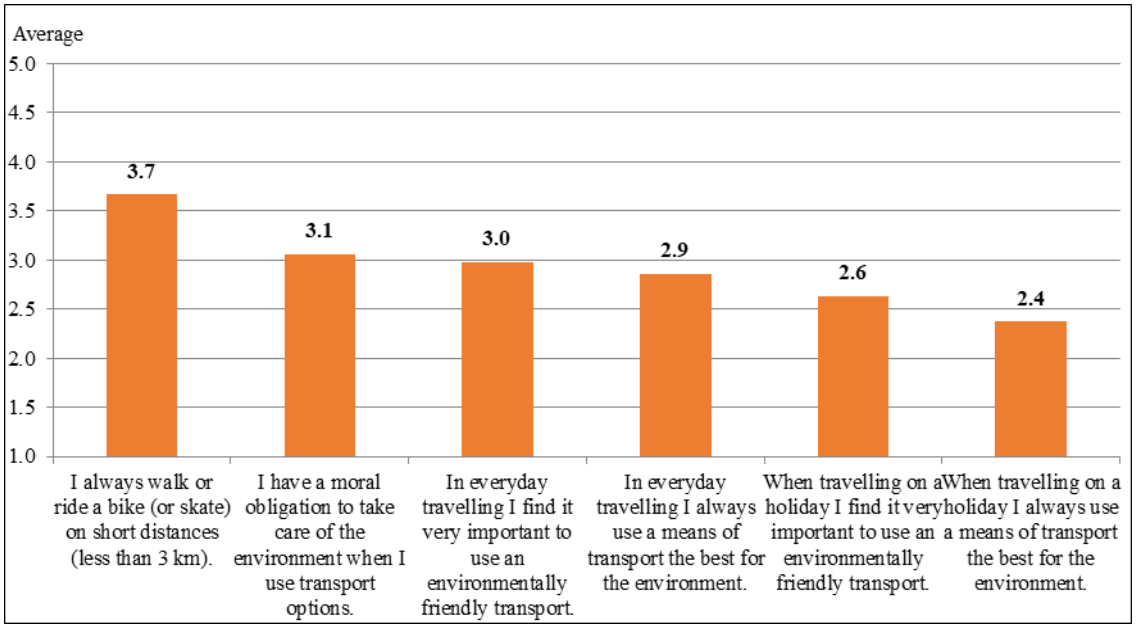

Figure 8. Respondents' attitudes towards transportation in everyday life and making holidays.

At the end, students' attitudes about their future plans regarding transportation options were investigated using Likert scale (1 - completely disagree, 5 - completely agree) (Fig. 9). In general, less expressed environmental concern in students' future transport plans could be recognised. Comparing to the previous value about walking and riding a bike in everyday lives, almost the same attitude is valid about students' walk and riding a bike (or skate) in the future (3.8), although the highest grade would be expected considering environmental awareness. Their environmental awareness is even more prominent when considering future plans of using a car against public transportation (3.1 vs. 2.9).

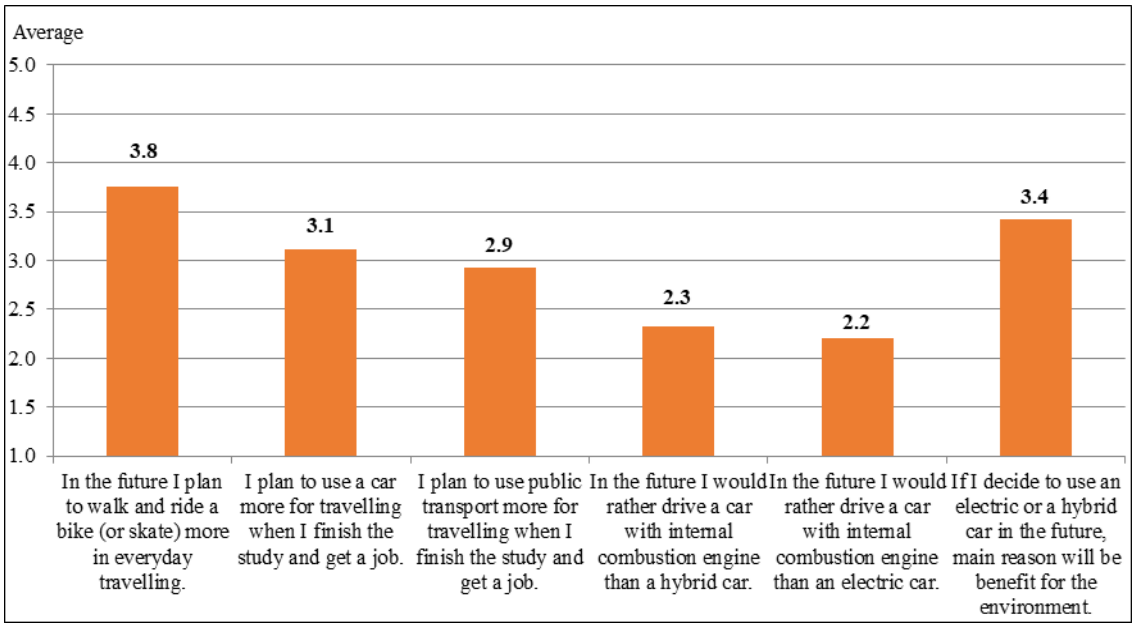

Figure 9. Respondents' future plans regarding transportation options

However, it could be related to students' living location and public transportation network developed in their living area, so car usage could be even more forced. Still, students are

aware of many positive sides of electric and hybrid cars, especially considering environment, so students expressed higher positive perception of electric/hybrid means of personal transport for the benefit of the environment.

CONCLUSON

This paper deals with an adoption of Environmental Citizenship concept amongst university students in Croatia. The paper presents students' attitudes about perceived environmental impacts of tourism and transportation, their personal choices in tourism and transportation related to the environment, and their willingness to change tourism and transportation options for the benefit of the environment. Students expressed high perception of environmental problems and environmental impacts of tourism and transportation (e.g. waste, gas emissions, landscape degradation). Still, students have indifferent or mildly conscious attitudes toward present practices in tourism and transportation. Their willingness to change behaviour in the future is expressed only in small extent where they only showed potential orientation to electric/hybrid cars.
It could be concluded that Environmental Citizenship is crucial for addressing current environmental and sustainability issues. It should be emphasized that this is a necessary condition for sustainability and has been identified as one of the EU's priorities [23], [24]. Educating people to become Environmental Citizens is one of today's challenges if sustainable growth and environmental awareness want to be achieved. Considering aim to achieve more sustainable and environmental aware societies, youth need to be taught to overcome important gaps or challenges in being part of a sustainable society.
The research presented in this paper has some limitations. One should be aware that it was impossible to implement more questions in the questionnaire, so some topics remained unexamined or somewhat unclear. However, this research contributes to a better understanding of relationship amongst youth and Environmental Citizenship, and their attitudes and awareness regarding environment. By this research some serious questions have been opened, and it could be a pledge for more detailed researches in the future.

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KATLANOVO MARSH

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ABSTRACT

Katlanovo Marsh is a main wetland hydrological object in the Skopje Plain, Macedonia. According to this classification, Katlanovo Marsh belongs to type of "Tp". The scope of the paper is to make a hydrological research one of the significant wetland objects in Macedonia, Katlanovo Marsh. Much smaller, but also important hydrological object is a permanent small lake, Katlanovo Pond, covering area of 5.130 m2, and have a water volume of 11.286 m3. The performed analysis created new morphometric and hydrometric results about the Katlanovo marsh and the pond, elsewise. Additionally, the hydrological basic regime is analyze also, using the nearby piezometric station Petrovec. In order to complete the hydrological work, the implementation of the Penmann-Monteaux equation helped to calculate the evapotranspiration, a Rational Method to calculate the runoff inflow and after that, with the simple water balance equation usage, which helped to estimate water budget of the Katlanovo Pond.

Keywords: wetlands, marshes, mapping, physiography, hydrology, Macedonia.

INTRODUCTION

Location

The country water belongs predominantly to the Aegean Basin with 22319 km2 and to Adriatic Basin with 3350 km2. The main river basin with its tributaries Lepenec, Pchinja, Bregalnica, Treska and Crna River has a drainage area in Macedonia of 20535 km2 is Vardar, with length of 388 km (301 km in Macedonia), which streams directly in Aegean Sea at Termaikos Golf near city of Thessaloniki in Greece. The second basin belongs to Strumica River with length of 114 km, 81 km in Macedonia (right tributary of river Struma in Bulgaria). The main river in Adriatic Basin is Crni Drim with two large lakes Oh¬rid and Prespa (connected with underground inflow in Ohrid Lake) and largest Crni Drim's tributary from the north, river Radika [20]. According to the relief structure, Macedonia has many plains, which before 1950 were covered by large wetlands. Today the area cover by the wetlands decreased significantly, which caused many changes in the country ecosystem.

Katlanovo Marsh is a main wetland hydrological object in the Skopje Plain, Macedonia. It is located in the lowest, southeastern part of the plain, between the river Vardar on the west and the Pchinja River on the east, with the coordinates N and E and elevation of 224 m a.s.l. Near this natural feature, on the north side, is the main country motorway (E75) and on the west is flat irrigated part of the Skopje Plain.

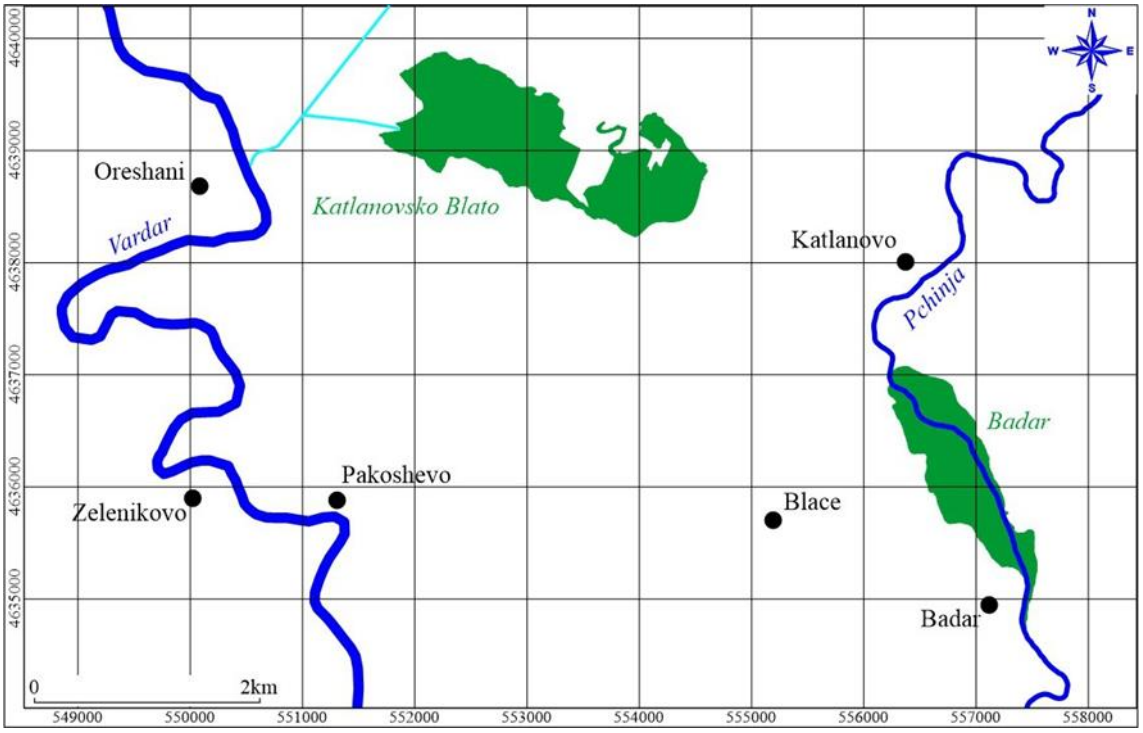

Figure 1. Location of the marshes Katlanovo and Badar

Climate characteristics

Skopje valley's climate touches the warm air that circulates from the Aegean Sea, especially in the summer period, and as such constitutes a distinct thermal valley area in which climate affects the temperature regime with very hot summer temperatures and an intensive evapotranspiration process, which strongly affects the permanently flooded Katlanovo March. The wind rose shows predominantly North and Northeast direction, which allows transport of very cold air masses in the winter and absolute minimum air temperature lower than -20°C. From the other point of view the Skopje valley is surrounded by high mountains, which maintain direct Influence of Mediterranean climate from the southeast, while from the north and north west penetrate free movement of continental air, which in winter resulting especially with low temperatures and a marsh water frosting. Additionally the largest problem of this part of the Skopje Plain is air pollution which is strongly concentrated in this lowest area of the plain. Annual quantity of rainfalls in the period from 1991-2010 year on average is 489.6 mm.

According to the annual rainfall values we can make a difference in between changed continental precipitation regime with maximum rainfall in November by 52 mm and December by 53 mm and May 54 mm and a minimum rainfall we have in months August 28 mm and February 34 mm. The average annual precipitation sum is 540 mm. The Vardar Valley in the Macedonia lies on the border of two large vegetation-geographical areas: Mediterranean and Euro Siberian [25], which causes the interference of the influences of the mild Mediterranean and sharp continental climate.

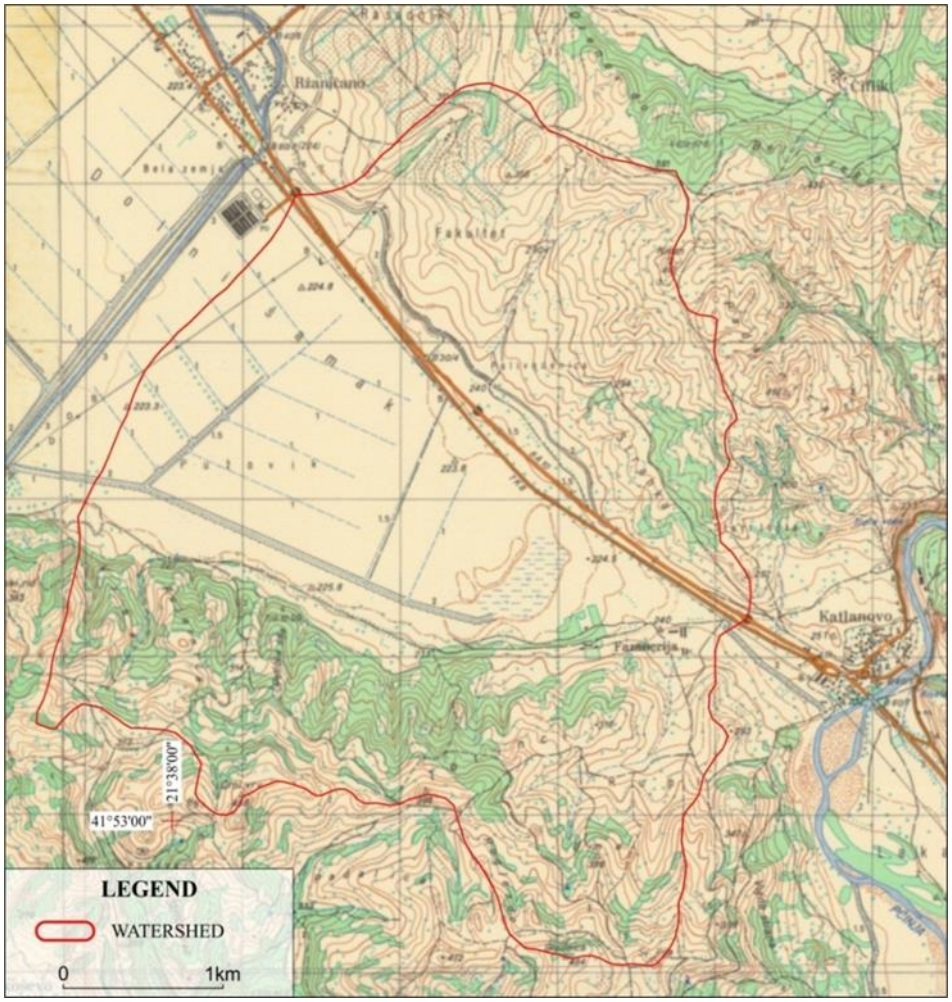

Figure 2. Topographic location of the basin of the Katlanovo Marsh in the south-east part of the Skopje Valley

This watershed segment belongs to the Aegean Basin, through the main water course Vardar. Skopje Valley is under significant Mediterranean and moderate continental climatic influence, with cold winters and hot summer season. The precipitation maximum occurs in the spring and precipitation minimum in the summer.

The result of these two influences is existence of a particular local climate highly modified by the features of the valley. The average annual precipitation in Skopje valley is 540 mm, so this valley may be characterized as one of the drier regions in Macedonia, with approximately 100 mm precipitation per year below the country average.

However, due to the high altitude difference of the tectonically highly developed relief with different exposure and inclination, the high mountains and deep depressions, the Vardar basin finds great differences from the nival conditions of the high mountains to the semi-arid areas of the lowest parts of the depressions around Vardar in the middle course. On the highest mountains, the snow cover is kept up to half a year, from the end of November to the beginning of June, while in the southernmost regions of Gevgelija, the occurrence of weak and short-term snowfall occurs once a few years. The Mediterranean climate along the valley of Vardar is present to Demir Kapija and in the north its changed influence is felt to the edge of the Skopje valley and the valleys of its tributaries. All this conditions in the Vardar basin to have four climatic regions: a

Mediterranean climate region, mixed Mediterranean and continental climate regions, continental climate regions and mountain climates.

Landscape

Tectonically, the working area belong to Vardar geotectonic zone, which was generally flooded during the Pliocene period. Besides, the numerous mountains in the country, there is no larger mountain around the study area, but Skopje Plain and two significant gorges, Baderska on Pchinja and Taorska Gorge on river Vardar. The Katlanovo Marsh was formed from the former historical Skopje Lake, which was a part of the historical Aegean Lake [3]. Elsewise, the pilot site landscape is a composition between flat cultivated plain, surrounded by several lower hills, and a massive human objects as motorway, Gas Station, Pheasantry and international Skopje Airport on several km.

On the south of the marsh basin there are to lower peaks Taninci (396 m) and Crni Vrv (458 m), and in the foothill the main Pheasantry which make a natural south border of the marsh. On the east, there is a flatter pass in relief, which is a natural watershed and divides the river Pchinja and River Vardar waters with abovementioned gauges. Beside this small pass, where the motorway pass there is the Pchinja riverbed in just 4 km distance from the Katlanovo Marsh.

Elsewise the previous study determine that the whole site covered 125 ha, located on Skopska Kotlina Basin, near rivers Vardar and Pcinja, and the village Katlanovo. Since 1960 water has been extracted and many of 95% of area is drainage. Present situation: only 5% of locality have fragments of wetlands characteristic [17].

Figure 3. Landscape of the Katlanovo Marsh (Photo: Markoski Bl., 2019)

The main marsh has still natural boundary, but it is predominantly bordered with huge anthropogenic objects. The frame of the marsh water aquatorium is oval, with a length direction NE-SW and the wide direction NW-SE. The total area of the under the protection is 70 ha. The marsh is the last final form of the extinction/disappearance of the former Skopje Pliocene Lake, formed by Aegean Lake [3]. It began with the elevation of the Vardar riverbed with a layer that deposited the water that flowed from Vardar from the north side. Between Lake and Vardar there used to exist the riverbed of the river Michkichka. Through it during the high water level Vardar poured into the Katlanovo Pond and then it increased its surface, flooding this part of the field until village Idrizovo. That is why this part of Skopje is known as Blatia (Marshland area). Elsewise, the lake from its normal surface area of 4,24 km2 increased to an area of 10 km2. However, after 1930 significant land reclamation was undertaken and the shamak was dried, and the surface of the lake significantly decreased

These works were extended in the second half of the last century, with the lake being brought to pre-drying. Its surface abruptly decrease after the huge country irrigation works were completed in 1950s. The research in administrative scope belongs to the Petrovec Municipality in the rural settings of Rzhanichino and Katlanovo villages.
The vegetation period starts in May and ends in November. The soil is mostly alluvial dominated by clay, with high content of organic substances. In the lower part of Skopsko Pole field, the soil is fertile and of high agricultural value. The groundwater level in the south-east part is artificially kept below the surface of the terrain by a drainage network and it is discharged into the Vardar before Taor gorge. The drainage network was constructed in the 1950s to drain most of the Katlanovo marsh.

RAMSAR CLASSIFICATION OF KATLANOVO MARSH

For wetland classification it is necessary to present the wetland classification according to the Ramsar Convention for the Inland and "Man-made" wetlands [4]. According to this classification, Katlanovo Marsh belongs to type of "Tp". Additionally with previous studies, the pilot study area contains euglena inorganic soils [5], which is complementary with the Katlanovo Marsh typology. The marine wetlands classification is not in the frame of research for Macedonia and therefore the bold was chosen selected class complementary with Katlanovo Marsh:

I Inland Wetlands

- L. Permanent inland deltas.
- M. Permanent rivers/streams/creeks; includes waterfalls.
- N. Seasonal/intermittent/irregular rivers/streams/creeks.
- O. Permanent freshwater lakes (over 8 ha); includes large oxbow lakes.
- P. Seasonal/intermittent freshwater lakes (over 8 ha); includes floodplain lakes.
- Q. Permanent saline/brackish/alkaline lakes.
- R. Seasonal/intermittent saline/brackish/alkaline lakes and flats.*
- Sp. Permanent saline/brackish/alkaline marshes/pools.
- Ss. Seasonal/intermittent saline/brackish/alkaline marshes/ pools.*
- Tp. Permanent freshwater marshes/pools; ponds (below 8 ha), marshes and swamps on inorganic soils; with emergent vegetation water-logged for at least most of the growing season.
- Ts. Seasonal/intermittent freshwater marshes/pools on inorganic soil; includes sloughs, potholes, seasonally flooded meadows, sedge marshes.*
- U. Non-forested peatlands; includes shrub or open bogs, swamps, fens.
- Va. Alpine wetlands; includes alpine meadows, temporary waters from snowmelt.
- Vt. Tundra wetlands; includes tundra pools, temporary waters from snowmelt.
- W. Shrub-dominated wetlands; Shrub swamps, shrub-dominated freshwater marsh, shrub carr, alder thicket; on inorganic soils.*
- Xf. Freshwater, tree-dominated wetlands; includes freshwater swamp forest, seasonally flooded forest, wooded swamps; on inorganic soils.*
- Xp. Forested peatlands; peatswamp forest.*
- Y. Freshwater springs; oases.
- Zg. Geothermal wetlands.
- Zk. Subterranean karst and cave hydrological systems.

* As appropriate, includes: floodplain wetlands such as seasonally inundated grassland (including natural wet meadows), shrublands, woodlands or forest.

II Artificial wetlands

- Aquaculture (e.g. fish/shrimp) ponds.
- Ponds; includes farm ponds, stock ponds, small tanks; (generally below 8 ha).
- Irrigated land; includes irrigation channels and rice fields.
- Seasonally flooded agricultural land**
- Salt exploitation sites; salt pans, salines, etc.
- Water storage areas; reservoirs/barrages/dams/impoundments; (generally over 8 ha).
- Excavations; gravel/brick/clay pits; borrow pits, mining pools.
- Wastewater treatment areas; sewage farms, settling ponds, oxidation basins, etc.
- Canals and drainage channels, ditches.

** To include intensively managed or grazed wet meadow or pasture.

POPULATION BASICS

The Skopje Plain is densely populated. The central part is occupied by city of Skopje - the major administrative and industrial center in Macedonia, with a total population of 506926 [21]. Along with the city of Skopje, the basin comprises the municipalities of Želino, Sopište, Čučer-Sandevo, Studeničani, Zelenikovo, Ilinden, Aračinovo and Petrovec – municipalities with an approximate population of 80000 citizens. More than 80% of the settlements and villages situated in the area are adjacent to rivers and streams. These data indicate the severity of the anthropogenic pressure upon the river Vardar and its tributaries.

PROTECTED AREAS WITHIN THE PILOT SITE
(name, subject and purpose of conservation)

The Katlanovo Marsh is protected according to the "Law of natural rarities protection" in 1965 on an area of 70 ha, and is a significant station of migratory birds in the autumn of Northern Europe, but also rich in ichthyofauna. According to the qualitative assessment of Nastov refers to the concern, i.e. the threat to the ecosystem, species and habitat diversity of the locality. In accordance with the international ones criteria [4] are allocated 10 ecosystem types: blunt, extraordinary, channel, low grass (pastoral), high fever (secondary overgrown with shamak and reeds), belts with shrub and woody species, arable land (fields), artificial meadows, forested complexes and a fish farm. Evaluation data is displayed in a tabular way. Based on the results obtained from the evaluation concluded that with a very high degree of concern/endangered are two ecosystem types: blatant and ancestral type. The medium intensity of the threat is four types of ecosystems: high grasses secondary overgrown areas, low grassland (pastoral), shrubbery and woody belts and a network with drainage channels. The remaining ecosystem types are distinguished by low level of endangerment, and the expert assessments that are applied in natural ecosystem types are not relevant [17].

In the end of the 1980s researchers proposed measures for wetland restoration with average marsh pond's depth of 2-3 m, which could be a serious natural fish farm for carp fish. The other significant studies propose that the revitalization of the Katlanovo Marsh in the much smaller area, as it is today will be very significant not only for scientific research, but for the ichtiophauna existence and fish spawning, which is obtained with a connection with river Vardar thru the Rzhanichino Channel [18].

In accordance with the Decree for classification of watercourses, lakes, accumulations and groundwater [19], the quality of water in the river Vardar after the Pchinja inflow is

from the second category with BOD = 7,5 mg with projection to 2025 to reach 1,5 mg [5].

Figure 4. Areal of Katlanovo Marsh

Biodiversity of Katlanovo Marsh

Katlanovo marsh ("Katlanovo Blato") represents the last remaining part i.e. the termination phase, of the Katlanovo Lake that once spread over a large area in the northern part of Macedonia. Katlanovo marsh is situated in the Skopje valley and is part of the northern watershed of the largest river in Macedonia – Vardar. Today the marsh occupies area of 70 ha, surrounded by arable fields, small marshes and humid meadows.

Katlanovo Marsh is an important locality for Macedonia due to its natural, biodiversity and scientific values, and also because of its esthetic, cultural characteristics and economic potential [15]. Hence, the marsh has been an important topic of scientific interest in the past three decades.

Katlanovo Marsh encompasses ten ecosystem types, including: Marshes/wetlands, Coastal formations, Artificial water channel networks, Low grasslands, High grasslands, Shrub and tree belts, Arable fields, Forest complexes and Fishery pond.

According to the qualitative ecosystem analysis [17], the marshes/wetland and the coastal formations, characterized by the following dominant plant associations *Cyperetum longi-caricetosum acutiformis* [16] and *Caricetum-Martinum-Nymphacetum,* as well as *Cladium mariscum, Oenanthe aquatica/silaifolia, Roripa amphibian, Potamogeton crispus, Salvinia natans* and *Juncus tenuis*, respectively, are the most critically endangered ecosystems. Other vulnerable ecosystems include the artificial water channel network and the coastal tree belt. They are dominated by *Scirus lacustris*, *Phragmites australis*, *Juncus tenuis* as well as *Salix alba*, *Populus alba*, *Tamarix parviflora* and *Alnus glutinosa*, respectively.

The main threats that endanger these ecosystems are anthropogenic activities such as water abstraction, water pollution, landscape degradation and transformation, cutting and

burning of trees and shrubs, drying of the wetland, degradation of the water channels and climate change.

The marsh/wetland encompasses four different habitats, which according to the EUNIS classification are categorized as:

- *Phragmites australis* (Common reed) beds normally without freestanding water (EUNIS code D5.11)
- *Typha* (Reedmace) beds normally without freestanding water (EUNIS code D5.13)
- Swamps and marshes dominated by *Juncus effusus* (Soft rush) or other large *Juncus* spp. (EUNIS code D5.3)
- Helleno-Moesian riverine and humid *Trifolium* (clover) meadows (EUNIS code E3.31) [6].
- This habitat is listed under endangered natural habitats in accordance with the Bern Convention on the Conservation of European Wildlife and Natural Habitats.

Katlanovo marsh has rich diatom biodiversity (74 identified species) and includes uncommon species. *Sellaphora bacilloides, Stauroneis palustris* and *Caloneis macedonicus*. Other common diatoms and epiphytic species include: *Nitzschia linearis, Surirella splendida, Caloneis amphisbaena, Mastogloia smithii, Cymatopleura solea, Diatoma vulgaris, Rhoicosphenia lacustris, Cocconeis pediculus, Gomphonema olivaceum, Gomphonema parvulum* and *Planothidium frequentissimum* [11].

The plant diversity is represented by roughly 100 species, among which most important are: *Utricularia vulgaris, Salvinia natans, Butomus umbellatus, Schoenoplectus matitimus, Iris pseudocorus, Rumex hydrolapatrum, Carex accutiformis, Carex distans, Carex hirta, Carex divisa, Eleocharis palustris, Juncus tenuis, Oenanthe silaifolia, Oenathe aquatica, Stachys palustris, Orchis lati ora, Scutelaria hastifolia, Equisetum palustre, Phalaris arundemersus, Typha angustifolia, Hydrocharis morsus-ranae, Spirodela polyrhiza.* The larger region of the Katlanovo Marsh hosts the rare and endemic species *Gastrocotyle macedonica* (previously known as *Anchusa macedonica*) [14].

Invertebrate biodiversity

Katlanovo Marsh is characterized by high faunal diversity [17]. *Odonata* (damsels and dragonflies) represent an important, highly abundant and versatile group of invertebrates at Katlanovo Marsh. They are represented by 24 known species: *Sympecma fusca, Sympetrum sanguineum, S. depressiusculum, Anax imperator, Calopteryx virgo, Calopteryx splendens, Lestes barbarous, Lestes virens, Platycnemis pennipes, Erythromma viridulum, Enallagma cyathigerum, Ischnura elegans, Onychogomphus forcipatus, Orthetrum cancellatum, Orthetrum albistylum, Orthetrum brunneum, Orthetrum coerulescens, Crocothemis erythraea, Sympetrum meridionale, Aeshna isosceles, Onychogomphus forcipatus, Ischnura elegans and Lestes barbarus*. Katlanovo marsh host 52% of all *Odonata* species collected in the whole territory of Macedonia [8, 9].

Vertebra diversity

Fish diversity

Vertebrates are the best-studied group of organisms inhabiting Katlanovo Marsh. Fish populations were previously represented by ten species, e.g. *Cyprinus carpio, Rutilus rutilus, Scardinius erytrophtalmus, Cobitis taenia, Perca uviatilis, Barbus barbus, Barbus peloponensis, Gobio gobio*. However today, only four species are found living in the drainage channels and the abandoned fishpond [18].

Herpetofauna biodiversity

Reptiles and amphibian dwelling in Katlanovo Marsh are represented by eight species typical for wetlands. These include: newts *Lissotriton vulgaris* (previously *Triturus vulgaris*), frogs *Pelophylax ridibundus* (previously *Rana ridibunda*), *Pelobates syriacus balcanicus*, *Hyla arborea*, snakes *Natrix tessellate*, *Natrix natrix* and turtles *Emys orbicularis*, *Clemys caspica* (or *Mauremys caspica*) [17].

Avifauna diversity

Birds are the most numerous group of vertebrates at Katlanovo Marsh. More than 70 bird species are using this locality for nesting, hunting, wintering or migration. Aquatic birds and those that are typically found in wetlands are the most numerous in Katlanovo Marsh, and these include: *Spatula clypeata*, *Spatula querquedula*, *Anser anser*, *Mergus albellus*, *Charadrius marinellus*, *Gallinula chloropus*, *Phalacrocorax pygmaeus (Microcarbo)*, *Phalacrocorax carbo*, *Podiceps cristatus*, *Tachybaptus rucollis*, *Aythya nyroca*, *Egretta alba*, *Egretta garzetta*, *Larus ridibundus*, *Alcedo atthis*, *Anas platyrhynchos*, *Rallus aquaticus*, *Podiceps nigricollis*, *Botaurus stellaris*, *Himantopus himantopus*, *Panurus biarmicus* and *Ciconia ciconia*, *Ixobrichus minutus*, *Nycticorax nycticorax*, *Ardea purpurea*, *Circus aeruginosus*, *Cuculus canorusi*, *Troglodytes troglodytes*, *Cettia cetti*, *Locustella luscinioides*, *Acrocephalus schoenobaenus*, *Acrocephalus palustris*, *Acrocephalus scirpaceus*, *Acrocephalus arundinaceus*, *Sylvia communis*, *Remiz pendulinusi* and *Emberiza schoeniclus*, *Recurvirostra avosetta*, *Eudromias morinellus*, *Sternula albifrons* [24].

Mammal diversity

Due to the drainage of Katlanovo Marsh, today only 23 mammal species (out of previously known 30 species) are found at this locality [17].

Biodiversity of humid meadows habitats

The vegetation of the humid meadows is largely represented by the following species: **clovers** (*Trifolium resupinatum*, *T. balansae*, *T. nigrescens*, *T. filiforme*, *T. patens*, *T. repens*, *T. pretense*), perennial grasses (*Cynosurus cristatus*, *Anthoxanthum odoratum*, *Agrostis alba*, *Alopecurus utriculatus*, *A. pratensis*, *Bromus racemosus*), **sedges** (*Carex hirta*, *C. vulpina*, *C. distans*, *C. divisa*) as well as **herbaceous plants** *Lychnis flos-cuculi*, *Ranunculus acris*, *R. velutinus*, and *Cirsium canum* and *Inula britannica*.

Similar to the marsh habitats, the humid meadows are populated by diverse and abundant butterfly species (Lepidoptera), and hence habitats represent a hot spot for these types of organisms. Among the most common butterfly species are: *Lycaena virgauraea*, *Parnassius mnemosyne*, *Thymelicus sylvestris*, *Issoria lathonia*, *Pieris brassicae*, *Maniola jurtina* etc. Other abundant invertebrate group is Odonata (damsels and dragonflies), which is dominated by the *Calathus*, *Brachinus*, *Amara* and *Harpalus* genera.

RESULTS AND DISCUSSIONS

Hydrological characteristics

As a hydrological separated object, Katlanovo Marsh is natural and clearly defined wetland area, located in the lowest part of Skopje Plain. Today because of the past human activities, this wetland is strongly connected with the largest river in the country, Vardar.

It is not only a hydrological significant relation, but also very important for hydrobiology. The main hydrological analyzed issues are the morphometry of the marsh and also the morphometry of the small pond in the central part of the wetland:

Katlanovo Marsh morphometry

Katlanovo Marsh Lake coordinates:

x: 553115,242; y: 4639053,115
φ: 41°54'06"; λ: 21°38'25"

Altitude:

z: 221m

Length (L) is the shortest distance between the two most distant points on the marsh border.

L=2935m

Width (W) is the measured distance of a line from shore to shore at right angles to the length.

W = 1059 m

Area (A) is the surface area of the marsh.

A = 198,5 ha

Shoreline (*L'*), is the length of the shore line (km).
L'=12,188 km

Katlanovo Pond morphometric characteristics

According to the many limnology studies the main pond/lake morphometric elements are: total length (L), total wide (W), average wide (Wa), total wetland surface (A) total surface of wetland aquatorium (Aw), Maximum Depth (Zmax), Average depth (Za) and the total lake volume-V [10].

Katlanovo Pond coordinates:

x: 554243,630; y: 4638602,665;
φ: 41°53'51"; λ: 21°39'14"

Altitude:

z: 218m

Length (L) is the shortest distance between the two most distant points on the pond shore.

L = 141,3 m

Width (W) is the length of a line from shore to shore at right angles to the length.

W = 52,4 m

Area (A) is the surface area of the pond.

A = 0,513 ha

Average width (W_a) is the scale between the pond area and its length.

$$W_a = 36,3\ m$$

Shoreline (L'), is the length of the shore line (km).

$$L' = 0,459\ km$$

Pond volume

$$V=5130\ m^2*2,2m=11286\ m^3$$

Mean depth (Z_{ave}) is the volume divided by the area.

$$Z_{ave} = V/A$$
$$Z_{ave}=2,2m$$

Lake catchment area (Ac)

$$16043\ km^2\ or\ 1.604,3\ ha.$$

Watershed length (W_l)

$$17557\ km$$

Development of shoreline [7] is the ratio of the shoreline length (L') to the circumference of a circle with area equal to the area of the lake (A). That is, the lake shape is compared with an idealized shape (circle). That is:

$$DL = L'/(2\sqrt{\pi A})$$

$$DL=1,81$$

The closer this ratio is to 1, the more circular the lake. A large ratio, larger than 1.5 indicates the shoreline is more crenulated and reflects the potential for development of littoral communities (plants) and usually of high biological productivity or massive relief structures (rapid changes from sand beach to vertical cliffs. In the above result, the pond shape is very well developed and allows the development of rich coastal vegetation, which is normal for a shallow marsh pond.

Katlanovo Pond hydrology

The small Katlanovo marsh lake belongs to the group of shallow lakes, created in the plain, as a result of fluvial processes and high underground water. According to the wetland hydrologic methodology [23], marsh hydrological condition depends on three hydrologic variables that are useful for characterizing wetland hydrologic behavior, the water level, hydro-pattern, and residence time. Each of these wetland descriptors are described in greater detail in subsequent sections. What follows here is a brief introduction of these concepts

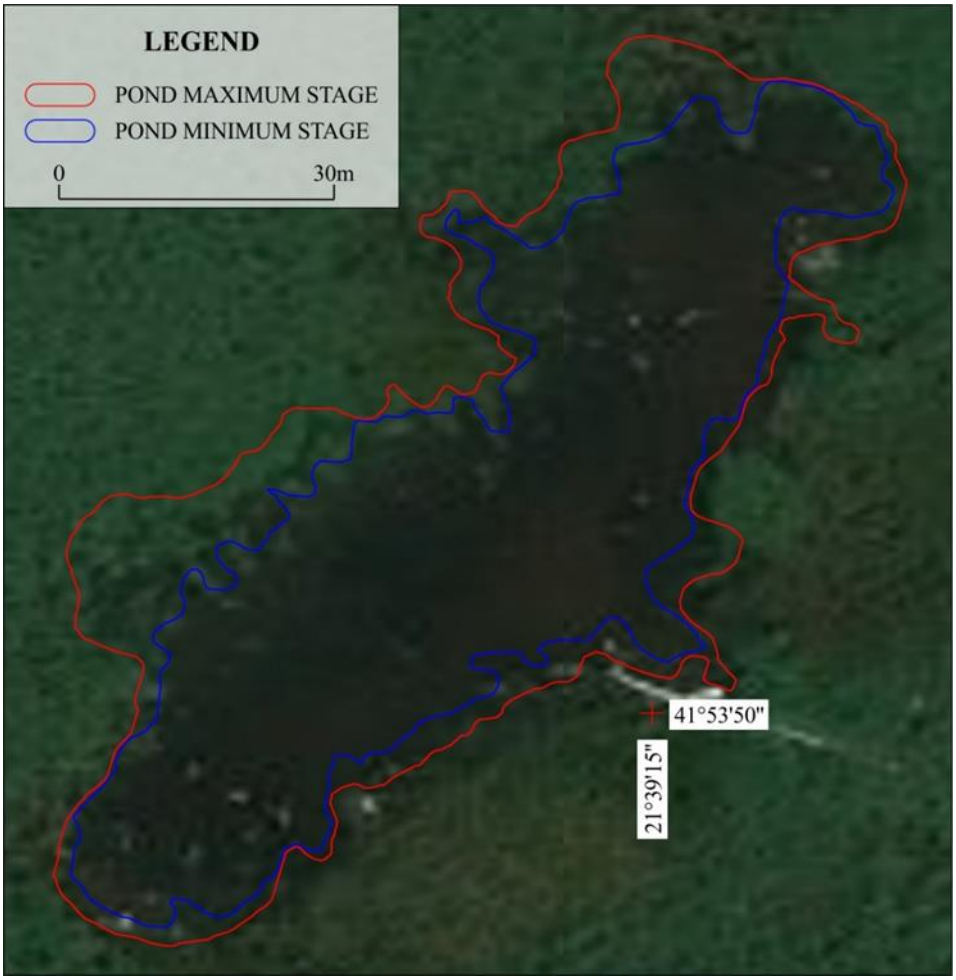

Figure 5. Areal of permanently humid zone and zone under permanent water in the Katlanovo Marsh

The water circulation in the Katlanovo Marsh is also artificial, because of the Rzhanicino channel, which outflows the marsh water for the "Skopsko Pole water irrigation system". The channel structure starts in the south western part of the Katlanovo Marsh and outflows in the East-northeast direction. This hydrological object has no water level monitoring.

One hydrologic descriptor is the general elevation of wetland water levels relative to the soil surface. The water level can, therefore, be used as an indicator of the vegetation types likely to occur in each of these zones.

A second descriptor of wetland hydrology is the temporal variability of water levels. The timing, duration, and distribution of wetland water levels are, together, commonly referred to as the wetland hydro-pattern, which incorporates the duration and frequency of water level perturbations.

The basic information about the Katlanovo Marsh in situation without of lake stage measurement is comparing the groundwater regime by using the nearest piezometric station in Petrovec village. The gauge elevation is 227,3 m a.s.l. This altitude is almost complementary with Katlanovo Marsh altitude 224 m a.s.l.

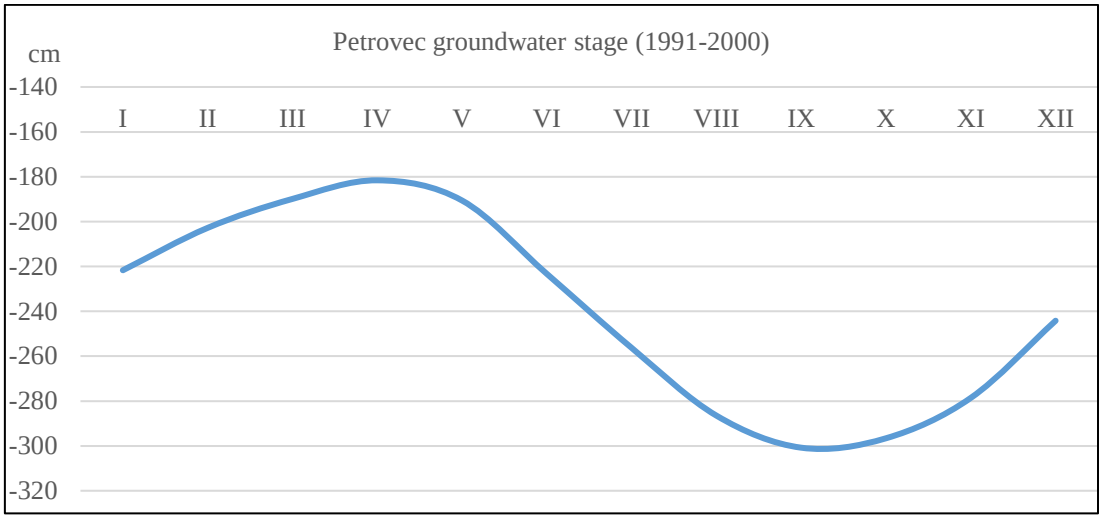

Figure 6. Multiannual monthly groundwater regime at Piezometer Petrovec
Source: National Hydrometeorological Service, Skopje, Macedonia

The Katlanovo Marsh groundwater recharge is crucial during the whole year. It is higher in the spring season, while there decreasing recharge in the dry summer period, particularly in August and September, when the groundwater stage is approximately -3 m, but even then there is a strong connection with marsh lake, which maximum depth is below the absolute groundwater stage minimum. The main groundwater role in permanent existing of the Katlanovo Marsh is in the March, April and May, when the aquifers are charging with precipitation water, but also from the snowmelt process in the surrounding hilly area. Elsewise, the groundwater recharge of the marsh is less intensive in autumn, and even after November it is increased again.

Katlanovo Pond annual water balance depends from the precipitation (P) on the pond aquatorium (A), groundwater recharge (GR) which is predominant factor in the pond existence and the surrounding catchment runoff which is a marginal factor, taking in consideration that the evapotranspiration value (895 mm/year) is significantly larger than the precipitation rate (540 mm/year). The evapotranspiration (〖ET〗_0) was calculated according to the Penmann-Monteauh equation in official United Nations FAO calculator [1, 23].

$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{900}{T+273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)}$$

where:

ET_o	reference evapotranspiration [mm day-1],
R_n	net radiation at the crop surface [MJ m-2 day-1],
G	soil heat flux density [MJ m-2 day-1],
T	mean daily air temperature at 2 m height [°C],
u_2	wind speed at 2 m height [m s-1],
e_s	saturation vapour pressure [kPa],
e_a	actual vapour pressure [kPa],
e_s-e_a	saturation vapour pressure deficit [kPa],
Δ	slope vapour pressure curve [kPa °C-1],
γ	psychrometric constant [kPa °C-1].

Besides in the study area there is no surface gauge, the Runoff (mm) as a significant input hydrological element was determined by the Rational Method, which is connected with dimensionless coefficient (CN) relating the amount of runoff to the amount of precipitation received. It is a larger value for areas with low infiltration and high runoff (pavement, steep gradient), and lower for permeable, well vegetated areas (forest, flat land) [12, 22]:

$$Q = (P - 0.2S)^2 / (P + 0.8S)$$

$$R = Q \times An$$

P	daily precipitation
An	net catchment area (A-Aa)
S	maximum retention potential
S	(1000/CN) - 10
l	related to soil and cover conditions of the watershed through the CN
l	determined by rainfall-runoff plots

Taking in consideration the specific anthropogenic influence on the pond, the water balance for the Katlanovo Pond is:

$$P + G_R + R(I) - O - ET_0 - \Delta S = 0$$

where:
The present study of the Katlanovo Pond water-balance contains the main water balance elements as: precipitation (P), evapotranspiration (ET_0), inflow runoff R(I), groundwater recharge (Gr), outflow (O) and change of the pond water storage ΔS. The equation of all these values should result with 0.

Table 1. Katlanovo Pond water balance (m^3/year)

Water Balance element		m^3/year	%	Inflow/Outflow %
Inflow	P	2770	20	100%
	R(I)	3223	24	
	Gr	7593	56	
Outflow	ET	4590	34	100%
	O	6330	46	
	ΔS (storage)	2666	20	

From the above table and graph, there are six crucial elements, making complete water balance hydrological pattern. The main human influence in pond water loses is presented with the outflow, which result with the multiple decreasing of the Katlanovo Marsh, but particularly the Katlanovo Pond.

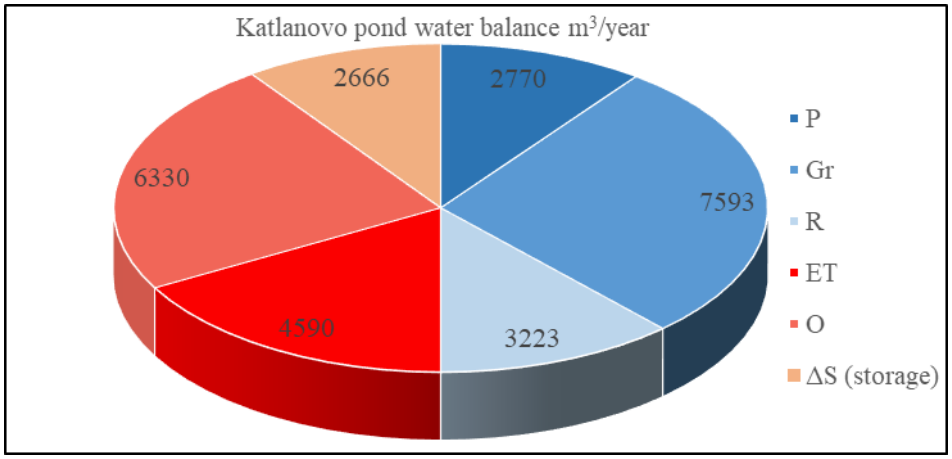

Figure 7. Water balance chart of the Katlanovo Pond

Other similar studies show several possible mistakes occurred with connection of the uncertainty of the parameters estimation in the pond water balance analysis [13]. According to the Brown [2], the total summer precipitation evaporates even in the high geographical latitudes, so the groundwater recharge is crucial for permanent existence of the wetland ponds. The same situation occurred in our analyzed case.

CONCLUSION

Katlanovo Marsh is previously natural, human modified hydrological object in the eastern part of the Skopje basin. The interaction with high underground waters is crutial for its existence. Only a small, a micro hydrological object from the Katlanovo Marsh is Katlanovo Pond. From the total marsh area of 198,5 ha (1985000 m2), only 5130 m2 is pond area. The total pond volume is 11286 m3.The annual water balance depends from the precipitation (P) on the pond aquatorium (A), groundwater recharge (GR) which is predominant factor in the pond existence and the surrounding catchment runoff which is a marginal factor, taking in consideration that the evapotranspiration value (895 mm/year) is significantly larger than the precipitation rate (540 mm/year). The precipitation participates in the suficite with 20% (2770 m3), inflow runoff from the Katlanovo Marsh basin contribution is 24% (3223 m3), and the most significant is groundwater recharge element with 56% (7593 m3) of total inflow. The artificial changes are evident with the built Rzhanichino canal, which made it a main deficite element with a contribution of 46% (6330 m3), highly above the evapotranspiration, ET=34% (4590 m3), and the storage contributes with 20% (2666 m3).

Taking in consideration its Ramsar status, it is very significant for the country environment to protect this last evidence of the ancient Katlanovo Marsh, which was existing in the past. The same situation with remains of the ancient marshes are also located in Pelagonia, Strumica Basin and Ohrid–Struga Plain in Macedonia.

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SECTION

SOCIO-ECONOMIC GEOGRAPHY

CHANGES IN CONSUMER ATTITUDE DURING THE COVID 19 PANDEMIC PERIOD - CASE STUDY CALARASI CITY, ROMANIA

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ABSTRACT

The COVID -19 pandemic affected all economic branches and implicitly the incomes of the population in Romania, as well as in other European and world countries. This study analyzes the attitude of the inhabitants of Calarasi regarding the consumption of food and non-food goods, as well as the way of purchasing, directly or online, between February 2020-November 2021.The methodology used was empirical, a questionnaire, which was completed by 886 people, inhabitants of Calarasi city in Romania. The respondents are between 18 and 75 years old, with different professions and level of education. The data processing was performed, using the SPSS program. The results of the study confirm that there are major changes in attitudes towards consumption. Attitude changes could be identified as follows: first of all, the way of purchasing some goods, the share of online orders has increased, especially among certain age categories of the population; another behavioral change is the quantitative oscillation for certain foods during the period analyzed in the study; a third observation is the attitude of consumers towards the purchase of non-food goods, including tourist services. The results of this study could be a guide for those who work in the production and distribution of goods and services, in order to adapt their distribution according to consumer requirements.

Keywords: pandemic, Covid-19, consumers, attitude, behavior

INTRODUCTION

The COVID 19 pandemic has influenced and continues to influence human behavior related to everything, including behavior related to daily activities, work, transportation, fun or recreational activities and eating. Human behavior is constantly changing, especially during the isolation in lockdown, but also in the period of restrictions. In this case, it is necessary to change the behavior of entrepreneurs and companies that meet the needs of these people. People' needs are maintained but the way they are met is different. Behavioral changes regarding service and food consumption appear gradually and differently, because it takes a period of adaptation to the new situation created.

The creation of food stocks is one of the first gestures manifest by the consumer. This conservation instinct is manifested by the creation of food stocks [12], [11], [8]. In difficult situation, is known this kind of consumer` attitude, especially for food products. The motivation is related to possible crises or shortages that may be created or to the eventual increase of prices [17], [3], [2]. These reserves can create negative effects such as the lack of food on the shelves and also, deterioration of the stored goods, without

being consumed by those who bought them. At the same time, the expenses of those who buy them are quite high at that time [13]. Not only food is purchased but also devices in which food products can be stored. This certainly influence the amount spent on making food reserves. This behavior is supported by a variety of reasons, including psychological [11], [5].

METODOLOGY

The data collection was done by applying a questionnaire in Calarasi, in two stages. A first questionnaire was applied during the beginning of COVID 19 pandemic (March 18-20, 2020).
The second questionnaire was applied more than a year and a half after the outbreak of the pandemic with COVID 19 (November 20-22, 2021).
These two questionnaires followed the behavioral changes of the population from this port city on Danube regarding:

- the consumption of food products, stockpiling of food and non-food goods and consumption of services;
- the way of purchase, directly or online;
- the percentage of purchasing products and services online compared to physical purchases, depending on the age and education of the consumer.

The choice of analyzing the behavior of the population in Calarasi city was influenced by several factors: a first factor can be considered local conservatism. Here, the life of each person is organized according to community` principles. People are a little bit influenced by the attitude of external life. There are connections with the big cities that include Bucharest (the capital city) and with rural environment, but this influence cannot be considered a determining factor in the daily life of inhabitants; another important factor is the power of influence among community members. There are opinion leaders in these local communities. Among them may be teachers, priests or elected leaders of the local administration (mayor).

RESULTS

In analyzing the results for each questionnaire applied, the situation seems to be different. Thus, from the first analysis, based on the questionnaire applied in the beginning of COVID 19 pandemic, the population` behavior is based on the creation of food reserves and less on non-food products. This is the first contact with this virus, and the measures announced by authorities have created a slight panic, manifested by food insecurity for the future and also, fear of illness due to contamination (the methods of disease` transmission are not known). This is exactly what made most of them to have a clear tendency to isolate themselves, after had made a sufficient food supply for a period of at least 2 weeks or more.
After analyzing the results of the questionnaire, it is considered that the virus is contagious, and isolation is a way to reduce the chances of infection, but the creation of food stocks is a justification to avoid the risk of running out of food or having to buy at higher prices. Isolation "until this problem is solved" seems to be the justification of each respondent who resorted to this behavioral method, based on the creation of food reserves.
The answers obtained to questions related to creation of food stocks and possible duration of these purchased goods - "At the time of announcing lockdown for how many days did you buy food supply?" and “What is the reason for creating food and non-food stocks

during COVID 19 pandemic?" confirms the fear of food shortages or rising prices (Table 1 and Fig. 1).
Another reason for food stocks is the fear of rising food prices. Among those interviewed, 32% considered that the price of food will increase and purchasing power is limited, thus are created difficult situations, based on the lack of opportunity to purchase the necessities of daily life (Table 1).

Table 1. The reason for creating reserves of goods and the average reserves` duration created by the population of Calarasi city, in the beginning of COVID 19 pandemic

The results of questionnaire applied between March 18-20, 2020	
The reason for creating food and non-food reserves	*The behavioral effects*
Fear of running out of food; Risk of contamination with COVID 19; Fear of being sanctioned by the authorities through repeated outings to stores Income insecurity; Belief that the price of products will increase, especially for food;	Emptying stores and lack of products on the shelf; Creating stocks of unnecessary products; Disposal of unused perishable products after expiration of validity period (waste of products and unjustified expenses);
Average duration for which they made food and non-food reserves	6-7 days

The disadvantages of creating food stocks are also given by high costs. This buyer "silence" does not have a rational foundation, is an emotional one, given by fear [4]. But there is also an explanation for understanding this type of behavior, resulting from the lifestyle that many formed during communist period when economy was centralized. In that time, the general lack of both food and non-food products created such behaviors; the population was forced to procure elementary products in large quantities, for a life considered "normal." Thus, is a culture of creating reserves [14] [9], [16], [7]. The age of those who practice this behavior is predominantly over 50 years.
The average duration for which were made reserves is 6-7 days. Shorter periods are specified for the purchase of basic products, such as bread or fresh vegetables and fruits, but there are also people who mention "freezing" as a solution to extend shelf life (including bread).
Regarding the way of purchasing products, 92% of them were physically purchased from stores and from agri-food market, through direct relationship between the seller and the buyer. The remaining of 8% were recorded as online transactions, for non-food products and less for long-term food (canned) products. The consumer profile highlights for the beginning of COVID 19 pandemic, that most people were oriented towards the purchase of products directly from stores and agri-food markets (table 2).

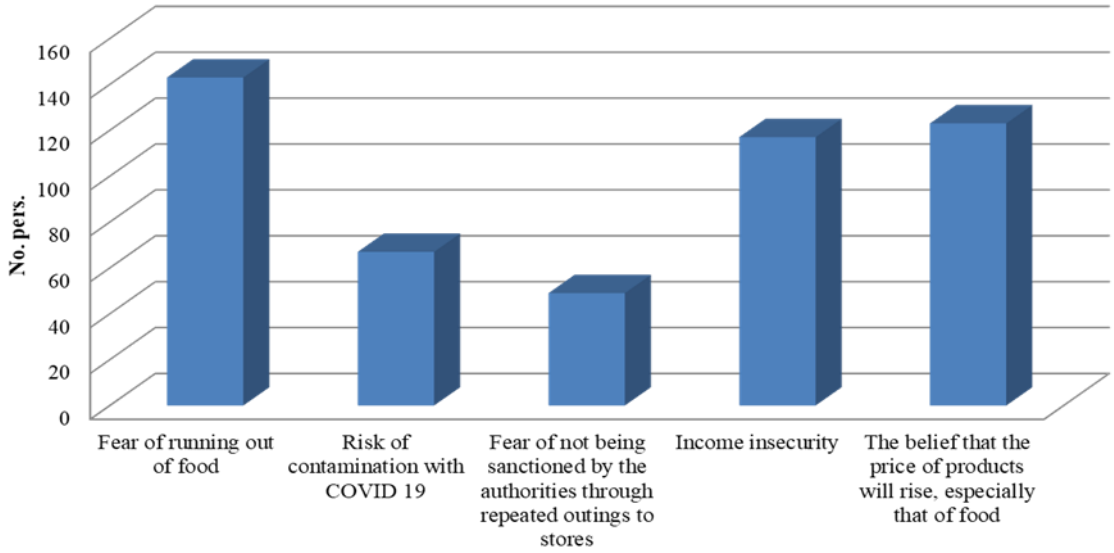

Figure 1. Reason for making food stocks for the population of Calarasi, Romania, between March 18-20, 2020

Table 2. Profile of goods consumer from Calarasi, Romania, from March 18-20, 2020

Consumer profile - **questionnaire applied between March 18-20, 2020**		
	Purchase of products directly - physically	Online shopping
Questionnaire applied to a sample of 200 people	93% of those surveyed	7% of those surveyed
Education	57% primary and secondary school 36% high school 7% university	28% high school 72% university
Women/Men	62% women / 38% men	13% women/ 87% men
Income	under 1000 lei – 17% 1000-2500lei – 45% above 2500lei – 38%	above 2500 lei – 100%
Age	18-24 years– 16% 25 -34 years – 22% 35-54 years – 23% 55-64 years – 19% 65 -84 years – 18% above 85 years– 2%	18-24 years – 1% 25-34 years – 47% 35-54 years – 29% 55-64 years– 23 %

After more than a year since COVID 19 pandemic outbreak, the behavior analyzed for the population in the same city, offers a changing image regarding the population`attitude, both the way in which goods are purchased but also in the quantities of goods purchased. The second questionnaire was applied more than a year and a half since COVID 19 pandemic outbreak, between November 20-22, 2021, on a sample equal to the first one, 200 people. When people were asked about the creation of food and non-food reserves ("If a new lockdown is required for how many days will you buy food?"), can be observed a change in attitude. The average time resulted from respondents' statements is 2-3 days, compared to the previous average of 6-7 days.

The biggest difference in obtained answers is found in the way of product purchase - physically from stores and markets or online. Making online purchases increases quite a lot, taking into account the short period. Among the respondents oriented on online shopping, most refer to both food and non-food purchases (clothing, cosmetics,

appliances, computers, tablets, phones, etc.). For food products, the prepared products are preferred. On the first place are complete menus and pizza, to which are added others, including cakes. This way of purchasing products is influenced by several factors: the most important is familiarity of many people with computer activity, online work, including school courses or other activities that have been carried out in this way. Familiarization with the virtual environment also favored the sector of acquisition of goods through the virtual space [9], [1], [13].

The age of those who have adapted more easily to a behavior based on the purchase of goods through the Internet, is mostly between 25 and 54 years. This is possible because of receptivity to something new, in this case virtual environment but also to material possibilities, financial availability to acquire the needed goods (Table 3).

For direct purchases, from stores and public markets from local producers, there are still many people, more than half, in general those who want to have the opportunity to choose their products following their direct observation [6], [15], [7], the pleasure of buying the needed product, the desire to socialize and, out of habit. There is also the inability to shop online, due to the lack of knowledge or necessary means. The elderly population but not only them are in this category. Along with them are young people, with a low level of education or those with low incomes, who do not have the necessary means.

Table 3. Changes in profile of goods consumer from Calarasi, Romania, November 20-22, 2021

Consumer profile - **questionnaire applied between November 20-22, 2021**		
	Purchase of products directly - physically	Online shopping
Questionnaire applied to a sample of 200 people	72% of those surveyed	38% of those surveyed
Education	59% primary and secondary school 34% high school 9% university	39% high school 61% university
Women/Men	59% women / 41% men	24% women / 76% men
Income	under1000 lei – 38% 1000-2500lei – 43% above 2500lei – 19%	above 2500 lei – 100%
Age	18-24 years – 9% 25 -34 years – 17% 35-54 years – 21% 55-64 years – 22% 65 -84 years – 29% Peste 85 years – 2%	18-24 years – 11% 25-34 years– 47% 35-54 years – 29% 55-64 years – 13 %

The change in attitude and behavior of the population towards the development of recreational and commercial activities is visible [10]. This is due to vaccination, which has created confidence in immunization against this virus, but there is also a greater risk of "we learn to live with the virus" or "that's it, we go on."

This trust has a logical basis, the one of vaccination, and on the other hand, the resumption of economic, social and cultural activity creates a general good condition

CONCLUSIONS

The COVID 19 pandemic has brought great behavioral changes among Romanian population, regardless the living place, urban or rural. These changes affect the attitude that the inhabitants of a city may have, such as Calarasi city, vis-à-vis the quantity of necessary goods that must be purchased, the type of products and the way of purchasing

them. Thus, many have understood that making reserves creates discomfort for other residents due to the lack of products on the shelf, and for those who buy them it is a big financial effort, and waste can be added to the negative effects.
Regarding the type of products purchased, there are changes. Many people were oriented towards the acquisition of means necessary to carry out an online activity: computers, tablets, smartphones, etc.
At the same time, many Romanians in Calarasi city stated that they had never accessed the Internet, did not have and did not know how to use a computer, a tablet or send an e-mail. Also, they have become more open about buying the needed goods online and found this action easier and less demanding.
However, there is also a less pleasant aspect in this way of shopping: lack of socialization! The elderly are the ones who want more socialization, they are used to a way of life in which can exercise and shop at the same time. For them, shopping in a market is a way of life. The pandemic had a negative effect on them, due to the lack of opportunities at leaving the house.
Between the two analyzed periods the differences are clear. The population was unprepared for a secluded life in their own home and with a virtual activity in the first period and much more prepared for such a life in the second period.
Over time, the population' confidence in the medical system and in the role that new drugs and the vaccine can play, creates a state of behavioral balance of the population in this Romanian port city, Calarasi.

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A NEW VISION FOR THE CENTRAL AND EASTERN EUROPE TOURIST SUBREGION[1]

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ABSTRACT

The tourist subregion of Central and Eastern Europe is one of the four subregions of the European tourist region. Before the crisis of 2020, the subregion registered the highest growth rate in its tourism within the European region which gives the World Tourism Organization reason to consider it as the most promising in Europe. The modern tourist subregion of Central and Eastern Europe consists of 21 countries. They are located not only in Europe, as the name of the subregion suggests, but in large parts of North and Central Asia. The countries are united by their common past in the Eastern bloc. From the socialist past originate the lower price levels preserved to this day, which are a common feature of the countries of the considered tourist subregion of Central and Eastern Europe. This is where the similarities end. The large territorial scope and the presence of a large number of countries leads to large differences within the subregion. The lack of homogeneity calls into question the real existence of such a tourist subregion. This gives us a reason to analyze critically the existence of the current tourist subregion of Central and Eastern Europe and to suggest its transformation. In order to prove our working hypothesis of heterogeneity between the countries and the need for transformation of the current tourist subregion, we use and analyze a significant amount of digital information provided by various international organizations monitoring world tourism as well as own calculations and analyzes.

Keywords: Central and Eastern European tourist subregion, international tourism, tourist destinations, tourist flows, opportunities for transformation

INTRODUCTION

The Central and Eastern European subregion registered the highest growth rate in its tourism within the European tourist region before the crisis of 2020, which gives grounds of the World Tourism Organization to consider it as the most promising in Europe. [10] A number of publications also report on the activities and prospects for tourism growth in the tourist subregion of Central and Eastern Europe. For example, Stankova points out new opportunities for developing the concept of boutique hospitality. [7] Apostolov considers the countries of Central Europe and Russia as one of the modern geographical poles to advance the science of tourism. [1] "Several Southeastern European governments have identified tourism as a priority sector to foster economic growth, paving the way for future policy reforms." [3] Banaszkiewicz, Graburn and Owsianowska outline as promising for the subregion types of tourism related to identity and memories such as

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commemorative tourism, as well as the revival of religious and ethnotourism. [2] Central and Eastern Europe are listed as one of the hotspots in the world for the development of adventure tourism by the Trade Association for Adventure Tourism (ATTA). [19] Other authors are more skeptical. They point out that "with a dynamic mix of mass and niche markets to target, the potential of rural tourism development in South-eastern Europe continues to be constrained by regional instability. [8] According to Nikolov, Lyubomirova and Tanakov the South-eastern European countries are lagging behind the other European states in the development of accessible tourism policy and practice. [6] The publication of New Trends and Opportunities for Central and Eastern European Tourism makes a significant contribution to the study of the peculiarities of tourism in the subregion.[5] The number of tourists from Asia is expected to increase, as well as the number of guests from the age group 65+ [22] Despite the pandemic, 277 new hotels are expected to open in Central and Eastern Europe by 2024, predominantly with four and five stars. Most of them will be in Poland (62) and Russia (61). Leading cities in the number of new hotels will be Budapest (14) and Moscow (11). [24]

The tourist subregion of Central and Eastern Europe is part of the European tourist region. Geographically, however, most of its territory is located in Asia. The subregion comprises 21 countries that are territorially dispersed, ethnically, culturally and religiously different, but with a common historical past. The countries also differ in the tourist resource potential, as well as in the degree of tourism development. All this calls into question the real existence of the tourist subregion of Central and Eastern Europe as a homogeneous whole and raises the question of whether a tourist subregion formed on the basis of a geopolitical principle is rather a mechanical sum of heterogeneous countries in tourism development. This is the working hypothesis of the present study.

The focus of the study are the countries of the tourist subregion of Central and Eastern Europe. These are 21 countries - Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Estonia, Latvia, Lithuania, Belarus, Ukraine, Moldova, Russia, Georgia, Armenia, Azerbaijan, Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan. They are located not only in Europe, as the name of the subregion suggests, but in large parts of Northern and Central Asia. The countries are united by their common past in the Eastern bloc. However, this does not include the countries of the Western Balkans, which originate in the former Yugoslavia (Serbia, Bosnia and Herzegovina, Croatia, Slovenia, Montenegro, Kosovo, Northern Macedonia) and Albania, which in other sources belong to Eastern Europe [16] [17] [18] [20] [21] [22] UNWTO classifies them as the tourist subregion of Southern Europe and the Eastern Mediterranean.

The subject of the study is the current state of tourism in the countries of the tourist subregion of Central and Eastern Europe, reported by basic and derived indicators characterizing the tourism industry.

The purpose of this article is to analyze the current state of tourism in the tourist subregion of Central and Eastern Europe, as well as to offer a vision for its future development. To achieve this goal it is necessary to solve a series of research tasks

- to choose an appropriate methodology according to the set goal;
- to select relevant and reliable sources of information;
- to analyze and present suitably the collected and processed information;
- to formule conclusions and recommendations.

The study encountered a number of difficulties and limitations in its conduct. The large-area region makes it difficult to study it extensively on the spot (in situ) and accordingly limits the opportunities of author's direct observations. This is a prerequisite for using

mainly ready-made (secondary) information provided by authoritative sources. Another difficulty is that some countries do not provide data of the surveyed indicators, and the data for other countries are not completely up-to-date. This in turn makes it difficult to compare and analyze between countries. We strive to use up-to-date and representative data. For some of the indicators data from 2020 or the beginning of 2021 are used (number of population, area, number of sites in the UNESCO list, etc.). On the other hand, the data from 2019, when tourism in the world and respectively in the subregion reaches its maximum progressat this stage, can be considered representative in terms of the state and development of the tourism industry. Therefore, the data from 2019 have been selected and used for most indicators characterizing tourism. However, this creates a contradiction between the pursuit of relevance and the pursuit of representativeness.

METHODOLOGY

Data from a number of established and prestigious world organizations have been used to determine the place of the countries from the Central and Eastern European tourist subregion in international tourism. The World Tourism Organization (UNWTO) monitors and analyzes the state of international tourism in over 200 countries around the world by providing up-to-date statistics. Data from the World Economic Forum, which ranks 140 countries in the world on a significant set of various indicators related to their tourism development, were also used. We also examined the UNESCO list of the World Cultural and Natural Heritage.

For the purposes of the analysis 2 types of indicators were used:

- basic

Such are tourist arrivals (excluding transits) and their modification and revenues from international tourism. They are examined by current UNWTO statistics. We also include reports on the number of sites in the list of World Cultural and Natural Heritage, the area of the countries and the number of their population.

- synthetic (derivatives)

Some of them are calculated and provided by the cited international organizations. Such are changes in arrivals, changes in revenues from international tourism, assessment of tourism, share of tourism in GDR, share of tourism in exports, share of tourism in exports of services.

Other derivative indicators are the share of arrivals in Europe and the subregion, revenues from one tourist, share of revenues from international tourism in Europe and the subregion, tourism efficiency, tourism intensity, density of sites included in the UNESCO list. These indicators are calculated and analyzed by the author on the basis of the main indicators. The obtained numerical indicators are presented in tables and diagrams. The tables are used for the purpose of relatively comprehensive presentation of a large amount of information. Charts are used to illustrate key indicators. The presented data are interpreted using general logical methods - analysis, synthesis, induction, deduction, generalization. Through the use of general logical methods, conclusions have been drawn and recommendations have been made.

TOURIST GEOGRAPHICAL LOCATION

The tourist-geographical position largely determines the tourist attractiveness of the countries and regions, although in itself it is not a tourist resource. It is important to clarify not just where a site is located, in this case the Central and Eastern European tourism

subregion, but above all how it interacts with major tourist markets, what is the accessibility to transportation services, and how the geographical location largely determines the tourist resource potential and the development of tourism industry in these countries.

Figure. 1: Countries in the Central and Eastern Europe tourism subregion [25]

Geographically, the Central and Eastern Europe tourist subregion covers not only Eastern Europe and large parts of Central Europe, but also the whole of North Asia and large parts of Central Asia (Fig. 1). This is the subregion that extends most widely in an east-west direction, covering almost half of the globe. The meridional subregion falls mainly in the temperate latitudes, covering parts of the subtropical and subpolar zones.

The area of the subregion is 23 167 985 km2, which is 15.5% of the land surface of the Earth. It includes 21 countries that differ significantly in area and demographic potential (Table 1). Near ¾ of the subregion is occupied by Russia. Another country with a significant area is Kazakhstan. The other countries are small (Czech Republic, Slovakia, Hungary, Estonia, Latvia, Lithuania, Moldova, Georgia, Armenia, Azerbaijan - a total of 10 with an area of less than 100 thousand km2) or medium in area (Poland, Romania, Bulgaria, Belarus, Ukraine, Turkmenistan, Uzbekistan, Tajikistan, Kyrgyzstan - a total of 9 with an area of 100 thousand km2 to 1 million km2). Therefore, there are strong territorial disparities between the countries in the subregion. On the one hand, there is a strong territorial fragmentation between a large number of small and medium-sized countries, and on the other hand, there are the giants Russia and Kazakhstan, covering 85.5% of the territory of the subregion.

The differences in the territorial scope largely determine the differences in the tourist resource potential of the countries. Countries with a small territory naturally have a more limited number of sights, places of interest and tourist sites. Large countries, on the other

hand, find it difficult to absorb and improve the huge spaces for the needs of tourism. Practice shows that the most successful countries in tourism are medium-sized countries.

Table. 1: Basic data for the countries in the tourist subregion Central and Eastern Europe

CountriesS	Area in km^2 [9]	Share of total area in % [2]	POPULATION in millions.[13]	Share of the population of the region in % [3]	The most famous tourist places and sites - tourist symbols
Poland	312 690	1,34	37,9	9,7	Old Torun, Old Krakow, Velichka Salt Mines
Czech Republic	78 870	0,34	10,7	2,7	Prague with Charles Bridge, Charles Boil, Brno
Slovakia	48 845	0,21	5,5	1,4	Bratislava, Kosice, Banska Bystrica
Hungary	93 030	0,40	9,6	2,5	Budapest - Parliament and Fishermen's Towers, Lake Balaton
Romania	238 390	1,02	19,1	4,9	Castles in Bran and Peles, the Palace of Parliament
Bulgaria	110 990	0,48	6,9	1,8	Black Sea coast, Madara horseman, Rila monastery, the Rose valley
Estonia	45 230	0,19	**1,3**	**0,4**	Tallinn, castles
Latvia	64 600	0,28	1,9	0,5	Riga - the old town, castles
Lithuania	65 300	0,28	2,7	0,7	Kaunas, Trakai Castle
Belarus	207 600	0,89	9,4	2,4	Nesvizh Castle, lakes
Ukraine [4]	603 700	2,61	43,7	11,2	Yalta, Kiev, Odessa
Moldova	33 840	0,15	4,0	1	The monasteries of Capriana, the town of Orheiul Vechi
Russia	**17 075 400**	**73,70**	**145,9**	**37,3**	St. Petersburg, Moscow, Lake Baikal
Georgia [5]	69 700	0,30	3,9	1	Tbilisi, the old capital Mtskheta, monasteries
Armenia	**29 800**	**0,13**	3,0	0,8	Yerevan, monasteries
Azerbaijan	86 600	0,37	10,2	2,6	Sheki, Naphthalene, mud volcanoes
Kazakhstan	2 724 900	11,76	19,0	4,9	Astana, Almaty
Uzbekistan	447 400	1,93	33,7	8,6	Samarkand, Khiva and the Silk Road, Tashkent, Kazalkum Desert
Turkmenistan	488 100	2,10	6,1	1,6	Ashgabat with the highest minaret
Kyrgyzstan	199 900	0,86	6,6	1,7	Tianshan Mountain, glaciers and lakes
Tajikistan	143 100	0,62	9,6	2,5	Pamir Mountains, lakes
Total	**23 167 985**	**100**	**390,7**	**100**	

Significant differences are also observed in the population. This subregion includes the most populous European country, Russia, but most countries have small population (less

[2] Own calculation
[3] Own calculation
[4] UNWTO considers Ukraine as a single country and provides data for the whole of Ukraine
[5] UNWTO views Georgia as a united country

than 10 million people). More than 390 million people or 5% of the world's population live in the subregion. The largest population is in Russia , where more than 1/3 of the population in the subregion. However, the country has some of the least populated areas on the planet. Most countries in the subregion have limited demographic potential, e.g., Estonia, Lithuania, Latvia, Georgia, Moldova (less than 4 million). The small population can be seen as a constraint on development. This speaks of limited demographic potential, which affects the quantity and quality of human resources, and as we know, tourism is a service industry in which the human factor is of paramount importance. Ukraine, Poland, Uzbekistan, Kazakhstan, Romania, the Czech Republic, and Azerbaijan (over 10 million) have significant human resources. Therefore, these countries can be considered as the largest potential generators of tourist flows. Probably this is one of the essential prerequisites for these countries to report growth in various indicators of their tourism industry. The location of the subregion can be defined as at crossroads. Important roads connecting Europe and Asia pass through it. This is a condition for significant traffic of human beings and goods, including those coming for tourist purposes, as well as transit.
Most of the countries are located in the continental interior of Eurasia, which limits their access to the sea, as well as predetermines the strong continental features of the climate - the Czech Republic, Slovakia, Hungary, Moldova, Belarus, Armenia, Azerbaijan, Kazakhstan, Turkmenistan, Uzbekistan, Kyrgyzstan and Tajikistan - a total of 12 countries, ie. more than half of the countries in the subregion. This fact can be considered as a significant obstacle to their tourist development, due to the territorially predetermined impossibility for development of the most widespread type of tourism, namely sea tourism. This is the reason why many of these countries are oriented towards the development of cultural tourism, mountain tourism and other types of specialized tourism, along with their function to generate potential tourist flows.
Other countries such as Lithuania, Latvia, Estonia and Poland have access only to the cold Baltic Sea, which is also a limiting factor for beach recreation, but contributes to the development of cruise tourism. Russia can also belong to this group, because over 90% of its coastline belongs to cold seas. A small number of countries have access to a warm sea coast. These are Ukraine, Romania, Bulgaria, Georgia and a small part of Russia; they are connected to the oceans through the Black Sea. The location of the Black Sea as the southern border of the subregion in relatively warm latitudes is a favorable prerequisite for the best development of beach recreation along the Black Sea coast. Although the Caspian Sea is essentially a lake, its coast can also be seen as a favorable precondition for the development of tourism and recreation in Azerbaijan, Kazakhstan, Turkmenistan and Russia. Lake Balaton in Hungary has well-defined recreational functions. The most significant generators of tourist flows in the subregion are Russia and Poland as countries with the largest population and relatively good socio-economic indicators. However, their citizens choose destinations mainly outside Central and Eastern Europe and the preferences are mainly focused on the tourist subregion of Southern Europe and the Eastern Mediterranean. Most incoming tourists are from other EU countries, but their trips are mainly to EU member states in the studied subregion due to the relaxed access regime and it is not an exaggeration to say that the Asian part remains unknown to them.
The location of the countries in the subregion is also strategic. They are on the verge of sharing influence between Russia and the Western geopolitical space on the one hand, and between the Christian and Muslim geocultural belts on the other. From a linguistic point of view, the Slavic languages in the north and west and the Turko-Altaic languages mainly in the south and east are predominant. In connection with these and other

differences, as well as in connection with the small territorial and demographic potential of most of the countries in the subregion, they rather combine and strive to balance these differences and find it more difficult to defend their own positions. This makes them dependent territories, which is largely true for their tourism development. The low solvency of a large part of the population is a prerequisite for their transformation into the cheapest destinations within the European tourist region. Therefore, the natural-geographical location of the countries can be considered as a limiting factor for the development of tourism and in particular the most popular type – sea tourism. Another limiting factor for tourist travel is the location of the subregion in two different geopolitical areas (European Union - Russia), which is accompanied by a visa regime between some countries. From the point of view of the location in relation to the main emitting tourist markets, the location of the Central and Eastern Europe subregion is rather favorable. The European tourist region has the most intensive tourist trips in the world, which is a prerequisite for the formation of a significant inflow of tourists from Europe. On the other hand, China is the southeastern border of the subregion, which can also be seen as a favorable precondition for the formation of a significant inflow of tourists from the world's largest generator in the future.

TRANSPORT ACCESSIBILITY

The transport accessibility of the countries is facilitated by the predominant flat and hilly relief in most of the territory of the Central and Eastern European subregion. This is a requirement for the unimpeded use of road and rail transport. The Trans-Siberian Railway passes through the entire territory of the subregion, which is also used for the purposes of tourist transport. On the other hand, the harsh conditions of the North, as well as the huge distances, make the use of land transport difficult and irrational. In this connection, air transport is becoming increasingly important. Key airports in the subregion are Moscow and Warsaw, which has a significant impact on the number of arrivals in Russia and Poland. Moscow airports make important connections with large parts of Asia, and transatlantic flights to America are made via Warsaw. It can be expected that air transport will continue to strengthen its position both in relation to the relative reduction in the cost of air transport and due to the implementation of important intercontinental air connections. The use of water transport is the most limited. There are conditions for cruises on the shores of the Baltic and Black Seas, as well as on the major rivers - Volga, Dnieper, Dniester and Danube. At present, only the potential of the Baltic Sea as a link to Northern and Western Europe is well used in this respect.

PLACE IN WORLD TOURISM

The Central and Eastern European tourism subregion is part of the world’s leading tourism region, namely Europe. This is the region with the best developed tourism in the world at this stage. 58% (2020) of the world’s tourist flows and 38.7% of the revenues from tourism in the world (2019) are concentrated in it. [12] In the European tourist region, the arrivals of international tourists as well as the revenues from international tourism are unevenly distributed between subregions and destinations, but are relatively more balanced than in the rest of the world’s tourist regions. The leading subregion in both indicators is the Southern European and the Eastern Mediterranean sub-region, followed by the Western European subregion. The subregions of Central and Eastern Europe and Northern Europe are more modestly represented. Belonging to the European

tourist region is a good prerequisite for intensive incoming and outgoing tourist flow; there are conditions to strive for high standards in tourism and favorable prospects for future development. On the other hand, the Central and Eastern European subregion ranks last among the other subregions in the European tourist region in terms of revenues from international tourism. The reasons for this are related to the lower prices of tourist products in the subregion, which is largely due to the lower payment opportunities of domestic tourists. The Central and Eastern European subregion ranks third in the European tourist region in terms of international tourist arrivals. According to this indicator, the subregion is less attractive to Southern Europe and the Eastern Mediterranean, as well as to Western Europe, which has older traditions in tourism and a significantly longer coastline.

MAIN INDICATORS FOR TOURISM

Table 2 characterizes the state of the tourism industry by key indicators such as number of arrivals of international tourists, changes in arrivals, share of arrivals in the subregion and share of arrivals in the European tourist region.

Table. 2: Arrivals to the countries of the Central and Eastern European tourist subregion in 2019 or 2018. (marked with *)

Countries	Number of arrivals in millions [12]	Share of arrivals among the countries of the subregion in % [6]	Share of arrivals in the European tourist region in % [7]
Poland	21,158	13,8	2,8
Czech Republic *	14,283	9,3	1,9
Slovakia*	5,453	3,6	0,7
Hungary	16,937	11,1	2,3
Romania	2,684	1,8	0,4
Bulgaria	9,312	6,1	1,2
Estonia	3,345	2,9	0,4
Latvia	1,935	1,3	0,3
Lithuania	2,875	1,9	0,4
Belarus	2,201	1,4	0,3
Ukraine	13,438	8,8	1,8
Moldova	0,174	0,1	0,02
Russia	24,592	16,0	3,3
Georgia	5,080	3,3	0,7
Armenia	1,894	1,2	0,3
Azerbaijan	2,864	1,9	0,4
Kazakhstan	There are no actual data	-	-
Uzbekistan	6,749	4,4	0,9
Turkmenistan	There are no actual data	-	-
Kyrgyzstan	8,508	5,6	1,1
Tajikistan *	1,250	0,8	0,2
Total /average	153,271	100	20,5

In 2019, more than 153 million tourists traveled to the countries of the Central and Eastern European subregion. These are 1/5 of all arrivals in the European tourist region. In table.

[6] Own calculations
[7] Own calculations

2 and FIG. 2 we can compare the countries according to the indicator number of arrivals of international tourists and respectively the share of the countries according to this indicator. Leaders of the researched indicator in the subregion are Russia and Poland. Hungary, the Czech Republic, Ukraine and Bulgaria also have leading positions. Uzbekistan, Slovakia, Georgia and Estonia are also characterized by more significant incoming tourist flows. The other countries form an insignificant share (less than 2%) of the arrivals in the subregion. These are Romania, Lithuania, Latvia, Belarus, Moldova, Armenia, Azerbaijan and Tajikistan. There are no up-to-date data for Kazakhstan and Turkmenistan, which shows that tourism is not yet a priority for these countries. Therefore, almost half of the countries in the subregion are characterized by weak incoming tourist flows, which indicates the weak development of the tourism industry there.

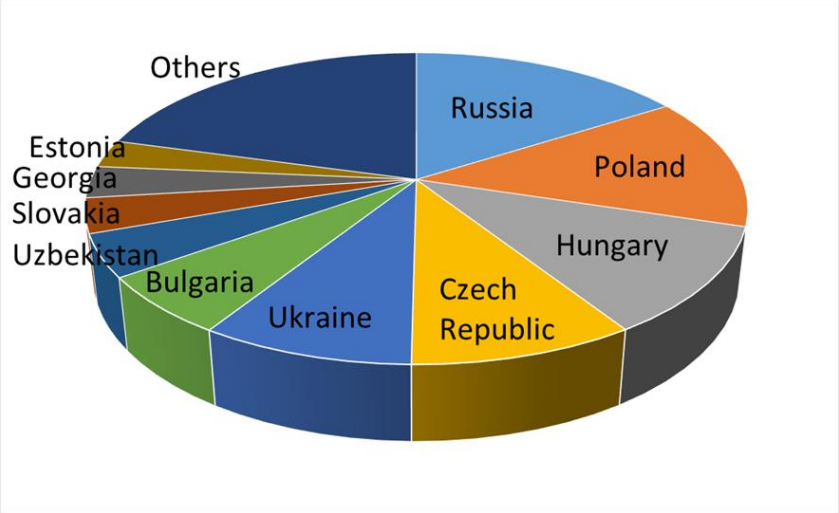

Figure. 2: Distribution of incoming international tourist flows among the countries of the tourist subregion Central and Eastern Europe.

The subregion recorded an overall growth in arrivals in 2019 of + 4.8%. The numbers are very different in terms of the development of the industry analyzed through changes in incoming tourist flows before the pandemic. As early as 2019, some of the countries in the subregion reported a decline in arrivals: Slovakia, Hungary, Latvia, Romania and Ukraine. At the same time, other countries are experiencing growth, as is the case in most countries in the subregion. The largest growth was recorded in the Central Asian republics - Tajikistan, Uzbekistan, Kyrgyzstan, with Tajikistan reporting an extremely large increase in arrivals of + 190% in just 1 year. This high value is related not only to the growth in the industry, but also to the low baseline of the arrivals of international tourists. Significant growth (over 5%) is also demonstrated by Armenia, Georgia, Moldova, Azerbaijan and Poland. Therefore, arrivals in the subregion before 2020 are increasing, but this trend is unstable and unevenly distributed among the countries. This shows some development of the tourism industry in this part of the world but still timid and unconvincing.

Table 3 gives us information about the financial part of the tourism industry through the indicators revenues from international tourism, changes in revenues and share of revenues in the subregion and the tourist region of Europe.

Table. 3: Revenues from tourism of the countries of the tourist subregion of Central and Eastern Europe in 2019

Countries	Revenues in billions of USD [12]	Share of revenues among the countries of the subregion in %[8]	Revenue share in the European tourist region in %[9]
Poland	13,705	19,9	2,3
Czech Republic	7,303	10,5	1,3
Slovakia	3,203	4,7	0,6
Hungary	7,305	10,6	1,3
Romania	3,576	5,2	0,6
Bulgaria	4,287	6,2	0,7
Estonia	1,745	2,5	0,3
Latvia	1,017	1,9	0,2
Lithuania	1,493	2,1	0,3
Belarus	0,901	1,3	0,2
Ukraine	1,620	2,4	0,3
Moldova	0,396	5,8	0,07
Russia	10,961	15,6	1,9
Georgia	3,269	4,8	0,6
Armenia	1,528	2,2	0,3
Azerbaijan	1,792	2,6	0,3
Kazakhstan	2,463	3,6	0,4
Uzbekistan	1,481	2,1	0,3
Turkmenistan	There are no actual data	-	-
Kyrgyzstan	0,644	0,9	0,1
Tajikistan	0,014	0,02	0,02
Total /average	68,701	100	11,9

In 2019, the countries of the tourist subregion of Central and Eastern Europe have raised over 68 billion USD revenues from international tourism. However, this is less than 12% of the revenues in the European tourist region. Table 3 and FIG. 3 show that the leading countries in terms of international tourism revenue are Poland and Russia, followed by Hungary and the Czech Republic. Bulgaria, Moldova, Romania, Georgia and Slovakia also generated more significant revenues. It is noted that most countries reach a share of over 2% of revenues in the region, which means that revenues are more evenly distributed among the countries than arrivals. Poland displaces Russia from the first position. Poland generates more revenue from fewer tourists than Russia, indicating higher price levels. Poland, the Czech Republic and Hungary are located on the western periphery of the subregion. Accordingly, a large part of their incoming tourists are from Western Europe due to the territorial proximity and facilitated travel in the EU, which is associated with higher solvency of tourists and thus the opportunity to impose higher price levels.

[8] Own calculations
[9] Own calculations

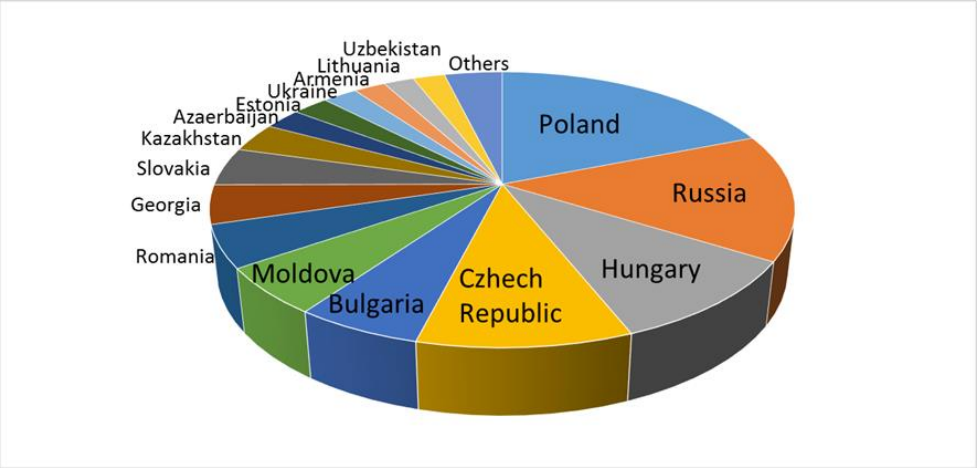

Figure. 3: Distribution of revenues from international tourism among the countries of Central and Eastern Europe in 2019.

Table 3. also shows that in 2019 almost all countries in the subregion have growth in revenues from international tourism. is the highest growth is in the Central Asian republics - Tajikistan, Uzbekistan and Kyrgyzstan, which, together with the growing arrivals, indicates a boom in tourism in these countries. High growth (over 10%) is also reported by Hungary, Romania, Ukraine and Armenia. Therefore, they can talk about rapid development of the tourism industry. Growth is significant (over 5%) in Kazakhstan, Poland and Slovakia. Only Russia and Azerbaijan report a decline, and in Azerbaijan it is large. Overall in the subregion the growth is significant (+ 8.9%), therefore, we can conclude that there is an active movement of the tourism industry, which will lead to its stronger development in the near future and a stronger performance of the Central and Eastern Europe in the European and world tourism. This growth will be uneven not only in territorial but also in temporal aspect. The biggest boom can be expected in the countries of Central Asia and the Caucasus republics, which are just beginning to make full use of their tourism potential. On the other hand, destinations in the western part of the region are more favored by the proximity of major European emitting tourism markets. In addition to the already mentioned Poland, the Czech Republic and Hungary, this also affects Estonia, which demonstrates the highest values of revenue of all the Baltic republics due to its close contacts with Scandinavia. The countries of the eastern part of the subregion rely mainly on the Russian emitting tourist market. It is quite promising in connection with the increase in travel of Russians, due to improvement in their socio-economic situation, increasing incomes, as well as the demand for new places for tourism.

ADDITIONAL AND DERIVATIVE INDICATORS

Table 4 provides information on the importance of the tourism industry for the countries by examining the following indicators: share of the incoming international tourism in the country's GDP, contribution of tourism to the formation of exports, contribution of tourism to the formation of services' exports to the countries of the tourist subregion Central and Eastern Europe. On average, for the Central and Eastern European tourism subregion, tourism forms 4.9% of GDP, which means that tourism is a well-represented industry, but the subregion does not rely on it. International tourism is most the important in the formation of GDP of Georgia, Armenia, Bulgaria and Estonia (over 7%). Therefore, the economies of these countries are highly dependent on tourism, which adversely affects

them in times of crisis, for example in 2020. Tourism is the least important in terms of GDP for Russia, as well as for Romania, Ukraine, Kazakhstan (less than 2%), which have other priority sectors in their economic development

Table. 4: Additional indicators characterizing international tourism in the countries of the Central and Eastern European tourism subregion

COUNTRIES	Share of incoming international tourism in the GDP of the countries in %	Share of incoming international tourism in the formation of exports of countries in %	Share of incoming international tourism in the formation of services' exports of the countries in %
Poland	2,7	4,8	22,7
Czech Republic	3,4	4,3	27,3
Slovakia	3,1	3,3	27,6
Hungary	6,2	7,2	35,6
Romania	1,4	3,2	11,9
Bulgaria	7,8	11,7	47,3
Estonia	7,6	10,2	20,9
Latvia	3,0	5,0	17,0
Lithuania	2,7	3,2	12,2
Belarus	2,0	2,9	13,6
Ukraine	1,7	3,8	14,4
Moldova	4,4	14,5	33,9
Russia	1,1	3,7	28,9
Georgia	21,7	39,5	78,3
Armenia	9,9	26,3	59,8
Azerbaijan	6,0	11,1	60,3
Kazakhstan	1,6	4,0	36,3
Uzbekistan	2,6	9,3	47,8
Turkmenistan	No data	No data	No data
Kyrgyzstan	6,0	18,7	61,1
Tajikistan	2,3	15,3	70,6
average	4,9	10,1	36,4

Tourism forms 1/10 of the exports of the countries from the tourist subregion of Central and Eastern Europe. Table 4 and fig. 4 show that tourism forms an extremely large share of exports of Georgia, Armenia, Moldova, Kyrgyzstan, Tajikistan, Bulgaria, Azerbaijan, Estonia, Uzbekistan, which indicates the strong dependence of these countries on the tourism industry and the weak export development of their economies at this stage. The least important is tourism in the exports of Belarus, but also for Russia, Slovakia, Romania, Lithuania, Ukraine (less than 4%). The share of tourism in the export of services in the tourist subregion of Central and Eastern Europe is 36.5%. Therefore, the subregion, although not a leader in Europe, is highly dependent on the tourism industry, which forms more than 1/3 in the export services sector. This dependence is most pronounced in Georgia, but also in Tajikistan, Kyrgyzstan, Azerbaijan (over 60%). Therefore, the economies of these countries are the most dependent on tourism and consequently the most vulnerable in the tourism industry in times of crisis. In half of the countries in the subregion, tourism accounts for over 1/3 of the exports of services, which confirms the essential and even leading importance of this industry in the economies of the countries. The smallest share in the field of services is formed by tourism in Romania, as well as in Lithuania, Belarus, Ukraine (less than 15%), which indicates that the economies of these countries are the least dependent on tourism.

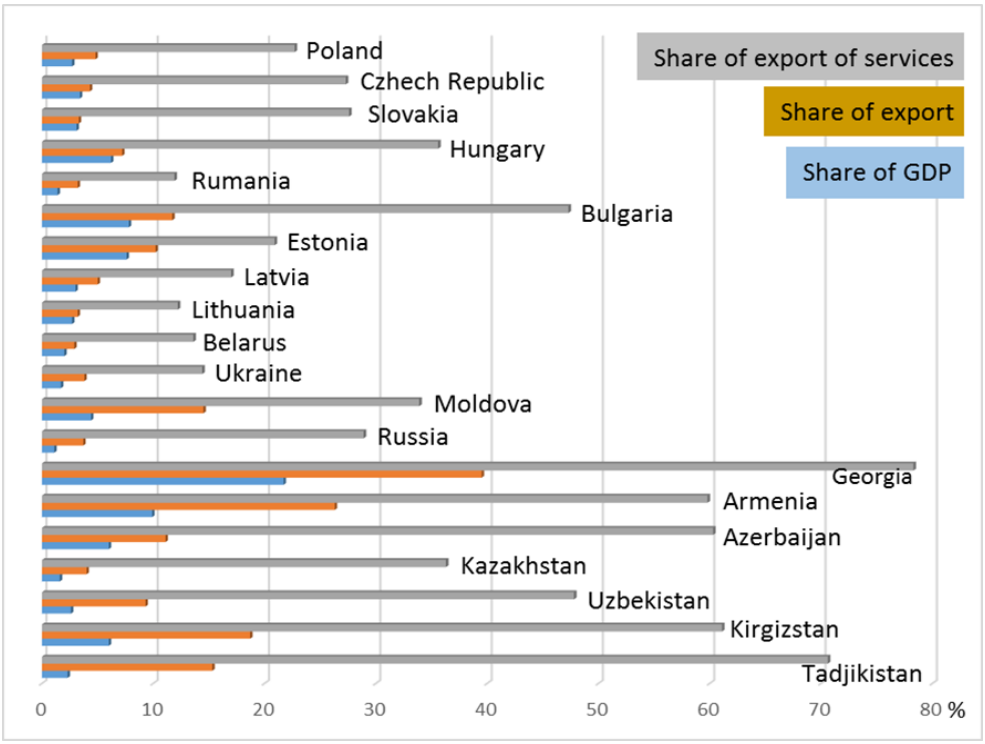

Figure. 4: Comparison between the countries of the Central and Eastern European tourism subregion by the indicators Share of tourism in the GDP of the countries and Share of tourism i n the export of the countries and Share of tourism in services export of the countries

In Table 5, Figure. 6 and Figure. 7, a comparison is made between the countries of the tourist subregion of Central and Eastern Europe in terms of derivative indicators characterizing international tourism, namely income per tourist, tourist intensity and tourist efficiency.

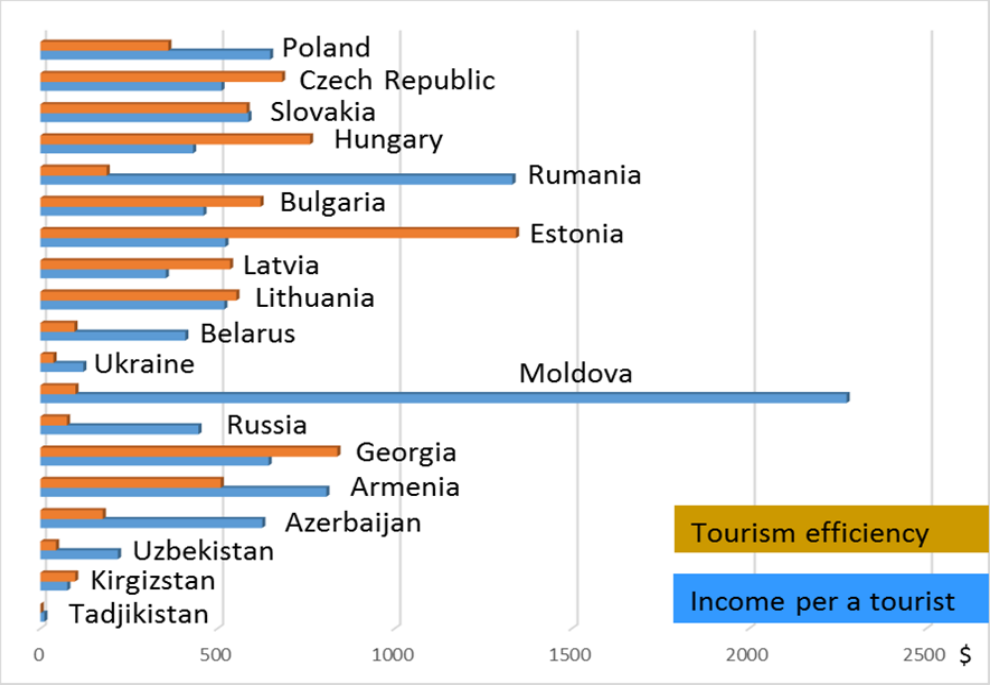

Figure. 5: Comparison between the countries of the Central and Eastern European subregion according to the indicators Income per tourist and Tourism efficiency

Table. 5: Derivative indicators characterizing international tourism in the countries of the Central and Eastern European tourism subregion in 2019[10]

COUNTRIES	Income per tourist in USD	Tourist intensity	Tourist efficiency in USD
Poland	648	0,6	361
Czech Republic	511	1,3	682
Slovakia	587	1	582
Hungary	431	1,7	761
Romania	1 332	0,1	187
Bulgaria	460	1,3	621
Estonia	522	2,5	1 342
Latvia	354	1	535
Lithuania	519	1,5	553
Belarus	409	0,8	96
Ukraine	121	0,3	37
Moldova	2 275	0,03	99
Russia	446	0,2	75
Georgia	644	1,3	838
Armenia	807	0,6	509
Azerbaijan	626	0,3	176
Kazakhstan	-	-	130
Uzbekistan	219	0,2	44
Turkmenistan	-	-	-
Kyrgyzstan	76	1,3	98
Tajikistan	11	0,1	1
Average	448	0,8	376

Estonia has the highest tourism efficiency due to its small population, on the one hand, and the realization of significant revenues from international tourism, on the other. In many countries, however, tourism efficiency is very low due to the reasons already discussed. Such countries are Tajikistan, Ukraine, Uzbekistan, Russia, Kyrgyzstan, Belarus. It is noted that they are all in the eastern part of the subregion.

Estonia, Hungary, Lithuania, the Czech Republic, Bulgaria, Georgia and Kyrgyzstan are distinguished by high values of tourist intensity. Most of them have small population, which leads to the fact that the number of tourists arriving in a year is more than the citizens of the country, and this burdens the social environment. However, there are no countries in which the values of tourist intensity are too high (over 3). Countries with low and very low values of tourist intensity (below 0.5) predominate significantly. Such are Tajikistan, Uzbekistan, Azerbaijan, Russia, Ukraine, Romania. This is related to the larger population of these countries, but also indicates the weaker development of tourism. The majority of their population has neither direct nor indirect contact with tourists, which limits their opportunities to generate income from the tourism industry.

Relevant data that can be used to compare the countries of the Central and Eastern European tourism subregion are provided by UNESCO and the World Economic Forum. They are presented in table. 6 and Figure. 8

[10] Own calculations

Table 6: Comparison between countries according to UNESCO and the World Economic Forum

COUNTRIES	Number of sites on the UNESCO list [24]	Density of UNESCO sites per 100 thousand km^{-2} [11]	Place in the rankings The Travel & Tourism Competitivness Index [15]	trend	Evaluation according to The Travel & Tourism Competitivness Index [15]	trend
Poland	17	5,4	42	↑	4,2	↑
Czech Republic	16	**20,3**	**38**	↓	**4,3**	↑
Slovakia	8	16,4	60	↑	4,0	↑
Hungary	8	8,6	48	↑	4,2	↑
Romania	9	3,8	56	↑	4,0	↑
Bulgaria	10	9	45	↓	4,2	↑
Estonia	2	4,4	46	↓	4,2	=
Latvia	2	3,1	53	↑	4,0	=
Lithuania	4	6,1	59	↓	4,0	↑
Belarus	4	1,9	-		-	
Ukraine	7	1,2	78	↑	3,7	↑
Moldova	**1**	3	103	↑	3,3	↑
Russia	**30**	**0,2**	**39**	↑	**4,3**	↑
Georgia	4	5,7	68	↑	3,8	↑
Armenia	3	10	79	↑	3,7	↑
Azerbaijan	3	3,5	71	=	3,8	↑
Kazakhstan	5	**0,2**	80	↑	3,7	↑
Uzbekistan	5	11,2	-	-	-	-
Turkmenistan	3	0,6	-	-	-	-
Kyrgyzstan	3	1,5	**110**	*	**3,2**	*
Tajikistan	2	1,4	104	↑	3,3	↑
Total / average	**146/ 7**	**5,3**	**65**	↑	**3,9**	↑

Legend: ↑ Improving the position / grade
↓ Lowering the position / grade
= Keeping the same position / grade
* New in the ranking

UNESCO annually updates the number of sites included in the List of World Cultural and Natural Heritage and enriches it with new ones. As a result, at the beginning of 2022, the list contains 1154 sites in 167 countries, including all countries in the studied tourist subregion. The average number of sites in a country is close to 7. Table 6 shows that Russia has the largest number of sites on the UNESCO List, followed by Poland, the Czech Republic and Bulgaria. The other countries have less than 10 sites. The lowest number is in Moldova (1), as well as in Estonia, Latvia and Tajikistan (2 sites each).
The different number is due both to the different cultural priorities of the countries in terms of applying for the List, the preservation and maintenance of the sites, and to their different territorial scope. Therefore, the derivative indicator Density of sites on the UNESCO list per 100 thousand km2 is also used here. This indicator gives a good idea of their concentration and distribution. According to this indicator, the most densely populated sites are in the Czech Republic. Slovakia, Uzbekistan and Armenia also have a high density of sites. The other countries have less than 10 sites per 100 thousand km2 or less than 1 site per 10 thousand km2, which makes the sites relatively distant from each other and to some extent makes it difficult to connect them in tourist routes. The average

[11] Own calculations

density of sites under UNESCO protection for the region is about 5 sites per 100 thousand km2. The lowest density of sites is in Russia and Kazakhstan, due to the large area of these two countries. Other countries with very low density of sites are Belarus, Ukraine, Turkmenistan, Kyrgyzstan, Tajikistan, which is associated, on the one hand, with their significant area and, on the other hand, with the small number of sites in each of them. Due to its large area, the country with the largest number of sites Russia has the lowest density of their distribution. The following regularity is observed: the countries with a large territory have a larger number of objects, but rather low density, and the countries with a small territory have a smaller number of objects, but they form a significantly higher density. The UNESCO list continues to be enriched with new sites from the subregion. The newly added are from the Czech Republic (2), Russia (1), Poland (1) Slovakia (1), Romania (1), Georgia (1). This is 21% of all new sites in the world, which testifies to the rapidly improving position of the subregion in the world map

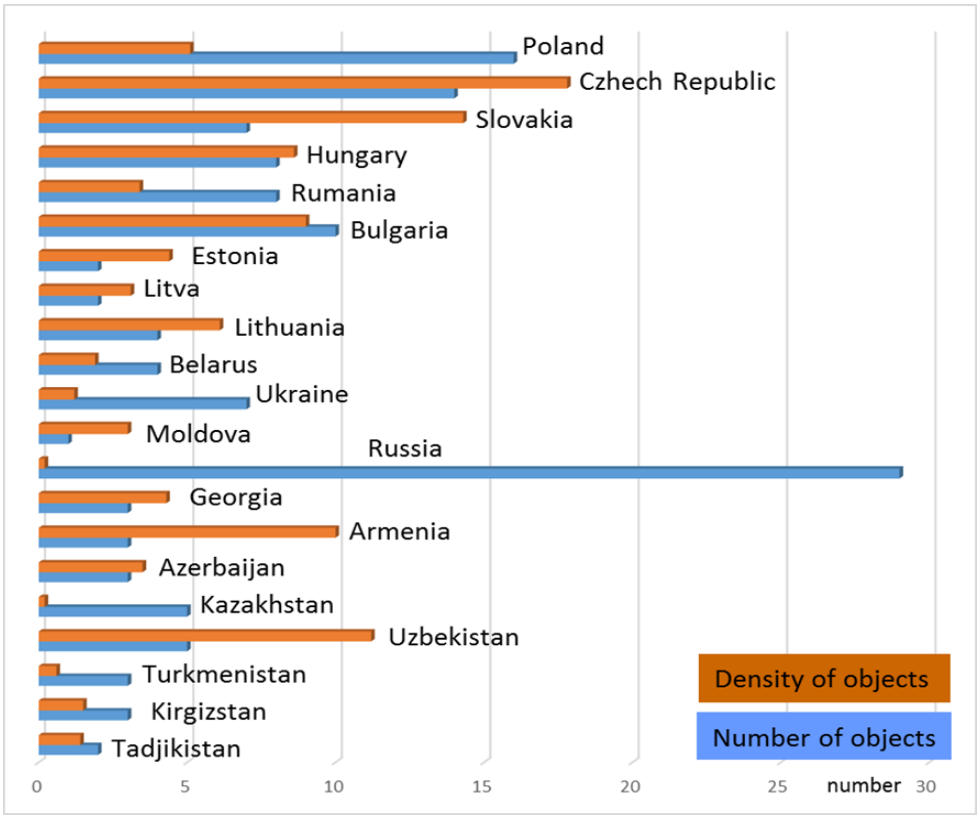

Figure. 6: Comparison between the countries of the Central and Eastern European tourist subregion according to the indicators Number of sites in the UNESCO list and Density of sites per 100 km2

The World Economic Forum regularly compiles and presents a ranking reflecting the state of the tourism industry of the countries in the world, regarding a number of indicators. This makes the assessment complex and extremely accurate. The latest edition of 2019 includes 140 countries from around the world. It also includes most countries in the tourist subregion of Central and Eastern Europe. Table 5 shows that the highest scores in this ranking belong to the Czech Republic (4.3) and Russia (4.3), which are respectively in front positions (38th and 39th). The rating of Kyrgyzstan is lowest, which takes 110th position with a score of 3.2. Belarus, Turkmenistan and Uzbekistan remain outside the ranking, although Uzbekistan is ranked 115th in the 2017 ranking. Kyrgyzstan is included in the ranking for the first time. Calculating the average score for the region we get 3.9,

and as it can seen the countries with a score of 4.0 (Slovakia, Romania, Lithuania and Latvia) and 4.2 (Poland, Hungary, Bulgaria, Estonia) are thr most.
Compared to the previous edition of the ranking in 2017, we observe some positive trends. Almost all countries have raised their ratings. This is to some extent reflected in the movement of many of them to higher positions in the rankings. There are considerable changes in:

- Ukraine, which moves from 88-th to 78-th position;
- Romania, which moves from 68-th to 56-th place;
- Russia, which moves from 43-rd to 39-th position

The ratings of these countries have increased by 0.2, which is a significant progress for such a short period and speaks of a rapid pace in the development of tourism and, more specifically of improvment in the quality of the tourism industry in these countries.

OPPORTUNITIES FOR TRANSFORMATION

The review shows that the tourist subregion of Central and Eastern Europe includes a large number of diverse countries. They were united not at random, but on the basis of their common past in the Eastern bloc. Thirty years after the disintegration of the socialist camp, however, there are not so many similarities between the countries as far as tourism is concerned. They can be marked in the following directions:

- The countries do not have the same characteristics and are not homogenious in the current subregion. They differ significantly in the main indicators in tourism such as the arrival of international tourists, revenues from international tourism.
- The countries differ significantly in the derivative indicators characterizing the tourist activities, namely income per tourist, tourist intensity, tourist efficiency, share of tourism in GDP, tourism share in countries' exports , share of tourism in exports of services.
- The assessment of the tourism industry of the countries in the subregion made by the World Economic Forum is also different, as the differences of the countries by position in the ranking are especially large.

The most significant similarity is that the countries of the subregion are characterized by maintaining relatively low price levels, which has a negative impact on revenues from international tourism and tourism efficiency. But even on this indicator there are significant differences between the countries in the western and eastern part of the subregion. This is due to the fact that this is the most extensive tourist subregion in the west-east direction, which inevitably leads to differences. Geographically, much of the subregion's territory is located in Asia and not in Europe, which calls into question not only the name but also the existence of the subregion in its current form.
The conclusion from these differences is that the tourist subregion of Central and Eastern Europe needs transformation. The subregion needs to be transformed into a more territorially compact area of a more homogeneous type. This is the only way to become a real tourist subregion.
The proposed transformation can be carried out in the following directions:

1. Preserving the existence of the Central and Eastern European tourist subregion within the European tourist region, but with a new scope. It is reasonable to include in the subregion Poland, the Czech Republic, Slovakia, Hungary, Romania, Estonia, Latvia, Lithuania, Belarus, Ukraine, Moldova, Russia, Georgia, Armenia and Azerbaijan - a total of 15 countries that are functionally related to the countries of the European tourist region through their incoming and outgoing tourist flows.

2. Establishment of a tourist subregion of Central Asia within the Asia-Pacific tourist subregion. It is reasonable for the subregion to include Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan and Tajikistan. These are 5 countries with a total area of over 4 million km2 and a population of over 70 million people, which is reasonable enough for these countries to become a separate tourist subregion. These countries are characterized by similar characteristics of their tourism, which is a prerequisite for homogeneity and, accordingly, for the existence of an independent tourist subregion. The Central Asian republics have a significant and specific tourist resource potential, which is yet to be discovered by international tourists. In some of them there is a rise in the tourism industry, which may grow into a boom in tourism in Central Asia in the near future. It can be expected that these tourists sites are most often visited by tourists from China and Russia, due to the territorial neighborhood, the demographic and economic potential of these generators. Due to all this, it is not right for these countries to be depersonalized within a significantly larger subregion.
3. Bulgaria's transition to the tourist subregion of Southern Europe and the Eastern Mediterranean. Geographically, Bulgaria is a Balkan country and therefore part of Southern Europe. International tourist flows to and from Bulgaria are formed mainly by the countries of the Southern Europe and Eastern Mediterranean subregion. These are 38.3% of incoming international tourists and 65.8% of outgoing international tourists in 2019. For comparison, the current tourist subregion of Central and Eastern Europe forms 31.7% of the incoming tourists of Bulgaria, and only 16.8% of the outgoing tourist flows from Bulgaria were directed to it in 2019. Therefore, it can be summarized that Bulgaria not only territorially but also functionally belongs to the tourist subregion of Southern Europe and the Eastern Mediterranean and its assignment to the tourist subregion of Central and Eastern Europe is artificial.

CONCLUSION

The studied indicators show that the most significant generators of tourist flows in the subregion are Russia and Poland. Russia, Poland, Hungary, the Czech Republic, Ukraine and Bulgaria receive the most tourists. The largest revenues are from international tourism in Poland, Russia, Hungary, the Czech Republic. The review of the current state of tourism in the current tourist subregion of Central and Eastern Europe leads to the conclusion that the differences between the countries in the subregion are more than the similarities. A similarity and a unifying factor for the countries of the tourist subregion of Central and Eastern Europe is their common historical past in the so-called Eastern bloc from the time of the Cold War. This fact still predetermines lower price levels, but also lower tourism efficiency in these countries compared to other parts of Europe. However, the socialist past passed more than three decades ago during which the countries are already members of various international organizations and supranational structures and therefore develop in different ways. This inevitably affects their socio-economic characteristics, including the peculiarities of their international tourism. Today there are significant differences in all considered indicators between the countries of the subregion. Revenues from international tourism, revenues per tourist and tourism efficiency are higher in the countries of the western part of the current tourist subregion of Central and Eastern Europe.
Countries located in the eastern part are just beginning to develop their international tourism more intensively, which is associated with a higher growth of international tourist arrivals, as well as higher growth of revenues from international tourism. They have

significant tourism resource potential. A favorable prerequisite for them is the proximity of the largest Asian generator of tourist flows, namely China. The observed heterogeneity, as well as the large territorial scope of the region, including large parts not only in Europe but also in Asia, are the main markers showing the need for transformation of the subregion according to modern realities.

The new Central and Eastern European tourism subregion should include European countries, as well as Russia and the Caucasus republics. Bulgaria should belong to the tourist subregion of Southern Europe and the Eastern Mediterranean, not only because of its location on the Balkan Peninsula, which is part of Southern Europe, but also because of the connection of the tourism industry of Bulgaria with the countries of Southern Europe. The Central Asian republics (Kazakhstan, Turkmenistan, Uzbekistan, Tajikistan and Kyrgyzstan) should form their own tourist subregion of Central Asia, not only because of their location in Central Asia, but also because of the presence of sufficient common features and the growth of tourism in them. The Central Asian tourist subregion should be part of the Asia-Pacific tourist region.

The proposed new division guarantees continuity with the current division of tourist subregions, on the one hand. On the other hand, the new division will be in line with modern realities and future prospects and will therefore more accurately reflect the current state of international tourism and ongoing processes. Accordingly, the new division will be more functionally suitable for observations, analyzes and forecasts as far as international tourism is concerned.

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RIVER TOURISM AS A FACTOR FOR THE DEVELOPMENT OF THE DANUBE TOURIST REGION – BULGARIA[12]

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ABSTRACT

Rivers are the basis of many human activities, including tourism - with the typical activities that can be carried out along them (cruises, sailing, rafting, fishing, etc.). Prerequisites for this are the attractiveness of their shores (diverse landscapes, flora and fauna), as well as the rich cultural and historical heritage of nearby cities.
River tourism is an alternative type of tourism that uses rivers for recreational and leisure activities, including excursions and walks in nature, swimming and sports. It stimulates the development of the respective territories and generates various opportunities for economic and social impact. The growing demand for such locations for recreation, entertainment and memorable experiences allows the renewal of river areas, their enrichment with new attractions and modern features, creating a new image of these destinations.
The aim of this study is to analyze the place and importance of river tourism for one of the nine separate tourist regions of Bulgaria - the Danube region. The study presents the general theoretical framework of water tourism, examines the potential of river tourism in the country, focuses on the relevant infrastructure along the Bulgarian coast and highlights the contribution of river tourism to the future and sustainability of the region.

Keywords: rivers, river tourism, Danube river, infrastructure, Danube tourist region – Bulgaria

INTRODUCTION

Water as a socio-natural materiality [5] is crucial not only for the maintenance of biological life, but also for social and cultural relations through its numerous interactions with humans. It has a special place in tourism, which is historically associated with holiness and religiosity and, later, with the ideas of well-being and health, established today with the development of spas and seaside resorts. Tourists enjoy the numerous sensory, spiritual and aesthetic experiences that water provides - from the dynamic drama of waterfalls to the quiet creeping of glaciers - and appreciate its erosive and creative impact on landscapes. Water as a tourist resource allows for a number of activities that can be carried out on, in or near lakes, rivers, estuaries, reservoirs, canals, seas and oceans. People consume it, swim or dive in it, snowboard, skate and ski in it when it is frozen, go down the rapids, sail the seas, travel the canals.

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The Danube is one of the largest rivers in Europe. Along its length of 2,888 km. the river crosses or is a border for the countries Germany, Austria, Hungary, Croatia, Serbia, Bulgaria, Romania, Moldova and Ukraine. Through the Rhine-Main-Danube canal it crosses the whole continent and connects most of the European countries. The river is an economic factor, energy resource, trade route, important artery, cultural route, historical witness and a factor determining the identity of peoples. [8] In recent decades, its tourist importance has increased significantly. The tourist product, created due to the growing interest, is based not only on the river and water, but also on the population, cities, culture, art, landmarks, opportunities for sports, entertainment, recreation.

Tourism is a multifaceted phenomenon. There is a great variety not only of the types of tourism that are practiced, but also of the criteria by which these types are distinguished. When the nature of the geographical environment in which the tourist activities are carried out is accepted as a leading criterion, sea, mountain, rural, urban, lake (lakeside), river (riparian) tourism, etc. can be distinguished. While maritime, mountain and now rural tourism are relatively well studied, the role of rivers as a tourist resource and river tourism are still out of focus.

The object of this study is the Danube tourist region of Bulgaria. The subject of the study are the state and prospects for tourism development in the region. The aim is to characterize the tourist functions of the relatively less studied Bulgarian section of the Danube. In order to achieve the set goal, the problems of the territorial definition are considered, a review of the tourist resource potential is made, the modern tourist development is characterized and the perspectives for future development are discussed.

According to the Concept for the tourist zoning of Bulgaria, the Danube tourist region includes the Bulgarian section of the Danube River, the adjacent islands, as well as the territories south of the river. The region is the largest of all nine designated tourist areas in the 2015 strategic document of the Ministry of Tourism. [19] It covers a total of 21% of the country's territory and 16% of its population. It includes 67 municipalities, which are part of 11 districts.

NATURE, FEATURES AND SIGNIFICANCE OF RIVER TOURISM

Rivers concentrate a wide variety of human activities, and tourism and recreation are just some of them. River tourism can be defined as a type of tourism that takes place along a river, as the river is the purpose of tourist travel and is directly related to the activities practiced by tourists. Rivers are a significant natural water flow, which flows in a well-formed natural river bed and are fed by surface (mostly rainwater) and groundwater. [9] Despite significant fluctuations in water volume, the flow is continuous. The rivers differ significantly according to their location and are divided into mountain rivers and valley rivers. The mountain rivers flow in narrow and deep valleys with a significant slope and high speed, while the plain rivers flow through wide and terraced river valleys with low speed. Depending on their water volume, rivers are defined as small and large. As there are no generally accepted criteria for the distinctive features of such a division, it is conditional.

The use of rivers is multifaceted. Undoubtedly, they are huge reservoirs of fresh water. Their waters are of special importance in agriculture for irrigation, as well as for water supply of inhabited areas. They are particularly important for transport and trade, as well as for industry. They are an important resource not only for the energy sector, but also for a number of other industries. Globally, the use of rivers for recreation is growing, and fishing in them is being transformed from a means of subsistence into a tourist attraction.

The tourist functions of the rivers are determined not only by their waters, but also by the presence of gorges, canyons, etc. interesting rock formations, as well as waterfalls, cascades, rapids, karst forms, etc. Wetlands, which are formed mainly in the lower reaches of rivers, are a specific landscape inhabited in many cases by rare and endangered species of plants and animals and they are of interest to nature lovers. All these features are a prerequisite for the great variety of tourist activities that can be practiced along rivers and form the dimensions of the concept of river tourism. The use of rivers for tourism is usually associated with cruises. However, only large rivers allow such. A number of rowing sports can also be practiced. Smaller rivers are suitable for canoeing, rafting, canyoning. Rivers are used for swimming to a lesser extent due to the lower temperatures of the running waters in the temperate and northern latitudes, as well as due to the presence of dangerous representatives of the fauna in the warmer natural areas. Fishing has traditionally been related to rivers, but growing environmental problems and pollution (especially in Europe) call for its limitation and control. Wetlands along rivers and especially in deltas are of paramount importance for ecotourism. The coasts are used for recreation (beach), as well as for sightseeing tours with natural and cultural-historical orientation. Some rivers are the subject of pilgrimages because they are considered sacred and are associated with a number of rituals and beliefs. The banks of many rivers have been inhabited since ancient times. Some of the first settlements in the world appeared near them. Today, many archeological finds have been discovered that are of interest not only to connoisseurs.

These tourist functions are not universal. They are differentiated according to the location of the river, as well as depending on whether we consider its sources, upper, middle, lower reaches or estuaries. The springs (especially of the big rivers) have always attracted people's curiosity. They are often associated with traditions, legends and religious beliefs. The upper reaches are clean and fast. They are suitable for fishing and some water sports such as rafting. The middle currents are used for recreation, sailing, as well as for sightseeing tours - visiting various sites of cultural, historical and cognitive value such as ancient mills, bridges, tepavitsas, historical sites associated with various events, old ships often of historical value. In the lower reaches the rivers are larger, their waters are calmer and flow through more densely populated areas. This determines their use for various rowing sports, cruises, recreation. The estuaries (especially when they are deltas) are subject to ecotourism, photo hunting, bird watching, rowing, panoramic walks. [1] [11]

RIVER TOURISM IN BULGARIA

There are over 1,200 rivers in Bulgaria. The total length of the river network is 19,761 km. However, only 30 of them are over 100 km long and only 2 have catchment areas over 10,000 km2. Most of the rivers are small and dry up in summer. These features are determined by the small area, diverse terrain and climatic specifics in the country.

However, river tourism in Bulgaria is one of the earliest types of tourism, along with sea and mountain tourism. As early as the 19th century, boating began to acquire a tourist character. The beginning of river tourism in Bulgaria is considered to be 1889, when the first company with such a goal was founded - "Swan". In the following years this type of activity took a serious position in Bulgarian tourism along a number of Bulgarian rivers: Iskar, Ogosta, Yantra, Vit, Osam, Struma, Maritsa, Tundzha, Arda, etc. Tourist trips during the summer season are carried out at the mouths of the rivers Kamchia and Ropotamo. Kayak is practiced on the Yantra, Danube, Rusenski Lom, Arda (Kardzhali dam), etc. The Arda rivers (recreational, water sports, fishing) Tundzha (ecotourism),

Rusenski Lom (nature-cognitive and cultural-cognitive tourism), Iskar (canyoning, fishing), etc. develop their significant tourist and resource potential.

On March 17, 1935 on the state pontoon of the port of Ruse was held the opening ceremony of the first passenger shipping on the Danube under the Bulgarian flag. After the official part in Ruse, the passenger ship Vit sailed for Vidin, and the passenger ship Iskar sailed from Vidin to Ruse. These are also the first ships available to the newly established River Coastal Navigation Service of the Railways and Ports Directorate. In 1940, the National Assembly passed the Law on Bulgarian River Navigation, and the directorate was transformed into an independent structure - shipping company "Bulgarian River Navigation" based in Ruse. In just a few years, the shipping company's activity grew, and the fleet was replenished with more and more vessels. Until the Second World War, the company has some of the most modern Danube 4 express cargo and refrigerator ships, 3 large luxury passenger ships ("Tsar Boris III", "Queen Joanna" and "Tsar Simeon"), a ferry for rail transport wagons and passengers between Bulgaria and Romania, tractors and barges. After the Second World War, the shipping company "Bulgarian River Navigation" began the accelerated construction of a series of vessels in the shipyards in Ruse, Burgas and Varna and in various European countries. In the early 90's its fleet numbered almost 300 vessels - pushers, passenger and express ships, open and closed barges, oil, specialized, ro-ro sections, etc. [265]

Today, the Bulgarian Shipping Company is one of the most authoritative and well-established carriers on the Danube transport market, servicing the cargo turnover of the Danube countries and the transit between Western and Eastern Europe, from Sulina and Constanta on the Black Sea to Mainz on the Rhine.

The only Bulgarian company specializing in river cruise tourism is Danube Tours. [30] It enjoys good reputation both on the domestic and international market, offering its customers professionalism, responsibility and emotion from unique travels. The company is the successor of the Balkantourist established in 1948. It made its first steps in cruising on the Danube in 1983 with the purchase of two passenger ships - "Sofia" and "Ruse", which were built in a Dutch shipyard. They have 4-star category and are suitable for cruises on the Danube from the German city of Passau to the Danube Delta. Seeing the prospects in the development of river cruise tourism, shareholders are investing in expanding shipping capacity and in recent years renovated and renewed their vessels annually. In 2004 the ship "Ruse Prestige" was built (capacity 160 passengers, 40 crew), whose area of navigation is from Amsterdam on the Rhine to the Danube Delta. In 2006, two new ships were purchased, which are smaller in size and allow for greater flexibility and coverage of other areas of navigation on European waterways – "Heinrich Heine" (capacity 110 passengers, 30 crew) and Elegant Lady (capacity 128 passengers, 32 crew). In 2012, the fleet of Danube Tours increased with the ship "Ariana" (160 passengers and 40 crew). The company is becoming an integral part of the European tourist market, successfully continuing the traditions of Bulgarian passenger shipping.

In the spring of 2019, the company's newest flagship was launched - the motor ship "Adora" (191 passengers and 48 crew). The modern court meets the latest trends in river navigation, both in terms of technical and operational characteristics and in terms of comfort of guests on board. It is 135 m long and 11.40 m wide. It has 95 cabins on three decks (some of them have French balconies). In addition to the usual for this type of ships - a main restaurant and a panoramic bar, a stern restaurant has been built, which offers alternative menus of choice, and tourists can watch how their food is prepared.

Currently, Danube Tours AD owns 4 river cruise ships with a total capacity of 640 beds, which cover 80% of the famous cruise destinations in Europe. They transport tourists from Western Europe, USA, Canada, Russia, Bulgaria, etc. The crews are Bulgarian, fluent in German and English. Highly qualified master chefs offer specialties from the Bulgarian and international cuisine. There are all-day animation programs, including presentations of Bulgarian folklore, competitions, fun games, tasting of Bulgarian wines, etc.

Bulgaria is also a participant in the International Tourist Regatta TID (German Tour International Danubien) on the Danube, held annually since 1956. This is the longest rowing trip in the world of this kind and is a 2.5-month boat trip. It is organized by the tourist associations of the participating countries. Since 1968, the regatta always starts at the end of June from Ingolstadt (Germany). It passes through the other co-organizing countries - Austria, Slovakia, Hungary, Croatia, Serbia, Bulgaria and Romania. It ends in the first week of September after 2516 km in Sfantu Gheorghe (Romania) on the Black Sea. Some participants sail the whole distance every year, others only some stages of it, according to their desire and abilities. The beginning for Bulgaria was set in 1964. In 1966 a full Bulgarian stage was suggested, which ended in Ruse. Three years later it was extended to Silistra, where is the last official stop in the Bulgarian part of the river to this day. In all Bulgarian ports where they dock, the participants are officially welcomed and places are are provided for their stay and feeding, cultural program and tourist tours in the region. In 2020 the regatta was postponed due to the Covid pandemic, and in 2021 about 50 Bulgarian rowers leaved Novo Selo, including the clubs in Pleven, Vidin and Sofia.

DANUBE TOURIST REGION OF BULGARIA

The Bulgarian section of the Danube is part of the lower reaches of the river. It stretches from the mouth of Timok River (the northernmost point of Bulgaria and the border with Serbia) to the town of Silistra along 470 km. It includes 48 of the islands of the river. The Danube River has both separation and integration functions. On the one hand, it is a border river for Bulgaria - 4/5 of the northern state border crosses it. On the other hand, the Danube River is crossed by one of the main European transport corridors (№7), which connects Bulgaria with Central and Western Europe. Due to the availability of significant water resources and cheap waterways, important industrial facilities and irrigation systems for agriculture are concentrated there, as well as two duty-free zones (near Vidin and Ruse). After the political changes in the early 90s of the twentieth century, the interstate trade flows changed, but nevertheless for a long time there was only one bridge across the river, built in 1954 (near Ruse, transport corridor № 9). This hampers transport and communications with neighboring Romania and Central Europe. In 2013, the Danube Bridge 2 - "New Europe" was opened (Vidin - Calafat, transport corridor № 4). Today, at the governmental and regional level, there are discussions of a third bridge between Romania and Bulgaria. For comparison, along the upper Danube from the springs to Bratislava there are 60 barrier facilities, 17 of which are hydraulic complexes. [10]

The Bulgarian Danube coast comprises those territories of the country, whose socio-economic development is directly or indirectly, in one degree or another, related to the use of the river. In the Transnational Strategy for Sustainable Territorial Development of the Danube Region with a focus on tourism (DATOURWAY) the Bulgarian Danube coast is considered to be composed of all administrative districts that have direct contact with the Danube River (Vidin, Montana, Vratsa, Pleven, Veliko Tarnovo, Ruse). Silistra),

as well as Razgrad district, which is only 20 km from the Danube bank and has well-defined regional ties with Ruse and Silistra districts. Defined in this way, the designated area covers most of Northern Bulgaria, 25.1% of the territory of Bulgaria, 20.4% of the country's population and provides 16.9% of GDP. The ratio between the numbers shows that this is a less populated area with lagging socio-economic development compared to other parts of Bulgaria. [10]

Table 1. Territorial scope and specialization of the Danube tourist region [12]

DANUBE TOURIST AREA	
Main specialization	Cultural and cruise tourism
Advanced specialization	1. Cultural and historical tourism 2. River cruise tourism 3. Adventure and ecotourism 4. Urban leisure and shopping tourism 5. Wine and culinary tourism 6. Religious and pilgrimage tourism
Management Center	Ruse
Districts	**Municipalities**
1. Vidin (partially)	Belogradchik, Vidin, Boynitsa, Gramada, Dimovo, Kula, Makresh, Novo Selo, Ruzhintsi
2. Vratsa (partially)	Borovan, Bregovo, Byala Slatina, Kozloduy, Moesia, Oryahovo, Hayredin
3. Montana (partially)	Boychinovtsi, Brusartsi, Vulchedrum, Lom, Medkovets, Yakimovo
4. Lovech (partially)	Letnitsa
5. Pleven (the whole)	Belene, Gulyantsi, Dolna Mitropolia, Dolni Dabnik, Iskar, Kneja, Levski, Nikopol, Pleven, Pordim, Cherven bryag
6. Veliko Tarnovo (partially)	Pavlikeni, Polski Trambesh, Svishtov, Suhindol
7. RUSE (whole)	Borovo, Byala, Vetovo, Dve Mogili, Ivanovo, Ruse, Slivo Pole, Tsenovo
8. Silistra (whole)	Alfatar, Glavinitsa, Dulovo, Kaynardzha, Sitovo, Silistra, Tutrakan
9. Razgrad (whole)	Zavet, Isperih, Kubrat, Loznitsa, Razgrad, Samuil, Tsar Kaloyan
10. Shumen (partially)	Venets, Kaolinovo, Nikola Kozlevo, Hitrino
11. Targovishte (partially)	Opaka, Popovo, Targovishte

The delineation of tourist areas is based on the territorial unity of natural and socio-economic sites and activities with a strong tourist orientation. The territorial scope of the Danube tourist region, defined in the Concept for tourist zoning of Bulgaria [18], coincides partly with the borders of the already defined Bulgarian Danube coast. As the sociologist and social entrepreneurship expert G. Gavrailov notes, “The Danube tourist region is the largest in the country, but unfortunately with the fewest visiting tourists. Only 2% of Bulgarian tourism is concentrated along the Danube. The potential is huge. The people are very hospitable, the nature is well preserved. There are also many problems related to demographic backwardness and lack of good infrastructure, but they can be solved gradually.(…) We all know that modern culture and European civilization have arrived in Bulgaria along the Danube. Unfortunately, in recent years we have turned our backs on this element of our development, but still in the Danube cities this sense of European culture is alive.“ [26]

Apart from being the largest, it is also the northernmost tourist area. It spreads on the territory of the Danube plain. To the north it reaches the Danube River, to the east - Varna Black Sea coast, to the south - the region of Stara Planina, to the west - the state border with Serbia. It is divided into two subregions - West Danube and East Danube. The center for management of the tourist region is Ruse.
The main specialization of the Danube tourist region and its unique competitive advantages as a tourist destination are in the field of cultural and cruise tourism. The extended specialization also includes cultural-historical, river, adventure and eco, urban entertainment and shopping, wine and culinary, religious and pilgrimage tourism. (Table 1.)

INFRASTRUCTURE FOR RIVER TOURISM ON THE BULGARIAN SIDE OF THE DANUBE RIVER

Along the nearly 500 km of the Bulgarian river border, 13 ports for public transport of national importance and 17 ports for transport of regional importance have been built. 10,445 m is the total length of the quay front. Possibilities for processing 10 million tons of cargo per year along the Danube are provided. The Bulgarian Danube ports (Vidin, Archar, Lom, Kozloduy, Oryahovo, Nikopol, Svishtov, Ruse, Silistra), as well as the ferries (Vidin - Calafat, Oryahovo - Beket, Ruse - Giurgiu, Silistra - Kalarash) are important mainly for freight and are used sparingly or not as passenger ports. The largest river port, Ruse, which includes several smaller ports, provides over 62% of the river's cargo turnover. 30% are for the port of Lom and 8% for the port of Vidin. In general, the current situation of port infrastructure does not meet the requirements of Directive 2000/59 / EU[13], since, with few exceptions, all facilities were built in the years of the last century. [3] Almost all European countries along the Danube have facilities to control water levels, which makes the river navigable throughout the year. However, no such infrastructure has been built on the territory of Bulgaria. For this reason, navigation is impossible in low waters. Another existing difficulty for unimpeded navigation are the deposits of sand, gravel and silt. The work on the modernization and optimization of the activities for rehabilitation of the waterway in the common Bulgarian-Romanian section of the Danube is in progress. Funding is from European programs. Delivery of equipment for the removal of critical sections and construction of the relevant hydraulic facilities is expected. The total budget of the project is over BGN 20.5 million. [20]
A significant problem for the development of the region (including tourism) is the outdated and poorly developed road network of land transport. Second-class and third-class roads make up 83.68% of the entire national road network in the region, and the highways are under construction. Republican roads without asphalt covering still exist (0.84%). Unsatisfactory operational condition do not meet market requirements and priorities set out in the country's transport policy. [2] The railway network is also not available for all (even major) towns and villages and is obsolete and depreciated.
The status of the road network hinders accessibility and reduces the attractiveness of tourist resources, especially the more peripheral ones. The roads managed by the local and municipal authorities are in the main part with deteriorated operationality. These roads are of low class and poor quality and this is a serious obstacle to economic development and tourism in the region. As a disadvantage should be pointed out the fact that the transport accessibility of the municipalities is better provided in the north-south direction, which ensures the connections of the Danube cities with the interior of the country. The actual lack of regular passenger river connection, combined with the lack of

a first-class road connecting municipalities in the west-east direction, is a serious obstacle to the economic integration of the region and its development as a tourist destination. Therefore, it is extremely important to build a first-class northern Danube road Vidin - Lom - Svishtov - Ruse - Silistra, which will improve transport accessibility to coastal areas and thus strengthen investor and tourist interest in them. Together with the Danube as a waterway, the direction will be important for the integration of the districts and municipalities located along the coastal territory and the strengthening of the territorial cooperation with the neighboring border areas. [24]

Some of these problems are set in the Bulgarian national position for the preparation and implementation of the EU Strategy for the Danube Region. [24] Within this strategy, Bulgaria offers the implementation of complex projects in a number of main areas, among which the infrastructure ones are the leading: modernization of port infrastructure, promotion of intermodal transport, provision of cross-river connections, leading transport infrastructure and development of information systems, etc.

The existing tourist infrastructure on the territory of the Danube region is concentrated mainly in several areas with established tourist destinations. This peculiarity in the localization of the means of accommodation, in the places for food and entertainment is determined by the territorial location of the available tourist resources and by the degree of representation of the resort-tourist functions in certain towns and villages. In practice, the tourist infrastructure is of a scale relatively corresponding to the available tourist resources. With a high concentration of accommodation and a high number of beds are the municipalities and their centers, which are the object of tourist interest. Such are Ruse, Pleven, Vidin, Razgrad, Silistra, Targovishte, etc. In the municipality of Ruse, for example, is concentrated 95.8% of the entire bed capacity of the district of Ruse used for the needs of tourism, in the city of Pleven - 93.5% of all beds in the district, etc. [22] The small municipalities in the zone of influence of the city of Ruse (Ivanovo and Dve Mogili), which have tourist resources, have poorly developed tourist infrastructure. The needs of tourists are met in the regional center. The discrepancy between the available tourist resources and the built tourist infrastructure in the municipalities around Pleven, Vidin, etc. is similar. In some of the small municipalities they have only 1-2 accommodation places with a total capacity of less than 50 beds. [22]

The complementary tourist infrastructure in the region, although slow and cumbersome, is growing and it is renewed with:

- eco-trails and roadside landscape parks, signposts and boards with routes, shelters, etc., used for the purposes of eco-tourism;
- hunting lodges, shelters, etc., serving the needs of hunting tourism;
- shelters and towers for photo tourists;
- small wine and tasting halls - for the purposes of wine tourism, etc

Foreign tourists who have landed on the Bulgarian coast most often complain about the lack of amenities in ports and approaches to urban areas - lack of toilets, currency exchange offices, POS terminals or ATMs, etc. [25]

The territory of the Danube tourist region as a whole has preserved environment, without serious industrial pollutants, severe environmental problems and contaminated areas. The main environmental parameters are within the permissible values. The existing problems are typical for the country as a whole and are due to the insufficient specialized infrastructure. The main environmental problems of the region are primarily related to air quality. A characteristic problem is the pollution of the waters of the Danube, which is largely due not to internal factors, but to pollution in the upper and middle reaches of the

river. In general, the gasification of settlements and improvements in waste collection, solving wastewater problems, cleaning and reclamation of areas contaminated by illegal landfills are expected to have a positive impact on the environmental situation with corresponding benefits for tourism. [14]

Not only roads and access have long been important for tourist destinations, but also the general technical and social infrastructure - availability of sewerage and clean drinking water, electricity, Internet, health care, shops, producers of local food and organic products, souvenir producers, qualification of the service personnel, etc. In this regard are the requirements for increased security of services, which relate to the security of tourists themselves (health, safety, terrorist acts, flights, theft) and the security of information exchanged on the Internet via computers and mobile devices and electronic payments - credit and debit cards, online banking, payment through a POS terminal or mobile phone, etc

RIVER TOURISM - THE TRADEMARK OF TOURISM IN THE DANUBE REGION

Each of the tourist regions of Bulgaria has the task to impose its "tourist physiognomy", which will be easily recognizable and attractive, to be distinguished by unique tourist destinations and offers. From this point of view, the specialization of the individual regions in terms of the offered tourist product is very important, in accordance with the tourist resources, the infrastructure and the gained experience. According to the guidelines of the Concept, cruise tourism is indicated as the main specialized type of tourism in the Danube region. (As already mentioned, this type of tourism in Bulgaria can be developed only in the region under consideration.) River tourism is related to the expanded specialization of the designated area. However, insofar as in this case the two types of tourism overlap and complement each other, it is appropriate to consider the concept of "river tourism" to be the broader of the two and to be a leader in defining the characteristics of the area. In the understanding of the authors of this concept should be subordinated to all other types of tourism existing and developing in the Danube tourist region - cultural, historical, adventure and eco, urban entertainment and shopping, wine and culinary, religious and pilgrimage tourism.

Cultural and historical tourism, for example, has significant resources in the region, but it could develop successfully in all other tourist areas and therefore cannot be perceived as profiling. The same applies to the other types of tourism mentioned. Bird watching can thrive in the country's numerous wetlands and nature parks. Wine tourism can also rely on the ever-increasing vineyards in Bulgaria and specific local wines. However, when it comes to the Danube tourist region, it is important to focus efforts on developing, creating and promoting a regional tourist product with an emphasis on river tourism, ie. to derive a distinctive set of tourist activities, connected one way or another to the Danube River.

The amazing nature, in combination with the cultural and historical heritage, is a natural brand of tourism in the Danube region, and the contribution of river tourism is crucial for the promotion and development of this brand. "A comparison is often made between the sights in the upper and lower reaches of the Danube. In the upper Danube are the countries whose capitals are located above the river and the cities face the Danube. In contrast, here in the lower Danube there are almost no settlements, wildlife prevails with typical sandy islands and river beaches and a wild world that can not be seen if one stands on the river bank. This world can only be experienced if you travel on the river.“ [7]

The presence of a large number of natural landmarks (rock formations, caves, waterfalls, islands, wetlands, rare plants, animals, etc.), some of which are of high quality, arouses undoubted tourist interest. Moreover, the diverse and attractive natural conditions and resources are combined with diverse anthropogenic tourist sites. This expands the chances of developing original products and proposals for tourism along or near the river. The presentation of these resources in an appropriate way is a prerequisite for the development of alternative types of tourism, generated by the interest in the river and its adjacent territories - ecological, cognitive, hunting, fishing, sports tourism, etc. However, all these specialized types of tourism should be considered as part of the main, river tourism product of the Danube region. At the same time, the fact that most sites with potential for tourism have both purely infrastructural barriers (access, cleanliness of the environment, etc.) and many unfulfilled actions for their exposure and socialization (restoration, visual information, attractive presentation, marketing, etc.) cannot be ignored.

Of the tourist resources, organically related to river tourism and the resulting opportunities, with great attractiveness and established as tourist destinations at different parts of the Danube bank are:

- the natural phenomenon Belogradchik rocks (Vidin district). Ancient Romans built a fortification there, which was later used by both Bulgarians and Ottomans - Belogradchik fortress. 100 meters from it is the Astronomical Observatory of the Institute of Astronomy at the Bulgarian Academy of Sciences;
- Magurata Cave (near the village of Rabisha, Belogradchik municipality) - they call it "the eighth wonder of the world". With its 700 extremely well-preserved rock paintings, it is the largest prehistoric gallery on the Balkan Peninsula. It is protected by UNESCO as a natural landmark. It resembles an underground cathedral and is one of the brightest tourist attractions in Eastern Europe. In terms of soil and climate, the area around Rabishka mound is close to that of the French region of Champagne, so here is produced the best natural sparkling wine in Bulgaria by classical technology;
- Rabishko Lake - the largest tectonic lake in the country with an area of 1.5 km2, with a well-formed beach. It offers perfect conditions for surfing and swimming, hunting and fishing. 100 meters from its southern shore there is a campsite.
- the unique nature park "Persina", located along the entire length of Svishtov - Belen lowland and covering all Bulgarian Danube islands in this part of the river. Among them is the island of Belene (or Persin) - the ninth largest along the Danube. The maintained reserve "Persian marshes" is situated there;
- Significant water resources of Pleven district - in addition to the Danube River, on its territory are the rivers Iskar (flows into the Danube in the district), Vit and many dams and water basins (mainly in the municipalities of Dolni Dabnik, Pordim and Levski) with rich tourist potential;
- Rusenski Lom Nature Park (protected area), covering the valley of the Rusenski Lom River (a right tributary of the Danube River) and its tributaries. There are 22 species of fish, 10 species of amphibians and 19 species of reptiles in the rivers. The greatest diversity is of birds - 193 nesting species, 127 of which are included in the Red Book of Bulgaria or are endangered in Europe. The Danube shore in the municipality of Ivanovo is one of the most picturesque sections of the Bulgarian river bank. It is covered with thick forests with diverse vegetation. Two parts are clearly separated: western - low, partially swampy and eastern - steep, in some places even vertical. There are many possible places for active recreation (boating, rowing, water sports, fishing and fishing competitions), as well as evidence of ancient ports and fortresses.

Here is the third longest cave in Bulgaria and one of the most beautiful - Orlova Chuka;

- the ruin of the Ivanovo rock churches and the medieval town of Cherven - "mountain under the plain", "oasis of wildlife" with surprising biodiversity. For the most part it coincides with the Rusenski Lom Nature Park. More than 110 representatives of the feathered world circle over its canyons, many of which are endangered worldwide. This is one of the 5 places in Bulgaria with the most birds nesting in the rocks. The rock niches of Polomieto in the 13th century were used for the holy monastery by monks who settled in the area. Nowadays this invaluable historical heritage is under the auspices of UNESCO;
- the rock monastery near the village of Basarbovo (12 km. from Ruse on the way to Ivanovo) successfully complements the history of the monasteries in the valley of the river Rusenski Lom and is an attraction as the only active rock monastery in our country;
- the maintained Srebarna Biosphere Reserve, included in the UNESCO World Natural and Cultural Heritage List. It is located on the territory of Silistra district and is one of the three Bulgarian wetlands of global importance. It is best known for its ornithological wealth with the only colony of the globally endangered Dalmatian pelican in Bulgaria;
- the coast in the region of Ruse and Silistra, developing in organic unity and harmony with the river. Most of the municipalities in the two districts that have access to the Danube have preserved the traditions in fishing, fish farming, fish cuisine and production of fish products. The exoticism of the environment and everyday life in the so-called "Fishing villages", combined with the opportunities for development of water sports, represent a significant resource for enriching the offered tourist product;
- Sboryanovo Historical and Archaeological Reserve (Razgrad District) with over 140 sites (settlements, sanctuaries and necropolises) from ancient times. The most significant discovery in this area is the Sveshtari Thracian Royal Tomb (III century BC), included in the UNESCO World Heritage List. Near Sboryanovo are the two hunting farms of Ludogorie - "Karakuz" and "Voden" (municipalities Dulovo and Alfatar), which offer elite hunting tourism.

RIVER CRUISE TOURISM

The importance of large rivers for tourism is most evident in the development of cruise tourism. It is also the leading, priority type of tourism, which can be developed only in this tourist region of Bulgaria. Today a cruise means a trip by water transport (including coastal excursions), sightseeing of port cities and their surroundings, combined with a variety of entertainment on board of sea and river liners. The main goal of tourists is relaxation and pleasure. The river cruise offers water tourist routes (usually multi-day) with a river boat, on which the tourist is provided with a package of transport, accommodation and meals, entertainment on board, land excursions and other tourist services. The ship moves along the river or lake-river system from one point to another according to the cruise program with a planned stop in cities or visits of interesting tourist sites. River trips and cruises are short-term (1 - 3 days) and long-term (25 - 30 days).

River cruises are an expensive type of tourism and this in modern economic conditions regulates passenger traffic on tourist lines. At the same time, these cruises have a number of advantages over other types of specialized tourism and tempting unique properties such as:

- constant proximity to the shore - there is practically no risk of shipwreck;
- there are no hikes during which tourists are surrounded only by water. During the trip, various landscapes change before the eyes, passing towns and villages;
- less accessible routes;
- the probability of seasickness is lower; the river cruise is like traveling by bus, but with the amenities of the ship - places for walks, animation, comfortable cabins, full board;
- organized and dynamic acquaintance with attractive natural and cultural sites in one or several countries;
- onshore excursions and / or participation in special events at places close to the respective ports;
- realization of different types and purposes of the trip (cognitive, business, educational, shopping, pilgrimage, etc.);
- conditions are provided for rest;
- high level of comfort and service;
- various animation and entertainment programs on board of the ship;
- recreational activities in the resort areas, beach;
- competitive prices, allowing the formation of stable demand.

The season of river cruises in our country starts every year in early March.

However, the surface waters of Bulgaria have little impact on the development of transport and river tourism in particular. There are no large navigable rivers in the interior of the country and therefore river transport and river tourism are relevant only to the Danube River. Convenient connections have been established with other Danube countries (Germany, Austria, Slovakia, Hungary, Croatia, Serbia, Romania, Ukraine). Cruise tourism in the Bulgarian section of the river is developing more and more intensively. Most of the Danube cruises last from 9 to 25 days. Ships are smaller than traditional overseas ships. The peak season in Europe is from June to September, but cruises in the transitional seasons (April to May or September to the end of October) are also popular because they save money. The price of river cruises on the Danube includes all the places listed in the offer for accommodation on land and while sailing on the river, most of the meals, entertainment, sightseeing, tour guide services, etc. [6]

Danube river cruises are slassified according to the quality of the cabins and accommodation as: [28]

- budget - from $ 45 to $ 130 per person per day, plus plane tickets to the initial ports;
- first class - from $ 80 to $ 275 per person per day, plus plane tickets;
- luxury - from $ 100 to $ 400 per person per day, plus plane tickets.

Ruse is the largest Danube port in Bulgaria and as such welcomes the largest number of cruise ships almost all year round - the season has already extended to such an extent that the first river tourists leave in early spring (March), and the last arrive shortly before the beginning of winter (in November). For the period from January 1 to August 10, 2019, 300 passenger ships with 41,651 tourists stopped at the port of Ruse. [29] (For comparison - in the first half of 2018 the figures are 25,262 tourists from 179 ships, and in 2017 - 18,900 tourists from 143 ships [31]) For the whole of 2020 (before the vaccines against COVID-19 appeared), only 24 cruise ships docked at the port of Ruse. From the beginning of 2021 to the end of August, there were 28 ships with 2,988 tourists, the first of which docked only on June 25. These data show that cruising tourism to the lower Danube has been severely affected by the global health crisis but is slowly recovering. The trips start late and stop early - in mid-September. In the first year of the pandemic,

Serbia and Hungary banned cruise ships from entering their ports. Before the COVID crisis, cruise tourists to the delta came mainly from the United States, Germany, Canada, Australia, the United Kingdom and France.

The other ports on the river that most often welcome ships are Vidin, Nikopol, Oryahovo. In 2016, 181 cruise ships with an average of 150 passengers docked at the port of Vidin. In 2017, the number of ships was 192, and in 2018 - 256. During the tourist season of 2019, the port of Vidin accepted nearly 340 cruise ships with nearly 40,000 foreign tourists. [25] In 2020, voyages and visits of 480 ships are planned, but none are realized. [23]

Ships carrying tourists on the Danube sail mainly under the Swiss, German and Canadian flags. Tourists are from all continents. The Americans travel the most, followed by the Japanese and Western Europeans, who most often travel on 14-day programs from the German section of the river to its delta. There are Canadians, New Zealanders, Australians, Chinese, Filipinos. 90 percent are elderly, with married couples predominating. Most of the passenger ships offer "all inclusive" packages, which include sightseeing of the four capitals along the river - Vienna, Bratislava, Budapest and Belgrade, as well as walking tours and sightseeing in Bulgaria and Romania. The trips are made in two directions - from east to west and from west to east. On Bulgarian territory they usually stop in Ruse and / or Vidin, but Svishtov, Nikopol, Silistra are also included in some programs . There are excursions to Vidin - Belogradchik, Ruse - Veliko Tarnovo - Arbanassi - Svishtov, Svishtov - Veliko Tarnovo - Ivanovo Rock Churches - Ruse and Ruse - Ivanovo Rock Churches - Rusenski Lom Nature Park - Basarbovo Monastery. Performances and presentations on board are offered in Vidin and Ruse. There are also attractive sites with potential, but they are not used for the needs of cruise tourism. These are: the Srebarna Reserve, the ethnographic complex - the Fishermen's Quarter in Tutrakan, the Majidi Tabia Fortress, the Persina Nature Park, etc.

PROBLEMS AND PROSPECTS

Despite the generous resources, tourism development does not correspond to the potential opportunities. The problems underlying this dissonance are widely known:

- lagging behind in the development of national and regional infrastructures and in the use of the possibilities of modern technologies, information and reservation systems;
- pronounced disproportion in the construction and concentration of the tourist infrastructure and resources;
- Insufficient staff - the region has the least number of working people in the field of tourism; [7]
- scarce information, marketing and advertising;
- Lack of a comprehensive strategy for the tourist area;
- Lack of a regional tourist product with an emphasis on river tourism; lack of coordinated tourist activities, connected in one way or another to the Danube River.

In recent years, the river region has come under the scrutiny of a number of strategic documents and forms of financing economic activities within the European Union. There are new opportunities to address the challenges and exploit its potential in a sustainable way, as set out in the EU Strategy for the Danube Region. However, this requires efforts on both local and national levels, from both the private and public sectors. Positive results can be expected only in the long run.

The analyses of the tourist development in the region are carried out periodically and serve the goals of various strategies and projects.[21] [17] [14] [15] [16] The positive

assessments most often note the tourist potential of the territory, the attractive nature, cross-border cooperation, the established partnerships between larger cities and neighboring countries, the availability of financial development schemes, etc. The weaknesses reported are the insufficient tourist flow; insufficiently utilized and socialized tourist potential; insufficient information about the region as a destination, sporadic and insufficiently well-targeted advertising; low level of the tourist infrastructure; technological and innovation lag, lack of administrative capacity; lack of interaction between institutions in the private sector, etc. Opportunities are usually sought in international cooperation in the framework of the Danube Strategy; expanding investments in the region, improving the existing and building modern transport infrastructure (high-class roads, sustainable and flexible transport, cheap and environmentally friendly public transport, bike lanes, etc.), strategically oriented communication and advertising; partnership between the public and private sector and local authorities, etc. Threats / dangers stem from economic stagnation; from the deterioration of the business environment (changes in legislation, tax policy, etc.); irrational use of the existing potential of natural and anthropogenic resources and deterioration of the environmental parameters; lack of consensus among stakeholders; lack of own funds; poor adaptability of the workforce; the negative impact of climate change, energy dependence, demographic collapse, etc. (Fig. 1)

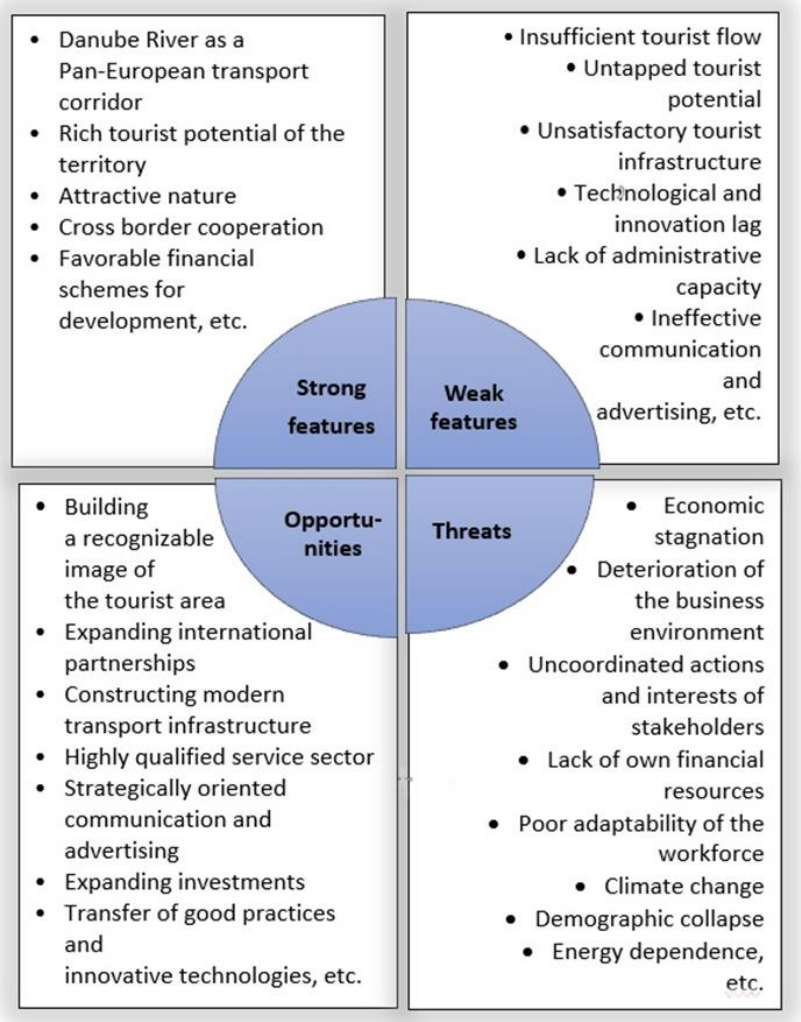

Figure. 1. SWOT matrix of the Danube tourist region

According to the World Wide Fund for Nature (WWF), one of the largest and most effective international conservation organizations, the Danube region could become the "Green Heart of Europe". [32] The Fund reports that more than 70 protected areas are located near the Bulgarian waters, and the protected areas included in the European Natura 2000 network are more than 1,000. At the European Union level, Natura 2000 sites attract between 1.2 and 2.2 billion visitors each year, which generates revenues between 5 and 7 billion euros. Unfortunately, statistics show that nearly 80% of riparian natural habitats and fish resources were destroyed in the twentieth century, and the rest are endangered. [33] The loss of biodiversity here, as in other parts of Europe, continues mainly due to the methods used in intensive agriculture, artificial plantations with atypical tree species, poaching, industrial pollution, inconsistent transport infrastructure, correction of natural riverbeds and dams along the rivers.

Nature conservation can, of course, be linked to the sustainable development of the areas concerned. In this sense, the tourist trademark of the Danube region should also include ecologically clean food products produced by small farmers in traditional ways in places of high conservation value. WWF's Danube-Carpathian program has been working for years to establish the region's image as the "Green Heart of Europe" and suggests that this trademark should be used in the framework of the Danube Strategy.

CONCLUSION

The development of tourism is a complex process that depends on the general state of the environment and the influence of various factors (external and internal) - infrastructure, accessibility, protection and display of natural and cultural heritage, economic opportunities of tourists, etc. The wealth, diversity and value of tourist resources in the Danube region are indisputable. Despite the specifics of each district and municipality in the region, the unifying characteristics of these resources are:

- the Danube River, which has been used by humans for thousands of years and has dominated the region's history;
- the Danube as the largest European transport corridor, on the one hand, and its distinctive features (islands, wetlands, unique biodiversity), on the other hand;
- the specific relief and landscape forms of the coast and its adjacent territories;
- the many natural landmarks and reserves with abundant diversity of flora and fauna;
- the exceptional wealth of cultural and historical monuments and artifacts;
- the preserved way of life, folklore and nature of a large part of the rural areas.

These common features offer a number of advantages and marketing prospects for the development of tourism in the region and predetermine the role of river tourism (including cruise tourism) as a strategic one. Virtually every municipality in the Danube tourist region has the resources to develop some kind of recreation and tourism related to the river. However, this does not mean that there are conditions for offering complete tourist products that attract visitors to all municipalities in the region.

The main conclusions that are reached with regard to river cruise tourism in Bulgaria are: [4]

- the available resources in the Danube region have significant potential for the development of this type of tourism and are a prerequisite for creating new tourism products and enriching existing ones;
- the flow of cruise tourists to the area and their costs on the coast are economically important for business and local communities and it is unjustified to miss the opportunities of growing demand;

- it is necessary to improve the tourist offers in order to diversify the programs on land and to disseminate widely the economic benefits of cruise tourism, as well as to work purposefully to improve the quality of services;
- regional cooperation is crucial for achieving the set goals;
- it is imperative to create a database that will allow monitoring of cruise tourism on the Danube;
- Institutional management of the destination, coordination and synchronization of the efforts of all stakeholders is the ultimate prerequisite for its development.

In the conditions of a dynamic market and great competition, each country in the Danube region expands its resources and opportunities. Among the reasons for the growing importance of tourism on the Danube is the general diversification of the tourist offer, which includes, among other forms of tourism, river cruise tourism as one of the most important forms of tourist activities in the region. The integrated approach to joint initiatives and partnerships to promote tourism along the river undoubtedly supports the sustainable development of the sector.

The task faced by all involved in the management and development of the Danube tourist region is to form the Bulgarian face of tourism and to turn this region into an attractive place, competitive with the Black Sea and ski resorts of the country.

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MEDICO - GEOGRAPHICAL ANALYSIS OF THE PREVALENCE OF THE SPECIFIC LANGUAGE IMPAIRMENT AMONG CHILDREN IN BULGARIA

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ABSTRACT

The development of cognitive sciences and in particular the language development of children has put on the agenda the issue of early diagnosis and intervention of language disorders. The aim of the article is to examine the frequency and prevalence of Specific Language impairment in Bulgaria and whether the specialists who support children are sufficient in quantity and quality. This goal is achieved by the detailed medical-geographical analysis of the prevalence of children's language impairments on the territory of the Republic of Bulgaria at NUTS III level for the period 2010-2020. The geographical analysis clearly shows the level of prevalence of language impairment among children by areas, accessibility to specialists, the presence or absence of policies to deal with the problem. It is very important for children with these specific needs and for the team of specialists to start working at the first markers of the impairment, because early diagnosis reduces the duration of therapy and further problems such as "Specific learning disability", "Dyslexia", "Dyspraxia", "Dysgraphia" and others. In Bulgaria, at the beginning of each school year, the Ministry of Education, as well as some private practices, provide free screening tests for children of preschool and school-age, which, however, does not always cover all children.

Keywords: Bulgaria, medico-geographical analysis, specific language impairments, screening

INTRODUCTION

Medico-geographical research and analysis in the field of specific language impairments in children are of particular importance to determine the prevalence and where specialists are needed. Every child develops and learns the language differently and attention is needed, especially in cases when even a slight delay in speech development begins.
The XVIII century marked the beginning of the study of children's language by physicians and philosophers in Germany, and psycholinguistics gradually accumulated voluminous material. In the 1920s and 1930s, Jean Piaget's theory [2019, [22]] of cognitive development considered that "the main driver of language development is the adaptation of the child to the socialized way of thinking of the adult." [Tsenova, 2008, 181 p. [15]]
The majority of children learn the language effortlessly and quickly and continue to do it during childhood and early adolescence. However, for about 7% of English-speaking children, this almost automatic language acquisition task does not follow a normal course. Specific language impairment (SLI) is a developmental disorder in which children lag

behind their peers in production and language comprehension for no apparent reason [Bishop, 1997, [17]]. SLI by definition is not secondary to factors that typically cause language problems, such as a local brain lesion or traumatic brain injury, hearing loss, or even environmental factors. In addition, in SLI, language problems occur without any other visible cognitive impairment, despite the relatively normal nonverbal intelligence. Therefore, SLI is diagnosed by its language specificity [Leonard, 1998, [19]].
Timely intervention is a key factor in bridging the lagging in the language formation and if the family has the necessary information to access specialists at national, regional, and municipal levels, the child has a chance for normal development and prevention of further impairments. Therefore, medical geography could help a lot in terms of providing specialists, clarifying the factors that would have an impact, and others.

THEORY AND METHODOLOGY

In the theory of psycholinguistics two directions are emerging: the formalists [Chomsky, N., [18]], who speak of innate language ability mainly in linguistic universals, and the functionalists [Snow, C. E, M. Tomasello, DI Slobin, Bates, E., MacWhinney, [23], [24], [16]], who believe that language is mastered through learning. In the second half of the XX century in the field of psychology in neurology and psychiatry transferred the associative model of brain function, according to which "large-scale networks in the human brain are dedicated to specific functions such as language, face and object recognition, behavior, visual-spatial sense, spatial attention, memory and emotions [Mesulam, 2000, [20]; Kolev, 2019, 23 p., [6]]. There is still no single theory that fully explains the formation of language, and it is probably a combination of all of them.
The object of the study is children in the age range 0 -19 years in the Republic of Bulgaria, who show specific language impairments. In view of the volume constraints, the causes of language impairments will not be analyzed.
The purpose of this report is to analyze the medical-geographical situation in the frequency and prevalence of the specific language impairments in children in the country and at the district level and to pay attention to the small number of specialists who help the children.
Methods which are used are many. The descriptive is one of the most important. The medical-geographical description is a description of a certain territory with the necessary data on the natural, economic-geographical, medical-sanitary conditions and their influence on the human health condition and the spread of various diseases.
Other methods are historical, statistical, cartographic, method of analysis, and synthesis.
Children are divided by the age factor of preschool and school-age, as at the end of the fifth year is considered completed the process of normal language development and by the beginning of first grade for most of them, it is overcome. When for one or another reason this does not happen, children develop secondary impairments such as dyslexia, dysgraphia and fall into another group of disorders.
For the present study, official data is taken from the National Statistical Institute and the Ministry of Education of the Republic of Bulgaria for the period 2010 - 2020 for children diagnosed with "Specific language impairments" and in that year were treated by specialists from the ministry. Data on children who visit private centers and organizations are not included here, as there are no statistics on this, and most of the children would be duplicated.
Geographers Veselinova [2021, [3]], Dimov and Angelova [2009, [5]], Boyadzhiev [2009, [1], 2011, [2]], Patarchanov [2011, [9]], Patarchanova [2010, [10]] and others pay

attention to issues related to the theoretical foundations of medical geography [Veselinova, 2021, [3]], the application of some spatial models in medical and geographical research [Patarchanov, 2011, [9]], the spread of various diseases in Bulgaria [Boyadzhiev, 2011, [2]], medical geography of Italy [Boyadzhiev, 2009, [1]] and others. Patarchanova works on issues related to human health and the environment [2010, [10]]. Veselinova [2021, [4]] also considers the problems related to medical-geographical cohesion.

The relationship between the quality of environmental components and human health has been studied by Staneva et al. [2016, [12], 2016, [14]]. The impact of geopathogenic zones on child development and learning abilities has been studied by Staneva and Marinov [2012, [11], 2015, [13]].

RESULTS AND DISCUSSION

The population of the Republic of Bulgaria has been steadily declining since 1989, according to national censuses conducted in 1992, 2001, 2011, 2021.

Table № 1 shows the total number of children with specific language impairments and the total number of speech therapists, in Bulgaria and by district, for three selected years - 2010, 2015, 2020. The review is for a ten-year period, between two censuses in the country after the beginning of its membership in the European Union.

The presented data show that the age group 0-19 years decreased by 104 700 people for the period. The districts of Varna, Plovdiv, and Sofia have an increase in children by 594 people, 359 people, 28,317 people. In all other districts, their number is significantly reduced. The reasons for this decrease are many, but some of the main ones are the aging population and the high level of emigration of young people to the big cities of the country and abroad.

The number of speech therapists has increased significantly - almost 3.5 times or 246.25%. This suggests that with the reduction of children and the increase in the number of specialists, there will be more than the necessary time to work with children with specific language impairments. In 2020, the statistics report a low number of specialists in the districts of Razgrad, Kardzhali, Gabrovo, Vidin, Lovech, Kyustendil, Montana. The best-provided districts with speech therapists are the districts of Sofia - city, Varna, Plovdiv, Blagoevgrad, Burgas.

After the democratic changes in Bulgaria (1989), the deinstitutionalization of work for children with impairments began, which led to the establishment of small centers with specialists. These are the regional resource centers and the speech therapy centers in the cities of Sofia and Varna. Children with developmental problems have been served by auxiliary schools and specialized kindergartens, which are very few. Speech therapy centers in Sofia and Varna at that time were the only ones to offer services outside these institutions, in which children with specific language impairments fall. According to Mikhailova and Mitova: "Like any change in values, change in the broadest sense of the word is slower and more difficult. It still faces barriers in the thinking of some people, including politicians and managers. [Mikhailova [2010], [8]; Mitova [2016], [7]].

Tabl. № 1
Number of children with specific language impairments and speech therapists by districts in Bulgaria, 2020

Year/Country	2010-2011					2015-2016					2019-2020				
District	Population 0 - 19 years	Specific Language impairment Preschool age	Specific Language impairment School age	Speech therapists	Children per 1 speech therapist	Population 0 - 19 years	Specific Language impairment Preschool age	Specific Language impairment School age	Speech therapists	Children per 1 speech therapist	Population 0 - 19 years	Specific Language impairment Preschool age	Specific Language impairment School age	Speech therapists	Children per 1 speech therapist
Bulgaria	1417952	1183	1650	240	11,80416667	1311257	1664	2049	465	7,9849462	1313252	2362	2704	831	6,0962696
Blagoevgrad	65503	40	94	28	4,785714286	58947	28	70	30	3,2666667	58264	39	86	42	2,9761905
Burgas	85581	45	97	12	11,83333333	82247	57	129	32	5,8125	83239	63	103	38	4,3684211
Varna	92749	163	85	4	62	91129	283	110	49	8,0204082	93343	361	321	85	8,0235294
Veliko Tarnovo	45799	29	59	14	6,285714286	40971	6	100	16	6,625	39366	16	75	26	3,5
Vidin	18125	4	45	9	5,444444444	14779	16	22	10	3,8	13396	22	39	10	6,1
Vratsa	37291	9	19	7	4	31203	10	48	12	4,8333333	29408	7	32	25	1,56
Gabrovo	20818	19	21	6	6,666666667	17242	24	42	7	9,4285714	16468	19	23	9	4,6666667
Dobrich	38315	12	23	8	4,375	33679	12	30	15	2,8	32182	45	56	19	5,3157895
Kardzhali	31862	4	17	4	5,25	27694	8	31	6	6,5	29246	23	44	7	9,5714286
Kyustendil	23831	6	54	7	8,571428571	19758	20	100	5	24	18835	21	68	11	8,0909091
Lovech	27837	7	31	8	4,75	23280	10	33	7	6,1428571	22157	14	34	11	4,3636364
Montana	28271	32	104	4	34	24653	14	53	9	7,4444444	22968	5	33	12	3,1666667
Pazardzhik	59057	22	57	8	9,875	51765	68	75	13	11	50545	80	74	27	5,7037037
Pernik	21379	13	27	2	20	19573	14	26	7	5,7142857	19632	40	51	12	7,5833333
Pleven	53393	30	82	9	12,44444444	45158	46	95	9	15,666667	43632	74	78	27	5,6296296
Plovdiv	128903	83	94	19	9,315789474	124777	81	119	16	12,5	129262	99	150	43	5,7906977
Razgrad	26896	8	32	1	40	21805	7	26	7	4,7142857	20215	9	31	7	5,7142857
Ruse	42723	37	74	8	13,875	37437	43	29	9	8	36344	55	52	12	8,9166667
Silistra	24128	16	29	4	11,25	20376	47	84	10	13,1	19659	50	46	16	6
Sliven	48293	13	23	5	7,2	44953	29	26	0		44511	41	43	17	4,9411765
Smolyan	21072	70	145	6	35,83333333	17140	103	102	6	34,166667	15652	173	169	23	14,869565
Sofia - city	223140	428	174	32	18,8125	235634	559	327	120	7,3833333	251457	788	502	219	5,890411
Sofia - Province	46412	3	60	8	7,875	42667	32	93	12	10,416667	42687	33	129	20	8,1
Stara Zagora	66694	25	79	10	10,4	61220	28	112	14	10	61473	73	142	24	8,9583333
Targovishte	26939	16	39	4	13,75	22455	47	51	3	32,666667	21505	99	157	14	18,285714
Khaskovo	47234	24	32	3	18,66666667	43758	33	58	20	4,55	42668	45	68	29	3,8965517
Shumen	39343	16	36	5	10,4	33308	16	29	17	2,6470588	31858	25	64	32	2,78125
Yambol	26364	9	18	5	5,4	23649	23	29	4	13	23280	43	34	14	5,5

Source: National statistical institute; Ministry of health

Data for some districts in the table show very few children with specific language impairments. It remains doubtful that a large proportion of children with such disorders have not been diagnosed and registered by speech therapists in the country. In some districts, such as Razgrad and Kardzhali, for some children, the mother language is not Bulgarian. These children do not fall into the clinical picture of the specific language impairments as a primary impairment.

The attached mapscheme shows the number of children with specific language impairments in districts in Bulgaria for 2020. The highest number of children is reported in the large regional centers, while the lowest number is observed in the border areas that are depopulated, areas with an aging population and deteriorating economic profiles. A complete change is needed in the early diagnosis of children with specific language impairments. It is very important for parents with lower education to be covered by the relevant structures, to be aware of the early signs of the impairments and where they can get the necessary help and understanding.

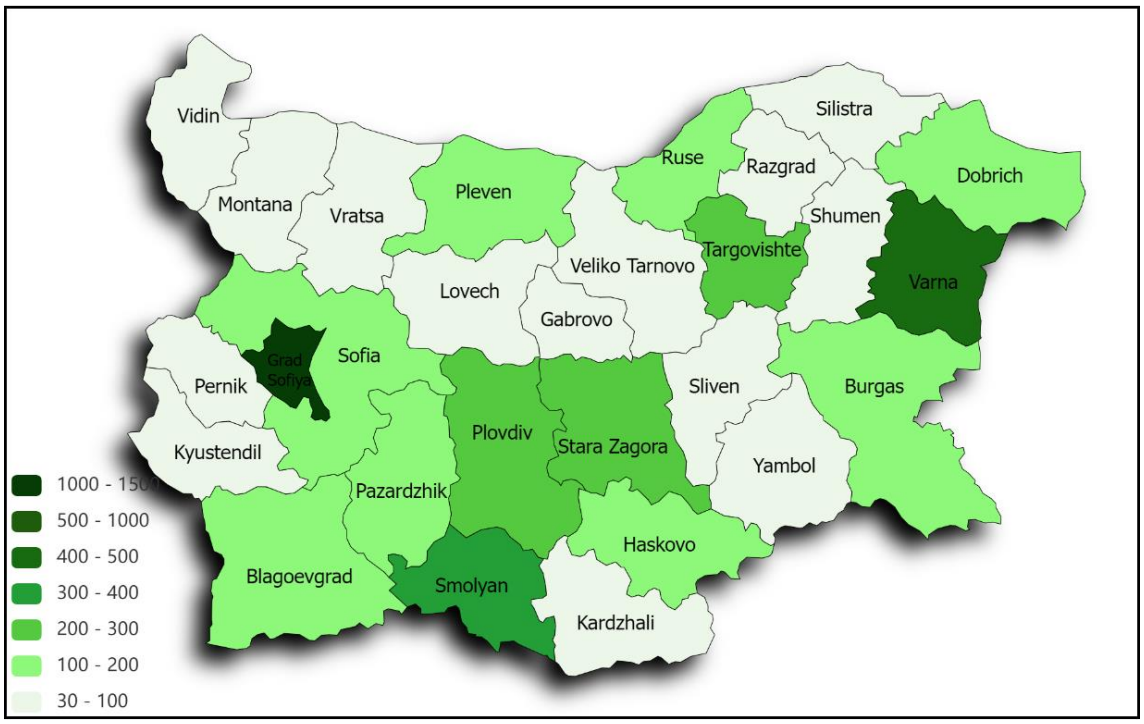

Figure 1. Mapscheme of the number of children with specific language impairments by districts in Bulgaria, 2020. Source: National statistical institute; Ministry of health

CONCLUSION

Early diagnosis and initiation of speech-enhancing therapy are very important when there is a need to work with children with specific language impairments. The number of speech therapists, which work with children with impairments, is of great importance. The fewer children are allocated to an average speech therapist, the more time and resources the specialist will be able to devote to each child. Often children do not have individual therapy but are included in the programs of small groups, which do not always meet the individual needs of children. At the same time, speech therapists have therapeutic sessions once a week, and in some more severe cases or temporary absence of another child - twice a week, which is insufficient. Improvements are needed in the relation to the collection of data on children with language impairments. This includes families who decide to visit

a private speech therapist and do not register with the speech therapy center of the specific district and municipality where they live. Private speech therapists are not obliged to submit a number of children with language impairments to the Ministry of Health, the Ministry of Education and Science. In this way, the data are distorted, and the frequency of specific language impairments is in fact higher.
Medico-geographical analyzes are of particular help. In practice, they show the need for specialists and where it is necessary to focus efforts to improve the medical and geographical situation in a particular area.

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THE SOCIO-ECONOMIC IMPACT OF COVID-19 PANDEMIC ON TOURISM FROM DOBROGEA REGION, ROMANIA

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ABSTRACT

Tourism is one of the most affected economic sectors by the Covid-19 pandemic. Its positive evolution until 2020 has been stopped, being affected at the same time the structure of the local or regional economic profile. Thus, it is necessary to quantify the impact of this epidemiological hazard on such an important area for the national economy in order to create a sustainable tourism industry. Such an analysis can reveal changes in the tourist flow. We will be able to draw trends on the evolution of tourism in the study area, in a context in which specialists predict several years of pandemic. Due to the spatial nature of tourism, in this study we will use GIS to obtain the proposed results. Although most territorial systems in Romania, where tourist activity is present, have been negatively influenced, the results obtained indicate an increase in the number of tourists in the rural area of Dobrogea. Such situations are rare in Romania and we will try to find the causes that have influenced this.

Keywords: Tourism, Dobrogea, Covid-19, GIS, Economics

INTRODUCTION

Numerous recent studies have focused on analyzing the impact of the COVID-19 pandemic on economic sectors. Some of these studies focused on tourism [1]–[6], proving that this is one of the most affected economic areas. In Romania, the share of tourism in the national GDP had a positive trend until 2020, when the imposed restrictions strongly affected this sector [7]. In 2011, 1.7% of the country's total GDP was provided by tourism activities, and in 2017, this percentage had reached 2.8%. The upward trend for tourism in Romania is clear even if we analyze the evolution of the number of tourist arrivals that have doubled since joining the European Union, from 2007 (6 million) to 2018 (12 million) [8].

The impact of the COVID-19 pandemic on the Romanian tourism sector has been the subject of several studies [9]-[11]. These studies highlighted the changes in the tourism flow in 2020 compared to previous years, changes that affected the entire national economy. However, few studies have addressed the analysis of the situation of tourism at the regional level in the period 2020-2021 [12]. The Romanian coast and the Danube Delta are two important places for tourist concentration, located in the Dobrogea region which is characterized by a diversity of tourism activities and requires a separate analysis to observe the different directions of various tourism branches during the pandemic. The

local economy is largely based on tourism activities, so the study about the impact of the Covid-19 pandemic is important to see its impact on the local economy.
The purpose of this study is to identify trends in the evolution of tourism-specific activities in the context of a global epidemiological hazard. Changes in the structure of tourism characteristics provide clues to the behavior of tourists in such difficult times. Thus, the competent authorities with a decision-making role in tourism management can reconfigure the directions in approaching the development of this field. In addition, the inventory of changes in the tourist flow for the analyzed period will allow other future studies to complete the information about the regional economic situation. Changes in the tourism sector have contributed to rising unemployment and changing the percentage of the active population in the tertiary sector.

CONCEPTUAL AND METHODOLOGICAL FRAMEWORK

From a methodological point of view, in this study, we intend to analyse the importance of permanent centers in Iasi county in terms of the accessibility of the rural population to the primary medical services provided by the family doctors. We will analyse the evolution of the medical staff in Iasi county and the accessibility of the rural population to permanent centers. We will use both objective/quantitative (analysis of the statistical data provided by the National Institute of Statistics) and subjective/qualitative research methods using the questionnaire method. Thus we will implement a questionnaire to be addressed to the on-call doctors at the 14 permanent centers in the rural areas of Iasi county with which we will find out information on the annual number of patients, the age of patients, the diseases prevailing in the local Community, the most frequently performed medical services, the way in which the SARS-Cov2 pandemic led to increased or decreased interventions, etc. We will also analyse information on the geographical distance traveled by patients to receive primary care services, the distribution of opportunities to access healthcare in the territory, identifying rural areas with special features in terms of clearly unequal access to healthcare facilities.
As regards the means and method of work, the study was conceived as a field survey (opinion), using the questionnaire as the main working tool, with several types of questions (open, closed, with only one choice of answer, etc.), sent between October 2020 and February 2021 both on place and through the telephone interview. Geographically, accessibility to health services is directly influenced by time-related accessibility (expressed in the real physical time patients can access the necessary health services, the optimal level being 30 minutes) and spatial accessibility, which represents "the proximity of healthcare providers to the population served, which can be quantified by the distance the patient has to travel to the healthcare facility in which the medical services he needs and he/she requires are provided [5]. A special feature is that the anisotropic characteristics of the area studied and the ability of the population to take advantage of the medical services in the proximity directly influence the quality and quantity of the services provided [6].

MATERIALS AND METHODS

The study area includes the two counties in the Romanian historical region Dobrogea (Figure 1). These are Tulcea, in the north, and Constanța, in the south. Located in the southeastern part of Romania, the Dobrogea region has a wide exit to the Black Sea,

which strongly boosts tourist flow from here. The Danube Delta and the seaside resorts in Constanța County are important tourist hubs nationally.

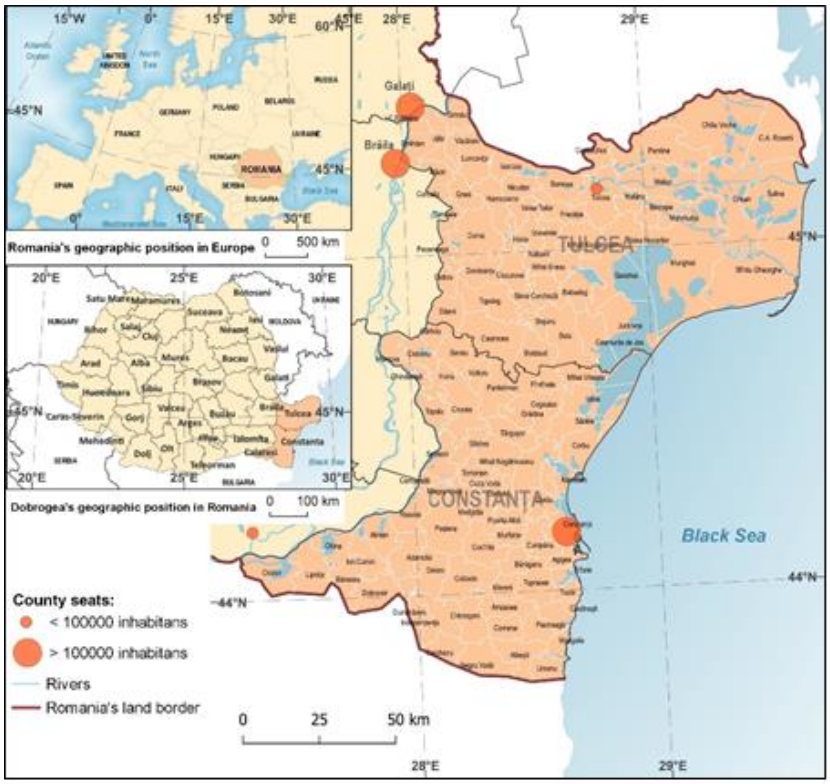

Figure 1. Dobrogea's geographic position in Romania and in Europe.

The present study involves the processing of statistical data on tourism in Romania and the Dobrogea region. In this sense, a database was created with the number of arrivals in tourist accommodation units and the number of companies active in the tourism field, indicators considered relevant for our analysis. Since this data is spatial, we used specific GIS (Geographical Informational Systems) tools integrated in dedicated software applications. Quantum GIS 3.16 is the GIS software used due to the diversity of ways in which we can manipulate and represent statistical data on cartographic products. The fact that this is an open-source licensed program was another important advantage of choosing QGIS in the workflow.

Statistical data taken from the National Institute of Statistics were an important part of the analysis. This was information about the number of arrivals in tourist accommodation units at county level and at administrative unit level. We were also interested in the information about the dynamics of tourists from the point of view of their nationality. The integration of this data in the GIS environment was done with the help of the Join tool, specific to several software programs. It joins the columns of an attribute table of a thematic layer with the columns of a nonspatial table, based on a common column.

RESULTS

The evolution of tourism in Dobrogea in terms of arrivals in tourist accommodation units indicates a different situation compared to other regions of Romania. After calculating the ratio between the average number of tourist arrivals from 2020-2021 and the average number of tourist arrivals from 2016-2019, we noticed that Tulcea County is the only

Romanian county with favorable results (Figure 2). Also, Constanța registered high values, during the pandemic, the number of arrivals in tourist accommodation units during the pandemic years representing between 90 and 100% of the normal period before the pandemic.

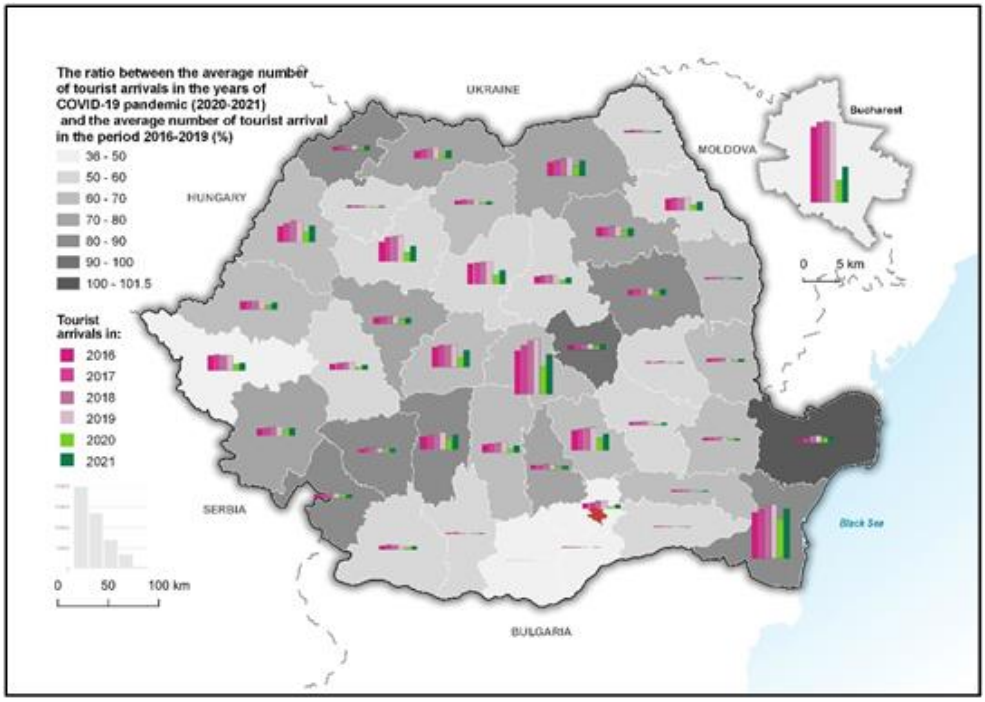

Figure 2. Statistical comparison of the situation of tourist arrivals in the years of the pandemic a nd the years before the pandemic (Source: The National Institute of Statistics, Romania [13])

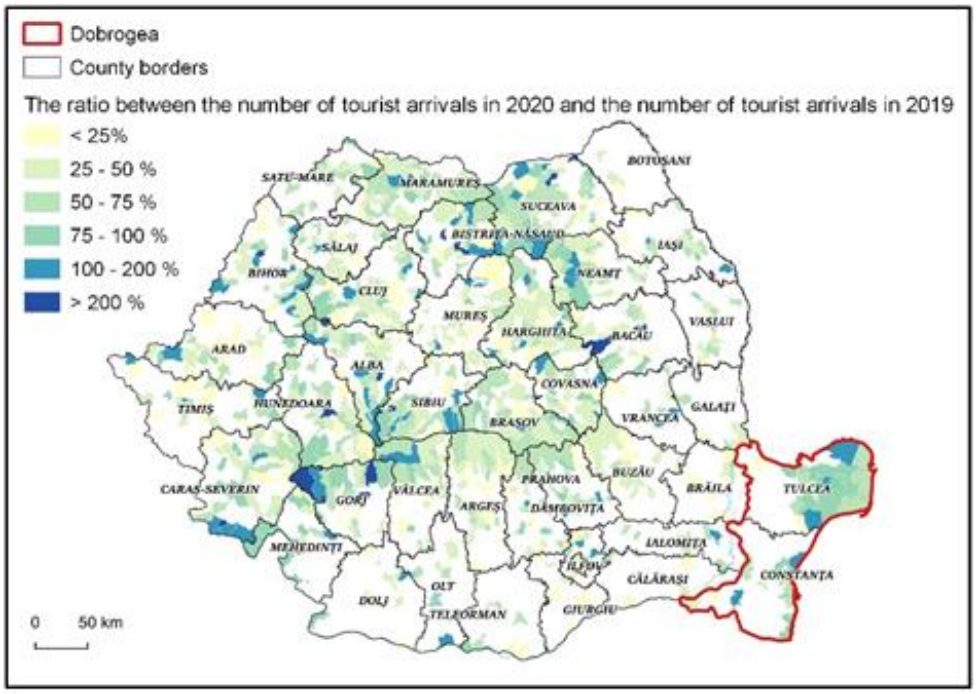

Figure 3. Changes in the tourist flow from the first year of the Covid-19 pandemic (2020) (Source: The National Institute of Statistics, Romania [13])

The national situation at the administrative unit level indicates a number of settlements, especially rural ones, which have seen an increase in tourist flow in the first year of the pandemic (Figure 3). The data used show that 2020 was the most difficult year for Romanian tourism in recent times. In an overall picture, the Dobrogea region does not seem to have been so strongly affected by the COVID-19 pandemic, as there are several localities, all rural, which have seen an increase in the number of arrivals in tourist accommodation units (Figure 3). The top of tourist attraction were the Danube Delta and the Romanian coast, and among the possible causes for these results are travel restrictions in other countries, especially in the summer season for coastal tourism. Thus, many Romanians chose the Black Sea coast or the Danube Delta in the summer of 2020. This is demonstrated by the lower percentage of foreign tourists in Dobrogea compared to the years before the pandemic [13]. The evolution of tourism in rural areas can also be attributed to the fact that tourists sought accommodation in less crowded places, avoiding large cities. The villages around and inside the Danube Delta are notable for the increase in the number of tourists during the pandemic.

The dependence on tourism of a local economy is reflected in the percentage of turnover in hospitality industry and in the percentage of companies active in this sector [14]-[16]. In the case of localities in Dobrogea, we identified a surprising increase in the number of such companies in several cities or rural settlements (Figure 4). This direction seems to continue an upward trend over the last five years. Murighiol, Mahmudia, Jurilovca or Sarichioi are rural settlements in the vicinity of the Danube Delta, which have higher percentages of those companies engaged in tourism. Although the number of these companies has increased recently, their percentage seems to have decreased. This indication may suggest a decrease in the importance of tourism in the local economy. The year 2020 is characterized by the lowest percentages of tourism companies in most of the localities analyzed.

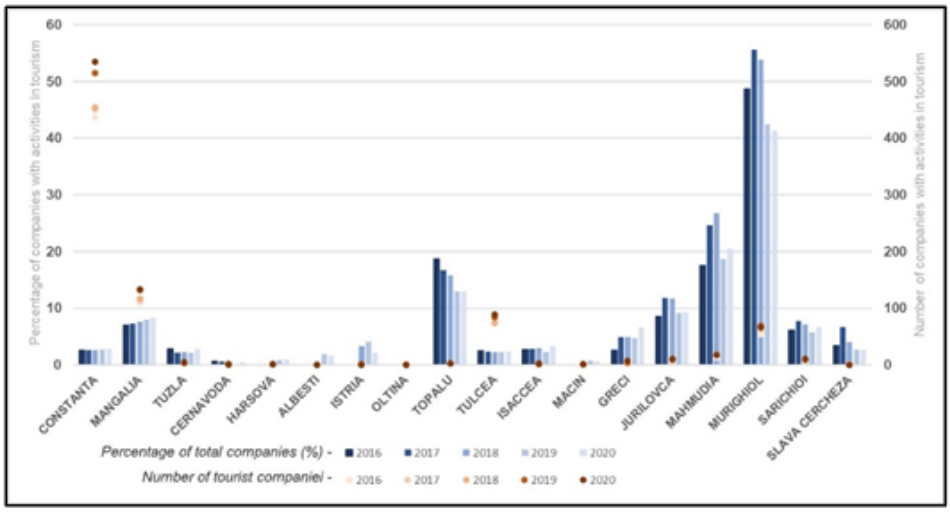

Figure 4. The importance of tourism in the local economy of the localities in Dobrogea through the number of companies destined for tourism

CONCLUSIONS AND DISCUSSION

Like other previous studies [17] - [19] which obtained favorable results regarding the development of rural tourism in various countries during the pandemic, Romania had a favorable behavior regarding the evolution of rural tourism. A good example of this is the rural areas in the Carpathian Mountains [20]. Through this study we showed that the

Dobrogea region is the main Romanian region that has made progress in the field of tourism during the Covid-19 pandemic. The positive evolution of the number of tourist arrivals for Tulcea County during the two years of pandemic compared to the previous period is noteworthy. We can expect the creation of a new important tourist hub for the country, which until now had a very little economy based on tourism.
The dynamics of the tourism sector was very active in the period 2019-2021 and new studies are needed to verify how tourism activities can help local and regional economic development.
The Dobrogea region benefits of important tourist resources, some of these being not properly valued or not at all. The archaeological resources from here, specific to several historical periods, represent such an example. These are mainly located in rural areas, and the new characteristics of the tourist flow in the region, presented in this study, show that rural settlements increased in the number of tourists during the Covid-19 pandemic.
The impact of the pandemic on tourism requires attention from researchers in the coming years. These studies will help to better understand the rationale of tourists in times of crisis. In this way, the competent authorities will be able to react more effectively to possible similar periods in the future.

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LINKS BETWEEN DEMOGRAPHIC CHANGES AND TRANSFORMATION OF CAPITAL'S URBAN SYSTEM

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ABSTRACT

Extremely polarized space and demographic processes, as well as the most significant concentration of population and functions on the territory of the capital and its surroundings, are the characteristics of the most post-socialist countries. One of those cities is Belgrade, the capital of the Republic of Serbia, on the example of which this research was conducted. At the beginning of the 21st century, urban systems, as observed, are experiencing significant transformations, which represent new trends in their spatial and population development. This paper investigates and analyzes the links between certain spatial-functional and demographic changes within the daily urban system of Belgrade. The model of spatial manifestation of daily labor migration was used to determine the boundaries of the observed area, while census statistics were used as a basic source of data. Changes in the core of the urban system, as well as in the most important satellite settlements and secondary centers, were especially emphasized. Based on the analyzed phenomena, conclusions about the connections and interdependence of contemporary demographic processes and spatial-functional changes within the urban system of the capital, on the example of Belgrade, are presented.

Keywords: demographic changes, urban system, transformations, Capital, population

INTRODUCTION

The connections between demographic processes and the stage of development of a certain area are characterized by a cause-and-effect nature. In a complex system of relations and connections, the needs and possibilities of the population affect the development of space, while space, by itself, with its general and current functional characteristics influences the determination of the directions of demographic processes. Among modern demographic problems, one of the most prominent is the uneven spatial distribution of the population. In the process of demographic or other forms of polarization, the existence of one or more poles of concentration of population or functions is necessary. In most cases, the role of the leading pole in the development of the entire territory is connected to the capital of a country. Often the attractive function and strength of the capital exceeds the capabilities of the rest of the country, creating a significant population and functional imbalance. The resulting situation leads to further deepening of negative population processes, as well as the creation of new problems of economic or organizational nature.

As the influences of cities often exceed their own bounds, it is necessary to study the processes that take place in the entire system of settlements that are formed around the

prominent core. In the process of urbanization, the strength and demographic position of the city are reflected, not only through its individual characteristics, but also through the characteristics of the settlements that gravitate to it. The core, which in this case represents the city, together with functionally dependent settlements, form a whole that can be viewed as a separate system, and as a subsystem of one of the higher levels of the organization. Demographic processes that take place within the observed system are a direct or indirect manifestation of the transformations that take place, both within it and at a higher level of the organization.

As a case study, it served Belgrade, the capital and largest city of the Republic of Serbia, i.e. the system of settlements in which it represents the core. To determine the boundaries of the observed area, as a basic indicator, the daily mobility of the employed population was used. The basic time frame for the research of population alterations in the settlement system was the inter-census period between 2002 and 2011, taking into account previously initiated transformations, directly or indirectly related to the observed area.

URBAN SYSTEMS AND DEMOGRAPHIC PROCESSES

At the center of the relations and connections between demographic processes and the settlement system, is the city, as the core of the concentration of the population and the functional center, around which the said assembly is formed. Urban settlements can be said to be the product of a very complex combination of natural and socio-economic conditions. At a certain level of development of human society, they arise because of the appropriate division of work in it. From the moment of their creation, the cities themselves caused further diversification of economic activities and occupations. A common feature of modern urban settlements is that together with the surrounding they form one organic whole [1]. Movements of people, goods and information are a constant spatial phenomenon, and take place between cities, between cities and rural settlements and between individual economic activities. With these movements, cities and all settlements are connected into a spatial system in which they have the function of hubs. From that, complex urban systems of different characteristics are developing, which means that the network of centers is expanding, cities are growing, functionally they are more diverse and powerful, and the interactions between them are stronger [2]. Functional relations and connections between the city and its surroundings depend on many factors: geographical position, relief, natural resources, climate, population characteristics, economic conditions, development of non-economic activities, etc. The traffic-geographical position is of great importance for the development of functional relations, therefore the influences of the city will be felt more strongly along the main roads [1].

The types of manifestations of the city in the network of settlements, developed in a certain geospace, can have a dual role. The city can play the role of a center in the spatial organization of two systems of phenomena. On the one hand, they are the production, exchange and consumption of goods and the provision of services; and on the other, the organization of life and work, meeting the needs of the population living in the surrounding settlements. In addition, the city can be a center in which activities are concentrated, which have the characteristics of the poles of development, and such a city manifests itself as a factor in initiating, encouraging and directing the development of surrounding settlements [3]. Due to its properties of geographical gender, the city in the system of two-way connections is the driving force and carrier of connections and changes in the network of settlements, i.e. acts as a factor in the development of surrounding settlements, their socio-economic, and functional and built structures in its

surroundings [4]. It has been determined that the city is a factor in the development of the surrounding geospace, and its activities can be manifested in several ways: by attracting labor, population, raw materials and financial resources from the surrounding area; encouraging the development of oscillatory migrations of labor and many other users of various services from the surrounding area to the city; relocation from the city or creation of new production plants in the surrounding settlements, ie - encouraging, creating and strengthening secondary genders, services, work, connections and development in the network of surrounding settlements; by significantly expanding the built-up areas of the city and by growing and integrating the nearest suburban settlements into the physiognomic and functional-spatial structure of the city [5].

Starting from the definition of the system, it can be said that the urban system is a set of cities between which there is an interaction that takes place through the circulation of people, goods and information [6]. These movements are performed by traffic connections, such as railways, roads, air corridors, telephone connections, or some other form of communication [7]. With all its characteristics, urban systems are a reflection of the manner and degree of development of a space, its socio-political organization and economic position in the national and world economic system. From that, it can be concluded that for the geographical knowledge of a space, it is extremely important to know the features and levels of development of urban systems. Urban systems are social and spatial systems, and their characteristics should be viewed through three important dimensions: vertical (hierarchical), horizontal (spatial) and temporal. The basis for observing all dimensions of urban systems is their interdependence, since at a certain moment the vertical dimension of the centers also has a certain spatial dimension [8].

As opposed to the regular size distribution of cities [9], on the examples of some countries, irregularities in the size distribution of cities were noticed. In the hierarchical distribution, there was one large city, which was usually the capital, and all other cities were much smaller. The law of the primary city, i.e. the capital or the largest, as well as its exceptional importance in the development and organization of space and the state [10] explain this distribution of sizes. Numerous later studies have shown that the irregular size distribution of cities is maintained in a large number of countries, i.e. the distinct primacy of the capital in their urban systems [11].

DAILY MOBILITY AS A DEMOGRAPHIC INDICATOR FOR DETERMINING THE BOUNDARIES OF THE SYSTEM

The field of influence of the city on the surrounding can best be observed through the interaction with the population of dependent settlements. The mobility of the population between the city and the surrounding area is extremely pendular - turbulent, and can be compared to the movement of money. There is a centrifugal relationship between the city and its surroundings, in addition to the gravitational or centripetal one. At the same time, there is a two-way movement of people and goods. The rural settlement, as well as the city, has its attractive functions, taking into account that the city is the cause of turbulence, ie the cause of functional relations. The residential function represents the gravitational force of rural settlements, where a significant number of passengers live on the city-surroundings route. As the city could not exist without the surrounding and functional connections, so the accelerated urbanization causes great changes in the countryside [1].

To determine the limits of the impact of a certain settlement, through demographic indicators, the use of daily mobility of the employed population has become more frequent. Commuting creates an opportunity that did not exist in the past, to live at a

considerable distance from the place of work. The size of the city is one of the key determinants, so in the largest agglomerations, through this form of population movement, the effects are felt over long distances. In the city itself as well as in its surroundings, a significant flow of population is being created. Therefore, commuting causes numerous consequences, which are reflected in the already mentioned spheres [12]. Daily mobility of the population represent both population and socio-economic and cultural connections between the area of housing and the area of work of daily residents, with numerous causes, but also consequences in both areas. The process of commuting, especially of the economically active population, given that it is strongly linked to demographic development, economic development, transport, settlements, as well as labor and real estate markets, has broad implications in all spheres of life and work, as well as the population of labor settlements [13].

The daily urban system consists of commuters and a regional entity that includes a space that unites the origins of daily mobility of the population [14]. The concept of the daily urban system was introduced into the scientific literature as a new form of spatial organization of metropolitan regions separated on the basis of daily population movements in the second half of the 20th century [15], [16]. Based on the experience in researching the demographic, spatial and functional components of the daily urban system, the model of spatial manifestation of daily labor migration was applied [17]. Within the model, by grouping settlements with a similar volume of daily labor migration, ie the share of commuters in the labor center in the total number of employees, according to place of residence, the fields of influence of the center are singled out. The daily urban system consists of commuters and regional goals. Based on the intensity of daily interaction, the following zones are determined within the field: zone of intensive influence (from which more than 70% of employees migrate to the work center daily), zone of strong influence between 50 and 70% of employees migrate daily), medium impact zone (from which between 30 and 50% of employees migrate to the labor center daily), low impact zone (from which less than 30% of employees migrate to the labor center daily), as well as the periphery of the daily urban system (from whose settlements less than 5% of employees migrate to the labor center daily). The categorized values of the share of commuters, who travel to the labor center every day in the total number of workers, according to the place of residence, are qualified by an appropriate name that suggests their dependence on the function of work. The model has been successfully applied within various types of research, covering most of the territory of the Republic of Serbia [18], [19], [20], [21], [22], [23], [24], [25].

SERBIA AND BELGRADE IN CONTEMPORARY DEMOGRAPHIC PROCESSES AND FUNCTIONAL TRANSFORMATION OF THE URBAN SYSTEM

Urban centers, urban and rural areas which compose urban systems in Serbia represent heterogeneous set of settlements which differs in demographic size, economic development and functional capacity. This is a consequence of different development predispositions in geographical and socio-historical context. Similarly, to the most of Southeast Europe, Serbia is not sufficiently urbanized compared to the most developed part of the continent [26]. During the second half of the twentieth century, the most intensive socio-geographical, socio-economic and demographic changes took place on the territory of Serbia, which influenced significant changes in the manner and organization of space. The main causes of these changes are the pronounced planned

industrialization of the then state, and then, politically initiated deagrarization and urbanization, whose action, the socio-economic structure of the total population, was fundamentally changed [21]. The last decade of the twentieth century is associated with negative processes initiated, primarily, by non-economic factors.

Regional and subregional differences, and especially the growing gap between the largest urban centers and the rest of the country, in the level of economic development, diversification and job offer, housing, health care, overall quality of life, but also subjective experience of opportunities to achieve life goals, determine directions and the intensity of internal migration. In such a system, Belgrade and Novi Sad stand out, above all, as the main poles of attracting internal migrants [27]. The effect of migration on demographic development is of different intensity and scope regionally. The spontaneous relocation of the population over a long period resulted in the depopulation of a large part of the territory of the Republic, which was also contributed to by emigration from the country, especially the young population. The mentioned processes conditioned the polarization of demographic development [28]. Over last decades, in Serbia are living about half millions of refugees from the ex SFRY. During that time, they fit less or more into new environment, with different level of adaptation that depends on factors such as education, profession etc., and the type of settlement in that refugee settled (urban or rural, collective centers). The largest part of refugees in overall population is enumerated in Belgrade, especially in municipalities, such as Zemun, Barajevo, Čukarica etc. [29]. The combination of natural and migratory components caused depopulation in rural areas, and polarization in urban centers or immediate surroundings. The concentration of functions and population in urban areas, and the depopulation of rural areas, have led to changes in the demographic size of settlements, especially to the fragmentation of villages [19]. In that way, social and demographic changes were faster, i.e. they were not in line with economic changes.

Within the presentation of modern intensive spatial-functional changes in urban regions, and due to the end of the demographic transition, spatial-demographic indicators have a more significant role. Some of them are indicators of changes in the concentration, ie population density and relocation of the population, as well as changes in the characteristics of daily migration and in the structure of activities. There are connections between economic and demographic development, which are reflected in the spatial redistribution of population, as well as in the redistribution of population by activity, where the concentration of population in urban settlements, around the center of industrial activity, represents changes in spatial structure. Such a pronounced migration dynamics in the horizontal and vertical sense, conditioned by human activities, is a significant indicator of spatial-functional connections that are established in the region and between regions [30]. As the geospace of Serbia is differently economically developed and unevenly populated, all phases, types and levels of urbanization of settlements are found in certain regional units. The most important is the Belgrade agglomeration, i.e. a complex system of urban settlements with a high degree of morphological and functional connection, with a multi-layered hierarchy and a large gravitational influence [31].

Half a century ago, the gravitational area of Belgrade was defined as an area with almost five million inhabitants, with its indirect influence felt in Serbia, Bosnia and Herzegovina and Macedonia, while direct influence was present in several neighboring and close regions [32]. The process of transformation of the surrounding settlements has advanced the most and is most widespread around Belgrade, with it being marked as the basic center of development in the network of settlements in Serbia. A wide zone of neural settlements

developed around it, some of which had already grown into continuously built tissue, while others, in addition to being spatially separated, were already included in the city in the early 1980s [3]. In terms of concentration of population and activities, the achieved development of Belgrade was considered the result of a process that took place over a long period. The capital is also called the super-concentration of population and activities in the Republic of Serbia and beyond, and this is a problem in regional development because Belgrade also appears as a factor in discouraging the development of these territories. The complex of factors of internal, intra-city concentration of functions in Belgrade is placed in the same context, which is considered a consequence of its monocentric structure, and this again has numerous consequences on the functioning of the city, both internally and within the structure of Belgrade's regional space [33].

The end of the XX and the beginning of the XXI century is considered a period of developmental stagnation of the Belgrade metropolitan region. The goal is to move from a classic monocentric agglomeration with a strong core and relatively poorly developed periphery centers to a modern polycentric agglomeration in which peripheral settlements will take over part of the spatial and functional competencies of the core. The current relations in the region are characterized by a pronounced polarization and dichotomy of center-periphery, where the settlement of Belgrade, in relation to the total population of sub centers that should take over the role of regional development centers (Lazarevac, Mladenovac and Obrenovac), has twelve times more inhabitants. [34]. Due to all that, as one of the primary tasks of our urban geography, the definition and exact limitation of the Belgrade metropolitan area, whose administrative area deviates from the metropolitan one, was emphasized. The terms Belgrade and its urban system, gravitational zone, sphere of influence, functional area, city region, nodal region, metropolitan area implies only one process, and that is the functional action of the capital of Serbia. In addition, the Belgrade hinterland is considered an important agricultural, production, entrepreneurial, transport and vital resource [35].

The directions and dynamics of spatial-demographic changes during the last decades outline the stages of urbanization that Belgrade has gone through and clearly point to the directions and effects of transformations of spatial-economic and spatial-functional structure. The strengthening of political-administrative, economic and cultural-educational functions and the role of Belgrade in the regional development of Serbia and the wider surrounding, i.e. their strong influence on population growth, territorial expansion and growth of the former town into a metropolitan wide field of influence [36] . Belgrade is also considered to have grown into a powerful pole of concentration of population and activity in a short period of time, as well as a factor in channeling demographic and economic flows in the wider area. Changes in territorial distribution, spatial displacement and structural features within the agglomeration were in close interaction with the development and expansion of the urban region [37].

The economic structure of Belgrade is dominated by the activities of the tertiary sector, while the industry is also being modernized, which determines the important place of Belgrade, as an industrial center, in the wider regional framework. Apart from the fact that today it is not a dominant activity, industry, as a city-building function, was a factor in the development of centers within the Belgrade region, primarily Lazarevac, Mladenovac and Obrenovac, while they stimulated the development of industry with agglomeration forms and content [38]. As in other parts of the country, the period of economic stagnation, and even the negative tendencies in production caused by a series of unfavorable circumstances (bombing, economic sanctions, the collapse of industrial

systems, recession, and entering the transitional phase) reflected on the changes in economic structure and population development [39]. The change in the spatial model of economic development during the last decades is a reflection of the scope, pace and success of implemented reforms, the existing economic network and spatial, positional, infrastructural, institutional, personnel and other possibilities of spatial forms development. The processes of deindustrialization, tertiaryization and reindustrialization intertwine from the angle of spatial-structural development of the economy, whose spatial organization in Belgrade represents a mosaic picture of various forms created in different epochs of urban development [40]. New development poles are being formed, taking into account the general tendency to move production from the city center to the periphery, as well as locating new production and service capacities in the peripheral zone of the City of Belgrade. In addition, it was estimated that the lack of adjustment to European policies of development, industry, spatial development, as well as environmental protection in the future territorial development of economic activities in the metropolitan area of Belgrade could have consequences in further processes [41].

POPULATION CHANGE IN BELGRADE DUS 2002 - 2011

During the analysis of demographic processes on the territory of the daily urban system of Belgrade, the basic indicators were singled out: absolute population change and the index of population change. Both indicators were analyzed in order to show the importance of transformation for each settlement of the system, and taking into account the different population size of these settlements. These indicators are presented for the last inter-census period, ie between the 2002 and 2011 censuses.

The change in all settlements belonging to the system was analyzed, with special emphasis on settlements located in the zones of stronger influence of the core itself. Within the core, parts of the settlements of Belgrade were analyzed separately, ie they were treated as separate settlements, in order to have an insight into significant changes within the very center of the system.

A total of 371 statistical units (separate settlements and parts of the settlements of Belgrade) were observed, of which an increase in the number of inhabitants was observed in 113 (Figure 1). The increase was of different intensity according to the types of settlements, their location and role in the observed system.

If we look at the periphery of the daily urban system of Belgrade, in the observed period, the largest absolute increase in population was in Novi Sad (40,142). It also represents the second most important center on the territory of the Republic and, together with Belgrade, forms the zone of the most intensive daily migration. Borča should be singled out as the most important satellite settlement in its immediate vicinity, which had an increase in population of more than 10,000. A significant group consists of settlements with an increase of 1,000 to 5,000 inhabitants, which included a large number of administrative centers of Belgrade municipalities. In the mentioned group, the most important was Kludjerica with an increase of 4,656 inhabitants, followed by the municipal center Surcin (3,913), Ugrinovci (3,608), Lazarevac (3,274), Sremcica (2,551), Leštane (1,981), Obrenovac (1,500) and Mladenovac (1,495). It is interesting that in the group of settlements whose number of inhabitants decreased by more than 1,000 in the observed period, there were mainly municipal and larger centers located on the periphery of the daily urban system of Belgrade.

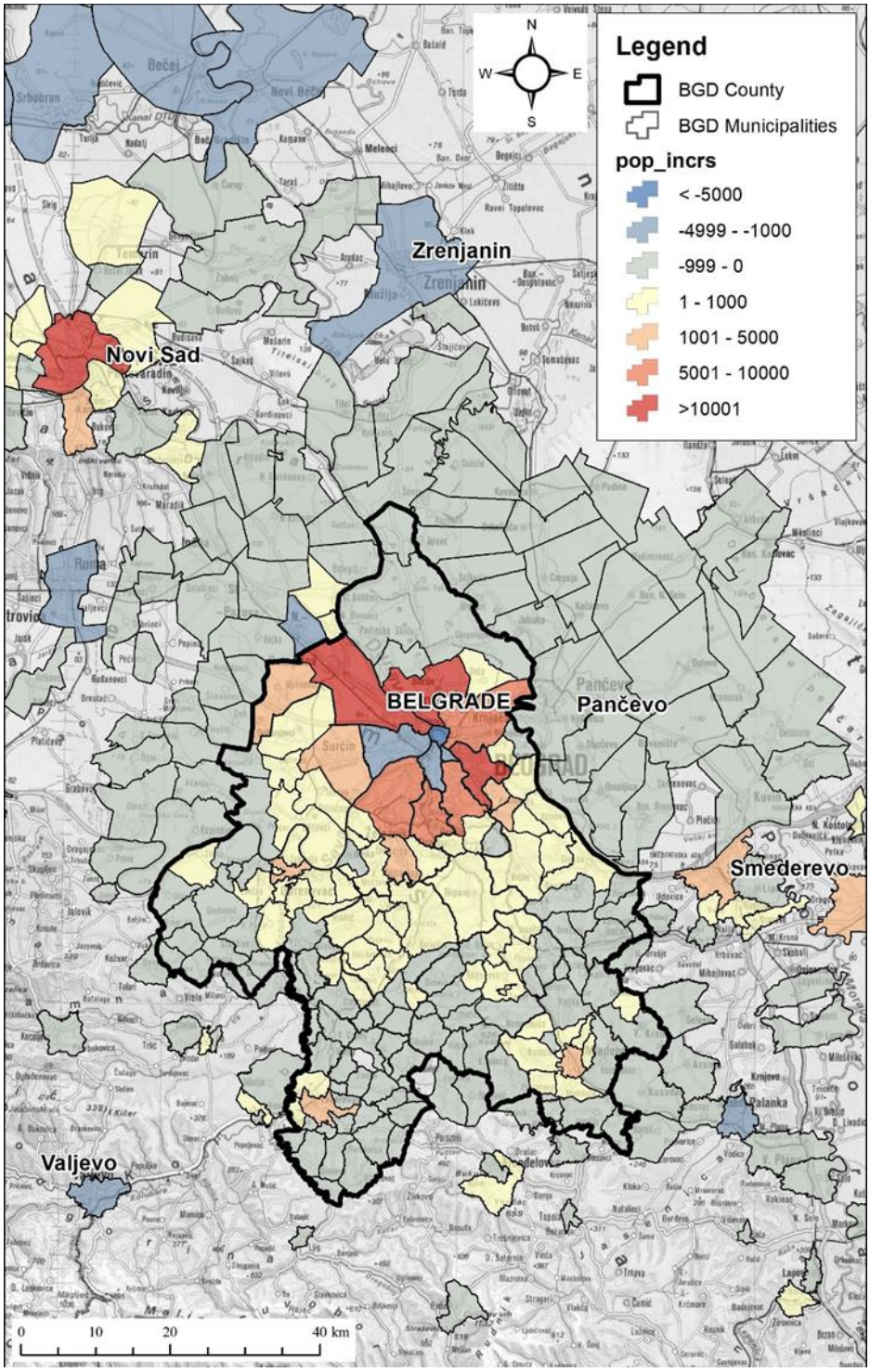

Figure 1. Absolute population change of Belgrade DUS 2002-2011.

The absolute population change within the parts of the core itself had significant differences. The most significant increase of almost 20,000 inhabitants was observed near Zvezdara. In addition to that, the part of Belgrade that belongs to the municipality of Zemun had an increase of more than 10,000 inhabitants. Rakovica was very close to this category, as well as the part of Belgrade that belongs to the municipality of Čukarica. Parts of Belgrade belonging to the municipalities of Palilula and Voždovac also had an increase of more than 5,000 inhabitants.

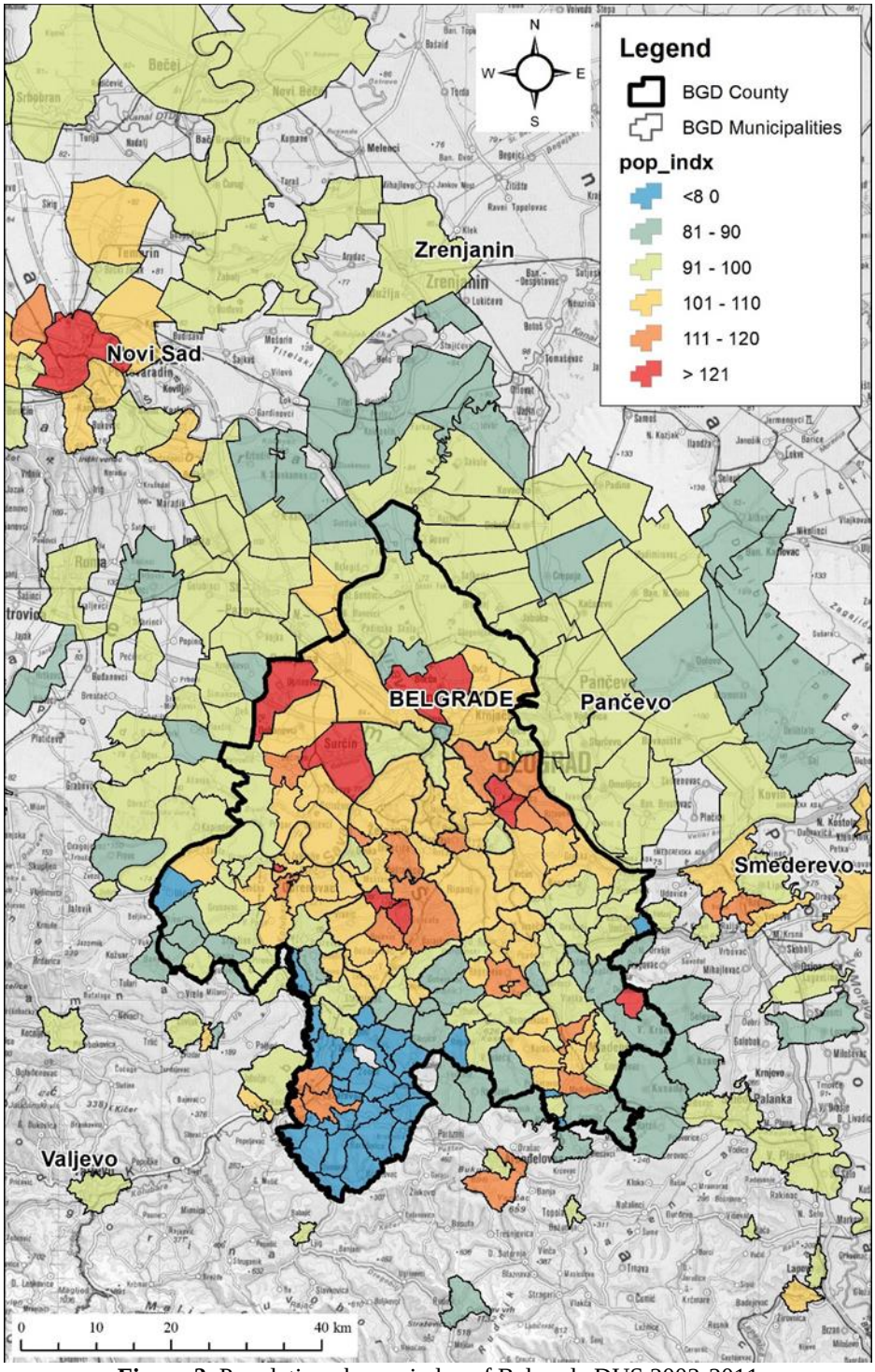

Figure 2. Population change index of Belgrade DUS 2002-2011

On the other hand, in the observed period, and according to the census, the number of inhabitants decreased in the municipalities of Vračar, New Belgrade, Savski venac and Stari grad. The municipality of Stari grad stands out as the only part of the settlement of Belgrade whose decline in population was more than 5,000, and at the same time a statistical unit with the most significant reduction in population in the entire system (7,093).

The percentage increase in the number of inhabitants among the settlements of the daily urban system of Belgrade had a slightly different schedule (Figure 2). Special mention should be made of the settlement of Ugrinovac in the municipality of Zemun, whose population increased by half in the observed period. Besides him, we should also point out the settlements whose population has increased by more than 30%, and they are: the settlement of Rvati in the municipality of Obrenovac, Borča in the municipality of Palilula and the settlement of Guncati in the municipality of Barajevo. A significant increase, with more than 20% in the observed period was also observed at the municipal center Surčin, then Meljak, Leštane and Kaludjerica. On the other hand, the population of Ušće in the municipality of Obrenovac and Vreoci in the municipality of Lazarevac had a population reduction of more than 20%. Other settlements where such a significant population decline was observed were parts of the periphery of the daily urban system of Belgrade. Observed according to the parts of the core of the system, the relative changes had different dynamics. The most significant increase was observed in the municipality of Zvezdara, whose population increased by 14.5% in the observed period. Rakovica (9.7%) and parts of the settlements of Belgrade belonging to the municipalities of Zemun (8.1), Čukarica (7.2) and Palilula (7.1) had an increase of between 5 and 10%. In contrast, the central city municipality of Stari grad had the most intensive decline in the number of inhabitants of 12.8%.

CONCLUSION

According to the evolutionary phases of the urban systems development and theoretical starting points of the urbanization processes spatial manifestation, city centers are the main initiators of socio-economic transformations of their surroundings. Belgrade, as a central settlement in the geospace of Serbia, directly and indirectly has a noticeable impact on the demographic, spatial and socio-economic transformation of settlements in its immediate and distant surroundings. The belated social and economic transition on the territory of Serbia had a significant impact on the role of Belgrade, and thus the transformation of its daily migration system. The distinctly polarized space of Serbia determined its position as the primary concentration of both the function of work and the function of housing within the borders of the state and beyond. Difficult conditions of development on the territory of the entire country were reflected in the intensification of deindustrialization and increasingly pronounced tertiaryization, in which Belgrade was in the forefront, as a social and political center. After the population growth of the urban core, and then the peripheral settlements, caused, above all, by the migratory influx of population, the attractive function of Belgrade was manifested by increasing the spatial coverage of its daily urban system.

On the whole, the territory covered by the boundaries of Belgrade's daily urban system represents a significant concentration of population. Unlike the rest of the Republic of Serbia, where depopulation trends have been going on for decades, the observed territory is characterized by positive population changes. In the last inter-census period, the number of inhabitants of all settlements belonging to the system, together with the core, increased by more than 60,000. Within the system, there are noticeable differences in population processes, which were significantly influenced by the functional transformations of certain settlements. The growth of the population is especially notable in the settlements that have physiognomically merged with the core, then in the municipal centers in development and in parts of the settlements of Belgrade where, instead of the traditional industrial orientation, the housing function is getting stronger. On the other

hand, depopulation processes are expressed in rural parts of the suburban area, mostly within municipalities that have traditionally had an industrial character. Special emphasis should be placed on the central parts of the system core, which represented the main depopulation zones in the observed period. Taking into account the continuation of the transformation of the center itself, as well as numerous settlements in its immediate surroundings, new trends in population movements can be expected, which once again confirms the dynamism of the capital urban system.

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STRATEGIC DOCUMENTS ON OLDER PEOPLE – THE CASE OF CROATIA

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ABSTRACT

With 21.4% of its population aged 65 and over and a median age of 44.4 years, Croatia is among the oldest European and world countries. Population ageing and changes in economic, political, and social life (particularly changes in the family, but also in the attitude of the individual and society towards ageing) require new approaches in planning to meet the needs of older people and organising comprehensive formal, institutional and non-institutional forms of care for those in need. This paper aims to analyse the main strategic documents dealing with older people and their most common problems and offering solutions, mainly to meet their primary needs. The following documents have been analysed: *the Social Welfare Strategy for Older People in the Republic of Croatia for the period 2017–2020, the Strategy for Combating Poverty and Social Exclusion in the Republic of Croatia 2014–2020, and the National Plan to Combat Poverty and Social Exclusion in Croatia for the period from 2021 to 2027.* The analysis will seek to assess the extent to which the specific objectives of the operational plans are in line with the planned integrated approach to social services, with the basic criterion being the quality of services and individual needs. Any analysis of the challenges relating to population ageing and the ways to solve them, as well as the quality of life of older people, should be focused on the concept of active and healthy ageing, i.e. the potential of older people to contribute to their own well-being, family and community well-being.

Keywords: older people, strategic documents, Croatia, active and healthy ageing

INTRODUCTION

The United Nations has proclaimed the decade we live in (2021–2030) the Decade of Healthy Ageing, aiming to improve the lives of older people, their families, and communities. The focus is on four strongly interconnected action areas: combating ageism, age-friendly environments, integrated care, and access to long-term care [1]. Changes in the population age structure, including an increase in the number of older people and a decrease in the number of young people, are present in a growing number of countries. Population ageing is a process that has started several decades ago due to the decline in fertility and the increase in life expectancy in Europe and is one of the greatest challenges for European modern societies. According to Eurostat estimates, the number of older people in the EU-27 will increase from 90.5 million to 130.2 million between 2019 and 2100, while the median age will increase from 43.7 to 48.8 [2]. With 21.4% of its population aged 65 and over and a median age of 44.4 years, Croatia is among the oldest European and world countries [3]. Decades of continuous emigration

have led to a deterioration of the age structure and negative natural development, resulting in an overall decrease in the population of Croatia [4]. The first results of the Croatian Census 2021 relating to total population and households indicate a continuation of depopulation, and the data to be published next are expected to show a deterioration of all indicators of the population age. Population ageing and changes in economic, political, and social life (particularly changes in the family, but also in the attitude of the individual and society towards ageing) require new approaches in planning to meet the needs of older people and organising comprehensive formal, institutional and non-institutional forms of care for those in need.

In order for society to be able to plan and respond to the needs of older people (in accordance with its material and organisational capabilities) it first needs to know what older people consider a good quality of life. The idea of all ageing developed societies is to ultimately use the potential of older members to improve their personal quality of life, but also the quality of life of their communities. Research has confirmed that the perception of a good quality of life among older people varies from society to society, but the most important domains can almost always be classified into three groups, differing in the rank of importance with regard to the cultural specificities and economic opportunities of each society: 1) social relationships, 2) health, activities and functional ability, and 3) own home, finances and personal beliefs and attitude [5].

According to Gabriel and Bowling, for older people, the perception of a good life includes, among other things, living in own home and a neighbourhood that provides satisfaction and a sense of safety, having sufficient resources to meet basic needs, maintaining good interpersonal relationships (providing and receiving help and support), having access to local institutions and transport, engaging in hobbies and/or various activities, feeling included in society by retaining individual roles, maintaining health as best as possible (mobility, acceptance of facts that cannot be changed, a positive attitude towards life) and autonomy and control over one's own life [6].

This paper aims to analyse the main strategic documents dealing with older people and their most common problems and offering solutions, mainly to meet their primary needs. The following documents have been analysed: *the Social Welfare Strategy for Older People in the Republic of Croatia for the period 2017–2020, the Strategy for Combating Poverty and Social Exclusion in the Republic of Croatia 2014–2020, and the National Plan to Combat Poverty and Social Exclusion in Croatia for the period from 2021 to 2027*. The analysis will seek to assess the extent to which the specific objectives of the operational plans are in line with the planned integrated approach to social services, with the basic criterion being the quality of services and individual needs.

STRATEGIC DOCUMENTS ON OLDER PEOPLE IN CROATIA

Social Welfare Strategies for Older People in Croatia

In 2014, the first three-year strategic document on care for older residents was adopted under the title Social Welfare Strategy for Older People in the Republic of Croatia for the period 2014–2016, whose implementation was coordinated by the Ministry of Social Policy and Youth. However, more than half of this document concerned the analysis of the situation [7]. In the part called the action area, three areas were defined: legislative framework; information, communication and raising awareness, and expanding the network of social services, each of them including defined goals, measures, and activities. A key shortcoming of this document was that it was not binding. State administration

bodies, local and regional self-government units, service providers and civil society organisations were merely recommended to implement the measures set out in this document, while at the same time they were required to report annually to the Ministry of Social Policy and Youth on their implementation.

After the mentioned document expired, Croatia was without a strategic document for older people for nine months, with the new 2017–2020 strategy being adopted only in late September 2017. (Social Welfare Strategy for Older People in the Republic of Croatia for the period 2017–2020) [8]. The Strategy was drafted in order to ensure better social welfare for older people in Croatia and to give service providers access to EU funds to finance community-based services which are not covered by the Social Welfare Act, but which increase the quality of life of older people, allowing them to stay in their homes for as long as possible. Apart from the fact that the Strategy was adopted late, it includes the same strategic areas that were listed in the previous one, only slightly refined in terms of terminology – improving the legislative framework, informing and raising awareness of the rights of older people, and expanding and improving community-based services. State administration bodies, local and regional self-government units, service providers and civil society organisations are obliged to implement the measures from this Strategy, in contrast to the measures from the previous one.

The very title of the Strategy reveals that it is aimed exclusively at older people in need of a certain form of care, rather than being conceived as a strategy to increase the quality of life of all older people, with social welfare being only one of the areas concerned. Although the introduction highlights the need for an individual approach to older people and their needs, this principle has not been translated to measures and activities.

As regards the legislative framework, the first objective was to harmonise access to the network of social services for all beneficiaries and service providers under the same conditions and rules, that is, to introduce a single financing model based on payment per service provided. This has not occurred, and all residents of so-called state-owned facilities continue to have subsidised accommodation costs regardless of their income and assets. On 31 December 2020, 16,555 people were accommodated in nursing homes in Croatia, 59.9% of them in so-called state facilities [9]. Given that accommodation in state homes is available at below-market prices, the demand is high, resulting in long waiting lists. The government should aim to provide accommodation in state homes to those who have no other solution, subsidising costs only for those financially most vulnerable, and clearly elaborate the criteria for admission to state homes and subsidisation [10], thus avoiding social injustice.

One of the objectives of the Strategy was to improve the monitoring of the work of service providers for older people. The COVID-19 pandemic has shed light on the many weaknesses of the present system: too many residents in nursing homes, a large number of illegal nursing homes, some of which do not have even the minimum necessary infrastructure, frequently inadequate management structure, too few staff who are often insufficiently trained for these jobs [11]. It has been shown that nursing home monitoring is either not carried out or is ineffective. Due to numerous irregularities, insufficient quality of service and even accidents resulting in human casualties, the government has announced changes to the legislative framework aimed at the abolition of family homes, which would have a transitional period of five years to reorganise and become private homes or foster care facilities. It is unclear how the lost capacities of family homes will be compensated, given the growing need for institutional accommodation.

In order to improve the financial situation and social security of older people, an objective was defined – to introduce a national old-age pension for those who are socially disadvantaged and who receive no pension based on previous labour and paid contributions. This did not happen and the measure was abandoned. In 2021, the so-called national benefit for the elderly was introduced under the Act on the National Benefit for the Elderly [12], amounting to HRK 800 (EUR 105). The right to this benefit may be exercised by a Croatian citizen who has reached the age of 65 years, with 20 years of continuous residence in Croatia immediately before applying for this right[13]. According to estimates of the Croatian Government, 19,700 persons were to receive this benefit in 2021, with a planned cost of HRK 132 million. It turned out that only 5,658 beneficiaries exercised this right and that the cost was HRK 42.7 million [13]. The measure clearly has not yielded the results that the government hoped for, as the number of applications and beneficiaries is significantly lower than expected. Bađun and Urban cite two possible reasons: the first is the lack of information about this benefit among older people and the inability to exercise the right due to difficulties with application and payment, while the second concerns the unfulfilled expectation of the proponents of the act that part of the current recipients of a pension or guaranteed minimum benefit would abandon these rights and replace them with a new benefit [13]. In early 2022, 5,757 beneficiaries received the national old-age benefit, which was increased to HRK 820.80 (EUR 108.5) [14]. The amount of the national benefit is extremely low, providing for not even a minimum standard of living.

Institutional Accommodation and Non-Institutional Services

Within the third strategic area of service expansion and improvement, the first objective is to increase the availability of services for older people by encouraging the increase of accommodation capacities in institutions and encouraging the development of those community-based services aimed at keeping older people in their homes. The comparison of data on the number of state homes and capacities at the beginning and end of the Strategy implementation period shows that there has been no increase in capacity. The number of nursing homes owned by the state – 3 and the counties – 45 has been the same for years. However, there has been an increase in the number and capacity of private homes, which are often too expensive for low-income older people due to their market prices.

In most EU countries, including Croatia, the ageing process of the older population is very intensive, with their share continuously increasing. There are 2.9% of people aged 85 living in the EU-27 and 2.4% in Croatia [15]. Since this age group is facing serious impairment of the physical and mental health, they are significantly limited in terms of functional abilities, and therefore dependent on other people's care. The increase in the population of this age indicates that the need for formal care, long-term care and

[13] Beside these two requirements, an applicant must comply with the following conditions: 1) the applicant is not a pension beneficiary or an insured person covered by the mandatory pension insurance; 2) the monthly income the applicant or his household members earned per a household member in the previous calendar year does not exceed the determined amount of the National Benefit for the Elderly; 3) the applicant is not entitled to the Guaranteed Minimum Benefit according to the regulations on social welfare, 4) the applicant is not entitled to service of accommodation according to the regulations on social welfare, 5) the applicant has not concluded a Contract of Support Until Death or a Lifelong Support Contract in capacity of a supported person

accommodation in nursing homes will also increase. Therefore, a shortcoming of the Strategy is that it does not specifically address the issue of reinforcing the network of nursing homes and increasing their capacity. The available strategies and plans suggest that the government does not intend to finance the construction of new nursing homes, but only plans to reinforce local-level non-institutional services. It seems that the expansion of the home network will be based on a private initiative, which for now clearly follows market principles and will therefore not be available to many people and in many areas.

Croatia sees large regional differences in the availability of institutional accommodation for older people. It is extremely low in less populated and less developed areas (for example, small islands, mountain areas, etc.). While these, usually small and traditional communities still record a very high level of solidarity, informal carers cannot compensate for the often complete absence of formal care for older people. According to SHARE study results, caring for a family member can become a burden that affects the caregiver, especially when it comes to caring for a severely ill person. The existence of a long-term care assistance system (even if one does not benefit from it) provides caregivers with a sense of control over the situation and improves their well-being [16].

POVERTY AND OLDER PEOPLE

Since older people are among the groups most at risk of poverty, the assessment of the role of public policies and strategies for tackling the problem of their large number in Croatian society needs to include two documents dealing with poverty and social exclusion: the Strategy for Combating Poverty and Social Exclusion in the Republic of Croatia 2014–2020 [17], and the National Plan to Combat Poverty and Social Exclusion in Croatia for the period from 2021 to 2027. [18].

The first document, the Strategy for Combating Poverty and Social Exclusion in the Republic of Croatia 2014–2020 was defined as the basic document that will enable a systematic and common approach of all relevant stakeholders in the solution of the issue of poverty and social exclusion, along with ensuring a minimum standard for the most disadvantaged members of society and preventing new occurrences of poverty and social exclusion. Three main priorities have been defined; providing conditions for combating poverty and social exclusion and reducing inequality in society; providing conditions for preventing the occurrence of new categories of the poor, as well as the reduction of the number of poor and socially excluded persons; and establishing a coordinated system of support for groups at risk of poverty and social exclusion. For the achievement of the three indicated priorities and corresponding primary objectives, activities are envisaged within eight strategic areas; education and lifelong learning, employment and access to employment; housing and availability of energy; access to social benefits and services; access to the healthcare system; care for older people; the fight against indebtedness and promotion of financial independence; balanced regional development. The initial part of the document singles out four groups of inhabitants most at risk of poverty and social exclusion, among which older people and pensioners occupy a significant place. They are specifically addressed in the fifth strategic area of care for older people, which envisages three activities: 1. improving the quality of life for older people and expanding community-based services; 2. improving the position of pensioners; 3. ensuring the sustainability of the pension system and ensuring the social adequacy of pensions.

Apart from the Strategy for Combating Poverty and Social Exclusion in the Republic of Croatia 2014–2020, the adoption of an Implementation Programme is envisaged.

However, the Strategy Implementation Programme was adopted only for the 2014–2016 period, and only at the end of the third quarter of implementation. The Programme included 40 activities with 96 measures for eight strategic areas. However, no implementation programme was adopted for the period since 2017, and several measures and activities were implemented that had been delayed in the previously planned two-year period. The proposal for an implementation plan continued to be delayed. Only in late 2019 was the implementation programme proposal for the period 2018–2020 submitted for public consultation.

The planned and especially implemented measures relating to older people at risk of poverty, which were intended to improve their material standard and increase their level of social inclusion, had no effect, given that in the period from 2014 to 2020 the at-risk-of-poverty rate for older people increased significantly, as shown by Central Bureau of Statistics (CBS) data.

Poverty is one of the biggest problems for older people in Croatia. Older people, especially women, are at high risk of poverty and social exclusion. According to CBS 2020 data, Croatia's at-risk-of-poverty rate by age group is highest in people aged 65 or over, at 31% (compared to only 23.1% in 2014) [19], [20]. In 2020, it was 34.6% for women (compared to 24.6% in 2014) and 25.8% for men (compared to 20.8% in 2014) [19], [20]. Comparing this 31% to the EU average at-risk-of-poverty rate of 16.5% in 2019, the situation seems to be dramatically worse. Particularly vulnerable are single households consisting of people aged 65 and over, where the at-risk-of-poverty rate is as high as 52.1% and has been steadily increasing in recent years [19].

This large number of impoverished pensioners reflects the economic conditions in which wages have been so low over the last 50 years that a large proportion of employees could not make significant savings, but also pension systems which neither in the former socio-political system nor after the 1990s enabled a significant increase in personal savings or mandatory savings in the introduced second pension pillar. So today, as in the past, pensions largely depend solely on intergenerational solidarity. Today, a large number of older people are financially dependent on their pension, which in Croatia averages 36.4% of the average salary. In early 2022, 1,139.229 pension beneficiaries were entitled to a pension under the Pension Insurance Act, with an average net pension of HRK 2,648.82 (EUR 353) [21]. However, the total number of pensioners is slightly higher at 1,232,708 as it includes Homeland War veterans, members of the Croatian Defense Council and former active military figures. Adding up their pensions, the average pension in Croatia was HRK 2,873.38 (EUR 383) or 39.4% of the net salary. According to the Strategy, the average pension for December 2013 (paid in January) was HRK 2,474.91, while the average pension share in the average net salary was 43.93%. In 2013, the average old-age pension for 40 and more years of pensionable service was HRK 3,479.08, with a 61.75% share in the average net salary. In 2022, the average old-age pension under the Pension Insurance Act for a pensionable service of 40 years and over is 4,078.14, which is 56.01% of the average salary [21]. This indicates a significant increase in the gap between the income of pensioners and employees.

The unfavourable ratio of the number of employees and pension beneficiaries is the reason for low pensions and the problem of sustainability of the pension system. Besides, the large number of pension beneficiaries[14] in Croatia results not only from unfavourable

[14] In February 2022, the ratio of the number of pension beneficiaries to the number of insured persons was 1:1.27 [21].

demographic trends but also from numerous problems caused by the transformation of the social into private property and related economic issues, including the collapse of many industrial companies throughout the country. The problem of unemployment has often been addressed by the model of early retirement of still working-age and vital residents[15] , which in the long run has left many negative consequences for the economy and society in general.

According to a study by the Institute of Economics [22], Croatian residents are poorly informed about possible forms of retirement savings, and real estate, life insurance and bank deposits are considered the most appropriate forms of savings for pleasant retirement life. While they are aware that they will need additional income in retirement, they intend to earn it through part-time work and agriculture, which requires good health, which they may or may not have after the age of 65. Besides, their expectations of pensions are much higher than what they may receive [22].

Other studies assessing the quality of life of older people confirmed that despite mostly small pensions, owning a property, an apartment or a house in which they live provides some material safety for older people [23].

Until a few years ago, due to high unemployment among young people, there were extremely few opportunities for pensioners to earn additional income based on some kind of paid work [24]. However, in recent years, opportunities have opened up for older people to work in addition to receiving a pension, driven by labour shortages due to the high age of the population and changes in the legislative framework. Pensioners are allowed to work a maximum of half of the working hours, while receiving their pensions. However, this reform has also failed to provide equal opportunities for all pensioners, as it allows, for example, retired military and police officers, some retired veterans and officials to work full time and receive half of their pensions if they wish, which is not possible for other pensioners.

Despite obvious problems with the financing of the Croatian pension system, not much has been done to encourage and allow people to stay employed for as long as possible, except at a declarative level. In one of its analyses, the World Bank concludes that despite the reforms implemented in Croatia, there are still numerous options for early retirement and no significant incentives for longer employment [25]. Therefore, between 2000 and 2020, the expected length of service in Croatia increased by just over 2 years, which is significantly lower than the EU average of 3.4 years in that period [26]. Croatia and Greece are at the bottom of the EU-27 scale with only 32.8 years of the expected length of service, with only Italy ranked worse with 31.2 years. In addition, men in Croatia record the shortest length of service in the entire EU – 35.1 years [26]. In addition to existing demographic and fiscal constraints, the only way to ensure a sustainable increase in pensions in Croatia is to extend the length of service.

The evaluation of the efficiency of the implementation of measures and actions undertaken to alleviate poverty in Croatia, carried out by the State Audit Office in 2020, pointed to numerous shortcomings in the implementation of the Strategy, including irregular meetings of working groups, failure to prepare the implementation programme since 2017, irregular drafting and poor quality of annual reports on measure implementation, but also non-compliance of the main objective of the measure with the activities, unclear target groups and indicators of measure impact, etc.

[15]The early retirement model has also contributed to low pensions.

After the Strategy expired, Croatia remained without any strategic document in this area for almost a year, as the National Plan to Combat Poverty and Social Exclusion in Croatia for the period from 2021 to 2027 was only adopted in December 2021. This means that the first year for which it was envisaged had expired before its adoption. The situation is similar with the Action Plan to Combat Poverty and Social Exclusion for the period from 2021 to 2024, whose first implementation year had also expired before its adoption. This speaks in favor of the thesis that this issue is not among the priorities of the Government or Croatian public policies.

The National Plan to Combat Poverty and Social Exclusion for the period from 2021 to 2027 defines eight programme areas: health care, education, employment and access to employment, pension system, housing, social welfare, civil society development and regional development. Unlike the 2014–2020 Strategy, a larger number of vulnerable social groups are now defined, while older people and pensioners are placed in the same category as children and young people. The only objective relating to reducing poverty among older people is to increase the amount of family and minimum pensions.

CONCLUSION

Any analysis of the challenges relating to population ageing and the ways to solve them, as well as the quality of life of older people, should be focused on the concept of active and healthy ageing, i.e. the potential of older people to contribute to their own well-being, family and community well-being. The active ageing approach implies changing the focus of society from what older people can no longer do to emphasising their abilities and knowledge. It is simply a continuation of the participation of older people in society, which is beneficial to all domains of life (including economic, which is extremely important) of an old person individually, but also to society as a whole.

Relevant plans and main strategic activities should focus on improving the quality of life of older people as individuals, but also as active community members. According to the documents analysed, the priority should be the protection of older people without an income and those with income below the at-risk-of-poverty threshold, then the development of community-based social services for all those in need and raising awareness of healthy living and the role of active and healthy ageing.

Regardless of a large number of pensioners, and in order to achieve social adequacy and sustainability of the pension system, the planned improvement of their position – by adjusting pensions, allowing them to work along with receiving a pension, increasing the number of people with remaining working capacity, i.e. their return to the labour system – are not public policy priorities under the conditions that have determined life in Croatia in the last two years in addition to the long-term economic backlog within the EU-27 – the COVID-19 pandemic and two major earthquakes, the consequences of which have not begun to be remedied to this day.

Unfavourable demographic processes, such as continued depopulation and emigration, unfavourable age and educational structure, low economic activity, extremely uneven population density, which will be further highlighted by the results of the Census 2021, should be mitigated by balanced regional development. It is necessary to create a quality network of institutional and non-institutional care for the ageing population, especially in counties with poor demographic indicators due to the high emigration of young people.

Therefore, the strategic approach to care for older citizens of Croatia should primarily seek to develop various forms of care available in their environment tailored to their needs, encourage their continued active participation in the life of the community, which

can contribute most to the personal quality of life, and establish non-institutional forms of care, such as home assistance, various daily activities adapted to the abilities and needs of older people, counselling to raise awareness of healthy life at a local level (local committees, city districts), encouraging volunteering in the local community among all age groups, and supporting existing and establishing new providers of non-institutional services for older people. However, due to the growing number of older people and their need for all forms of care, it is necessary to continuously expand the network of nursing homes.

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THE IMPORTANCE OF DEMOGRAPHIC DEVELOPMENT AND SETTLEMENT SYSTEM IN THE GEOPOLITICAL EVALUATION OF THE GEOSPACE OF THE REPUBLIC OF SRPSKA

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ABSTRACT

Population, as the most important resource and element of socio-economic development, forms a system of demographic characteristics that has a specific value in the geopolitical evaluation of the geospace of the Republic of Srpska.

Also, specific historical circumstances and political-geographical processes, natural-geographical and economic-geographical features are the basic factors of social development and distribution of settlements in the geospace of the Republic of Srpska. These factors conditioned the existing network of settlements, as well as their development functions and characteristics.

In approaching the topic, we start from the premise that demographic processes and the existing network of settlements are one of the basic factors and determinants of the political-geographical and geopolitical position of the Republic of Srpska as an entity in Bosnia and Herzegovina. In this context, we develop a thesis on the fundamental importance of demographic factors and relevant settlement potentials as a quantitative-qualitative category that ultimately determines contemporary geopolitical characteristics. The subject of research in this paper are the demographic elements and the settlement system of the Republic of Srpska, more precisely, the connection and interaction between demographic and settlement particularities and their implication to the geopolitical characteristics of the researched geospace.

The research methodology is based on the analysis of demographic processes, settlement specifics and development functions, in accordance with scientifically accepted indicators of individual and general regional development. In this context, we determine research methods, both within the framework of standardized methods of analysis and synthesis, and on the basis of methods immanent to geographical research: historical-geographical, comparative, statistical, demographic, mathematical, cartographic and graphic.

Research results should meet a scientific and practical objective. More precisely, scientific results would indicate demographic specifics and development problems, but also offer models of administrative organization and management of geospace that could be applied in different areas of social practice. The paper would improve geopolitical and regional-geographical knowledge of the researched geospace, viewed through the prism of contemporary demographic and political-geographical processes in Bosnia and Herzegovina and the Western Balkans as a whole.

Keywords: Republic of Srpska, Bosnia and Herzegovina, demographic characteristics, settlements, geopolitical position

INTRODUCTION

From the political and legal aspect, we can define the state as a community of people in a certain territory in which the political system works effectively.

Thus, population and territory are the basic elements of the political-territorial community. This statement is confirmed by the fact that the Swiss-French philosopher Jean-Jacques Rousseau pointed out that: "A political body can be viewed in two ways - in terms of territory, or in terms of population size, and the appropriate size of a state will depend on the relationship between them (Rousseau 1949)" [1].

States pay special attention to the population - they take care of their health, general ability and culture, because the continuity and stability of the political-territorial community largely depends on the population. Population changes, vital statistics, migration trends, belonging to the rural and urban contingent, national and religious structure - all this has a specific value in the geopolitical valorisation of a particular area.

The Republic of Srpska (RS) is an entity in Bosnia and Herzegovina with an area of 24.641 km2 and represents about 48% of the total territory of BiH. Mathematically and geographically, it occupies the northern and eastern part of the geospace of BiH, between 42033'18" and 45016'36" north latitude and 16012'18" and 19037'44" east longitude (Figure 1).

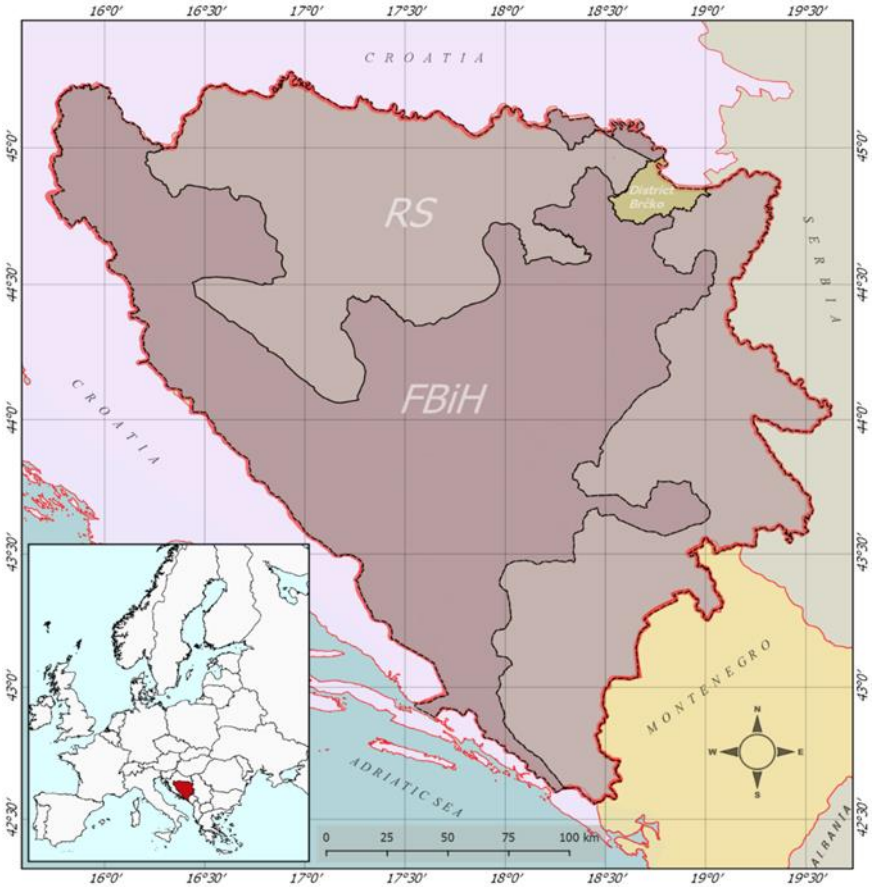

Figure 1. Bosnia and Herzegovina (Republic of Srpska – RS and Federation of Bosnia and Herzegovina – FBiH)

The geospace of the Republic of Srpska, in accordance with its geographical position and historical-geographical features, represents an extremely complex civilizational, ethnic and demographic spatial-functional and territorial system.

Due to complex historical and geographical circumstances, but also modern processes and constellations in the international community in this area, there have been frequent interruptions in the continuity of cultural, economic, ethno-demographic and political-territorial development. It is rare that in such a small, naturally and geographically diverse and strategically important area, three opposing religions, and their cultural-civilizational areas, permeate each other, and sometimes to the point of exclusivity.

"Therefore, the geospace of the Republic of Srpska and Bosnia and Herzegovina is specific in many ways. It has its own integration and disintegration flows in different historical-geographical periods and political-geographical circumstances. This is the reality of this area, and all positive and negative changes are reflected and conditioned primarily by ethno-demographic characteristics, whether it is intra-national or multinational changes" [2].

One of the most important factors of socio-economic development and a determinant of geopolitical evaluation of a political-territorial community, such as the Republic of Srpska, is the population. Total population, population density (distribution), population structures, migration, ethnopsychological characteristics form a set of quantitative and qualitative characteristics, which determine its geopolitical characteristics [3].

A special problematic issue that opens up the analysis of demographic characteristics and specifics of the settlement system of the political-territorial community, such as the Republic of Srpska, are the geopolitical consequences arising from demographic development and existing differences in the spatial-functional polarization of this geospace.

Since the second half of the 20th century, the socio-economic development of the Socialist Republic of Bosnia and Herzegovina has been conditioned by a strong process of industrialization and deagrarization. The number and function of urban settlements affected by these processes have spatially and functionally increased and expanded to the surrounding rural settlements, accelerating urbanization.

However, "Bosnia and Herzegovina was not a highly urbanized republic in Yugoslavia. Only five cities had a population of more than 50,000, and only municipal centres (64) had more than 5,000 inhabitants, and if we accept the classification according to which urban settlements are determined in this way, then in 1991 there were 1,575,498 inhabitants, or 36.1% of the total population" [4].

Demographic and settlement specifics of the Republic of Srpska make a very heterogeneous area. This heterogeneity is manifested through isolated areas, regions that have their own characteristic demographic development, economic characteristics, settlement system and urban centres [5].

In approaching the topic, we start from the premise that demographic processes and the settlement system are one of the basic determinants of the geopolitical characteristics of the Republic of Srpska as a separate entity within the internationally recognized state of Bosnia and Herzegovina. In this context, we develop a thesis on the fundamental importance of demographic development and relevant settlement processes as quantitative-qualitative categories which, ultimately, determine the geopolitical perspective of the Republic of Srpska.

DATA AND METHODOLOGY

The issue and the subject of the research are defined by the title of the topic. The research of demographic development and settlement system and their influences on the geopolitical specifics of the Republic of Srpska will be based on a complex analysis and study: population trends, ethnic structure, population density, regional differentiation and spatial distribution, basic elements of natural population movement and specifics of the settlement system, as well as relevant negative demographic processes, which have a specific value in the geopolitical valorisation of geospace.

Given the complexity of the issue, a multidisciplinary methodological approach and research methods were necessary. Thus, the work was realized by general (analysis and synthesis) and special methods, immanent in geographical and demographic research, and data processing techniques (statistical, cartographic). In this context, we used geographical, demographic, comparative, mathematical-statistical, cartographic and historical methods, as well as the method of generalization in geography in accordance with the historical, geographical, structural, functional and dialectical methodological approach.

The objective and results of the research should indicate that demographic and settlement processes have a specific significance in the geopolitical evaluation of the geospace of the Republic of Srpska.

Basic data on the number, territorial distribution and ethno-confessional structure of the population of the Republic of Srpska are found in publication, published by the Institute of Statistics of the Republic of Srpska, more precisely by analyzing the book Census of population, households and dwellings in Republic of Srpska 2013., 2017). Demographic data on the estimate of the number of persons and population trends in the Republic of Srpska were obtained from the publications of Bulletins - Demographic statistic, published by the Institute of Statistics of the Republic of Srpska.

For the study, as well as the analysis of contemporary demographic, ethno-demographic and political-geographical processes, and level of development of local self-government units in the Republic of Srpska, we used relevant scientific literature (Marinković, D. Majić, A., 2018; Zekanović, I., 2020; Mandić, M., 2019) and Proceedings from international scientific Conferences (Third Congress of Serbian geographers with international participation, Banja Luka, 2011; Geopolitical processes in modern Euro-Asian space, Banja Luka, 2017), more precisely the scientific papers (Zekanović, I., 2011; Zekanović I., 2017).

THE INFLUENCE OF DEMOGRAPHIC DEVELOPMENT ON THE GEOPOLITICAL CHARACTERISTICS OF THE REPUBLIC OF SRPSKA

According to the results of the last pre-war census in 1991, Bosnia and Herzegovina had a total population of 4,377,033. The constituent peoples were represented as follows: 1,902,956 Muslims (43.5%), 1,366,104 Serbs (31.2%) and Croats 760,852 (17.4%). The religious structure was almost in line with the percentage of national communities: 42.8% Muslims, 30.1% Orthodox and 17.7% Catholics.

"According to the results of the 1991 census, the demographic situation within the entity division would look like this: The current borders of the Federation of BiH would be home to 2,720,074 people or 61.14% of the total population. The majority of the population would be Bosniaks with 52.34%. In the Republic of Srpska, there would be

1,569,332 people or 35.85% of the total population, and Serbs would be the majority population with a share of 55.43%“ (Table 1, [6], [7]).

Table 1. Estimation of population distribution based on the 1991 census - according to the entity division of BiH

ENTITY	FEDERATION B&H	REPUBLIC OF SRPSKA	BRČKO DISTRICT	BOSNIA AND HERZEGOVINA
Bosniaks	1 423 593	440 746	38 617	1 902 956
%	52,34	28,08	44,07	43,48
Croats	594 362	144 238	22 252	760 852
%	21,85	9,19	25,39	17,38
Serbs	478 122	869 854	18 128	1 366 104
%	17,58	55,43	20,69	31,21
Other	62 059	39 481	2 899	104 439
%	2,28	2,52	3,31	2,39
Yugoslavs	161 938	75 013	5 731	242 682
%	5,95	4,78	6,54	5,54
TOTAL	2 720 074	1 569 332	87 627	4 377 033
%	62,14	35,85	2,00	100,00

The war conflict in the geospace of BiH, which lasted for about three and a half years in the period from 1992 to 1995, resulted in direct and indirect demographic losses. The war caused an increased mortality rate on the one hand, and a reduction in natural increase on the other.

The consequences of disintegration processes, war conflict, refugee migration and post-war trauma have reduced the reproductive contingent of the population. As a consequence of the reduction of this contingent in the Republic of Srpska, we have continuously negative natural movements of the population.

For twenty-two years, no general census has been conducted in the geospace of Bosnia and Herzegovina according to modern standards of the United Nations Demographic Service, and numerical data on the population were mainly based on estimates, which further complicated the precise analysis of the impact of demographic development on the geopolitical characteristics of the Republic of Srpska. In 2013, the Census of Population, Households and Dwellings in the Republic of Srpska was conducted. According to the Census, the Republic of Srpska had 1,170,342 inhabitants [8].

The results of the census stated the following ethnic structure: the Serb population is the most numerous with 970,857, or 82.9%. They are followed by the Bosniak population with 148,477, or 12.7%. Croats are third with 26,509, or 2.3% of the total population. Other ethnic groups and the population that did not want to declare their ethnicity represent 24,499 persons, or 2.1% (Table 2, [8]).

Table 2. Ethnicity of the population of the Republic of Srpska according to the 2013 Census

Total	Serbs	Bosniaks	Croats	Other
1 170 342	970 857	148 477	26 509	24 499

Political-geographical and socio-economic processes, but also geopolitical relations in the international community in the last decade of the 20th and the first decade of the 21st century, have strongly influenced the number and spatial distribution of the population of the Republic of Srpska. In the inter-census period 1991-2013, the number of inhabitants in the territory of the Republic of Srpska decreased by 25.4%. Demographic potentials

are a limiting factor in the development of most administrative-territorial units in the Republic of Srpska.

Table 3. Estimated population and population density of the Republic of Srpska 2012-2020

Year	**Population** (estimate)	**Density of population in/km^2**
2012	1 173 131	47,61
2013	1 171 179 (1 170 342 census)	47,53
2014	1 167 082	47,36
2015	1 162 164	47,16
2016	1 157 516	46,97
2017	1 153 017	46,79
2018	1 147 902	46,58
2019	1 142 495	46,37
2020	1 136 274	46,11

Based on the estimated population in the period 2012-2020, the Republic of Srpska is characterized by a constant decrease in population compared to 1991. We record a decrease in population in 2020 compared to 1991 by 27.6%, which in absolute terms amounts to 433,058.

Estimates for 2012 indicate that the Republic of Srpska had 1,173,131 inhabitants, and in 2020 1,136,274 inhabitants. These estimates of the population confirm the previous facts that in the geospace of the Republic of Srpska, in the period 2012-2020, there was an absolute decrease of 36,857, i.e. every year, according to the linear decline, the population is less by 4,607. In the Republic of Srpska, in the last 8 years, decrease in population density is recorded, from 47.61 to 46.11 inhabitants / km2, which means that on each km2 of its area in just eight years, it has lost an average of 1.5 inhabitants (Table 3 [9], [10], [11], [12], [13]).

Among other things, the Republic of Srpska is characterized by extreme demographic heterogeneity, more precisely, regional differentiation of the population, given that in the western part (between Novi Grad and Brčko) live about 63%, while in the east about 37% of the total population. Differences in population distribution become even more pronounced if we compare the northern and southern parts in accordance with the regional-geographical principle of nodal-functional regionalization. About 74% of the total population live in the northern part, and 26% in the southern.

Based on the nodal-functional principle and its basic criteria, we can single out four regions in the Republic of Srpska:

- 1. Banja Luka region, with the Banja Luka development centre. The mesoregions consist of the functional and gravitational areas of Prijedor and Mrkonjić Grad, and the subregion consists of the gravitational area of Gradiška;
- 2. Doboj-Bijeljina region, which is determined by the function and gravitational range of the two main urban development centres: Doboj and Bijeljina;
- 3. The Sarajevo-Zvornik region is determined by the developmental role of Istočno Sarajevo and Zvornik;
- 4. The Trebinje-Foča region is determined by the sphere of influence of the cities of Trebinje and Foča.

Zones of population demographic growth are in line with the gravitational spheres of the leading nodes in the regions, where the City of Banja Luka stands out with the greatest demographic expansion, thanks to its leading political, economic, administrative, developmental and cultural functions.

Table 4. Spatial distribution of the population of the Republic of Srpska according to nodal-functional regionalization in 2013

REGIONS	**Population** (2013)
Banja Luka region	**527 840**
Doboj – Bijeljina region	**340 578**
I. Sarajevo – Zvornik region	**210 018**
Trebinje – Foča region	**91 906**

From the aspect of nodal-functional regionalization, the most populated and largest concentration of population is in the Banja Luka region (527,840 inhabitants). Then follows Doboj-Bijeljina region with 340,578 inhabitants. The third is Sarajevo-Zvornik region with 210,018 inhabitants, and the last is Trebinje-Foča region with 91,906 inhabitants (Table 4, [8]).

Natural population movement

"Components of the natural movement of the population of the Republic of Srpska indicate negative tendencies in the form of declining birth rates and increasing mortality rates. Since 1999, when the absolute maximum number of live births was registered in the Republic of Srpska (14,500), the number of children born has decreased by a third (35%). At the same time, there is an increase in mortality by a quarter as a result of the mortality of the baby boom generation born in the late 1940s and early 1950s. As a result, the process of natural depopulation has been present in the Republic of Srpska since 2002, accompanied by a constant negative natural increase and a decrease in the total population" [14].

Demographic losses in the geospace of the Republic of Srpska in the period 1996–2020. are estimated at almost 255,000 inhabitants. Based on that, the degree of total depopulation of the population exceeds 18% of the population from 1996, ie 28% of the estimated population from 1991 [15], [13].

The components of the natural movement of the population of the Republic of Srpska in the period 2012-2020 confirm the continuation of negative demographic tendencies. In the observed period, the number of newborns was 85,424, and 132,301 people died in the same period, which tells us that the absolute natural increase was negative and amounted to -46,877 (Table 5). As of 2011, the total number of live births does not exceed 10,000 (9,561) [16].

Disorders of vital structures are the result of many years of action of various demographic, sociological, biological, but also political-geographical and psychological factors. With an overall birth rate of 8.1‰ (2020), the Republic of Srpska can be characterized as a very low birth rate area. Demographic aging is a basic determinant of increasing mortality rates. According to data for 2020, the overall mortality rate was 14.6‰, while the natural increase rate was negative (-6.5 ‰), more precisely, in 2020, due to negative trends in natural movement, the Republic of Srpska had 7,421 less inhabitants than in 2019 (Table 5,[13]).

All administrative-territorial units in the Republic of Srpska are characterized by demographic stagnation and negative tendencies in natural increase. According to the data of the Republic of Srpska Institute of Statistics, in 2018 only two local communities achieved a positive natural increase (the City of Banja Luka and the Municipality of Istočno Novo Sarajevo). In the last two reviewed years (2019, 2020), no positive natural population movements were recorded. All local communities in the Republic of Srpska have a negative natural increase, except for the municipality of Jezero, which in 2020 recorded an absolute increase in population by 1 person (6 births and 5 deaths), so that

the statistical indicators of this local community, according to the number of inhabitants and natural movement, are almost negligible.
Disorders of biological structures mostly affected the process of demographic aging of the population of the Republic of Srpska, which is evident from the assessment of data for 2020, where the share of elderly people (65+) reached a record value of 235,972 people or 20.8% [13].

Table 5. Natural movement of the population of Republic of Srpska 1996, 2005, 2009 and 2012-2020

Year	Population	Natality		Mortality		Natural increase	
		Total	‰	Total	‰	Total	‰
1996	1 391 593	12 263	8,8	10 931	7,8	1 332	1,0
2012	1 173 131	9 978	8,5	13 796	11,8	-3 818	-3,2
2013	1 171 179	9 510	8,1	13 978	11,9	-4 468	-3,8
2014	1 167 082	9 335	7,8	14 409	12,3	-5 074	-4,5
2015	1 162 164	9 357	8,0	15 059	13,0	-5 702	-4,9
2016	1 157 516	9 452	8,2	13 970	12,1	-4 518	-3,9
2017	1 153 017	9 339	8,1	14 663	12,7	-5 324	-4,6
2018	1 147 902	9 568	8,3	14 763	12,9	-5 195	-4,5
2019	1 142 495	9 724	8,5	15 081	13,2	-5 357	-4,7
2020	1 136 274	9 161	8,1	16 582	14,6	-7 421	-6,5

Population concentration and population density

According to the results of the 2013 census, the population density in the Republic of Srpska is 47.5 inhabitants / km2. According to the estimates of the Republic of Srpska Institute of Statistics, the population density in 2020 was 46.1 inhabitants / km2, which puts the Republic of Srpska in the zone of medium-populated areas. Population by local units indicates even greater differences between overpopulation and uninhabited areas.

Table 6: Population density of the Republic of Srpska by administrative-territorial units in 2013

Municipality	Area km^2	Population	Density of population in/km^2
Banjaluka	1 238,9	180 053	145,3
Berkovići	264,0	2 041	7,7
Bijeljina	734,1	103 874	141,5
Bileća	636,8	10 607	16,7
Bratunac	293,1	18 651	63,6
Brod	230,1	15 720	68,3
Višegrad	449,1	10 118	22,5
Vlasenica	217,4	10 657	49,0
Vukosavlje	73,8	4 363	59,1
Gacko	728,4	8 710	12,0
Gradiška	761,7	49 196	64,6
Derventa	516,6	25 922	50,2
Doboj	816,3	68 514	83,9
Doboj (without Stanari)	655,3	61 556	93,9
Donji Žabar	46,8	3 669	78,4
Zvornik	374,4	54 407	145,3
Istočna Ilidža	29,3	14 437	492,7
Istočni Drvar	75,2	66	0,9
Istočni Mostar	88,6	244	2,8
Istočni Stari Grad	88,0	1 116	12,7
Istočno Novo Sarajevo	37,9	10 401	274,4
Jezero	63,2	1 039	16,4
Kalinovik	679,5	1 962	2,9

Kneževo	326,0	9 368	28,7
Kozarska Dubica	499,4	20 681	41,4
Kostajnica	85,9	5 645	65,7
Kotor Varoš	557,3	18 361	32,9
Krupa na Uni	93,2	1 560	16,7
Kupres	44,6	293	6,6
Laktaši	388,3	34 210	88,1
Lopare	297,8	14 689	49,3
Ljubinje	341,3	3 319	9,7
Milići	278,9	10 445	37,5
Modriča	332,1	24 490	73,7
Mrkonjić Grad	669,7	15 926	23,8
Nevesinje	887,1	12 542	14,1
Novi Grad	469,7	25 240	53,7
Novo Goražde	123,1	2 915	23,7
Osmaci	79,5	5 546	69,8
Oštra Luka	206,6	2 705	13,1
Pale	490,4	20 359	41,5
Pelagićevo	115,9	4 358	37,6
Petrovac	146,1	354	2,4
Petrovo	109,5	6 317	57,7
Prijedor	834,1	80 916	97,0
Prnjavor	630,0	34 357	54,5
Ribnik	499,9	5 851	11,7
Rogatica	645,9	10 302	15,9
Rudo	347,7	7 578	21,8
Sokolac	692,3	11 620	16,8
Srbac	452,6	16 933	37,4
Srebrenica	529,8	11 698	22,1
Stanari	161,0	6 958	43,2
Teslić	846,5	37 236	44,0
Trebinje	862,5	28 239	32,7
Trnovo	109,8	1 983	18,1
Ugljevik	170,4	15 118	88,7
Foča	1 118,4	17 580	15,7
Han Pijesak	315,8	3 445	10,9
Čajniče	273,7	4 679	17,1
Čelinac	361,8	15 117	41,8
Šamac	172,2	16 308	94,7
Šekovići	242,4	6 323	26,1
Šipovo	550,2	9 969	18,1
Republic of Srpska	**24 641,3**	**1 170 342**	**47,5**

According to the adopted criteria and the achieved degree of concentration of the population in the area of the Republic of Srpska, we single out four zones:

- 1. sparse population zone (up to 11 inhabitants / km2)
- 2. medium population zone (from 11 to 50 inhabitants / km2)
- 3. dense population zone (from 51 to 100 inhabitants / km2)
- 4. overpopulation zone (more than 100 inhabitants / km2)" [17].

Based on the results of the 2013 Census, the following municipalities belong to the sparse population zone (up to 11 inhabitants / km2): Han Pijesak, Kalinovik, Ljubinje, Kupres, Petrovac, Istočni Drvar, Istočni Mostar, Berkovići, which is 7.93% (1955.1 km2) of the geospace of the Republic of Srpska. This area is formed by municipalities in the hilly-mountainous and karst eastern and southwestern parts of the Republic of Srpska.

The area of medium population (from 11 to 50 inhabitants / km2) includes the territories of 34 local communities: Bileća, Višegrad, Vlasenica, Gacko, Derventa, Istočni Stari Grad, Jezero, Kneževo, Kozarska Dubica, Kotor Varoš, Krupa na Uni, Lopare, Milići, Mrkonjić Grad, Nevesinje, Novo Goražde, Oštra Luka, Pale, Pelagićevo, Ribnik, Rogatica, Rudo, Sokolac, Srbac, Srebrenica, Stanari, Teslić, Trebinje, Trnovo, Foča, Čajniče, Čelinac, Šekovići, Šipovo and they represent 60.63% of the geospace (14,939.4 km2) of the Republic of Srpska.

Dense population zone (from 51 to 100 inhabitants / km2) covers 21.64%, or 5,332.5 km2, and consists of the following local community territories: Bratunac, Brod, Vukosavlje, Gradiška, Doboj, Donji Žabar, Kostajnica, Laktaši, Modriča, Novi Grad, Osmaci, Petrovo, Prijedor, Prnjavor, Ugljevik, Šamac.

Overpopulated administrative-territorial units (more than 100 inhabitants / km2) are: Banja Luka, Bijeljina, Zvornik, Istočna Ilidža and Istočno Novo Sarajevo, and they occupy 9.80% of the area (2,414.6 km2) and are mainly urban or nodal-functional centres.

The following have the highest population density: Istočna Ilidža 492.7 inhabitants / km2, Istočno Novo Sarajevo 274.4 inhabitants / km2, Banja Luka 145.3 inhabitants / km2, Zvornik 145.3 inhabitants / km2 and Bijeljina 141.5 inhabitants / km2, while the border municipalities towards the Federation of Bosnia and Herzegovina still have the lowest population: Istočni Drvar 0.9 inhabitants / km2, Petrovac 2.4 inhabitants / km2, Istočni Mostar 2.8 inhabitants / km2, Kalinovik 2.9 inhabitants / km2 and Kupres 6.6 inhabitants / km2.

The most administrative-territorial units (municipalities and cities) have between 10-25,000 inhabitants, a total of 23, or 36.51%. This is followed by units with a total population below 5,000, 18 of them, or 28.57%. Ten units have between 10-10,000 inhabitants, or 15.87%. 7 units have between 25-50,000 inhabitants, or 11.11 %, and 5 have over 50,000 inhabitants, or 7.94% (Table 6, [8], [14]).

Geopolitical premises of refugee

Refugee, as a complex socio-political and demographic process is a consequence of the civil conflict in the geospace of the former SFR Yugoslavia.

About 2.2 million people left their pre-war homes in Bosnia and Herzegovina, which represents more than half of the total population. About 1.2 million BiH residents have sought refuge in more than 100 countries around the world. At the same time, about one million people were displaced within Bosnia and Herzegovina.

The refugee process has caused a wide range of socio-economic and political consequences in the geospace of the Republic of Srpska, but also in the wider geopolitical environment.

In addition to spatial and demographic, it caused socio-economic, psychological, cultural-historical and political consequences.

Spatial consequences refer to changes in the natural conditions and social way of life of the refugee population. This consequence is most pronounced among the refugee population from rural areas, because they find it difficult to accept the new - urban way of life. Demographic consequences are represented by disorders in age, gender, education and economic structure. Socio-economic consequences are based on the negative effects of refugees given the inadequate socio-economic status with most of this category of population. The psychological consequences of forced migration and refugees are determined by problems due to changes in lifestyle and refugee status, which often have a negative impact on a person's mental state. Cultural and historical consequences of the refugee process are based on the aggravated process of cultural assimilation of refugees

and displaced persons and adaptation to new environments. Political consequences are manifested in elements of national fragmentation and national disunity when sometimes even minimal differences between refugees and indigenous people are emphasized (overemphasized) and given a political context.
Even today, the refugee and displaced population as a recurrence of the war conflict is one of the most complex demographic elements of the geopolitical position of the Republic of Srpska.

SETTLEMENT SYSTEM OF THE REPUBLIC OF SRPSKA

After the end of the war and the harmonization of the inter-entity demarcation line in Bosnia and Herzegovina, the former 64 municipal centres were divided between the entities, so that the Federation of Bosnia and Herzegovina got 37 and the Republic of Srpska 27 of them.
The inter-entity line of demarcation conditioned the formation of new units of local self-government in the Republic of Srpska. Some of the newly formed municipalities are: Istočni Mostar, Istočni Drvar, Kupres, Krupa na Uni, Berkovići, Drinić - Petrovac, Petrovo, Vukosavlje, Pelagićevo, Donji Žabar, etc. Only 17 administrative-territorial centres belonging to the Republic of Srpska remained within the same administrative boundaries from the pre-war period.
In the administrative-territorial sense, the settlement system of the Republic of Srpska is organized by division into municipalities and cities.
It is represented by 8 cities (Banja Luka, Istočno Sarajevo, Bijeljina, Doboj, Prijedor, Zvornik, Trebinje, Gradiška) and 56 municipalities. According to the data from the 2013 Census of Population, Households and Dwellings, there are 2,756 inhabited places in the Republic of Srpska.
In composite river valleys: Vrbas, Sava, Sana, Una, Bosna, Drina and Trebišnjica, the following urban settlements developed: Banja Luka, Gradiška, Brod, Bijeljina, Prijedor, Novi Grad, Doboj, Zvornik, Foča, Trebinje. It is estimated that over 70% of the urban population is concentrated along the river valleys.
Based on the functional development of urban centres, the City of Banja Luka is of primary importance in the Republic of Srpska, as the leading political and administrative centre, which has the greatest geopolitical significance. Functional development, territorial size and demographic potential highlight Banja Luka as a strong macro-regional centre.
"The following stand out as the centres of the secondary hierarchical order: Istočno Sarajevo, Bijeljina, Prijedor, Doboj, Trebinje and Gradiška, which have a regional significance in the network of settlements. The centres of the third order are the following cities: Foča, Zvornik, Modriča, Teslić, Prnjavor, Laktaši, Novi Grad, Kozarska Dubica, which have the function of subregional centres. Fourth order centres are underdeveloped urban settlements, which are integrative factors of spatial and functional integration of municipal areas into subregional systems, and these are: Kneževo, Čelinac, Kotor Varoš, Bileća, Gacko, Nevesinje, Mrkonjić Grad" [4].
Based on various parameters (population, economic structure, employment rate, etc.), local self-government units in the Republic of Srpska, according to the level of development, can be classified as follows: developed, moderately developed, underdeveloped and extremely underdeveloped (Table 7 [18]).

Table 6: Local self-government units of the Republic of Srpska according to the level of development

Degree of achieved development of local self-government units - category	Lokal self government unit
Developed	Banjaluka, Bijeljina, Gacko, Gradiška, Derventa, Doboj, Zvornik, Istočna Ilidža, Istočno Novo Sarajevo, Laktaši, Modriča, Mrkonjić Grad, Pale, Prijedor, Prnjavor, Teslić, Trebinje, Ugljevik
Medium developed	Bileća, Brod, Višegrad, Kozarska Dubica, Kotor Varoš, Milići, Novi Grad, Sokolac, Srbac, Stanari, Foča, Čelinac
Underdeveloped	Bratunac, Vlasenica, Donji Žabar, Kostajnica, Ljubinje, Nevesinje, Pelagićevo, Petrovac, Petrovo, Ribnik, Rogatica, Han Pijesak, Šamac, Šipovo
Extremely underdeveloped	Berkovići, Vukosavlje, Istočni Drvar, Istočni Mostar, Istočni Stari Grad, Jezero, Kalinovik, Kneževo, Krupa na Uni, Kupres, Lopare, Novo Goražde, Osmaci, Oštra Luka, Rudo, Srebrenica, Trnovo, Čajniče, Šekovići

CONCLUSION

As a result of the war conflict in the geospace of Bosnia and Herzegovina and the former SFR Yugoslavia, but also global political and geographical processes in the last decade of the 20th and the first two decades of the 21st century, the Republic of Srpska is still going through turbulent phases of demographic and spatial transition.

Historical circumstances, natural-geographical features of the territory and socio-economic development have conditioned the current network of settlements in the Republic of Srpska, its development functions and specific demographic processes.

The demographic development of the Republic of Srpska in the last thirty years is characterized by unfavourable tendencies represented by natural depopulation, intensive aging process and unfavourable influence of emigration processes. Intensification of negative demographic processes threatens to become a decisive factor in the geopolitical valorisation of the Republic of Srpska.

Elements of demographic development directly affect the geopolitical characteristics of the Republic of Srpska. A special problematic issue, which opens with the analysis of demographic factors, are the geopolitical consequences arising from the existing changes in demographic structures and the spatial-demographic polarization of the geospace of the Republic of Srpska.

Demographic development and characteristics of the settlement system, as a quantitative-qualitative category, are an important factor that determines the geopolitical characteristics of the Republic of Srpska. They represent the primary component of the geopolitical position and one of the most important determinants of its political and geographical future.

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THEORY OF ECONOMIC CLUBS: SPATIAL PLANNING PRACTICE IN THE EU

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ABSTRACT

This paper discusses the importance of the theory of economic clubs for the spatial-planning study of Europe. This means that the subject of this paper is the economic development of countries/regions, as the leading indicator of differences in today's Europe. Understanding this issue requires knowledge of the theory of economic clubs and the general classification of public goods [2]. Buchanan modified the previous type of goods [18] and defined "strictly public good," which is not a rival, is exclusive and indivisible between persons, and is contrary to "strictly private good," which is presented as a rival, exclusive and utterly divisible between individuals. The logic of this economic development is clarified through world-system analysis, which defines poles such as the center, periphery, and semi-periphery [22]. In today's Europe, these poles are recognized as the traditional core or European Pentagon (center); the periphery is a vast hemisphere in the Mediterranean and eastern zones with low-income regions (GDP), while the semi-periphery is a wide range of geographic NUTS2 regions with medium incomes. The first authors presented the functioning of the EU through the model of economic clubs and based their analysis on the daily EU offer of several goods and services, starting with the standard agricultural policy, common foreign and security policy, common currency, and access to structural funds [19]. The modern interpretation of economic goods is explained by the insufficient balance in public goods in terms of rivalry and exclusivity [9], which indicates that the EU functions as a multi-producer club, with about 50 countries divided into lower-ranking units [3]. This theory has found practical application in numerous analyzes of the EU Directorate for Regional Policy ([4], [5]).

Keywords: theory of economic clubs, core-periphery, spatial planning practice, EU clubs VH, H, M, and L.

INTRODUCTION

Paul Samuelson wrote a concise article on economic goods, in which he defined the existence of goods for collective and private consumption through the analysis of the new welfare economy [18]. Determining the optimal conditions for establishing these goods, Samuelson linked with marginal conditions, utility limits, and collective consumption concepts. His definition of the public good starts from the fact that they are "goods that everyone enjoys together, in the sense that the consumption of such a good by each individual does not affect the consumption of that good by any other individual ..." From this definition derive its main properties, which are non-competitiveness and non-exclusivity. The opposite of the public good is the private good.

Buchanan upgraded Samuelson's classification of economic goods, between which there is a sharp division (the awesome Samuelson gap) into "strictly public goods" (non-exclusive, indivisible, and non-rival) and "strictly private goods" (exclusive, divisible and

rival) [2]. Buchanan explained this sharp division through the utility function of a particular good (exclusivity). The starting point was the realization that public interest is non-competitive and non-exclusive (pure public good). There can be a public good that is "always only to a certain extent or only for a while like that, "i.e., it is non-competitive and exclusive (unclean public goods). He marked such goods as a club (theory of economic clubs) and thus made a new classification of goods based on the optimal size of the club. He defined two essential tools for his analysis (modified utility function and cost/production function), combined to establish balance (club size) and classify a particular good. Some premises had to be set to strengthen this revolutionary theory because Buchanan based his analysis on the assumptions of homogeneity among club members and that individual members have similar preferences for the goods the club provides. Also, the author considered that exclusivity does not include: costs, perfect and symmetrical information, and the existence of only one club reasonable.

> This does not mean that property rights will, in practice, always be adjusted to allow for optimal exclusion. If not, there is the problem of the "free rider." This perspective suggests one issue of the utmost importance, which the analysis of this paper has neglected. It is a question of the costs involved in securing an agreement among group members. Suppose individuals think that exclusion will not be entirely possible, that they can expect to provide benefits as free-riders without really becoming full members of the club. In that case, they may not be willing to enter into cost-sharing arrangements voluntarily. This suggests that an essential means of reducing costs is through the provision of voluntary cooperation agreements, which will allow for more flexible property arrangements and the introduction of instruments that exclude them. For example, if a lathe hunter is allowed to chase poachers, then it is more likely that potential poachers will be willing to pay in advance for a hunting license [2]..

METHODOLOGY AND DATA

Based on Buchanan model, several additions were developed to build a theory that is more in line with reality, most notably the matrix (2 x 2) on types of economic goods, based on relevant notions of exclusivity and competitiveness:

Table 1: Types of economic interests in terms of competitiveness and exclusivity

Variety of goods	Exclusive	Non-exclusive
Uncompetitive	Club goods (parks, copyright, hall)	Public goods (Air defense)
Competitive	Private goods (food, parking, cars, clothes)	Common goods (trees, fish, coal)

Based on: [3].

It can be seen from the previous table that Chohan and D'Souza emphasized that club goods are only one of the four types of goods, which are non-competitive and exclusive [3]. By non-rivalrous, they mean that the use of public interest at some point by a particular person does not exclude the possibility of using that good by other persons. In contrast, by non-exclusive, they mean that using a good does not preclude other people from abusing the same good simultaneously or in space. They explain that with the example of air defense, which is uncompetitive and non-exclusive in providing public services. If the city has air defense, the person covered by that air defense perimeter will not benefit at the expense of any other person, so it is uncompetitive. Also, all people staying within the defense perimeter cannot be expressly excluded from coverage by air

defense. Therefore it is non-exclusive and represents an example of the public good. To define EU economic clubs as club goods, it is necessary to clarify important issues related to the regional development of Europe. Also, Buchanan's model with various additions, has become a methodological framework for establishing economic clubs within the EU over the last decade. Confirmation of this can be seen through the strategic development documents of DG Regio [5], in which the theory of economic clubs becomes very visible. It is based, primarily, on data on the movement of GDP p / c in member countries, i.e. their NUTS 2 statistical regions ([24], [25]).

EXISTING ECONOMIC DIFFERENCES

Significant socio-economic inequalities in Europe are beginning to be recognized with the advent of modernity. They should be linked to the fact that the UK has become the first country to achieve continuous growth. However, it flowed slowly, starting from the second half of the 18th century, and lasts today. This process is associated with the intensive application of technical and technological inventions (First Industrial Revolution) to gradually transfer these inventions to British close partners in the Commonwealth (Canada, Australia, New Zealand) and then to the United States and Western Europe. All these are generally accepted attitudes, and Acemoglu and Robinson [1] present an exciting thesis according to which, in the domain of distribution of global wealth (the richest and poorest countries), there have been no significant changes during the last century and a half. This means that only a few "East Asian tigers" entered the circle of the wealthiest thirty countries, apart from the first industrialized ones, and that the situation is identical (without changes) with the list of the poorest countries (mostly sub-Saharan Africa). Therefore, they question the reasons for the prosperity of some nations and the poverty of other nations, emphasizing the supremacy of "Western European nations and their colonial offspring with European immigrants," noting the existence of different hypotheses about the reasons for such distribution of wealth in the world.

The French philosopher Montesquieu [16] first suggested the geographical hypothesis who was one of the first scientists to connect the economic and geographical development of the world with the climate [8]. He asked questions: why are there different peoples and ethnic communities as they were before; is there a connection between geographical location, physical differences, and social and moral capabilities of other peoples? The answer was that climate has the most significant impact on establishing differences within human society. Acemoglu and Robinson support this thesis with the views of economist J. Saxony, which, in addition to the influence of climate on the thought and work process, mainly emphasizes the factors of tropical diseases and low soil productivity in these areas [1]. Naturally, all these factors negatively affect the economic development of the tropical regions. However, they are irrelevant to explaining the pronounced regional differences on European soil.

The hypothesis of culture unites the second group of factors [15]. Max Weber [17] indicated its contours by emphasizing the importance of religion (Protestantism) for the industrial development of Europe, i.e., of the Catholic-Protestant West [23]. This work derives from his rich theoretical work (theory of social action and rationalization), which has left a

[16] See: Mutabdzija, Geophilosophy of the premodern, 250-251

[17] See: G. Mutabdzija, Sociological theory in geography: phase of empirical - analytical science, 2021

significant mark in the social sciences [13]. However, his second theory (rationalization) has greater significance for culture, in which he recognized the considerable influence of the ethics of different religions in the development of capitalism. For Calvinists, this influence was based on eschatology (the notion of predestination), which considers business success the main sign of choice (the path to paradise). So, this Belief contributed to the formation of moral qualities in workers and entrepreneurs (thrift, diligence, accuracy, honesty, pursuit of money), which significantly improved the spirit of capitalism, based on the motive to succeed as an expression of moral norms, not greed. Related to this is the structure of government, which has different legitimacy (tradition, charisma, and legality) and which, depending on the degree of rationalization, develops in the direction of traditional, charismatic, or rational-legal. Suppose we were to translate Weber's theory of rationalization elements into contemporary European circumstances. In that case, we might explain the differences in the level of economic development of predominantly Protestant Flanders (economically more prosperous community) than predominantly Catholic Wallonia (obsolete industry). Still, that logic does not apply to a country such as France on the one hand and Spain and Portugal on the other.

The third hypothesis can be recognized in the work of Immanuel Wallerstein [22], which is part of the neo-Marxist grand-theory [18]. It is based on economic entities and the division of labor and is not limited by political or cultural boundaries. The broadest framework of this theory in the world-system [19] is a vast economic entity composed of different social structures and social groups with a certain lifespan. From the spatial-planning aspect, two dimensions of this theory are essential. In the first, the world capitalist system implies the existence of an asymmetric division of labor between producers of highly profitable essential commodities and producers of much less good peripheral goods, leading to the establishment of a clear hierarchy through a center-periphery form [20]. There is also a middle zone called the semi-periphery, so the tripartite spatial division of labor is completed, which showed specific mobility during its existence (up and down). Based on the structural analysis (core-periphery) of world history, Wallerstein explained the development of modern capitalism through the exploitation of peripheral resources. The debate of this theory is complemented by the knowledge of the existence of resistance (peoples of the periphery) to imposed exploitation and domination (peoples of the center), which has played a decisive role in shaping world history. The best Examples of center-privilege theory are provided by the current economic picture of Europe [12]. in which there is a traditional center (European Pentagon) and a significantly poorer periphery (Balkans). The second dimension of this theory is Wallerstein's concept of Geoculture [21], which emerged as an analogy to geopolitics. It refers to norms and ways of discourse that

[18] Ricer (2009) recognizes two such theories, namely: critical theory (1923) and the theory of the transformation of Fordism into post Fordism (1974), where Wallerstein's work is part of this second theory.

[19] He recognizes only two types, the world empires that have disappeared (e.g. Rome) and the modern world capitalist economy, with the former emerging from military and the latter from economic domination. He foresaw the possibility of the emergence of a third world system, the socialist world government. Unlike the transitional type (separating the political and economic spheres), the new type should reintegrate them.

[20] The center is the dominant area that exploits the rest of the system, the periphery supplies the center with resources, and the semi-periphery is a set of regions located between the exploiters and the exploited.

[21] Described in detail in I. Wallerstein's "World-system analysis: An introduction", part four: The Creation of a Geoculture

are widely accepted as legitimate within the world system and do not arise automatically with the emergence of the world system but must be created. This means that it refers to a wide area of manipulative actions of the government through the imposition of various ideologies, social movements, and social sciences.

CLUB GOOD

According to Buchanan, the economic theory of clubs is applied to goods that have three key characteristics: exclusivity, divisibility, and congestion [2]. The first is recognized by the fact that individuals who do not finance the club (membership fee) do not have access to the benefits of the club. The second refers to the optimal size of the club, i.e., a division that depends on demand. This means that individuals who want to join or are previously excluded can form a new club that will produce and consume the same good. In the end, although spending is not fully competitive, each member of the club imposes a negative impact on other members. This negative impact materializes in congestion, which reduces the quality of the benefits that everyone consumes (e.g., Wi-Fi). Finally, the club's functioning is defined by a series of clear rules (rights and obligations of members). The "free riders" problem often appears as the most challenging economic problem faced by club members. This means that non-members use the benefits of the club, e.g., utility costs in condominium communities (one reported, but there are two members).

The most important parameter for defining economic clubs is the achieved GDP per capita. According to this criterion, the practice is recognized by such three clubs (high, medium, and low GDP per capita), while DG Regio, for its reasons [22], and uses a four-degree scale [5]. Each club is characterized by a specific "growth path" that differs from others, which leads to the establishment of transparent geographical regions of different levels of economic development. Therefore, the attention of spatial planners and regional geographers is shifting from the national to the regional level because economists have recognized the existence of different entities (mainly NUTS 2), which show different levels of development (primarily based on GDP, but also savings, investment, and demographic growth). Based on the previous matrix (Table 1), an example of the European Union as a club good can be reported, excluding several non-EU countries' services. In contrast, some of these services are not competitive in consumption (or at least some are).

Nevertheless, several of these non-competitive services are essential for the functioning of the EU, primarily the "four freedoms" (movement of people, goods, services, and capital) within the internal market. Chohan and D'Souza [3] also discuss some current interests for which there is no consensus regarding their status (social status, media, cyber security, crypto currencies). There are no such examples in the mentioned matrix of public goods, where cyber security is a relatively straightforward public interest case. At the same time, social media and cryptocurrencies are more nuanced and debatable. All these examples indicate that the EU functions as a multiproduct club, in which there are about 50 countries divided into lower-ranking units.

This issue has been addressed in more detail by McNutt, who states that the economic theory of clubs is "an attempt to explain the insufficient balance in the provision of public

[22] Mutabdžija (2022) analyzes the distribution of GDP at the level of NUTS 2 and notes that out of 24 regions with very high incomes, the first eight NUTS 2 belong to non-EU countries (Switzerland and Norway).

goods, which raises many different and controversial issues affecting government policy" [9]. In the public sector, club goods offer an alternative to the centralized state provision of local public goods in many respects. Of particular importance is exclusivity, which can affect the equal and democratic distribution of club goods. He emphasizes Buchanan's original concern about voluntary clubs and the possibilities of the given theory to define the optimal number of club members and, at the same time, the maximum usefulness for all club members. As a special feature, it emphasizes the challenge of scientists who try to theoretically describe the emergence of public goods because they can "abandon the conventional postulate of maximizing individual utility and critical evaluation so that rational behavior in individuals can be encouraged to provide public goods voluntarily." Sandler and Tschirhardt [19] were the first authors to emphasize the importance of multiproduct clubs and their theoretical foundation. They raised this issue and presented a model of such a club. They based its analysis on the EU's daily offer of several goods and services, ranging from a standard agricultural policy, a common foreign and security policy, a common currency, and access to EU structural funds. These were the starting points about the European Union, as a heterogeneous club, which also contained a dose of caution in its sustainable development. However, after almost seven decades of functioning of the EU, despite its standard products' significant heterogeneity and diversity, it has shown sustainability and adaptation through frequent additions to these theoretical assumptions, as evidenced by the cohesion policy. At the same time, within the EU club, certain contradictions between club members are harmonized and reconciled (different cultures and languages, different values of GDP, stages of development, growth rates). This has led to many challenges, from the decision-making process, determining membership fees, opportunities, and characteristics of sharing certain rights, to the need to establish central bodies (seven institutions and several other bodies). From club theory and the existence of club goods, the EU provides non-competitive and exclusive goods to its member states through various funds. This means that each member state, if it has an average level of GDP p / c lower than 75% of the EU average, automatically acquires the right to access the Cohesion Fund. At the same time, all NUTS2 regions (only those with a GDP below 90% of the EU average) have the right to access any of the funds [5]. Therefore, EU funds can be seen as an instrument for harmonizing economic disparities in the Member States, i.e., as a club asset that promotes growth within countries and regions, enabling the reduction of economic differences between them.

Classification of EU economic clubs

After the general remarks on the genesis of the emergence of club theory, we can focus on the emergence of European economic clubs. They are based on theoretical assumptions that there are economic differences between countries, regions, and cities, which can be sublimated through their division based on their wealth, i.e. GDP p / c. Such regions may belong to different "development clubs," each characterized not only by different income levels but also by different structural characteristics, such as level of education of the population, infrastructural equipment, innovation capacities, and institutional quality. Clubs are systematically different in these dimensions, and for each club, there are specific needs and challenges related to its starting point. Grouping similar regions create insight into economic development and provide a perspective for pursuing a successful regional policy. According to the EU methodology on economic clubs, uneven regional development between regions is revealed based on income. This fact helps identify the means that enable overcoming obstacles to development and lagging behind such regions.

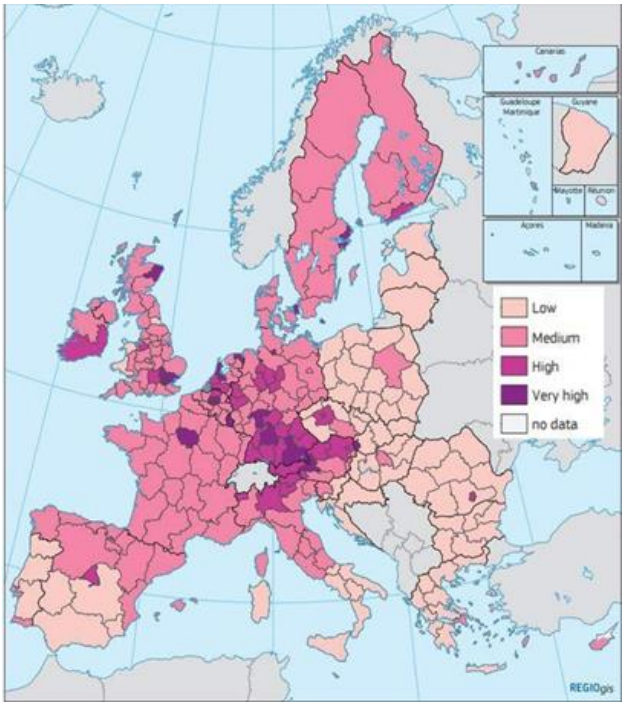

Figure 1. EU Economic Clubs (Source: [5])

The previous diagram shows the number of NUTS2 regions by country and extreme values of GDP (max and min). Their color immediately indicates their affiliation to a particular club. Therefore, this is an introduction to dividing the NUTS2 region into two large groups (above-average and below-average developed), with their limit being the national average. This division is essential when accessing individual structural funds. The second division is related to the average GDP p / c compared to the EU average (100%). It concerns the existence of four different clubs: the first club is VH (very high) with very high incomes (GDP p / c 150% or more), H (high) high-income club (120-149%), M (middle) middle income club (75-119%) and L (low) low-income club (below 75% of the EU average). The examination of the labor market in different clubs provides a broader insight. Certain regularities in the movement of individual parameters can be observed, which are expressed through average annual growth values. Therefore, Map 1 can also be presented in tabular form, allowing a better overview of these regions within each country.

Table 2: Average values of population growth, employment, and patents 2001-15.

Club	GDP p/c	Population	Employment			Unemployment	No. patents / 1 mil. inh.
			Change	Industry	Av. change		
VH	1,4	10,7	0,8	12,3	-1,2	5,8	254
H	0,9	7,3	0,5	16,9	-0,8	5,9	232
M	1,0	6,2	0,3	14,4	-1,5	8,4	103
L	1,7	-2,0	-0,6	20,3	-1,0	11,6	8
EU-28	1,3	4,4	0,1	16,1	-1,2	8,5	113

Source: [5]

The movement of the population shows an apparent regularity through the declining trend, from the richest to the poorest, and this general rule, with certain deviations, is present in other parameters, especially in the unemployment rate and the number of

patents. In the domain of GDP growth rate p / c, there is a trend of steady decline in regions with higher incomes (VH, H, and M), while in those with low incomes (L), it has increased. Regions with very high and low incomes have experienced the highest GDP growth p / c due to their level of competitiveness and specialization in the production of high-quality goods and services. Indicators on the share of employees in the industry are also indicative, with a declining trend, which can be related to the economy's structure, and probably to GVA and the level of personal earnings. This means that industry is not the main branch of the economy in the wealthiest regions. Still, it is service activities, research, and development, in which highly educated staff with specific knowledge are in demand. Therefore, it is essential to clarify the spatial distribution of individual economic clubs and describe the challenges they face in more detail.

> While low-income regions are catching up with the more developed ones, taking advantage of their ability to mobilize cheap capital and work in the fight to get jobs gives them a competitive advantage. At the same time, middle-income regions had the lowest growth. They faced a unique challenge, the so-called "Middle-income trap," because they are neither cheap nor particularly innovative or productive. Their manufacturing sector tends to be smaller and weaker than in regions with higher GDP p / c or lower, and their costs are too high to compete with the latter, such as innovation is not strong enough to compete with the former [5]

Before moving on to the geographical distribution of individual clubs, it is necessary to briefly get acquainted with an essential structural element of wealth and competitiveness of particular regions, which is related to the organization of the economy in which a large group of systemically and functionally related companies plays an important role. This organizational form is called a cluster [23]. According to Jovanović, it must have a critical mass, not only quantitatively but also in the domain of concentration of "knowledge, skills, and specialized institutions in a certain geographical area" [7]. This functional relationship between companies refers to suppliers, competitors, associates, and customers through the circulation of accumulated knowledge and skills through the circulation of staff. The concentration of functionally related business activities within a relatively small area provides companies with a collective profit, which would not be available if these companies were distant from each other. These expected benefits or external effects are different from those created within a single firm because clusters develop economies that are "external to individual firms but internal to the network of firms in the cluster." Venables states that this demand will be high in areas where most producers have chosen to locate (circular interdependence process or cumulative causality) because there is a certain degree of uncertainty in the location of activities. After all, firms are located due to the presence of other firms. And not because of the essential characteristics of the site. As a confirmation of this thesis, Venables states that "there are about 600 tanners in Arzignano near Vicenza, most of whom employ only a few dozen workers, and this region accounts for 40% of European leather processing" [21]. In that area, a complete technological process of leather processing has been

[23] The company is located in an area where there are companies from the same or related industries because: it has production links with other companies; can benefit from an already existing group of suppliers; there are common services such as finance, information, consulting and maintenance; there may be a set of trained and experienced workforce; businesses can reduce costs, and the effects are so great that they can serve as an example for economic comparison with an integrated Europe.

achieved, which includes not only "soaking, dyeing, stretching, sealing, cutting and shipping materials used for Gucci bags, Louis Vuitton suitcases, Nike sneakers, and BMW car seats, but also produces gold chains, clothing, and machine tools, many of which are for export." From this follows the economic regularity that the main problem of a small or medium enterprise is often not that it is "small," but in its isolation, and grouping can overcome this problem. The most recognizable examples of specific European clusters are watchmaking (Geneva and Jura), knives (Solingen), financial services (London), fashion clothing and motorcycles (northern Italy), entertainment (Paris), flowers (Netherlands), carpets (Kortrijk). Significant features of the European urban system are polycentricity and concentration of solid metropolises, so based on that, the European Spatial Planning Network (ESPON) has developed two potential scenarios for researching the effects of EU cohesion policy.

> The first scenario is cohesion-oriented, which analyzes social, economic, and territorial goals as the priority of cohesion policy. The second scenario refers to competitive orientation, with the primary goal being to achieve the global competitiveness of the EU economy. The cohesion-oriented method showed that the number of areas at risk of marginalization and declining activities was comparable to that in the baseline scenario. Still, their size was reduced and their intensity lower. The final picture of the 2030 competitive-oriented scenario showed a stronger attraction and polarization of the potential of metropolitan areas and concentration in the traditional Pentagon. A minimal number of the urban regions outside this area will generate significant effects of attraction and polarization [5].

Characteristics of EU clubs

The most recent developments in the spatial distribution of GDP p / c at the level of NUTS2 regions across Europe, including non-EU countries, confirm most assumptions about grouping regions with similar characteristics into broader regional units ([10] [11]). This means that the wealthiest regions are concentrated in the central and western part of Europe, they are moderately developed, mainly in the north, and the least developed in the southeast and east of the continent. Therefore, the overview of European economic clubs will be presented through a combined summary of economic reality (GDP p / c), an analytical framework developed by the EU Directorate-General for Regional Policy [5], and parts of the regional geographical description derived from general civilization (history and culture) and spatial-functional (population, urban-rural relations) framework. If we try to unite the existing clubs into geographical regions by generalization, then we can also give names according to the methodology of Mutabdžija [24].

Very high-income club (VH)

These regions are located within the EU, called the European Pentagon or the traditional core, and which frames five major cities: Paris - Amsterdam - Hamburg - Munich – Milan [12]. Also, there are highly developed regions outside the EU borders (UK, Switzerland

[24] The names of the five regions (west, north, center, south and east) reflect the unity of three concepts: the dominant climatic phenomenon (fog, boreal, wind, sun and ice), socio-economic specificity (institutions, monarchies, money, religion and spirituality) and ethno-psychological characteristics of individual regions (superiority, endurance, rationality, ease and modesty).

[25], and Norway [26]). In the further analysis of the spatial distribution of these most developed regions, it is realized that within the EU, of the existing sixteen NUTS2 areas with very high incomes (based on data for 2020), eleven are within the Pentagon, and five are outside (Bratislava, Salzburg, Copenhagen, Stockholm, and Dublin). If we expand the focus to the whole of Europe, this club includes all seven Swiss, one Norwegian, and one British NUTS2 region. That is why it is essential to make a summary overview of all European areas. In addition to the spatial distribution of the wealthiest regions of the EU, Switzerland, Norway, and the UK, it is necessary to look at their mutual relations (ranking) and explain the reasons for this schedule. The overall population change varies depending on the gradation of the club, with people moving to higher-income regions and away from low-income ones. Many high-income regions had high population growth rates between 2001 and 2015, except Germany. In many low-income areas, in the east and south of the EU and the industrial parts of north-eastern France and northern England, the population is declining. Some low-income regions have experienced population growth during this period, but these are usually those regions with a wide range of content and low cost of living.

The area of concentration of flows and activities within this club is recognizable within a broad and compact area from the Paris Basin, Benelux, and Germany to northern Italy, which is called the European core or traditional Pentagon due to five major cities (Paris, Amsterdam, Hamburg, Munich, and Milan). Its name comes from the fact that this area was the first to be urbanized, and after later industrialization (compared to the UK), it achieved the highest degree of economic development and social wealth in Europe. This area specializes in the production of high-quality goods and services, and within it stands out the agglomeration of Greater Paris, three highly urbanized conurbations (Rhine-Ruhr in Germany, Randstad [27] in the Netherlands, and Flemish Diamond [28] in Belgium), which are interconnected in the south with the Alpine foothills (Swiss cantons and the Po Valley) and influential cities in the north (Hamburg). Jovanović [7] explains the aspects of business in conditions when the concentration of business becomes too high, which is somewhat appropriate in this area. However, there may be negative consequences for work and private life (pollution, problems with water purifiers and waste disposal, congestion, crime, and increased land prices and rents). This can affect the expansion and decentralization of businesses and their relocation to other regions, as companies may want to leave "vulnerable" regions. Also, this is a space of very developed and powerful clusters, which act as generators of national development and integrators of essential industries (the best example is the automotive industry).

The second zone within this club is the edge of the traditional core, which refers to regions [29] with very high incomes, which are outside the European body and most often belong

[25] The data refer to GDP p / c for 2019, which are originally presented by cantons in CHF, which the author converted into EUR and presented as 7 NUTS2. Official statistics do not provide an average value for the level of NUTS 2, so the author expressed this in the form of an index (EU database = 100) which amounts to 124 to 467% for cantons (NUTS 3).

[26] Data were given for the NUTS3 level, so the author presented their individual values within NUTS2. A more detailed description of all 7 NUTS2 and associated NUTS3 with an overview of GDP p / c.

[27] Amsterdam Rotterdam, The Hague and Utrecht.

[28] Brussels, Antwerp, Leuven and Ghent

[29] Based on data from DG Regio, 2017, the cartographic basis and methodology was developed by Eurostat (2021), according to which the threshold for VH club was lowered to 146% of the EU average, and since the UK is no longer part of the EU, it has not been processed

to the areas of capitals, and which can be classified into three geographical units (island, Scandinavian, Central European). The first region, according to the DG Regio methodology [5], includes two Irish parts (Dublin and Limerick) and the Scottish area (Edinburgh). The Scandinavian region consists of three capitals (Copenhagen, Stockholm, and Oslo). According to the first methodology, the Central European part is only Bratislava, and the second is Vienna, Prague, Budapest, Warsaw, and Bucharest. The general characteristic of all areas of the VH club is that they have a tremendous gravitational force (all of them are capital cities, except Edinburgh) in attracting the population. However, some have high unemployment rates and have not developed enough since the economic crisis. According to Dijkstra et al. [4], their primary concern is to keep pace with global competitors, maintaining their high specializations and comparative advantage in high-paying industries. Of the mentioned six regions [5], it is noticeable that only one part did not previously belong to this highly industrialized and highly urbanized area, the Bratislava region. The most straightforward reason why Bratislava is in this club is the result of the development phase of capitalism and its spatio-temporal shift. This led to the formation of a powerful automobile complex right next to the border with Austria and Germany, in the city of one of the former Eastern European capitals, which is located only 50 kilometers from Vienna. This region was one of the first gates of Western capital to the world of the former socialist republics of the Slavic East.

The predominantly Catholic (Slovakia and Poland) and Protestant states (Czech Republic) were chosen first. Before the fall of the Berlin Wall, there was only one BAZ (Bratislavské Automobilové Závody) factory in Slovakia, which Volkswagen [30] privatized in 1991. After a very successful start, and thanks to a good business environment and geographical location [31], the following car factory was opened by Kia Motors [32] in Žilina. PSA Group (Peugeot-Citroen) [33] started working in Trnava, and recently JLR (Jaguar-Rover) in Nitra. Due to this, the automotive industry is the essential branch of the economy in Slovakia, which directly or indirectly employs 250 thousand people, and whose value is over 40% of the total Slovak exports. The importance of this industrial sector is shown by the fact that there are more than 350 factories in Slovakia that produce specific automotive components in addition to the mentioned factories. It is now clear why Serbia is struggling to preserve the production of FIAT cars because this industry generates many subcontractors, thus creating a synergistic effect for the entire economy [12].

High-income club (H)

Although high-income regions (H) have many similar characteristics as VH regions, their recognizability is that they are not large cities. Dijkstra et al. [4] state that their stop employment is high. The challenge is to preserve the innovative potential because these regions are more susceptible to competition from the lower-income areas (M and VL). "They are especially vulnerable to the standardization of what they produce, which allows companies from that club to move to regions with lower costs and less skilled labor."

[30] Here are produced SUV models of the entire VW group: Audi Q7 and Q8, Volkswagen Touareg and Porsche Cayenne, but also small cars such as: VW up, Seat Mii and Škoda citigo

[31] 300 million potential buyers of their cars live in the perimeter of 1000 km from Bratislava.

[32] Here are the models: Ceed, Ceed Sportswagon, Sportage and Venga.

[33] Models are produced: Peugeot 208, Citroen C3 and Picasso

Their challenge is to advance innovation in their specialization areas and expand into high-value-added (GVA) activities."

Mutabdzija [14] defined Western Europe as "Fogs, institutions, and superiority of the West" and described it through cultural-civilizational characteristics, which in cultural terms represent a heterogeneous whole that is recognized in the framework of civilization based on two essential determinants. First, most of the population belongs to one of the two prominent families of Indo-European peoples, the Germans or the Romans. In religious terms, the dominant Christian religion is emphasized here. However, the existing peoples are not ethnically compact in the ethno genesis sense. Still, they have built their identity (language, culture, majority religion, and historical development) over a long period by mixing with other peoples. Some are wholly extinct or merged with a more dominant ethnic group. In terms of space and functionality, urbanization is very high, and traditional villages have remained only in France and Ireland. With the expansion of cities in space, urban agglomerations were created, called metropolitan areas or, according to the Eurostat methodology of the Larger Urban Zones (LUZ-Larger Urban Zones), defined based on urban transport to create Functional Urban Areas (FUA). Apart from the traditional Pentagon, the largest urban zones in Western Europe are London and Limerick, and Helsinki in northern Europe.

The second region within this majority club is called "Wind, Money, and Rationality of the Center" [14]. From the position of spatial-functional relations, the cultural diversity of this part of Europe in the past was a source of tensions and conflicts. Today, this represents an invaluable potential for the sustainable spatial development of the EU. Especially in the new Member States, there is a risk that only isolated growth areas around metropolitan regions are developing. In contrast, other regions with different sizes and rural areas are excluded from the development process. However, Europe can achieve polycentric development, with significant areas of growth, including those on the periphery, organized as urban networks that will provide dynamism and the necessary externalities to attract additional investment. According to DG Regio [5], polycentric development reduces environmental pressures and social tensions and helps stabilize democratic structures. A simple reproduction of the center-periphery model across Europe would harm the center as much as the periphery. It would not correspond to the historical development of different settlement patterns on the continent. Greater integration of populated areas within and between major European regions is essential for establishing new development processes in remote parts of Europe, leading to long-term strengthening of their urban structures and making them more competitive. In addition to metropolitan areas, the cities of the gate through which communications pass and trade with other continents through traffic ports, major airports, trade fairs, cultural centers represent a step forward towards the model of polycentric growth of the entire continent. While gate cities have developed in the past in the coastal regions of Western (Laurel, Rotterdam, London, Antwerp) and Southern Europe (Barcelona, Marseille, Genoa, Piraeus), opportunities for the development of these cities on the eastern periphery of Central Europe (Gdansk, Warsaw, Prague, Vienna, Budapest), today is the result of the emergence of new transport and energy corridors to Asia. Their priority is to connect metropolitan areas, and they were created based on the shared interests of the EU and future members through which they should pass. The best examples of such regions are large German cities (Berlin, Cologne, Dusseldorf, Hanover) or smaller cities on navigable rivers (Regensburg, Passau, Karlsruhe), as well as large Austrian cities (Linz, Graz, and Innsbruck).

Middle-income club (M)

This club has a large group of regions within which there is a significant structural difference, which makes them different. Therefore, according to DG Regio [5], two subgroups have been formed within Club M, each with specific challenges. One consists of regions that have "lost productive jobs and in which the level of education of the labor force is below that in regions with higher incomes, so they are economically fragile." The second subgroup consists of regions that "record an increase in population, but mostly older people, who are moving there due to local content and low cost of living." This means that older residents are moving out of big cities (more expensive, more complicated, and less healthy) living conditions) towards smaller cities where life is more pleasant (cheaper utilities, more pleasant climate, more recreation areas). Such internal migration stimulates employment in non-commercial local services, thus encouraging "limited development of skills, innovation capacity and export capabilities, thus risking both subgroups falling into the middle-income trap." The specificity of this club is reflected in the fact that the increase in productivity and income shows all the complexity of economic development so that the regions within club M "become less attractive for labor-intensive but also low-skilled activities because raising the value scale requires more investment per worker than is the case in the earlier stages of development." If we tried to group these regions completely geographically, we would fall into the trap of generalization. However, it is possible to state, based on the insight into the statistical atlas of Eurostat, that there are two broad geographical zones dominated by these regions, namely Scandinavia and the western Mediterranean.

The first can be called "Boreal, monarchies, and endurance of the North" [14]. Mainly, due to the pronounced natural geographical difficulties (primarily the climate) and the unfavorable geographical position [34], the area of Scandinavia has been continuously an emigration area. Nevertheless, quality political decisions with far-reaching goals have significantly mitigated this geographical determinism (nature) and made Scandinavia a highly prosperous society despite the obvious problems arising from its geographical location. This is partly explained by Jovanović [7], who states that in critical moments the structure of the economy can become unsustainable and that then decisive measures of the government are necessary to overcome such a situation. He describes it as "certain critical points of branching (bifurcation) at which economic changes acquire new qualitative characteristics" and cites the example at the end of the 19th century. Argentina and Sweden were relatively comparable backward economies based on agriculture. At about the same time, Argentina invested in the education of lawyers and priests, while Sweden invested in the education of engineers. The impact of such choices, combined with other economic policies, on the material living standards of the two countries is evident. Despite the excellent results achieved by the Nordic economies, there is still a very pronounced demographic "threat" to this area. It is directly related to the quality of life and indirectly to the sustainable development (economic, social, environmental, and cultural aspects) of the whole society, which indicates severe problems in most parts of the region. This process of uneven distribution of the population is accompanied by population aging, and it will be further expressed in depopulation regions. They will also increase the challenges in service delivery and maintenance of infrastructure systems. According to current international standards, the Nordic labor markets are among the

[34] With the increase of geographical latitude, the difference in the duration of the daytime increases during the year, which negatively affects the work, but also the mental stability of people.

highest globally, and Nordic companies are well-positioned and increasingly oriented towards services in the global market. The EU28 (2013) employment average was 64.1%, with all Nordic countries above that average (72.8%). As in most developed countries, the Nordic countries have shown positive signs in several aspects in the last few decades. A large part of the population is employed, the share of women in the labor market has adopted an economic model to strengthen the tertiary sector.

Another conditional region can be called "Sun, Faith, and Comfort of the South," which refers to the western Mediterranean (the Iberian Peninsula, southern France) [14]. In the true sense, it reflects the title of this chapter because, in historical and geographical terms, this is the area of the most dynamic European regions. This is recognized through the cultural and civilizational development of the ancient period when classical Greece and ancient Rome laid the foundations of modern Europe through city building, state development, dissemination of scientific knowledge, and the rise of civilizational values. This was a constant until the end of the Middle Ages when European interests shifted to the Atlantic and the New World and remained so until modern times. In terms of space and function, the turning point in developing these Mediterranean regions was the economic crisis of 2008. Before that, GDP in the EU grew continuously from 1995 to 2007 at an average rate of 2.4%, to record a sharp decline in 2009 by -4.8%. In these difficult circumstances, the EU has responded with various measures, from supporting banks to providing fiscal stimulus and crisis assistance packages.

Nevertheless, it can be seen that the recovery in the countries of Southern Europe has been slower than in other parts of the EU. Employment rates, i.e., unemployment, especially youth unemployment, are essential for the sustainability of development because these indicators assess the quality of life and social inclusion as a cornerstone for socio-economic development and prosperity. On the other hand, unemployment mainly affects people, their families, and their future. Respecting regional differences, e.g., Andalusia and Sicily have the highest values of these indicators, so it is clear how much depression there is in these societies and regions. These indicators are especially characteristic of young people, so the question of the efficiency of the education system and the labor market is rightly praised. One of the most severe problems of today arises from such relations, and that is inequality. It is visible at the EU level and the regional or national level.

The economic aspect of the development of these regions is significantly defined by clusters, i.e., companies that are grouped to benefit from the availability of a network of suppliers and are usually grouped in locations with high local demand. This demand is high in areas where there are the most producers because they have chosen to be located according to circular interdependence or cumulative causality processes. "There is a degree of uncertainty in the location of activities - companies because they are located due to the presence of other companies, and not because of the basic characteristics of the location" [7]. In today's circumstances, the regions that belong to this club are developing within the mentioned area. They are mostly related to the biggest conurbations as centers of NUTS2 regions; Lisbon, Barcelona, Valencia, Vigo, and Oviedo are the Iberian cities. The most important French cities are Lyon, Toulouse, Bordeaux, and Marseille, and this club also includes Italian cities: Rome, Turin, Florence, and Venice.

Low-income club (L)

The short definition of a low-income club, according to DG Regio [5], starts from the fact that these are regions that face a low level of technological and business organization and a workforce with limited skills, and a particular advantage is that they can offer low costs

land and labor. These regions continuously have a negative migration balance, with well-educated young people and the population of certain specialties having a significant share in the structure of emigrants. As their populations move to high-income regions, at the same time, these regions are unable to attract new firms and talented individuals from other areas. These are the fundamental reasons for the intensive emigration of the local population and creating a long-term perspective of poor living conditions. Only the regions of the capitals and some large urban centers of the mentioned regions deviate from such gloomy projections of economic development, which characterize the entire southern and eastern rim of the European continent. Within the EU, these regions are inhabited by their total population. When countries with the status of potential EU candidates or candidates are added and members of the Eastern Partnership and the European part of Russia, it is clear that they are the majority of Europe. Which has a larger population than the previous three clubs. Despite the stated political-geographical diversity of the countries/regions that belong to this club, they can be classified into two conditionally large geographical areas: east and south. A more detailed description will refer to two examples: the Eastern Partnership and the Balkans.

The first region is "Ice, spirituality, and modesty of the East," within which the demographic development (Eastern Europe) since the middle of the XX century. To this day, it indicates two periods [14]. The border between them was the moment of the collapse of the Soviet Union, which was reflected in the demographic growth of all countries in the region. In terms of space and function, the analysis of Eastern Europe as a single region is impossible and similar to the region of Southern Europe; there are two groups of countries. They are characterized by an uneven methodological framework for creating a modern concept of spatial and functional relations in the region's countries. EU members, Lithuania, Latvia, and Estonia in the north and Romania and Bulgaria in the south pursue EU territorial agendas. There are uniform documents, most notably the National Spatial Development Strategy (NSDS), which operate on umbrellas for branch strategies. The common denominator of all these strategies is the need for accelerated development and implementation of the started pan-European transport network as a necessary precondition for good accessibility to large areas throughout the continent. In addition to the principles related to the policy of sustainable spatial development, more detailed measures for the spatial development of European cultural regions have been proposed, and extraordinary measures aimed at achieving more balanced and sustainable development in individual European regions.

The very nature of these areas characterizes them as areas with a high degree of biodiversity and partial overlap, and geographically, the focus is on two sub regions: the Barents-Euroactics and the Black Sea region. It is first seen as a multimodal transport area covering the northern provinces of Sweden, Finland, Norway, and the Russian Federation - the Republics of Karelia and Komi (Murmansk and Arkhangelsk). There is a clear orientation towards the resources of this region (mineral wealth and gas deposits), whose exploitation implies safe transport flows as a combination of different types: railway-road-water-pipelines. Another region is the Black Sea states Turkey, Georgia, Ukraine, Romania, Bulgaria, and Moldova, while Armenia and Azerbaijan have observer status. From the point of view of spatial development policy, they must not be considered only as elements of comprehensive construction of transport infrastructure, but more important is their interaction with the settlement network, regional economy, regional transport networks, and environmental requirements. All of the proposed ten corridors end in this region, with almost every country (except Estonia and Latvia) intersecting at

least two corridors. The specifics of this region are numerous, and its spatially smaller part is made up of the Eastern Partnership [35] countries. The Riga Summit (2015) defined the strategic goals of this organization and the EU, which relate to strengthening the resilience of the state and society through the stated priorities; economic development and market opportunities; strengthening institutions and good governance; connectivity, energy efficiency, environment, and climate change, mobility and people-to-people contacts.

The second region is best described by the new term Open Balkans[36] as a sub-region of Southeast Europe, which is recognized as a fluid space with unclear borders and ethnolinguistic dependencies, complicated political-geographical relations, and intertwined urban-rural relations. Attempts to "fix" this space for the last 30 years have been between "interference and imposition" by the great and incompetent domestic actors. Perhaps, the common denominator of all the mentioned ambiguities has its origin because there are no clear goals of sustainable spatial development. This stems from numerous and very reference spatial-planning and economic studies prepared by international organizations, according to which this region with about 18 million. In 2017, it had a total GDP of $ 89.1 billion, only half of one of the weakest EU economies (Portugal), with only 10 million inhabitants. In terms of space and function, Serbia is divided into four NUTS2, with a significant difference in the values of GDP p / c (between 8,100 and 21,700), which means that the Belgrade region has an index of 70 or 70% compared to the EU = 100); Vojvodina 41; Western Serbia and Šumadija 27, and Eastern and Southern Serbia 26. Montenegro is treated as one NUTS2 with an index of 50, and in Northern Macedonia, the value is 38. Albania is divided into three NUTS2 (GDP ranging from 7,800-11,500), and index values from north to south are 25-37-22. BiH, Kosovo, and Metohija have not applied the NUTS classification, which speaks of unfinished political-geographical processes.

While Kosovo and Metohija are an integral part of Serbia according to UN Resolution 1244, which declared independence on its initiative, there is no internal consensus in BiH between the representatives of the three nations on the modalities of internal organization and constitutional relations. There are two entities in BiH (RS and FBiH), and the problem is the territorial organization of FBiH (Bosniaks and Croats), in which there is no consensus between the two principles (national and civil). Perhaps this new political agreement can be achieved by applying the NUTS classification as a first step towards creating the desired framework. Population, ethnic and economic imbalances are very pronounced within the existing framework.

Due to the above, creating a measure for the spatial development of this part of Europe is of the utmost importance for this region, and there are two assumptions in this regard. The first concerns completing the Pan-European Road Corridors, where Corridors V, X, and XI are roads, Corridor VII is a waterway (Danube). Corridor V has three branches (a, b, c), which depart from the Adriatic ports (Venice-Trieste, Rijeka, and Ploče) and go via Budapest to Lvov, where it connects to Corridor III (Dresden-Kyiv). Branch Vc goes through the valleys of the Neretva and Bosnia. Near Doboj, it intersects with the highway through the Republika Srpska (Gradiška-Banja Luka-Doboj), making these highways the backbone of the BiH traffic system. Corridor X is of the most significant importance for

[35] These are: Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine.

[36] Currently, Serbia, Albania and Northern Macedonia are members, while BiH, Montenegro, and Kosovo and Metohija have not yet commented on the initiative.

Serbia, which it enters from two directions (Salzburg-Graz and Budapest) and continues via Nis towards Sofia (connection with Corridor IV, Dresden-Istanbul), towards Skopje (relationship with Corridor VIII, Durres-Constanta) and continues to Thessaloniki and Igoumenitsa. The newly established Corridor XI connects the southern Adriatic (Bar-Boljare-Požega-Belgrade-Vršac-Timisoara) with Corridor IV (Dresden-Thessaloniki). This will significantly improve the entire region's infrastructure and create an environment for a more favorable business environment.

Another assumption relates to establishing the regional initiative Open Balkans, which should relax economic and political relations in the region and alleviate the terrible economic situation (average GDP index p / c is below 40% of the EU average). An important measure that strengthens the guiding principles of the sustainable spatial development of the European continent is the care of cultural landscapes in Southern and Southeastern Europe. This particular measure is aimed at achieving more balanced and sustainable development in individual European regions, primarily hotbeds of European ancient culture and art, linked to ancient Greece and ancient Rome, but hotspots of other cultures in this region (Byzantine and Ottoman culture, beautiful examples of Romanesque and Renaissance in the Adriatic coast, and Baroque art and classicism in the Pannonian Plain). This confirms that the whole region comprises a multitude of cultural landscapes. They are a significant part of Europe's heritage and witness past and present relations between man and his natural and built environment. Spatial development policy can contribute to the protection, management, and enhancement of protected areas by adopting appropriate measures by organizing better interaction between different sectoral policies while respecting their territorial impacts. Appropriate measures in landscape protection include the integration and development of landscapes through spatial planning and sectoral policies.

CONCLUSION

The concept of economic clubs came to life in theory during the 1960s, but in practice, on the example of the EU, it began to be applied only recently [5]. This means that the path from economic theory to spatial planning practice took a long time and that today it represents a clear framework for defining major regional geographical issues. This implies shifting the focus from large supranational entities (macro-regions) to the subnational level (NUTS2), where the regional (cohesion) policy of the EU member states is implemented. This is well recognized in Serbia, which is trying to reduce regional disparities through reindustrialization and infrastructure works, and thus balance the spatial distribution of the population.

It is evident that modern social problems, not only economic-geographical and spatial-planning, can be recognized, and their dynamics can be predicted based on the theory of economic clubs. The neo-Marxist grand view "from Fordism to post-Fordism" provides a historical basis and ideological guidelines and center-periphery theory as it’s an important segment. In modern terms, it is clear that the European Pentagon and its edge represent the center (VH and H clubs), the most significant parts of Northern and Western Europe, as well as the Western Mediterranean (M club) represents the periphery, while the Balkans and Eastern Europe (VL club) represent the periphery.

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THE ASSOCIATION BETEEN ECONOMIC AND MARITAL TRANSITION IN SERBIA-SEQUENCE ANALYSIS

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ABSTRACT

The main aim of this paper is to examine the economic trajectories of persons who have changed marital status. Based on the data from the Survey on Income and Living Conditions SILC (waves 2014-2017), the author uses sequence analysis to construct economic activity histories separately to the subsamples of single to married men and women, married to divorced men and women, and married to widowed men and women. The results show that the different types of marital change are associated with different patterns of economic activity transitions. In general, it turns out that ensuring stable employment is a „prerequisite“ for marriage, and also that economic instability can be considered as a cause of marriage dissolution and divorce. On the other side, different gender patterns of economic activities transitions by types of marital change suggests slow slow separation from traditional marital behavior (patriarchy).

Keywords: Economic trajectory; marital change; sequence analysis; SILC survey; Serbia

INTRODUCTION

The author started from the assumption that economic stability is a „prerequisite“ for marriage. This assumption is based on the economic theory of marriage which offers a simplified model of marriage based on the maximization of his and her well-being. This model offers an explanation that the gains from marriage compared to the remaining single for any two persons are positively related to their incomes and human capital [1]. Marriage reduces the incidence of poverty and social ills among adults while divorcing increases it [6].

Numerous studies are indicating the economic barriers to marriage. Thus, Gurrentz (2018) has indicated that marriage rates of adults depend on economic security matters in many ways, as labor force participation, wages, poverty, and housing all play a role. Concerning labor force participation, the author has stated that full-time work had a robust positive association with marriage rates while unemployment and median hours worked produced less consistent results [8]. Gibson-Davis (2009) pointed out that couples who became poor were associated with a 37% decrease in marriage likelihood which posits that positive economic circumstances are necessary for marriage [7]. Smock, Manning, and Porter (2005) are shown, through in-depth interviews, that cohabitors typically perceive financial issues as important for marriage ie. that cohabitors believe marriage should occur once something has already changed their financial status [20]. In general, economic circumstances are important for marriage among both men and women. Thus, White and Rogers (2000) have explored the consequences of economic well-being on family outcomes separately for men and women. They have concluded that both men's and women's economic advantage is associated with more marriage, less divorce, more marital happiness, and greater child well-being [25]. On the other side, there are still

studies that are point out different gender patterns in this sense. For example, Yu Xie, Raymo, Goyette and Thornton (2003) have explored the relationship between economic potential and rates of entry into marriage, and conclude that earnings potential strongly and positively influence the likelihood of marriage for men, but not for women [26]. Contrary, Keeley (1977) has offered a gender pattern of an economic model of the determinants of first marriage which implies a negative effect of male wages and a positive effect of female wages on own age at marriage [11].

Secondly, the author of this paper started from the assumption that economic instability causes marital instability and dissolution. As noted above, the starting point is the economic theory of marriage which assumes that each person maximizes his or her expected utility as he decides whether to marry or to remain married. The probability of dissolution is greater when the expected gain from marriage is smaller and the variance in the distribution of realized outcomes is larger [2]. As Hardie and Lucas (2010) have stated, economic hardship was associated with more conflict among married and cohabiting couples [17].

There are a lot of studies in different countries that have examined the impact of a couple's unemployment on union dissolution (both marriage and cohabitation). Hansen (2005) has indicated that unemployment leads to an increased risk of marital dissolution among couples in Norway, but also on gender differences with regards to the impact of unemployment. While economic problems seem to be an important explanation for the impact of husbands' unemployment, the impact of wife's unemployment remained after controlling for other factors [16]. Similar results were obtained by Lewin (2005) and Jelovaara (2003), emphasizing in this way that the most notable reason for family instability is chronically husband's unemployment associated with women's reduced economic gain from marriage [9] [12].

On the other hand, some studies show that a wife's economic independence destabilizes marriage. Liu and Vikat (2004) has evidenced the „independence effect" in Sweden: the linear relationship between the share of a wife's income and the divorce risk is positive [13]. Manting and Loeve (2007) have highlighted that women in the Netherlands who earned more than half of the household income have a high probability of divorce or separation [14]. Kalmijn, Loeve and Manting (2007) have indicated that the shape of the effect of the woman's relative income on separation depends on the type of union. Movements away from income equality toward a male-dominant pattern tend to increase the dissolution risk for cohabiting couples, whereas they reduce the dissolution risk for married couples. Movements away from income equality toward a female-dominant pattern increase the dissolution risks for both marriage and cohabitation [10]. Similarly, Sayer and Bianchi (2000) have shown a positive association between a wife's percentage contribution to family income and divorce, but they point out that this relation is reduced to nonsignificance as soon as variables measuring gender ideology are introduced into the model [19].

Bearing in mind the significant relationship to economic resources-family formation, the idea of this paper is to examine changes in economic activities with respect to the different patterns of marital transitions in Serbia. The economic and social characteristics of Serbia, which will be described in the next section, indicate that this type of research is very important in this country.

BACKGROUND

Slow separation from traditional marital behavior

Sociological researches point out that marriage in Serbia presents an institution that is shaped by the great influence of the social environment. Serbia has been characterized by high universality of marriage, rare divorce, and cohabitation as well as the very slow changes in marital behavior [5]. The data from the UNDP-SECONS (2010) supports the universality of marriage in Serbia and shows that widowhood is as prevalent as divorce (10%) among female respondents who have ever married and that almost 80% of them are still married. This author stated that even a slight decrease in the rate of nuptiality in the recent period does not reflect a decline in the universality of marriage but a steady increase of age at entry into marriage [18].

Analysis of the value preferences of the Serbian population from 2008 has shown that marriage and family are still the main generators of patriarchal orientation, even existing tendency to mitigate "hard" traditionalism (patriarchy) in relation to the partnership. Patriarchy is confirmed by findings of mentioned research which has shown that the majority of respondents considered that „marriage as an institution“ has not lost its importance (60% of respondents) as well as they oppose to divorce as an option (34% of respondents). Respondents' opinion that the husband should be employed in case that only one spouse should work (57% of respondents), also confirms patriarchy in Serbia [5]. Based on this information, it can be assumed that marriage will have a different effect on the economic activities transitions among men and women.

Sociologists consider that the high universality of marriage and family and blocking of transformational processes of the formation of egalitarian relations between spouses are the consequence of specific structural barriers, the devastating consequences of wars and prolonged economic crises in Serbia as in other post-socialist countries in the Central and Eastern Europe [3] [4] [5] [15] [18]. Thus, a significant decline in divorce in Serbia was recorded during the 1990s marked by a social crisis, the breakup of the former Yugoslavia, and a systemic breakdown. As the authors point out, divorce was a “high risk” during the 1990s in Serbia [5]. Also, Petrović (2011) has stated that structural barriers deepen institutional weakness in Serbia, which leads to a series of paradoxes in strategies of control of risk at the individual-level, such as the biggest relative representation of cohabitation among low social stratification of Serbian society [18].

The challenge is to examine whether an economic factor (economic activity) can be considered as a " transformer" of traditional marital behavior in Serbia? It is interesting to examine whether economic instability still prevails over the traditional opinion that "divorce is not a good option"?

Low economic conditions in Serbia at macro and micro-level

Serbia is characterized by low economic activity. Serbia belongs to the group of countries (predominantly neighboring countries) that have the lowest economic activity rates in the European context. Eurostat data show that the economic activity rate in Serbia is almost 10 percentage points lower than the European average, or more than 20 percentage points lower than in the most economically developed countries such as Switzerland, Sweden, Netherlands, and so on [27].

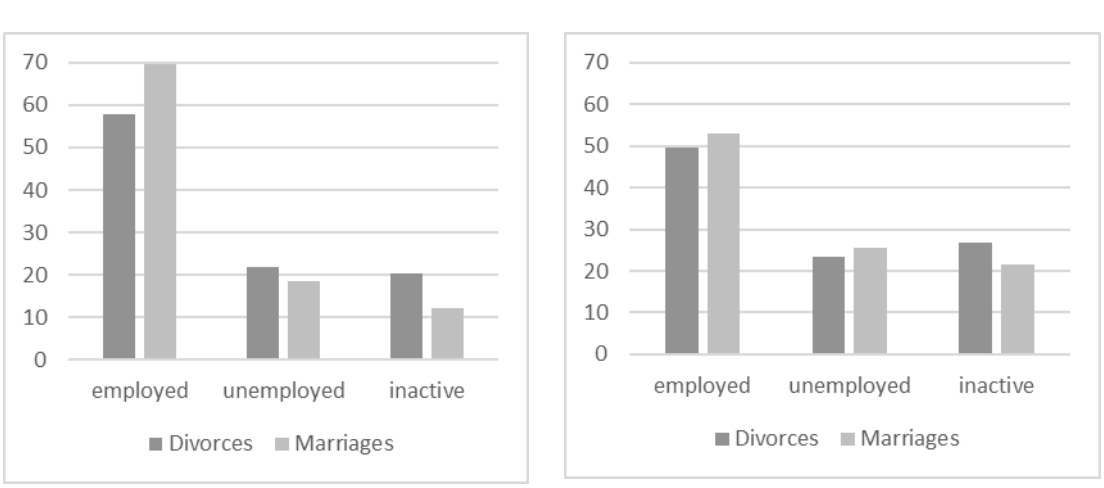
It is expected that the unfavorable economic conditions at the macro level have a negative impact on economic circumstances at the micro-level. This is indirectly confirmed by recent sociological research by Tomanović, Stanojević and Ljubičić (2016) which

showed the low self-perception of the financial situation of young couples with/without children in Serbia. Precisely, this research has shown that 65% of couples report having financial problems, while only 60% of them are fully financially independent. [37] Logically, the causes of financial problems are either unemployment or inadequate (poorly paid) inter-paid jobs among partners [24]. Regarding to the findings in other countries (previous section), it can be assumed that this economic dissatisfaction can potentially result in marriage dissolution and divorce in Serbia as well.

Bearing in mind the presented unfavorable economic circumstances, it is, therefore, no surprise that the relation economic resources-marriage are very pronounced in Serbia, which have shown by many sociological studies [22] [23]. This is confirmed by the mentioned sociological research of the transition to marriage (and parenting) as one of the indicators of transition in adulthood, in individual life paths. The authors, through quantitative and qualitative analysis, have indicated that the standard trajectory implies the linearity of key life events: graduation, followed by employment (temporary and/or permanent), and then the marriage and birth of a child. This research shows that both spouses are employed among half of the married couples which confirmed that economic stability is a „prerequisite" for marriage in Serbia. This is especially true for high-educated married couples who have a high proportion of cases where both spouses are employed (over 70%), as well as a decrease in arrangements that imply that the man is employed while the wife is unemployed or inactive. Also, these authors point to gender differences in "working strategy" after the birth of a child, which implies that male unemployment declines when they become fathers, while the opposite pattern is observed among women [24].

Given that marriage "precedes" parenthood in Serbia [24], it will be interesting to examine whether the precondition of both is actually a stabilization on the labor market. Is the economic precondition for marriage relevant for both men and women, or no?

Graph 1. Marriages and divorces in Serbia, by economic activity of husband and wife (2018)



Source: Statistical Office of the Republic of Serbia (2018) [21]

[37] The survey was conducted in 2011 on a nationally representative sample in 62 Serbian municipalities. Survey was included 1627 respondents aged from 19 to 35 years.

In support of the author's assumptions is the fact about the different structure of marriages and divorces in Serbia by the economic activity of the husband and wife. Data from vital registration in Serbia show that employed, especially husbands, participate more in the structure of marriages than in divorces. The opposite pattern is evident when it comes to the share of the unemployed and the economically inactive persons. There is definitely a relationship between economic activity and different types of family formation in Serbia (Graph 1)

OBJECTIVE

The first aim of this paper is to examine the trajectories of the economic activity of individuals who have changed marital status. The answer to the question of whether different types of marital changes are associated with different patterns of economic activities transitions is considered as the first aim of this research.
The second aim is to investigate the gender pattern of trajectories of economic activity by marital changes. In other words, answer the question of whether trajectories of economic activity differentiate by gender and types of marital changes.
Building on the first and second aim, the third goal of the paper is to try to answer on few specific questions: 1) Whether labor market stabilization can be considered as an economic precondition for marriage? 2) Whether economic instability can be considered as a cause of marriage dissolution and divorce? 3) Are there differences between men and women in this regard? 4) Whether, in line with other studies, the male economic (in)stability deciding when it comes to (divorce) marriage?

DATA AND METHOD

This analysis is based on the data from the Survey of Income and Living Conditions in Serbia (EU-SILC). The first wave was carried in 2012/13, and it has since been conducted every year in Serbia. Considering that longitudinal surveys (such as SHARE, GGP…) are not currently being conducted in Serbia, the EU-SILC survey is significant because it allows monitoring of changes at the individual level over a four-year period on different dimensions of life.
The author uses the longitudinal microdata from the EU-SILC (waves 2014-2017) to construct economic activity histories (36 months-from January 2014 to December 2016) for individuals who have recorded a marital change. The author constructed economic activity histories separately to the subsamples of single to married men and women, married to divorced men and women, and married to widowed men and women. Summary statistics of the sample are presented in Table 1. The follow-up starts 18 months before the registration of marital change and ends 18 months after this registration. It should be noted that the exact date (i.e. month) of marital change is unknown in the analysis, therefore the whole year between June 2014 and June 2015 is considered as the reference period in which the change could have occurred.
The author's empirical approach consists of two steps. First, by applying sequence analyses, the author obtains economic activity histories separately by gender and types of marital change. Second, the author estimates transition rates separately by gender and types of marital change.
In order to describe and visualizing trajectories of economic activity, the author uses sequence analysis in TraMiner (R-package). The author defined possible states that shape trajectories of economic activity: unemployed (UN), training (TR), part-time employed

(EP), full-time employed (EF), self-employed (SE), domestic work (DW), and retirement (RE). All data on economic activity histories were obtained by the retrospective information provided by respondents in the EU-SILC survey.
Transition rate presents estimated probability to be in state i at t when we are in state j at the previous position t-1 (Formula 1). In the case of this research, the transition rate presents an estimated probability to be in a certain state of economic activity at the one month when we are at a certain state of economic activity at the previous month. In formula 1, i and j are the possible states of economic activity (UN, TR, EP, EF, SE, DW, RE) while t is months (36 months-from January 2014 to December 2016).

$$p = (x_{it} \mid x_{j(t-1)}) \quad (1)$$

Table 1.Summary statistics of the sample

		Total	Types of marital change		
			Single to married	Married to divorced	Married to widowed
Gender	Male	47.5	55.8	50.0	23.1
	Female	52.5	44.2	50.0	76.9
Age	20-29	23.0	37.9	13.6	2.6
	30-39	22.5	25.3	30.3	2.6
	40-49	18.0	21.1	24.2	0.0
	50-59	13.5	10.5	16.7	15.4
	60+	23.0	5.3	15.2	79.5
N		200	95	66	39

The reason for the small sample (Table 1) is that, due to the lack of longitudinal demographic surveys in Serbia, the author had to use EU-SILC data and select individuals who: 1) changed their marital status and 2) repeated it in three consecutive waves of survey. Therefore, this can be considered a preliminary analysis while one of the goals of future research is to examine opportunities for expansion of the sample

RESULTS

Sequence of state distributions

Results show that three types of marital changes clearly are associated with different patterns of economic activity transitions in Serbia. Graph 2 offers a dynamic view by plotting the proportion of individuals in each of the seven states of economic activity at each time point by type of marital changes and gender. Graph 3 highlights the most frequent patterns of economic activities transitions by type of marital changes and gender. Generally, the results indicate the importance of economic stability for marriage for both men and women. This is confirmed by the big proportion of those with stable economic status or those who were full-time employed before and after entering into marriage. Stabilization on the labor market is evident before entering into marriage among 28% of single to married men and women (Graph 2).
But expectedly, given the findings of previous studies (Background section), the economic activities transitions for single to married individuals are different among men and women. On the one side, it turned out that entry into marriage starts activation on the labor market among men. This is confirmed by the fact that the most frequent state ordering is unemployed-full-time employed for single to married men. In other words, 50% of single to married men who change their economic status have transited from

unemployed to full-time employed. As we can see in Graph 2, the timing of the transition from unemployment to employment coincides with the reference timeframe in which marital status has changed among those men (June 2014-June 2015). Even a certain number of cases have transited into employment and before this reference period which more testifies about male economic stability as a precondition for marriage (Graph 2; Graph 3).

On the other side, the trajectory of economic activity is completely different for single to married women. The most frequent state ordering is full-time employed-unemployed, which means that, unlike men, entry into marriage for women means withdrawal from the labor market. Results show that women experience a "delayed" transition of economic activity that begins after entering into marriage. The transition from employment to unemployment gradually begins in the middle of the reference period, which means that the transition could occur 6 months after entering into marriage. It can be assumed that the female economic activities transition may be more related to pregnancy or childbirth at the beginning of marriage than with a change of marital status. A certain number of women who transited to domestic work after entering into marriage also can be related to the birth of a child (Graph 2; Graph 3). Likewise, over 60% of single to married individuals are optimal reproductive age (Table 1).

Results show that the death of the spouse does not greatly affect the transition of economic activity which is confirmed by the fact that about 54% of married to widowed individuals have recorded the same economic status before and after the death of a partner. This is especially true for married to widowed men among whom this share reaches almost 100%. These are retirees in most cases which could be expected given that 80% of married to widowed individuals are over 60 years of age. However, it turned out that widowhood to a greater extent changing economic status among women than men. The most frequent state ordering is domestic work-retirement or 50% of married to widowed women who change their economic status has transited from domestic work to retirement (Graph 2; Graph 3). It can be assumed that they are women who were housewives in the marriage while they inherited a pension after their husband's death. The timing of the "delayed" transition confirms this assumption because it suggests some time for obtaining a family pension after the husband's death. More precisely, the transition from domestic work to retirement gradually begins in the middle of the reference period, which means that the transition could occur 6 months after the husband's death.

Marriage dissolution and divorce have been shown to have a greater impact on male economic activity status than females. In other words, 66% of married to divorced women have recorded the same economic status before and after divorce, while this percentage for men is 48%. Most of them are full-time employed which suggests, on the one side, that the economic instability of the spouses is not the "cause" of the marriage dissolution and divorce. But on the other side, the fact that a higher proportion of married to divorced men than women had been unemployed for at least 6 months before a divorce suggests that the husband's economic instability can be considered as a factor of the marriage instability and ultimately of divorce. Precisely, 20% of married to divorced women and 34% of married to divorced men had been unemployed for at least six months before the divorce. However, as mentioned, it turned out that divorce to a greater extent changing economic status among men than women. The most frequent state ordering is self-employed-unemployed or 50% of married to divorced men who change their economic status have transited from self-employment to unemployment (Graph 2; Graph 3). It can be assumed that they are men who had a private business with their wives, but marriage

dissolution and divorce implied interruption of joint business and a change in their economic status.

Transition rates

As explained in the section Method and Data, transition rates show estimated probabilities to be in a certain state of economic activity at a certain month when an individual is in a certain state of economic activity in the previous month. Bearing in mind that these rates indicate the probability of transition of economic status between two months (month t and month t+1), it should not be surprising that the rates are highest when it comes to the transition to the same state of economic activity. This is a characteristic of all individuals regardless of the types of marital changes and gender. For example, a person who was unemployed in June 2016 is most likely to remain unemployed in July 2016 regardless of types of marital changes and gender.

But on the other side, transition rates suggest that three types of marital changes clearly are associated with different patterns of economic activities transitions which correspond with the results of the sequence analysis presented in the previous section.

The importance of economic stability for marriage is reflected in the fact that the transition rate EF-EF (the estimated probability that an individual remains full-time employed in the month t and t+1) is the highest for both single to married men and women. Although low, the probabilities of transiting from training and unemployment to employment between two months (TR-EF, UN-EF) were recorded among single to married men which suggests the particular importance of their stability on the labor market. On the other hand, the tendency to withdraw from the labor market confirms the existence of the probabilities of transition from (self) employment to unemployment (EF-UN, SE-UN) among single to married women (Table 2).

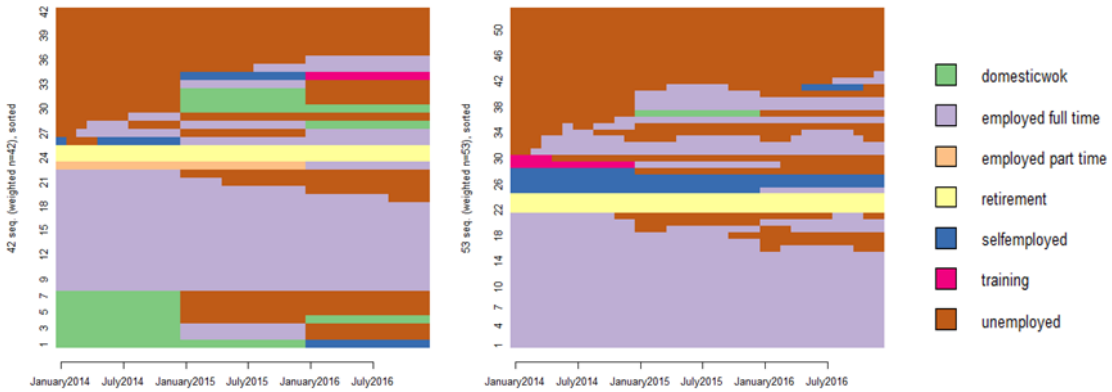
The estimated probability of remaining retired between two months is 1 (RE-RE) among married to widowed individuals which definitely confirms that the death of the spouse does not affect the transition of economic activity. Of course, this result is related to the old age structure of this category of individuals (Table 1, Table 2).

On the one hand, the estimated probability of remaining full time employed between two months is the highest among both married to divorced men and women, therefore it can be considered that the economic instability of the spouses is not the only "cause" of the marriage dissolution and divorce. But on the other hand, transition rates indicate a causal link between male economic status and divorce, thus confirming the assumptions from the previous section. Specifically, a comparison of male and female transition rate EF-UN suggests that the estimated probability to transition from employment to unemployment is higher among men than women which can mean that male economic instability can be considered as a factor of the marriage instability and divorce. Also, the assumption that interruption of joint private business after the divorce changes male economic status is supported by the result of the existence of a certain probability to transition from (self)employment to unemployment between two months (SE-UN) among married to divorced men.

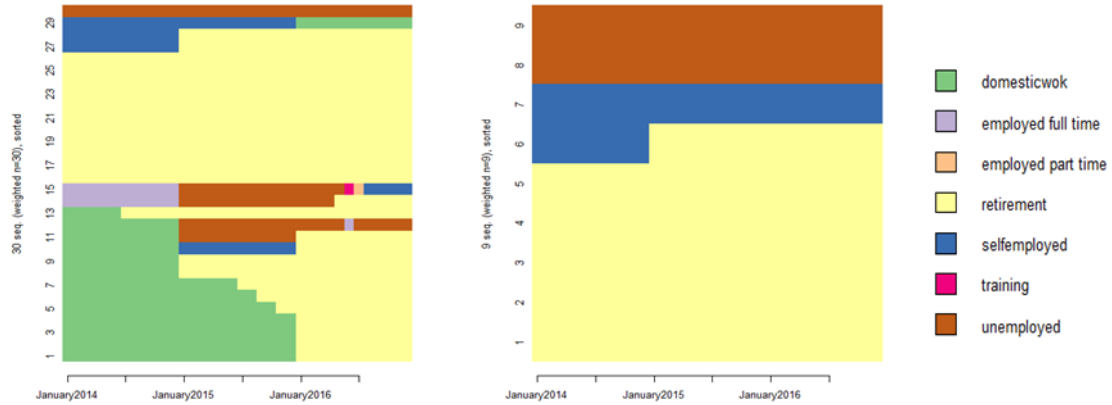
Graph 2. State distribution plot by economic activity, type of change of marital status and gender.

Female Male

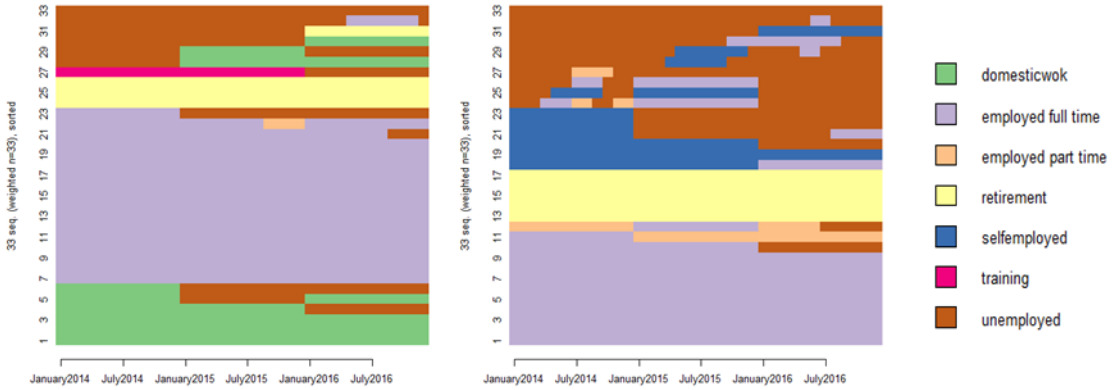
Single to married



Married to widowed



Married to divorced/separated/single

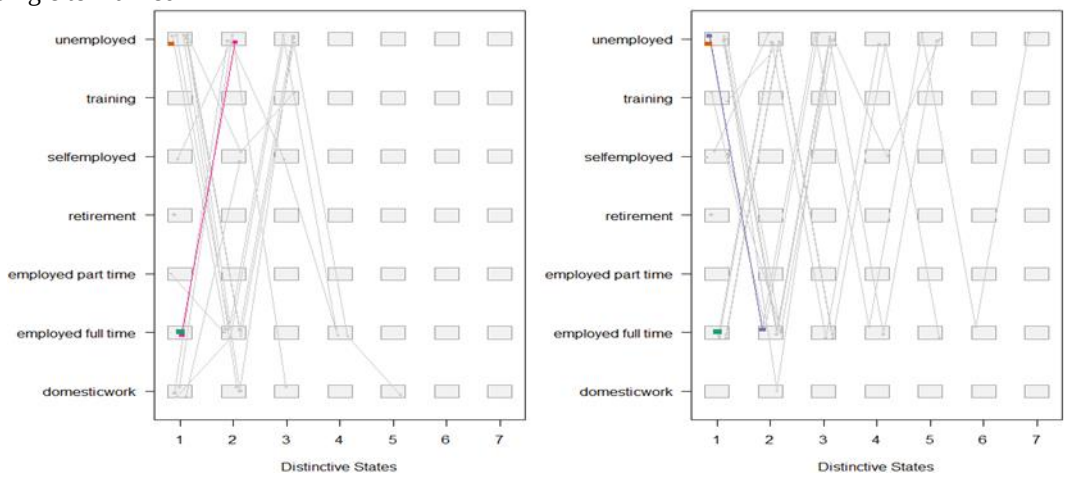


Source: Author' calculation

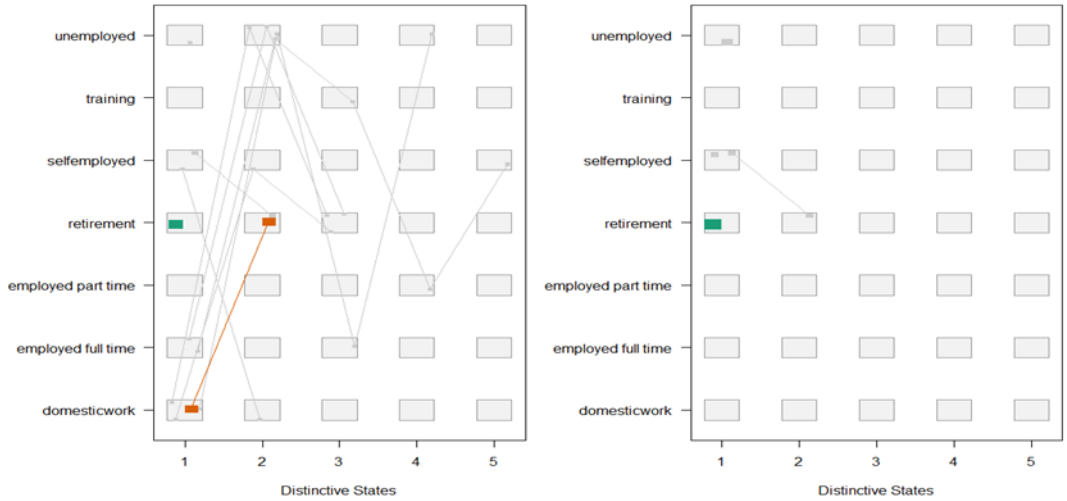
Graph 3. Parallel coordinates plot on economic activity sequences by type marital changes and gender.

Female Male

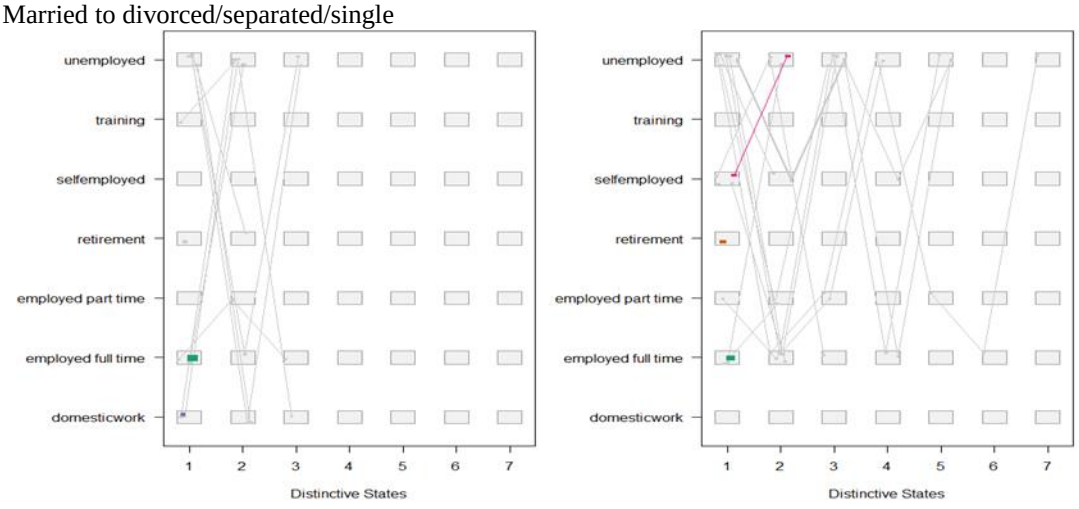
Single to married



Married to widowed



Married to divorced/separated/single



Source: Author' calculation

Table 2. Transition rates in certain state of economic activity by type of marital changes and gender

	DW	EF	EP	RE	SE	TR	UN
Single to married							
Male							
EF		0.984		0.000	0.000	0.000	0.016
RE*		0.000		1.000	0.000	0.000	0.000
SE		0.009		0.000	0.973	0.000	0.018
TR*		0.063		0.000	0.000	0.875	0.063
UN		0.032		0.000	0.000	0.000	0.968
Female							
DW	0.956	0.002	0.000	0.000	0.006	0.000	0.036
EF	0.000	0.979	0.000	0.000	0.000	0.000	0.022
EP	0.000	0.042	0.958	0.000	0.000	0.000	0.000
RE*	0.000	0.000	0.000	1.000	0.000	0.000	0.000
SE	0.000	0.021	0.000	0.000	0.906	0.031	0.041
TR*	0.000	0.000	0.000	0.000	0.000	1.000	0.000
UN	0.008	0.015	0.000	0.000	0.004	0.000	0.973
Single to widowed							
Male							
RE				1.000	0.000		0.000
SE*				0.021	0.979		0.000
UN				0.000	0.000		1.000
Female							
DW	0.946	0.000	0.000	0.038	0.005	0.000	0.011
EF*	0.000	0.880	0.000	0.000	0.000	0.000	0.120
EP*	0.000	0.000	0.000	0.000	1.000	0.000	0.000
RE	0.000	0.000	0.000	1.000	0.000	0.000	0.000
SE*	0.016	0.000	0.000	0.047	0.938	0.000	0.000
TR*	0.000	0.000	1.000	0.000	0.000	0.000	0.000
UN*	0.000	0.010	0.000	0.020	0.000	0.010	0.961
Married to divorced/separated/single							
Male							
EF		0.979	0.001	0.000	0.000		0.020
EP*		0.041	0.898	0.000	0.000		0.061
RE		0.000	0.000	1.000	0.000		0.000
SE		0.006	0.000	0.000	0.944		0.050
UN		0.019	0.006	0.000	0.016		0.959
Female							
DW	0.981	0.000	0.000	0.000		0.000	0.019
EF	0.000	0.993	0.002	0.000		0.000	0.005
EP*	0.000	0.250	0.750	0.000		0.000	0.000
RE	0.000	0.000	0.000	1.000		0.000	0.000
TR*	0.000	0.000	0.000	0.000		0.958	0.042
UN	0.018	0.004	0.000	0.004		0.000	0.974

Source: Author' calculation

CONCLUSION

In this research, the author uses the data of the EU-SILC survey in order to examine trajectories of the economic activity of individuals who have changed marital status. The author started from the assumptions, on the one side, that economic stability is a „prerequisite“ for marriage, and on the other side, that economic instability causes marriage dissolution and divorce.

The result that the different types of marital changes are clearly associated with different patterns of economic activities transitions indicates the three conclusions of this paper.

Firstly, it is evident that economic stability is a „prerequisite“ for marriage for both men and women which is consistent with the economic theory of marriage and also previous studies (section Introduction and Background). Securing employment before marriage is a feature of over a quarter of individuals who changed their marital status from single to married.
Secondly, as expected given the economic and sociological background of the Serbian population (section Background), turned out that marriage different effect on the economic activities transitions among men and women. Given that slow separation from traditional marital behavior (patriarchy), it was expected that entry into marriage starts activation on the labor market among men which unambiguously suggests that male economic stability can be considered as deciding for marriage. Contrary, entering into marriage for women means withdrawal from the labor market which can be linked with pregnancy or childbirth at the beginning of the marriage. This finding has raised the question for future research, namely the return of women to the labor market after marriage and childbirth. To which extent these life events can complicate the position of women on the labor market? This question is gaining importance given the structural and institutional barriers in Serbia, precisely, unregulated labor market and inadequate institutional support especially regarding the inability to achieve a balance between work and family life among women.
Thirdly, male economic instability can be considered as a cause of marriage dissolution and divorce. This is confirmed by the existing probability for the transition from employment to unemployment among men who changed their marital status from married to divorced. On the one side, this conclusion is explained by the economic theory of marriage and the fact that job loss overslaughs the maximization of well-being in marriage. On the other side, this conclusion can be related to the value profile of the Serbian population ie. not-eradicated traditionalism that implies the gender construct of the male breadwinner. Of course, male economic instability cannot be viewed separately from other socio-psychological determinants that can potentially lead to divorce. The fact that the economic factor is not the sole cause of the divorce is confirmed by the fact that among the individuals who changed their marital status from married to divorced exist a large proportion of those who were employed both before and after the divorce. Therefore, future research should be directed towards examining the predictors of divorce in Serbia through the inclusion of various variables of both economic and socio-psychological nature.
As pointed out above, this research is based on a small sample of persons who recorded marital change obtained from the EU-SILC survey due to the lack of longitudinal surveys in Serbia. So, this can be considered a preliminary findings, while one of the goals of future research is to examine opportunities for expansion of the sample.

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MUNICIPALITIES AND CITIES ALONG THE ENTITY BOUNDARY IN BOSNIA AND HERZEGOVINA: PROBLEMS OF LOCAL AND REGIONAL DEVELOPMENT

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ABSTRACT

The Dayton Peace Agreement established a new political and territorial division of Bosnia and Herzegovina in 1995, which led to changes in the internal regional structure and the concept of regional development, which was decisively influenced by the Inter-Entity Boundary Line. Such circumstances have caused certain changes also at the local level, where the number of municipalities/cities has increased from 109 to 143. The subject of research in this paper are newly formed units of local administration, among which the majority are those that were created by the inter-entity disintegration of once unique municipalities. In most cases, these are small, rural, underdeveloped and marginalized municipalities, whose economic self-sustainability is highly questionable. This study analyzes the basic socio-economic parameters, which also indicate a certain degree of differentiation among the observed municipalities, with those areas that are closer to larger urban centers being perceived as more positive examples.

Keywords: municipalities, regional development, marginal areas, disintegration, Inter-Entity Boundary Line (IEBL)..

INTRODUCTION

The turbulent process of disintegration of Yugoslavia left the most severe consequences on Bosnia and Herzegovina. The war, which lasted between the spring of 1992 and the fall of 1995, took about 100,000 lives, caused unmeasurable material damage, contributed to major geospatial transformations and permanently disrupted social relations. It ended with the Dayton Peace Agreement, which established an asymmetric two-entity administrative structure, and a few years later the Brčko District was formed as a separate territorial unit. The entities of the Federation of Bosnia and Herzegovina and the Republika Srpska represent integral parts of the state with a high degree of autonomy, as well as the right of veto in decision-making at the national level. The Federation of Bosnia and Herzegovina consists of ten cantons, which are formed primarily on ethnic criteria (ethnic majority in them are Bosniaks and/or Croats). On the other hand, the Serb-dominated Republika Srpska is a fairly centralized entity, in whose administrative division there is only the local level, i.e., the municipalities and cities. Apart from the entities, the political representatives of the above-mentioned constituent peoples also have the possibility of vetoing any decisions of the national government level, which has significant implications for the political functionality of Bosnia and Herzegovina as a

whole. The post-war development of this country in the political, economic, social and even geographical context has often been analysed by various authors, who often emphasize the dysfunctional character of the existing administrative system [1], [6], [8]. On the other hand, relatively little attention among authors in the field of geographic, political or social sciences is paid to the Inter-Entity Boundary Line (IEBL) itself. It is the administrative boundary between the Federation of Bosnia and Herzegovina and the Republika Srpska, which was the focus of peace conference in Dayton, Ohio (USA) in 1995. It ultimately became a key element of the Dayton Peace Agreement. It was primarily drawn along the military front at the end of the war, with certain practical changes in some of its segments, such as removing the 'siege ring' around Sarajevo, establishing a corridor to Goražde, allocating Odžak to the Federation of Bosnia and Herzegovina, or returning of Šipovo and Mrkonjić Grad back to Republika Srpska. Apart from the proclamation of the Brčko District by the decision of the Arbitration Commission in 2000, which neutralized entity line on the territories of this former municipality, there were almost no subsequent corrections, although there was an objective need for it in many places. The biggest exception is the relocation of the entity line in the Sarajevo neighbourhood of Dobrinja in 2002, which only mitigated the negative functional effects of the negligent delineation through a densely populated area [2], [3]. Remenyi (2011) writes of the entity line as a symbol of violent secessionism, which prevents the re-establishment of ethnic mix [5]. It is also interpreted as a factor that limits the functional regional development, as well as the construction of adequate transport infrastructure [7].

The effects of IEBL on local communities has so far been studied to an even lesser extent. It is even difficult to find reliable cartographic sources with a precisely delineated entities, so that popular internet sources usually show a more or less inaccurate representation of the territorial coverage of the Bosnian entities. As this line is not compatible with the local administrative structure from the pre-war period, which practically means that its drawing did not take consideration of the municipal borders from 1991, nor any other geographical criteria, it is clear that it caused significant changes in territorial and the functional organization of many local administrative units [4]. The principal aim of this short study is to start the process of evaluating the geographical implications of IEBL in Bosnia and Herzegovina on the political, demographic, urban, rural, economic, infrastructural and social dimensions of regional and local development.

ADMINISTRATIVE CHANGES ALONG IEBL

The IEBL was defined during the Dayton peace talks in 1995 in such a way that the Federation of Bosnia and Herzegovina roughly gained the central, southern and western parts of the national territory of Bosnia and Herzegovina, while Republika Srpska got northern and western regions (Figure 1). However, the spatial reality of this division is much more complex, as it largely reflects the military situation on the ground at the end of the war, as well as various strategic interests, and the pre-agreed principle of 51-49% territorial distribution in favour of Federation of Bosnia and Herzegovina. In order to facilitate the analysis of the social effects of this type of administrative delineation achieved through difficult and exhaustive negotiations, this line of demarcation needs to be dissected into several spatial segments. At the same time, special attention is paid to cases of division of once unique municipalities into two or even more newly formed local administrative units (municipalities and cities).

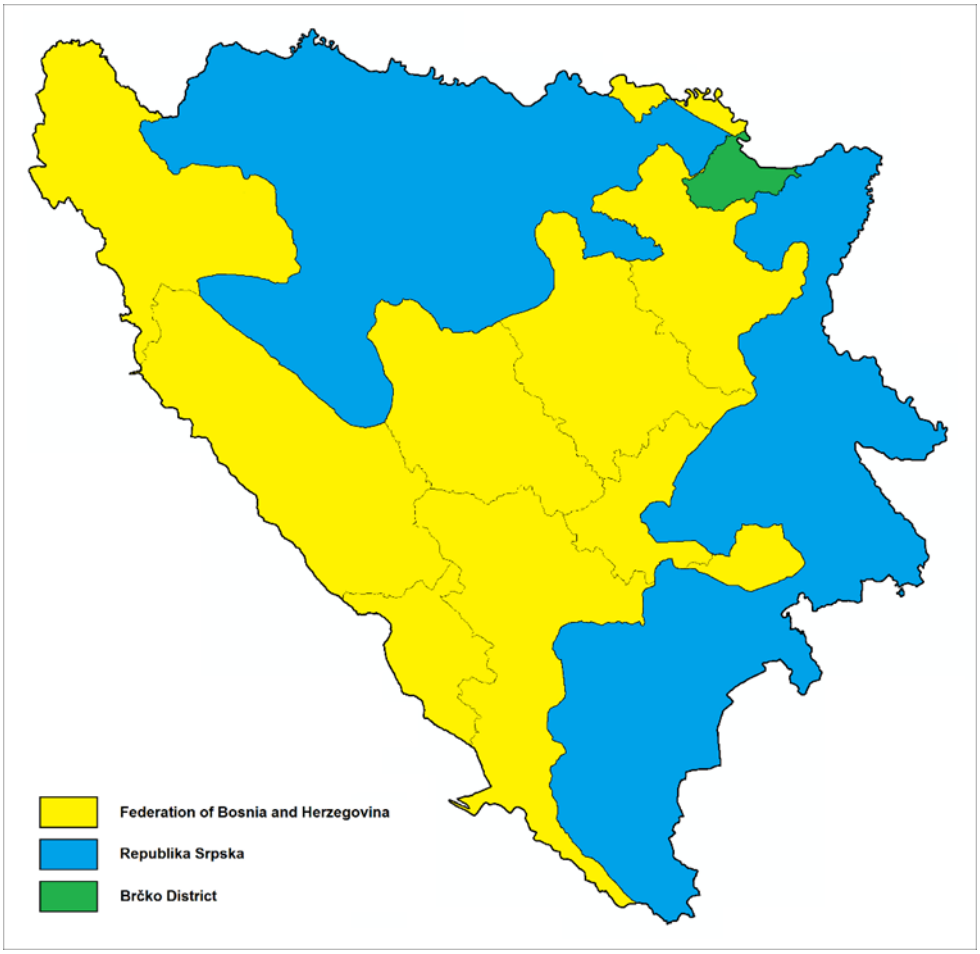

Figure 1. Territorial extension of entities of Bosnia and Herzegovina

The western sector of the entity line between Republika Srpska and the two Federal cantons, Una-Sana and Canton 10, emerged almost entirely after the joint final offensive operations of the Army of Republic of Bosnia and Herzegovina, the Croatian Defense Council and the Croatian Army in the autumn of 1995, i.e., significant reduction of territories under the control of the Army of Republika Srpska, and boundary correction and consolidation in Dayton. In this part of Bosnia and Herzegovina, also known as Bosnian Krajina, IEBL significantly changed the territorial scope of six pre-war municipalities: Bosanska Krupa, Sanski Most, Ključ, Bosanski Petrovac, Drvar and Kupres, with minor changes in the case of Šipovo and Glamoč. Most of the municipality of Bosanska Krupa belonged to the Federation of Bosnia and Herzegovina, while a new municipality in the Republika Srpska – Krupa na Uni, with its center in Donji Dubovik, was formed from several villages on the southeastern periphery of the municipal territory. The entity line also divided two municipalities in the Sana River valley - Sanski Most and Ključ. The urban centers of these municipalities went to the Federation of Bosnia and Herzegovina, and in the territory of the Republika Srpska, rural municipalities were formed – Oštra Luka and Ribnik. Oštra Luka is characterized by an elongated 'snake-like' shape of the territory, and Ribnik is territorially the largest municipality in Bosnia and Herzegovina that was created in this way. One of few cases of the subsequent alteration of the original IEBL took place in this area – Bosniak village of Velečevo was transferred from the municipality of Ribnik to Ključc, while in return the Serb village of Koprivna was transferred from Sanski Most to Oštra Luka. The village of Drinić was

excluded from the federal municipality of Bosanski Petrovac, thus creating the municipality of Petrovac in the Republika Srpska. The three mountain villages (Potoci, Uvala and Srnetica) were separated in the same way from the municipality of Drvar in Canton 10, thus creating the municipality of Istočni Drvar, which has the smallest population in the entire country. The municipality of Kupres is also divided into two parts, which interestingly retain the same name. However, the municipality of Kupres in Republika Srpska, which includes only a few villages on the northern edge of the Kupres field, is incomparably smaller than its counterpart in the Federation of Bosnia and Herzegovina.

The second analyzed sector refers to the delimitation of the Republika Srpska towards the Central Bosnia and Zenica-Doboj cantons in the central part of the Federation of Bosnia and Herzegovina. Here, the front lines in the war shifted significantly less compared to Krajina, and changes at the local administrative level are smaller. In the Vrbas River valley, the municipality of Donji Vakuf underwent minor changes (transfer of one village to Šipovo municipality), while the entity line caused a somewhat greater effect on the municipality of Jajce, which became part of Central Bosnia Canton, excluding the smaller western segment, that became the municipality of Jezero. Formerly named municipality of Skender Vakuf is divided into Kneževo in the Republika Srpska (most of it) and Dobretići in the Federation of Bosnia and Herzegovina. Here the IEBL passes along the Ugar River, which is one of the few cases where it follows a geographical feature. Certain changes in the municipal borders also affected Travnik, Kotor Varoš, Teslić, Zenica, Žepče and Maglaj, but no new local administrative units were formed in that area. However, the same cannot be said for the area between Tešanj and Doboj, where two new municipalities were established, while being among the smallest in Bosnia and Herzegovina. These are Doboj Jug, which consists of the villages of Matuzići and Mraviči (separated from Doboj in Republika Srpska), and Usora, a municipality that includes villages predominantly inhabited by Croats, which were previously part of the municipalities of Tešanj and Doboj.

The northern sector of IEBL is also the most complex. It refers to delineation of the two Federal cantons, Tuzla and Posavina, towards the Republika Srpska, and as previously mentioned, the Brčko District was subsequently formed within identical boundaries as the pre-war municipality of the same name. The meandering entity line delimiting the Tuzla Canton divides the following pre-war municipalities: Doboj, Gračanica, Gradačac, Lopare, Zvornik, Ugljevik and Kalesija. In that way, the new municipalities of Doboj Istok, Čelic, Sapna and Teočak in the Federation of Bosnia and Herzegovina, as well as Petrovo, Pelagićevo and Osmaci in the Republika Srpska were established. All of them have a distinctly rural character, as they do not have a classic urban core. A special case are the units of local administration within the Posavina Canton, which were formed by the division of the previously unified municipalities of Orašje, Bosanski Šamac and Odžak. Most of the territory of Orašje and Odžak became part of the Federation of Bosnia and Herzegovina, while their small rural segments in Republika Srpska formed the small rural municipalities of Donji Žabar and Vukosavlje. On the other hand, the town of Bosanski Šamac and most of the belonging municipal territory became part of the Republika Srpska, while a small municipality of Domaljevac-Šamac was formed in the Posavina Canton. The complexity of the geographical position of this canton is further enhanced by the fact that it is a double exclave. Namely, Posavina Canton is territorially separated from the rest of the Federation of Bosnia and Herzegovina, and the municipality of Odžak is territorially separated from the rest of this canton.

The eastern sector of IEBL refers to the disintegration of the wider Sarajevo region. Here, opposite to the territory of the Republika Srpska, lies Sarajevo Canton, Bosnian Podrinje Canton and the eastern periphery of Zenica-Doboj Canton. In the period up to 1992, Sarajevo was broadly made up of ten municipalities. Most of that territory became part of the Federation of Bosnia and Herzegovina, and thus the Sarajevo Canton was formed, which includes the capital of Bosnia and Herzegovina. It is also the most densely populated and developed region of Bosnia and Herzegovina. Among the ten former Sarajevo municipalities, only Vogošća and Hadžići have not undergone any territorial changes. The entity line has only slightly reduced the coverage of the municipality of Centar, while in other cases the changes are significantly greater. The urban part of the municipality of Stari Grad remained part of the City and Canton of Sarajevo, but in the Republika Srpska the mountain municipality of Istočni Stari Grad was formed, which included also a smaller part of the pre-war municipality of Ilijaš, the majority of which became part to Sarajevo Canton. It is interesting that the municipality of Istočni Stari Grad is characterized by territorial discontinuity, which means that several of its villages can be considered as exclaves. The urban part of the municipality of Novo Sarajevo belong to Sarajevo Canton in the Federation of Bosnia and Herzegovina, but a much larger, initially rural, and subsequently partially urbanized part of it today represents the municipality of Istočno Novo Sarajevo in the Republika Srpska. Smaller segments of the pre-war municipalities of Novi Grad Sarajevo and Ilidža were also assigned to the Republika Srpska, so the municipality of Istočna Ilidža was formed in that area. A specific case is the once unified municipality of Trnovo, which is divided in such a way that the Federation of Bosnia and Herzegovina got most of its territory, but most of its urban center together with the territorially separate northern, southern and northeastern parts of the municipality became part of Republika Srpska. That is how two municipalities were created, which today bear the same name. The municipality of Pale became a part of the Republika Srpska to a much greater extent, but its extreme southern segment went to the Federation of Bosnia and Herzegovina and became part of Bosnian Podrinje Canton. This canton, with the smallest population in the Federation of Bosnia and Herzegovina, includes only three municipalities - Goražde, Foča (FBiH) and Pale (FBiH). The genesis of this canton comes from the war enclave of Goražde and its need to connect with the rest of the territory of the Federation of Bosnia and Herzegovina through a corridor. Part of the pre-war municipality of Goražde was still assinged to the Republika Srpska (today's Novo Goražde), while on the Federal side of the entity line, a smaller, northern segment of the municipalities of Foča and Pale remained. When it comes to the eastern part of Zenica-Doboj Canton, only the municipality of Olovo comes into contact with IEBL – its territory was partially changed (in favor of Sokolac and to the detriment of Han Pijesak), but no new municipalities were formed. The six mentioned municipalities in the Republika Srpska (Sokolac, Pale, Istočni Stari Grad, Istočno Novo Sarajevo, Istočna Ilidža and Trnovo) today together make up the City of Istočno Sarajevo.

The last, or the southern sector of IEBL refers to the territory of Herzegovina, the eastern third of which was assigned to the Republika Srpska, while the rest is in the Federation of Bosnia and Herzegovina (Herzegovina-Neretva and West Herzegovina cantons). As Western Herzegovina is the only canton that does not have physical contact with the entity line, this sector is entirely about the delineation of Republika Srpska and Herzegovina-Neretva Canton. In the northern zone, the municipal boundary of Konjic was moved to the east, as several villages from the pre-war municipality of Kalinovik were transferred to the Federation of Bosnia and Herzegovina, but no new municipality was formed in that

area, due to the fact that it is a sparsely populated mountainous region. However, similar geographical features did not deter the inhabitants of the village of Zijemlje from forming a new municipality of Istočni Mostar from the three territorially discontinuous mountainous segments of the pre-war municipality of Mostar. The entity line also divided the once unified municipality of Stolac. Its territorially smaller, but more populated part with an urban core is today located in the Federation of Bosnia and Herzegovina, and the rural municipality of Berkovići was formed in the Republika Srpska. The southern end of the inter-entity demarcation line is located in the area of the former municipality of Trebinje, which today includes the city of Trebinje in Republika Srpska and the municipality of Ravno in Federation of Bosnia and Herzegovina. The entity line in Herzegovina mostly stretches through high mountainous areas – the only exception is the delineation between Trebinje and Ravno, which only partly goes through the flat and low Popovo field

DEMOGRAPHY OF MUNICIPALITIES AND CITIES ALONG IEBL

If we take as a criterion any physical contact of the municipal/city territory with IEBL, regardless of the length of the contact sector, then at the very beginning of the analysis an interesting fact can be stated. Namely, the IEBL touches slightly less than two thirds of local governments in Bosnia and Herzegovina – 92 in total, or 64.1% of all municipalities/cities (Figure 2). This area covers a total of 59% of the state territory, and according to the last census, 58% of the population of Bosnia and Herzegovina lives in this zone (2.1 million in 2013). It should be emphasized that in 1991, 2.6 million people lived there, which is half a million more than in 2013. Although it is well known that the whole of Bosnia and Herzegovina experienced a significant population decline in the same period (from 4.4 million to 3.5 million inhabitants), in municipalities along IEBL this decline is more pronounced in relative quantitative terms (22% versus 19%), which indicates the direct consequences of the war, that were generally greater in these municipalities/cities than in the rest of the country. According to the 2013 census data, the average population density of the observed area is 68 inhabitants per square kilometer, which is very close to the national average. However, large spatial variations are expressed in this regard, since the densest settlements of municipalities/cities in Bosnia and Herzegovina are located in this area, as well as most of those least populated ones.

Vital statistics of municipalities/cities along IEBL also reflect similar values to the national average. In the last pre-pandemic year 2019, less than 17 thousand children were born in this zone (birth rate of 8‰), while at the same time more than 22 thousand people died (death rate of 11‰). A natural decrease rate of -3‰ clearly indicates negative demographic trends. Within the age composition, according to the 2013 census, the number of young and old population is almost equal, with the population under 15 still slightly outnumbered those over 65 years old (15.2% vs 14, 3%). Generally, the ageing process is evident. In the ethnic composition, Bosniaks are the most represented group with 59%, which is significantly more than their share in the total population of Bosnia and Herzegovina. On the other hand, the share of Serbs and Croats in the population of this zone is lower than in the population of the whole country – 25% and 12% respective. A much higher percentage of Bosniaks in relation to Serbs indicates a significantly higher concentration of population in the segment of the observed zone that belongs to the Federation of Bosnia and Herzegovina, in relation to the Republika Srpska. The most favorable aspect of demographic statistics in the area along IEBL is related to the education structure, which can be related to the fact that four out of the five largest cities

and university centers in Bosnia and Herzegovina are located in this area. A tenth of the population is highly educated, and a third is completely computer literate

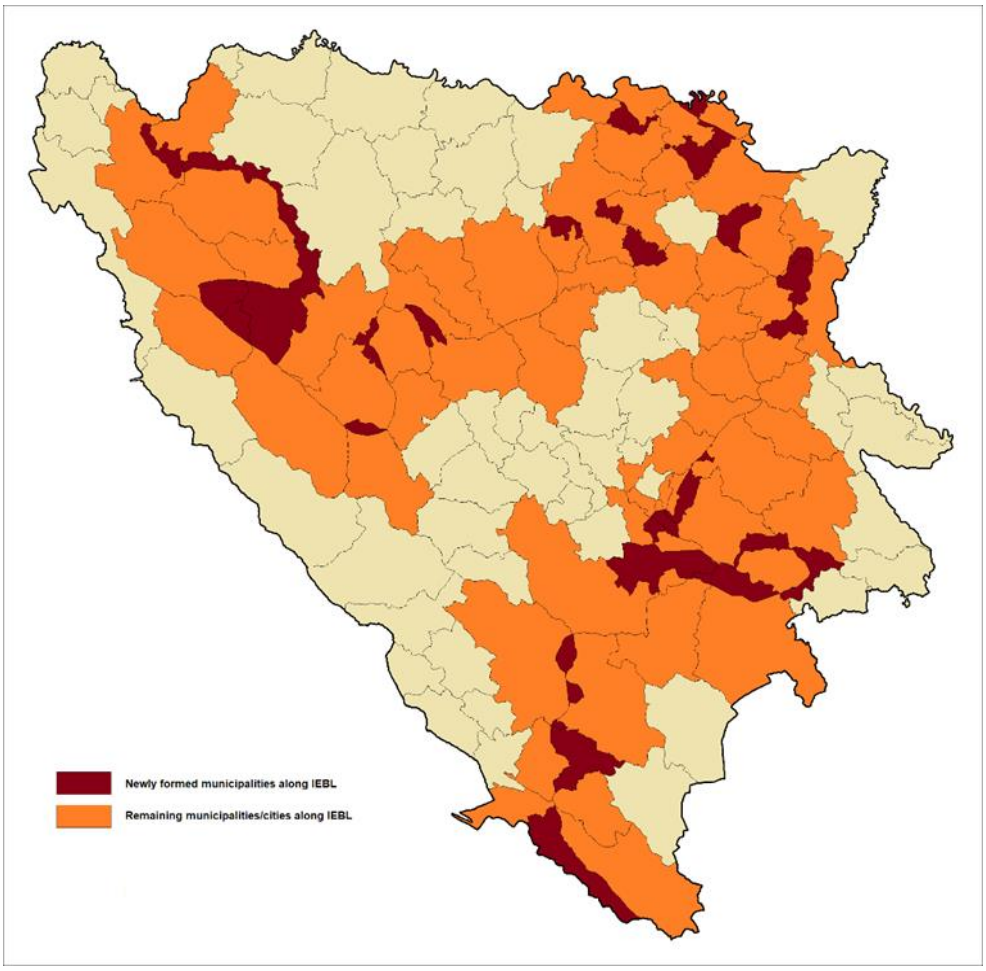

Figure 2. Municipalities and cities along the IEBL in Bosnia and Herzegovina

Thus, it is obvious that according to most of the analysed and available parameters, local administrative units along IEBL in the total do not deviate significantly from the national average. However, when analysing the structure of these municipalities/cities, it is possible to reach some differentiated conclusions. Among the 92 municipalities/cities considered, only 14 (or about 15%) did not experience significant territorial reductions, and some such as Žepče, Konjic and Modriča were even territorially enlarged. The majority of the considered municipalities of cities (48 or 52%) belong to the category of those whose territorial extension is significantly reduced compared to the state from 1991. However, it should be noted that this category of local administrative units is defined by retaining the urban core as it had in the pre-war period, due to which their local development problems have been mitigated. On the other hand, a special category of local administrative units along IEBL consists of 30 municipalities that emerged during the war or after the signing of the Dayton Peace Agreement (Table 1). In most cases, these are completely or predominantly rural areas, where even municipal centers have not experienced a significant degree of urbanization. This fact is a great obstacle to their socio-economic development, and special attention is paid to them in the following segment of this paper.

Table 1. Demography of recently formed municipalities along IEBL

Municipality/city	Area (sq km)	Population 1991	Population 2013	Population density (2013)	Average age
Istočna Ilidža	28	8590	14763	527	41,4
Sapna	118	14091	11178	95	34,7
Istočno Novo Sarajevo	35	4082	10642	304	40,2
Čelić	140	12337	10502	75	38,7
Doboj Istok	41	9002	10248	250	37,8
Teočak	29	7773	7424	256	37,1
Usora	50	8627	6603	132	39,5
Petrovo	144	9155	6474	45	45,1
Ribnik	511	9134	6048	12	44,8
Osmaci	78	7340	6016	77	38,9
Pelagićevo	122	10333	5220	43	46,0
Domaljevac Šamac	44	6315	4771	108	39,9
Vukosavlje	95	8082	4667	49	40,7
Doboj Jug	10	3259	4137	414	35,8
Donji Žabar	47	4092	3809	81	42,3
Ravno	331	1804	3219	10	43,5
Novo Goražde	119	4813	3117	26	44,2
Oštra Luka	205	5746	2786	14	43,0
Berkovići	250	3512	2114	8	43,7
Foča (FBiH)	169	4373	1933	11	43,9
Dobretići	59	4790	1629	28	42,0
Krupa na Uni	84	2960	1597	19	46,3
Trnovo (FBiH)	338	3138	1502	4	49,1
Jezero	56	2161	1144	20	40,6
Istočni Stari Grad	70	1380	1131	16	48,1
Pale (FBiH)	86	1961	904	11	42,2
Petrovac	155	408	361	2	46,5
Kupres (RS)	48	781	300	6	53,7
Istočni Mostar	88	562	257	3	44,9
Istočni Drvar	75	61	79	1	48,0

Source: Population Census Data, 2013, Agency for Statistics of Bosnia and Herzegovina

These 30 municipalities cover an area of 3625 km², which represents slightly more than 7% of the national territory. In 2013, almost 135,000 people lived in these areaa, or only 3.8% of the total population of Bosnia and Herzegovina. This data shows that these municipalities are significantly less populated compared to the national average. The average population density for these 30 municipalities is only 37 inhabitants per km². However, it is interesting that the population decline experienced by these municipalities in the last inter-census period (16%) is actually lower than one at the state level (19%), which indicates that the establishment of these municipalities managed to mitigate the depopulation that these rural areas would otherwise experience after separaton from their pre-war urban centers, to which they gravitated. However, all other socio-demographic parameters indicate a higher degree of deprivation in these areas. Among other things, they have a lower birth rate (6 ‰ in 2019) and higher mortality (12 ‰ in 2019) compared to the national average, which is why the rate of natural change can already be considered practically irreversibly negative (-7 ‰). The vital index is less than 0.5, which means that the continuity of the trend has already been established that in the mentioned municipalities almost twice as many people die every year than there are newborns. The number of the old people (over 65 years of age) was already higher than the young population (up to 15 years of age) in 2013 - 16% versus 15%. The educational structure

is also less favorable than national average - only 5.7% of the population is highly educated, and 27.2% computer literate. In addition, these areas have a general illiteracy rate of more than 4%. In the combined ethnic structure of these 30 municipalities, the most numerous are Serbs (44%), followed by Bosniaks (40%), Croats (15%) and others (1%). The ethnic composition indicates the fact that 60% of the observed municipalities are located in Republika Srpska, and 40% in Federation of Bosnia and Herzegovina.

Among the 30 recently formed municipalities, there is a high degree of similarity in the level of socio-economic development, but a certain degree of heterogeneity can also be detected. The territory of only one municipality in this category can be considered larger than the Bosnian average. That is the municipality of Ribnik (511 km²), while Trnovo (FBiH) and Ravno are within the scope of average values. The other 27 municipalities are relatively small municipalities, most of which have an area of less than 100 km². When it comes to the population numbers, all municipalities observed here, without exception, have a smaller population than the municipal average at the national level. Only five municipalities have more than 10,000 inhabitants – Istočna Ilidža, Sapna, Istočno Novo Sarajevo, Čelić and Doboj Istok, while on the other hand five municipalities have less than 1,000 people according to the last census from 2013 – Pale (FBiH), Petrovac, Kupres (RS), Istočni Mostar and Istočni Drvar. The greatest degree of heterogeneity is observed in the analysis of population density. Slightly more than a third of the observed municipalities are characterized by a higher concentration of population compared to the national average. Very densely populated (above 200 people per km²) can be considered two municipalities that make up the urban core of the city of East Sarajevo – Istočna Ilidža and Istočno Novo Sarajevo, and three small rural municipalities in the Federation of Bosnia and Herzegovina - Doboj Jug, Doboj Istok and Teočak. A small number of these municipalities are characterized by a medium level of population density, and practically half of them can be considered sparsely populated. Ravno, Berkovići, Kupres (RS), Trnovo (FBiH), Istočni Mostar, Petrovac and Istočni Drvar have a particularly low population density (less than 10 people per km²).

In terms of vital statistics, it is important to point out that among these 30 municipalities, only Doboj Jug had a positive natural change in 2019, and as many as two thirds of them are characterized by extremely low rates (below -5‰). Among the municipalities with a relatively young population (average age below the national average and over 15% of the young population) are Sapna, Doboj Jug, Teočak, Doboj Istok and Čelić. In most other cases, the ageing process is very pronounced, especially in Kupres (RS), Trnovo (FBiH), Istočni Stari Grad, Petrovac, Krupa na Uni, Pelagićevo and Petrovo, whose population has an average age of over 45 and more than 20% of older people (over 65). The most favorable education structure is in the urbanized municipalities of Istočna Ilidža and Istočno Novo Sarajevo, as well as Ravno in Herzegovina, with less than 2% of the illiterate population and over 10% of the highly educated. Kupres (RS), Krupa na Uni, Dobretići and Ribnik have the highest illiteracy rates (above 8%) and the lowest share of the university-educated population (below 5%).

PROBLEMS ANALYSIS AND DISCUSSION

Although municipalities/cities positioned along IEBL on average have similar demographic and socio-economic parameters as the rest of Bosnia and Herzegovina, it is necessary to point out that in this zone are located four of the five largest urban centers in the country – Sarajevo, Tuzla, Zenica and Mostar, which significantly affect the raising of the average values of the observed indicators. Given this heterogeneity, special

attention should be paid to those units of local administration whose regional and local development is largely determined by IEBL, primarily in a negative sense. This is in particular true of municipalities created during the war or after the signing of the Dayton Peace Agreement, whose economic self-sustainability is very questionable. As previously pointed out, these are mostly rural municipalities, whose population is predominantly dependent on agriculture or the exploitation of primary resources, such as timber. The local population in these areas also enjoys certain benefits of this status, such as employment in the municipal administration or the establishment of other local institutions of social importance, such as schools, ambulances, police stations, post offices, etc. Despite significant budget allocations from the state and entity level for these purposes, this has not instigated the economic development of these deprived areas.

The IEBL radically changed the social relations and spatial interactions that were previously established, which in many cases influenced the strengthening of socio-economic disparities. Long-term gravitational connections have been interrupted in this way, both in the case of many local communities and at the level of wider regions. A number of regional centers have weakened their centripetal function due to the reduction of their gravitation area, and many municipalities/cities have lost significant parts of their pre-war territory. On the other hand, the new local and regional centers have generally failed to fulfill the role assigned to them, i.e., to be the driver and backbone of the social development of the narrower and wider surrounding area. Often the lack of population potential in these divided regions proved to be the primary limiting factor, while in some cases spatially dysfunctional administrative solutions were also created, characterized by inadequate transport connections and coherence, and even complete territorial discontinuity. A special dimension of this problem is the role of IEBL as a political and social barrier. Given the interethnic tensions and mistrust as a legacy of the past war and the obvious differences in the social landscape, crossing the entity line in many people in Bosnia and Herzegovina on a perceptual level causes a certain sense of discomfort. The low level of coordination between political structures in Federation of Bosnia and Herzegovina and Republika Srpska greatly hinders cooperation between local communities along IEBL, however with significant exceptions in the form of successfully implemented joint projects.

Finally, it is necessary to discuss the problems that IEBL has posed to researchers in quantitative terms. While the qualitative implications of drawing such a political-administrative line can be realistically seen by applying a range of research methods, one should be particularly careful when using statistical parameters (as is the case in this study). Thus, for example, territorial division on entity level does not respect the borders of municipalities and even settlements from 1991, and it is not possible to simply or accurately compare data from the last two censuses due to this territorial inconsistency. More than 300 settlements are divided by IEBL, and there are even residential buildings located on the line itself [3], which in addition to statistical doubts is a major practical problem for local residents. In some cases, residents of the areas near IEBL fictitiously report their place of residence in one entity, even though their property is located in another. They do so for ethnic, political or practical reasons, but so often they are prevented from exercising all their rights in the place where they live. It is not uncommon for children on one side of the entity line to enroll in school in neighboring municipalities/cities on the other, or for people to use health services in a different entity than the one in which they actually live. In some units of local administation, the 2013 census determined the number of inhabitants that does not correspond to the real situation, due to a politically

motivated campaign aimed at fixing the ethnic composition of population. All these phenomena deserve special treatment in some future studies, and through this paper some topics have just been opened within which geographers can contribute to the rationalization of spatial relations in Bosnia and Herzegovina.

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HOW TO CATCH DEPOPULATION IN SERBIA? ALTERNATIVE APPROACH FOR DETECTION AND MONITORING

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ABSTRACT

Depopulation has been a process present in Serbia for decades, with constant progress and spatial expansion. Although depopulation is more common for rural areas, nowadays the population declining is affecting urban areas, as well. This paper is focused on the new possibilities and innovative approaches for detection and monitoring of population dynamics and economic activities, their spatial and temporal patterns and changes in Serbia. Therefore, a set of 12 indicators is created, classified into four groups: demographic indicators, (urban)morphological, (geo)spatial, and composite indicators, based on various datasets. In addition to traditional datasets, which are used to express population quantitative changes, the data relies on alternative sources that were incorporated too, such as satellite images of nighttime lights, digital terrain model, GHS Population Grid datasets, etc. This research is conducted at the municipal level and regarding the deeper insight into studied phenomenon, it has been extended to the settlement level for the territory of Serbia. Data preparation and calculation of indicators were performed in the GIS environment. The chosen approach highlighted the opportunities and advantages of different datasets crossover, which allowed greater precision and applicability of the obtained results and accurate detection of potentially demographically "empty", depopulated areas in Serbia.

Keywords: depopulation, traditional datasets, alternative datasets, remote detection, Serbia

INTRODUCTION

The project "Remote detection of (de)population processes" was realized as one of the winning solutions to the challenge "Data to better understand the depopulation process" announced by the United Nations Development Program (UNDP) and the UN Population Fund (UNFPA) in Serbia. The primary idea of the project was the identification and monitoring of depopulation at various territorial levels in the Republic of Serbia, using a mixed approach with data sets based on traditional statistical sources and remote sensing. Social phenomena, processes and events, such as the depopulation process, are complex, changeable, diverse, dynamic and multidimensional [1], so approaches and methods for their identification and monitoring, are exceptionally important. Some methods could be recognized as traditional, based on statistical data, on the other hand, there are other modern and innovative approaches [2,3,4]. First group is sometimes characterized as insufficiently precise, while the second characterized as more precise.

As an alternative tool for tracking social processes and phenomena, remote sensing has been introduced [5]. Remote sensing provides the possibility of using satellite-based indicators with high spatial resolution (e.g., from a few to several hundred meters) and time resolution (daily, monthly, annual level). According to OECD Glossary of Statistical Terms, includes a set of methods that enable the collection of information without direct, physical contact with the examined phenomenon or object by recording the emitted or reflected energy (satellite observations, aerial imaging, etc.), and then processing and analyzing the information obtained. Geospatial data generated by remote sensing methods have a wide range of applications in various research fields.
Demographic processes in Serbia have traditionally been expressed through quantitative changes registered in the inter-census period. On the other hand, the introduction of alternative data sources minimizes the generalization, enables observation at the local level (statistical and administrative spatial units). The application of remote sensing data in the study of (de)population processes enables us to overcome the limitations and supplement traditional data sources (e.g., Census). The advantages, as spatially and temporally "sensitive" data, are the possibilities of continuous monitoring of population changes [6,7].

INDICATORS BUILDING

For this purpose, a set of 12 indicators has been created that directly or indirectly detect and monitor the depopulation process in Serbia. For the identification, visualization, and interpretation of (de)population changes, it was used one or combination of several different data types which are overlapped. Satellite images and other remote sensing data, enable to monitor population dynamics with a spatial resolution of several hundred meters (e.g., fields of 250 x 250 m) at the settlement and municipality level. In order to generate the selected indicators, different source of data have been used:

- European Digital Elevation Model EU-DEM version 1.1 [European Environment Agency, 2016];
- 2011 Census of Population, Households and Dwellings in the Republic of Serbia (BOOK 2): AGE AND SEX" [Statistical Office of the Republic of Serbia, 2012];
- GeoSrbija [Open data of the National Data Infrastructure, Republic Geodetic Authority, n.d.]);
- The GHS-POP R2019A dataset—GHS population grid multitemporal [European Commission, Joint Research Center, 2019]
- GHS-BUILT R2018A—GHS built-up grid, derived from Landsat, multitemporal (1975-1990-2000-2014) [European Commission, Joint Research Center, 2018].
- satellite images of nighttime lights - Version 1 VIIRS DNB [Earth Observation Group (EOG); Colorado Mining School, 2012–2019] to determine the radiance (nW cm–2 sr–1)
- Corine Land Cover (CLC) 1990, Version 2020_20u1 [European Environmental Agency, Copernicus Land Monitoring Service, 2020]
- Corine Land Cover (CLC) 2018, Version 2020_20u1 [European Environmental Agency, Copernicus Land Monitoring Service, 2020].

Indicators are classified into four groups:

- **Demographic indicators** are based on the long-term population data as the exact numerical values. The novelty comes from the gridded data sets showing the population count on more prices spatial resolution. Two indicators are in this group:

Population Age Structure by Altitude Zones, 2011 and Population Change Index, 2015/1975.

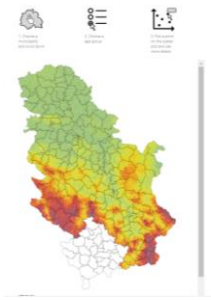
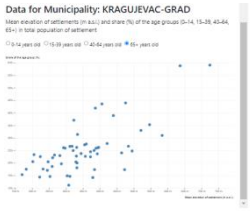
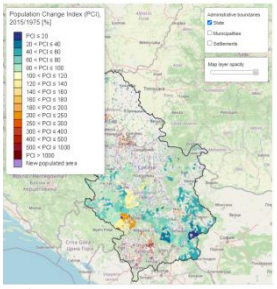
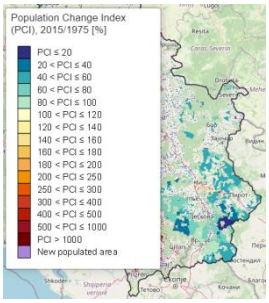
- **(Urbo)morphological indicators** are focused on the spatial distribution, and contains population data. This group enables identification of temporarily and permanently abandoned objects directly indicating the depopulation process. Three indicators are in this group: Population Density in Serbia, 2015, Lot Coverage Change Index, 2014/1975, and Real Abandoned' and Temporarily Used Built-Up Areas, 2015.
- **(Geo)spatial indicators** express spatial changes and their connection with population processes. The innovation is the nighttime lights used to detect the process of depopulation and the seasonal character of settlements [8]. Spatial component is perceived through the development of road networks as basis for studying spatial "isolation". Four indicators are in this group: Hypsometric Structure (Altitudinal Zonality) of Municipalities and Settlements, 'Spatial Lighting', Seasonal Character of Settlements, and Road Network Density.
- **Composite indicators** are combination of different types of data (spatial, morphological, population changes). For instance, population density (grid-based) was overlapped with hypsometric zones, population changes with accessibility to municipal centers and land cover with the emphasis on land conversion to natural ecosystems. Such indicators are non-typical in the research of population changes and represent a contribution to scientific methodology in Serbia. Three indicators belong to this group: Altitudinal Conditionality of the Population Density' Changes, Accessibility as a Determinant of Depopulation, and Land Cover as a 'Tool for Monitoring' Population Change.

RESULTS

Some of the proposed indicators are well known in science, however, others are non-typical and used in this research for identification of the depopulation causes and spatial transformation under the population changes (nighttime lights, seasonal settling, distribution of the population by hypsometric zones, accessibility, and land cover changes, etc.).

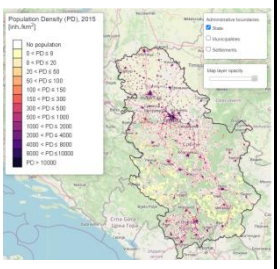
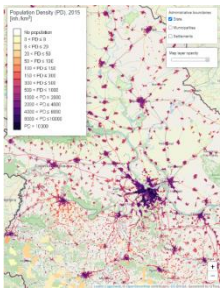
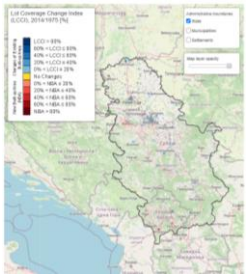
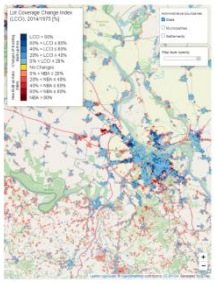
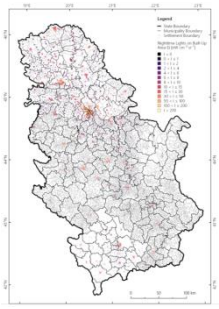
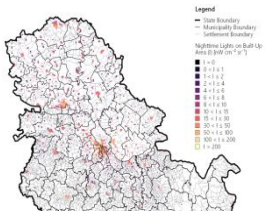
Demographic indicators have enabled monitoring of temporal and structural components of depopulation (Table 1). They have highlighted that 1) with the increase in altitude, the share of the elderly reciprocal increases; 2) population changes in Serbia 1975-2015, emphasized a decrease in the inhabitants number, especially dominant in the peripheral zones of South Serbia, while the population increase is characteristic mostly for urban areas;

Table 1. Summary of demographic indicators and outputs [9].

Indicator	Research interest	Output	Output
Population Age Structure by Altitude Zones, 2011	Where is the elderly population located? Is the elderly population prevalent in mountainous areas?		
Population Change Index, 2015/1975	Depopulation – a challenge or a reality? How intensive is the population decline in Serbia? Where is depopulation the most pronounced?		

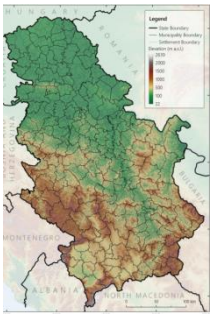
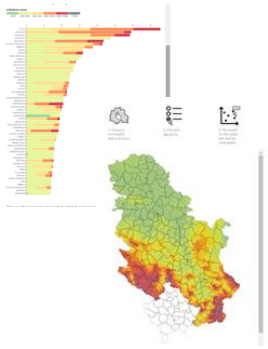
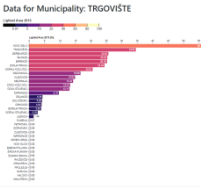
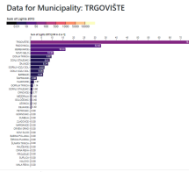
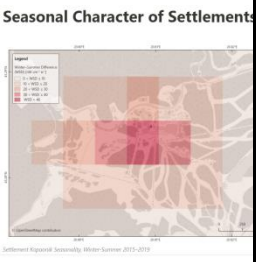
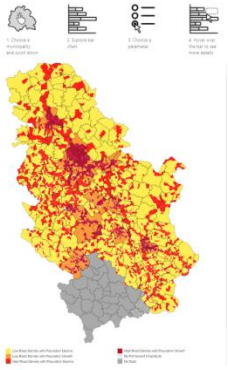
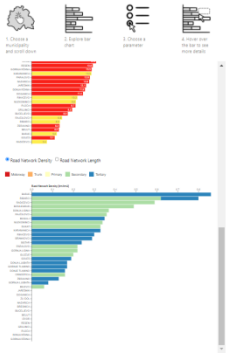
(Urbo)morphological indicators (Table 2) served for the depopulation zones delimitation. The results highlighted that: (1) low population density is typical for peripheral parts of Serbia, while highly urban areas and frequent traffic routes have been identified as zones of population concentration; (2) the lowest population concentration per built-up area is dominantly identified in East and Southwest Serbia. Low population concentration is characterized by low presence of built-up area, and the spatial transformation is "absent"; (3) the areas that are the most affected by abandoning of the facilities are: traditionally depopulated municipalities, municipalities in East Serbia and Pomoravlje area with intensive emigration, municipalities in border and mountainous areas and some municipalities in Kosovo and Metohija.

Table 2. Summary of (urbo)morphological indicators and outputs [9].

Indicator	Research interest	Output	Output
Population Density in Serbia, 2015	What are the poles of the population concentration? Which areas are gradually shrinking? Which areas are growing in height?		
Lot Coverage Change Index, 2014/1975	Where do you plan to live? Which areas are attractive for new?		
'Real Abandoned' and Temporarily Used Built-Up Areas, 2015	Where are the areas that really have no inhabitants? Which facilities are abandoned?		

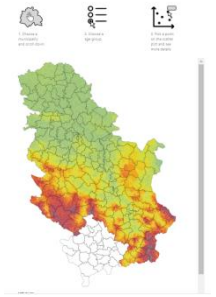
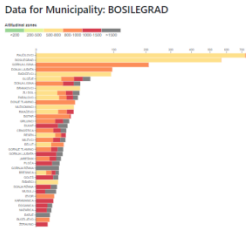
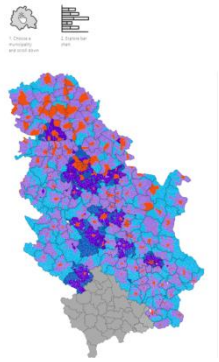
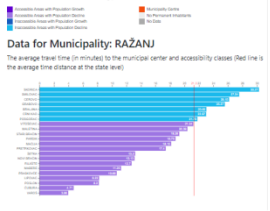
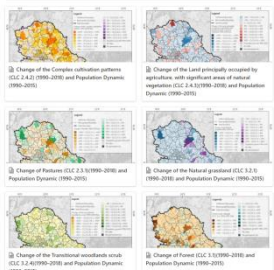
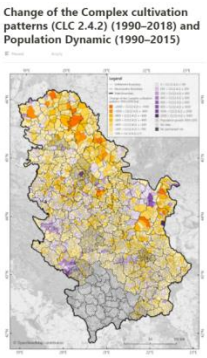
(Geo)spatial indicators (Table 3) pointed out: (1) the altitude of 800 m a.s.l. is the upper threshold for settlement distribution; (2) areas with intensive depopulation have the lowest light intensity; (3) seasonal migrations, temporary settling and occasional use of residential and economic facilities are particularly observed in tourist and weekend settlements in the winter–summer season [8]; (4) with increasing altitude the number of high-density settlements decreases.

Table 3. Summary of geospatial indicators and outputs [9].

Indicator	Research interest	Output	Output
Hypsometric Structure (Altitudinal Zonality) of Municipalities and Settlements	Which are the "highest" settlements in Serbia? What is the altitudinal limit for settling?		
'Spatial Lighting'	Where the "dark has fallen" in Serbia? What are the areas where the overall activity is reduced?	 	 
Seasonal Character of Settlements	Which areas are permanently abandoned and which are still occasionally used?		
Road Network Density	What is the relationship between the road network and the population size of the settlement? Does poor infrastructure lead to population decline?		

Composite indicators (Table 4) pointed out: (1) approximately 40.5% of settlements in Serbia have unfavorable traffic infrastructure, which contributes to their isolation and depopulation; (2) poor accessibility occurs in one-third of all settlements in Serbia (32.1%), usually in mountainous and border areas; (3) reduced activity or absence of population is detect through conversions of cultivated land towards transitional categories of mixed, grassland and forest.

Table 4. Summary of composite indicators and outputs [9].

Indicator	Research interest	Output	Output
Altitudinal Conditionality of the Population Density' Changes	Does altitude determine settling trends? Does the population prefer living at lower or higher altitudes?		
Accessibility as a Determinant of Depopulation	Isolation = depopulation? Are accessible areas also attractive?		
Land Cover as a 'Tool for Monitoring' Population Change	Does depopulation affect land cover changes? Does depopulation imply untouched nature?		

CONCLUSION

For identification and monitoring of the depopulation process in Serbia, a set of 12 indicators has been specified, based on spatially and temporally sensitive data. Considering that depopulation is a complex phenomenon, various factors were incorporated during the defining of indicators. The list of indicators for monitoring

depopulation in Serbia was designed through the intersection of different data sets in order to enable the identification, visualization, and interpretation of the population changes in general.

General remarks regarding applied indicator set pointed out that for complete understanding of depopulation in Serbia, should consulted and use traditional (statistical data), as well as, modern datasets (remote sensing). Proposed alternative data are characterized with "finer" spatial and temporal resolution, which provide accurate identification and monitoring of population processes. Application of the satellite images of nighttime lights, as one of the innovative approaches, gave impressive results during detection of spatial dispersion of the population and activities, their trends as well as seasonal changes. Used data sets enable further analysis, mathematical-statistical modeling, and upgrade to new data sources. The high spatial resolution layers resulting from the project can serve as input data for all models, where one of the variables is the spatial distribution of the population, the dynamics of population change, as well as the transformation in built-up area and land use due to population changes. The developed platform is an open data concept. Integrating the new results represents a key task for the future.

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THE SOCIAL ROLE OF MEDIA IN KNOWLEDGE, PROMOTION AND VALORIZATION OF CULTURAL AND RECREATIONAL HERITAGE – SNAGOV, ROMANIA

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ABSTRACT

Social media has become a widely used way of promotion in recent years, including in the field of tourism, facilitating fast communication between users, being available to anyone with a device with the possibility of connecting to the Internet. The purpose of this research is to identify the importance of social media in promoting the cultural and recreational heritage in the vicinity of Bucharest, represented by the lake, forest and Snagov Monastery. The objectives of the study were: the analysis of the Facebook, Instagram and Twitter pages that promote the cultural and natural heritage of Snagov and the analysis of the promotional content on each platform. The results of the research revealed that although there are no pages to promote heritage elements in Snagov, the area remains known on social media, due to the communication between those who enjoyed this recreational space or visited the Snagov Monastery for tourism or religious purposes, but it is also worth mentioning the social media pages of the accommodation units that indirectly promote the heritage elements as well. The hashtag option favored the popularity of the area on Instagram, Facebook and Twitter, but to a lesser extent in the direct or indirect promotion of tourism.

Keywords: social media, tourism, culture, heritage, internet

INTRODUCTION

The development of social media is a global phenomenon that affects the current generation [20]. Social media is defined as a group of Internet-based applications, built on the ideological and technological pillars of Web 2.0 [14]. Social networks (Facebook, Instagram, Twitter, etc.) are platforms where users build a profile and a network of "friends" that connect them with other users having the ability to create and share content [4]. In the context of tourism, social media has significantly changed the way tourists search for information, plan their travels, and more importantly, share their travel experiences with others.

Facebook was launched in 2004 and is currently one of the most popular sites in history. Initially, was available only for Harvard University students, but since 2006 it has been open to the general public, aged 13 and over, who could register by e-mail. This decision was immediately followed by a huge wave of recordings [1]. In 2019, Facebook had 2.9 billion monthly active users [11], [20], [9]. The promotion of a tourist destination on

Facebook facilitates creation of content among users, determines direct relationships between current and potential tourists and promotes the exchange of impressions online, which can improve the image of the destination [15], [33], [24].
Another very popular platform is Instagram. Since its launch in 2010, Instagram has developed and registered more and more users, being mainly intended for photographic content, which can be used both for marketing campaigns of various brands [35], but also for promotion of cultural tourism [19]. In the context of tourism, the purpose of online photography is to induce a positive public perception of the tourist destination [10], [31], [29], 12]. Some researchers have highlighted the value of Instagram as an effective means of communication for operators and travel agencies to promote a destination [22], [8]. Not only that has Instagram has become a vital tool in multi-destination promotion strategies, but one of the latest marketing practices of travel organizations is to involve travel bloggers and influencers on this platform in tourism promotion strategies, for example Dubai, Jordan, Scotland and Australia etc.
Twitter was created in 2006 and is considered the most popular microblogging site in the world [2], [25], [9]. Bassolas in 2011 emphasizes the value of Twitter data and metadata for analyzing user behavior, and Deddens also notes in 2011 that Twitter's original purpose was to inform people about what they are doing. However, Twitter has become one of the most important information channels about current personal and public events [23], [27], [3].
Tourism is one of the industries that has gained many benefits from the development of social media, especially in terms of tourism behavior analysis, planning and creation of marketing strategies.
In the literature analysis related with the importance of social media for tourism industry, Mirzaalian & Halpenny in 2019 found that most studies analyzed destination image [15], [18], [17], tourist satisfaction with the chosen destination [5], but also travel models and tourist flows [13], [32], [30]. Also, research that analyzed various features of tourism industry used social media as a database to forecast tourist flows to a specific destination [21], [24], but also to measure the performance and accuracy of analytical methods [11]. The variety of methods based on social media data includes the analysis of posts, feelings, trends, but also predictive analysis and spatialization of tourism phenomenon [23], [16], [8].
Social media platforms are ideal for organizations with a small marketing budget [26]. Content for posting in the form of text, images and videos is easily created and shared with mobile users [34], [28], [7]. Király in 2011 mentions a Skyscannar study that looked at how social media influences travel attitudes. The result was interesting, half of the participants said that they selected their next holiday destination after the photos shared by friends online. In addition, this study also showed that 88% of users always look at their friends' holiday photos.
Positive and negative online reviews provide information that helps tourism service/ product providers to evaluate consumer perception and appreciation in order to determinate how the tourist product / service managed to fulfill its brand promise. Negative reviews highlight situations in which a destination has failed to meet the requirements of tourists, while positive reviews provide new ideas for tourism service providers. Also, the revisiting intentions are consolidated which can lead to loyalty over time. Gilbert & Veloutsou in a 2006 study concluded that online reviews for hospitality and tourism tend to be better compared to other service industries, such as banking and finance.

METODOLOGY

The research methods in this study are based on the observation and analysis of content on 3 social platforms (Facebook, Instagram and Twitter). According to Weber 1990, the analysis of content posted on social media networks is particularly useful, allowing researchers to identify the link between text and / or visual content through a set of procedures. Content analysis is often photo-oriented and this makes possible to simultaneously study both observable features of images and latent content by examining additional elements embedded in the message [4], [10]. The decision on the methodology was based on studies conducted by Iglesias-Sánchez and his collaborators in 2020. Were also analyzed the most popular hashtags related with ”Snagov” using brandmentions.com for Instagram and dash.tweetbinder.com for Twitter. The results refer to the period November 22-28, 2021.

RESULTS

Promotion via Facebook

According to the data provided by napoleoncat.com in October 2021, were 11,949,900 Facebook users in Romania, which represents 62.1% of the entire population. The majority of users are women, 50.8%, and in terms of age most users are in the category of 25-34 years (Figure. 1)

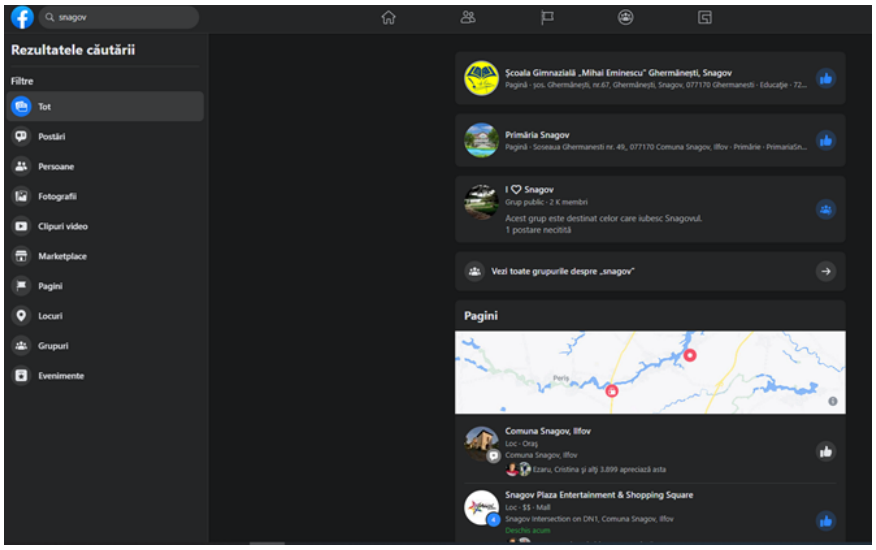

Figure 1. Search results for the word "Snagov" on Facebook

On Facebook, the promotion of the heritage of Snagov commune is reduced. There are over 130 pages that contain the word "Snagov" in their name , but only two of them deal with the promotion of the natural and cultural heritage of Snagov commune. These pages are managed by the same NGO, Snagov Foundation, which actively promotes the natural and cultural heritage of the commune, and also functions as a travel agency. For sights such as Snagov Monastery and Snagov Palace there are Facebook pages, each with about 500 likes. Regarding the groups, there are about 12 whose main purpose is to facilitate the exchange of news and announcements of public interest for the inhabitants of Snagov commune. In the analysis of the posts within these groups, the promotion of the natural and cultural heritage of the commune was not observed. As seen in Fig. 1, Facebook

platform displays the events, photos, and videos in which Snagov is mentioned as location.

Promotion via Instagram

In the tourism sector, Instagram takes the form of an online photo album that can be accessed by other users, but also a promotion channel for various tourist destinations. The advantage offered by Instagram for self-promotion is the ability to turn users into a target audience for each visual material uploaded. Tour operators have exploited this advantage, using it in promoting the image of some tourist destinations [14], [6]. According to napoleoncat.com in October 2021, there were 4,890,300 Instagram users in Romania, which means about 25.4% of the entire population. The majority of users are women, 50.2%, and the predominant age group is 18-24 years.

There are no pages dedicated exclusively to the promotion of the natural and cultural heritage of Snagov on Instagram. Tourist attractions are promoted by hotels or restaurants located here in addition to their own promotion. Examples include Snagov Club (hotel and restaurant), Lagoo Snagov (restaurant), Mood Snagov (restaurant). All these pages have between 3-6,000 followers and over 100 posts each.

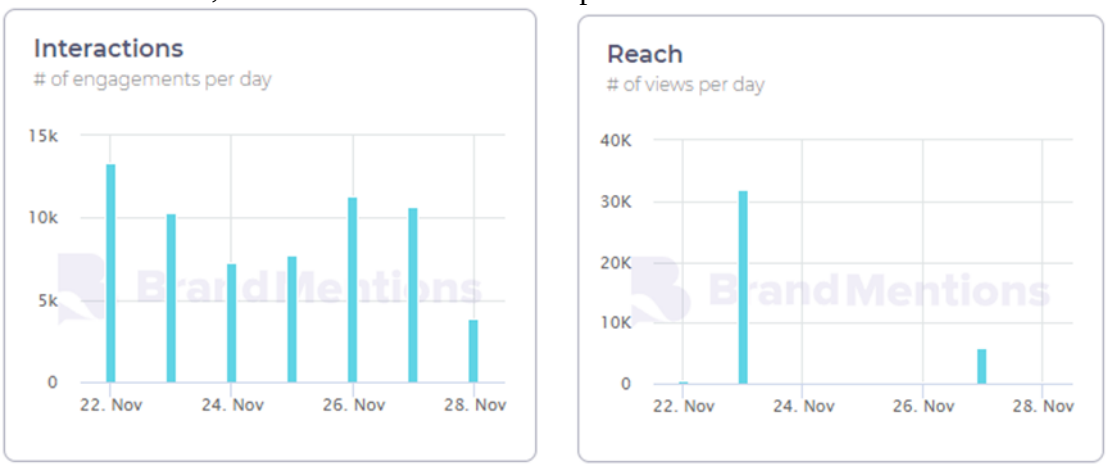

Figure 2. Analysis of hashtag "snagov" on Instagram

Another element that promotes Snagov on Instagram is the use of hashtag. There are about 20,000 posts that have the hashtag "snagov", 1,000 that have the hashtag "snagovlake" and several hundred with the hashtags "snagovmonastery", "forest". Figure 2 shows the image of the unique interactions and views of the posts that have the hashtag “snagov” between November 22-28, 2021. More than 10,000 people viewed photo or video content that was related to Snagov, which is quite a good impact among users.

Promotion via Twitter

Examining the social media activities of eight top international tourist destinations, Hays and his collaborators in 2013 found that DMOs (national tourism organizations) generally posted more often on Twitter than on Facebook. The researchers argued that Twitter algorithm was built for real-time updates and mass dissemination of information. Due to the constant updates on this platform, tweets are quickly disappearing from the news sphere. Thus, travel organizations or agencies need to constantly update their content in order to remain visible. Fig. 3 presents the results of hashtag "snagov" analysis on Twitter. It is noted that on Twitter the hashtag "snagov" is least used, which can be explained by the low number of users in Romania.

Figure 3. Analysis of hashtag "snagov" on Twitter

CONCLUSIONS

Although Snagov is not sufficiently promoted and known from a tourist point of view, social media plays an important role in the visibility of this area. In this study, three social networks were chosen, the most used when it comes to Romanian Internet users, and the ways of promoting their heritage were analyzed. It can be said that Youtube is a platform that offers a more detailed and attractive perspective in promoting Snagov and has a greater international influence, unlike other social media networks. In terms of internet user preferences, most prefer green spaces, Snagov Forest, and religious tourism, respectively Snagov Monastery.

The size of social networks increases which offers a real opportunity to promote a tourist destination. Although the heritage elements of Snagov are not promoted on these networks through accounts intended exclusively for this purpose, they are promoted indirectly through photos posted by users or through the use of hashtags. Social media platforms, especially Instagram and Facebook, which have the highest market penetration in Romania can be useful tools in promoting a tourist destination and can significantly contribute to improving the destination image.

In the future, this form of promotion will be used more and more. The consumers of a tourist product transform that area in which that product is located into a tourist destination.

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THE CULTURAL, HISTORICAL AND SOCIAL EXPRESSIVITY OF THE GOVORA MONASTERY, ROMANIA, MENTIONED IN THE HISTORICAL DOCUMENTS DATING FROM THE 15TH – 16TH CENTURIES

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ABSTRACT

The historical monuments represented by the places of worship are the most important cultural, artistic and architectural resources, offering historical and social information for many generations. The purpose of this study is to capture the religious and social role that this place of worship had within the mentioned period, of the 15th -16th centuries and of to make visible the cultural expressiveness in art, in painting and in the form offered by architecture, as well as to make transparent the kind and number of people who visit this place of worship today. The consultation of documents and publications related to the role played by Govora Monastery, is mentioned in the documents issued by each ruler, or in the donation acts offered by the boyars or the common people. The documentation meant to help understanding the concern of Govora Monastery for religious and cultural education, has been made within the National Archives of Romania in Bucharest. All these aspects highlight the religious, social, economic and cultural role held by this monastery for the entire territory located in the south and southwest of Romania. It is one of the monasteries in Romania whose orientation towards the education offered to the monks was distinguished by writings with historical value and by the art expressed in painting. The art rendered in painting is today a real starting point in understanding the religious message from a rather turbulent period. The role of this study is to decipher the messages transmitted with the help of the brush through painting, or of the art rendered in wood and wall. These are just some of the values left by those who were able to leave the treasures to the further on generations.

Keywords: monastery, culture, painting, religious architecture, education

INTRODUCTION

The church was organized in Wallachia in close connection with the development of relations in the medieval period. Documents from the 15th and 16th centuries regarding the existence, functionality, development and involvement of the church in community life often appear as donations from boyars or others in support of the church or documents that provide implications of the church in mitigating conflicts or in establishing rules for the division of property or land.

Many of the donations made to the church have helped to improve the appearance of places of worship. Many of the churches were built on wooden structures and their

deterioration was inevitable. This is exactly what led to their reconstruction, renovation or expansion. From this point of view, the 15th and 16th centuries are notable for the changes in the interior and exterior appearance of churches and monasteries. Govora Monastery is no exception, being in the attention of the voivodes of that period, and the documents reproduce these aspects, through the multitude of donations offered by ordinary people, boyars and Wallachian rulers of these two centuries under study, because it is in a stage not exactly favorable [6], [11].
Very few documents directly mention painting in places of worship which is a surprising result for that period. The analysis of the church art and implicitly of the architecture was made taking into account the economic, social and historical context of the period. There are peculiarities in drawing lines of force in art, color, shape, height and orientation, thickness and decorative elements. All these forms a style or within the same style, elements of style are captured, which come to particularize a century or an epoch [4], [7].
The 15th and 16th centuries are quite full of events, which played an essential role in architecture, especially in religious architecture, dominating the cultural landscape of the villages and fairs of that time. Oltenia is the historical province of Romania that does not deviate from these events, all oriented towards the establishment of the independent state, Wallachia. This struggle is very well represented in art and architecture being in line with the trend of that time in which buildings were enriched in their appearance with paintings or decorative elements carved in stone and wood. It is the century of historical events when the directions of consolidating the central authority against the centrifugal (removal) tendencies manifested by the great feudal lords and the defense of the borders against the danger of conquest posed by the neighboring powers are pursued [5], [11], [10].

METHODOLOGY

Regarding the method used to develop this study, we went through the following steps:
1. Identification of the Govora Monastery and the particularities of art and architecture characteristic of the analyzed period, ie those of the 15th and 16th centuries;
2. Analyzing the specific documents existing in the National Archives of Romania with the Govora Monastery;
3. Discussions regarding the cultural value offered by architecture, picture and sculpture, present at Govora Monastery.

RESULTS AND DISCUSSIONS

Regarding the construction of this place of worship, there are assumptions about the existence of a much older church. The existing documents place it in this area starting with 1495, when it is mentioned in the document issued on September 15 by Radu cel Mare, the ruler of Wallachia. The inscription of the monastery is not from that period being rebuilt together with the church. What is important are the mentions made, regarding Radu the Great and also about the general condition of the church and its painting. "...from it's beginning, it is not known who erected this church, and during Radu Voda's time, the son of Vlad-Voda, they had found this church as deserted and broken at the date of 7000 (1491-2) and through good will they started to fix it and make it more beautiful..." (fig. 1).

Due to the "deserted and broken" state of the monastery church at the end of the fifteenth century, in regards to its deterioration, we can admit that the church was build before this time, maybe it was even built during the reign of Mircea the Elder (Mircea cel Bătrân) [6].

Following the historical documents carefully, we can conclude that during the reign of Radu cel Mare the construction of this place of worship was completed. During his reign, which lasted 12 years, he paid special attention to it, offering him gifts (donations) and privileges, mentioned in the 12 documents that are kept today at the National Archives of Romania. What is interesting is that none of them (out of the 12 documents issued by Radu the Great) mention Radu the Great as the founder of the monastery.

Thus, the first existing document referring to the Govora Monastery is the one dated April 14, 1496, which mentioned the donation to the Monastery of the village of Ionesti, Selistea Corbenilor and a vineyard on the border of Copacel [19]. From another document issued on August 1, 1496, Radu the Great donated gypsy slaves and an annual gift of money and food to the villages of Govora Monastery [3]. It is mentioned in the document that "with all my heart, especially towards the holy monastery, the place called Govora", shows that has a certain attraction towards this place of worship. The ruler explains his intervention by the reason that "I saw it without saints" and therefore, working hard, I raised and renewed it"[19], [12].

The document from March 22, 1497 is the one that, among those offered to the Govora Monastery, makes one last and important reference to the foundation of the monastery. It is mentions in the document that "… 3000 aspri are donated, the village of Stoicianii, half of Stolniceani and part of Curtisoara…" [19] and "Seeing that the well-honored lords, who built and beautified and took pitty for the holy churches, especially those in that place, were the Govora Monastery" [19].

Figure 1. The inscription of the Govora Monastery.

The 16th century brings other documents that refer to the Govora Monastery especially to the donations received from the rulers of this period. At the beginning of the 16th century, on June 6, 1508, the document was issued by Mihnea the evil voivode, who donated the village of Glodu and Hinta to the Govora Monastery, following a judgment [19], [14].

It can be stated that the Govora Monastery in the 16th century played an important role in the social, cultural, religious and economic life of Oltenia. This can be supported by the multitude of documents issued by the rulers of this century and beyond.
Thus, Prince Vlad the Younger issues a series of documents supporting the donations to the Govora Monastery. One of them is the one issued on April 19, 1511 in Targoviste, through which 3 slave gypsies with their sons were donated by Neaga, daughter of Dan Durduca to the Govora Monastery [19].
Neagoe Basarab the ruler (1512-1521) focuses on the Govora monastery through a series of donations. Similarly, to the others before him, he reinforces the donations already received. Thus, out of the documents issued by him, it is worth mentioning: the document issued on 16th of September 1512, which gives hill in Bunesti and gypsies, gifted by Danciu when he became a monk; another document is the one issued on the 1st of April 1513 through which the ruler gifts the Nevoia meadow to the Govora Monastery, gifted by the treasurer Tudor and the hill near the meadow, gifted by the ruler; but also the document issued on the 30th of October 1517, through which Neagoe Basarab the ruler gifts villages, parts of villages, vines, mills, ponds, gypsies, a quarter of the royal customs from Rancu, and 2000 litres of wine from the royal winery in Ramnic, exempting them of all taxes and services. Radu from Afumati is the ruler who gifts the enslaved gypsies to the Govora monastery on the 31st of March 1526 [19].
During the reign of Vlad Vintila Voievod (1532-1535), a series of documents are preserved by which the previous donations are confirmed (fig. 2). A series of documents are also issued during the reign of Radu Paisie (1536-1545), who continues to pay attention to the goods and aspect of the Govora Monastery, issuing 9 documents. He confirmed the donations of his predecessors (fig. 3 and fig. 4) and gave villages and gypsies. [1]. Mircea Ciobanu Voievod, with his reign in Wallachia interrupted in terms of duration (1545-1552; 1553-1554; 1558-1559), is the one who offers a series of privileges and attentions to the Govora Monastery, through the donations he made [8].

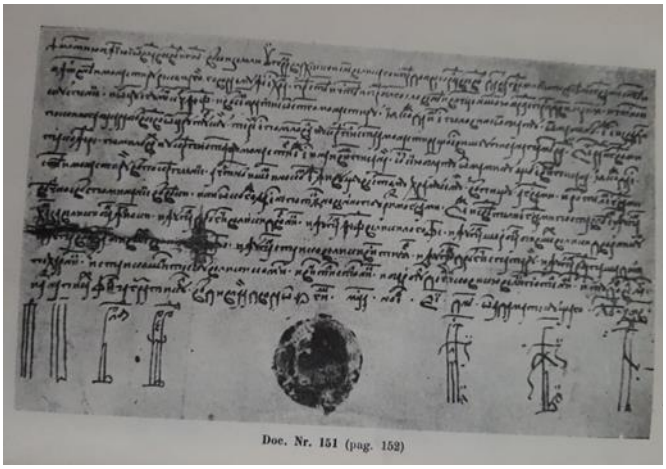

Figure 2. The document issued on November 15, 1533 at the Court of Arges, in which Vlad Vintila Voievod donates to the Govora Monastery half of Balta Mamina; National Archives of Romania, Bucharest

Figure 3. The document issued on June 30, 1542 in Târgoviște in which Radu Paisie Voievod donates to the Govora Monastery the village of Strâmbele, the National Archives of Romania, Bucharest

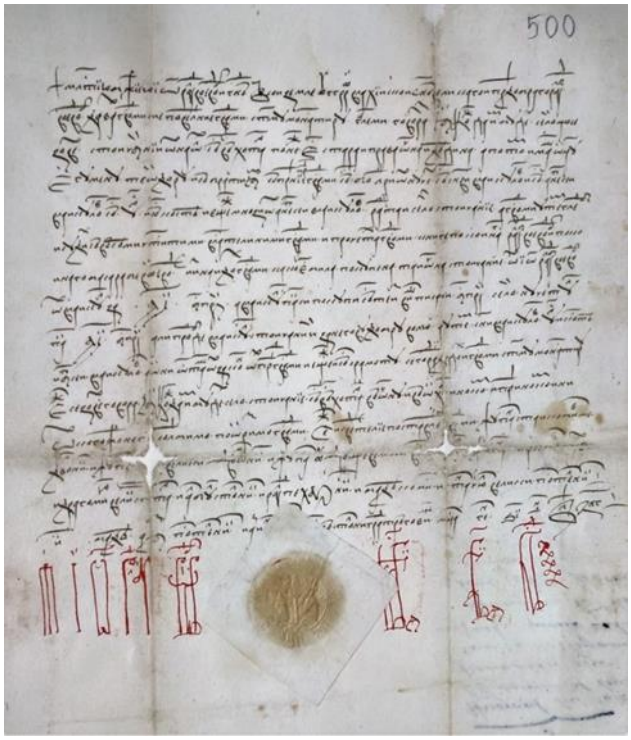

Figure 4. The document issued on January 16, 1545 in Târgovişte. Radu Paisie donates to the Govora Monastery Stoicenii village on Olt, National Archives of Romania, Bucharest.

The architecture of today's Govora Monastery is mostly the one rebuilt during these two centuries, intervening only to maintain the specificity of this place of worship (fig. 5). Many of the donations and revenues of this place of worship were aimed to maintain the cultural value of Oltenia in the 15th and 16th centuries, with details attached in the following centuries, especially during the reign of Constantin Brancoveanu [11], [18], [15].

Figure 5. General image of Govora Monastery today.

Inside, since the reign of Radu the Great, the preoccupation for restoring the painting has existed. These are the clear influences of Byzantine painting, today presented as a true point of analysis and understanding of what the Byzantine represented for the entire

Orthodox church in Romania in the medieval period [16], [17] [13], [9]. There have also been some changes over time, but the basic features are clear. The most important image is the one of the winged Virgin Mary (fig. 6). The whole picture highlights the Byzantine cultural values (fig. 7)

Figure 6. The winged Virgin Mary.

Figure 7. Interior painting at Govora Monastery.

The cultural value is completed by the wood and stone sculpture present at the Govora Monastery (fig. 8 and fig. 9). These wooden embroidery elements offered by the iconostasis comply with the requirements of the 15th and 16th centuries but are remade due to damage.

Figure 8. Iconostasis - wood carving at Govora Monastery.

Figure 9. Framing of the entrance door - stone sculpture at Govora Monastery.

The vegetal elements were in all the geographical space of Oltenia a real source of inspiration for those who decorated the places of worship in painting or sculpture. All

these artistic representations respected the requirements imposed by certain dispositions in order to maintain the significance of each form. The same thing was observed in the painting and sculpture at Govora Monastery [2].
The exterior decorative elements, from the median area, which separate the two registers, also come to complete the mentioned ones. The whole image offered by the Govora Monastery keeps the clear image of its construction in a period disturbed from social and historical point of view, but from artistic point of view, under the clear Byzantine influence.

CONCLUSIONS

Govora Monastery is one of the places of worship with a remarkable cultural value, not only for Oltenia but for the entire southern part of Romania and for Romania as a whole. It is a symbol of orthodoxy in this space, with a remarkable antiquity, founded in historical documents.
The historical documents, through the impressive number referring to the Govora Monastery, reinforce the idea that the importance of this place of worship is great. For only two centuries, dozens refer to this place of worship. Every ruler of this period considered it, through the donations or reinforcements of the previous donations.
Through the historical information provided, through the details of architecture, painting and sculpture in wood or stone, it offers multiple possibilities, from the religious ones to the cultural-tourist. The cultural values of any area, through the peculiarities provided by the historical information supported by documents as evidence of what is stated, to which is added the appearance, color, shape or location, can generate the ideal support for knowing the true history of that place.

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DYNAMICS OF THE SPATIAL STRUCTURE OF SUBURBAN SETTLEMENT SYSTEMS IN MODERN RUSSIA

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ABSTRACT

One of the key modern trends in the process of transformation of rural areas is the growth of the suburban population against the background of depopulation of other non-urban territories. During the Soviet period, this process was held back by both institutional and socio-economic factors. Even different by their nature suburbs were still parts of the zonal types of rural areas. Over the past three decades, suburban areas of large cities have grown by more than 20% in terms of population while their share has exceeded a quarter of the entire rural population of Russia.

The center-peripheral processes of spatial differentiation of rural areas also have their own zonal features like the difference in the shifts in settlement patterns and dynamics of these processes. The population density in suburban and other rural municipalities already differs by several times in the majority of Russian regions. Changes in quantitative indicators are complemented by qualitative changes: the socio-economic inequality between suburban and other rural areas is growing. Suburban areas that are essentially less connected with the agricultural sector are becoming the leading type of rural area in many regions.

Regional specifics of the dynamics of suburban settlement systems in the post-Soviet period are studied on the basis of census and current population register data. The socio-economic situation in the suburban areas of key regions is analyzed on the municipal level by three indicators: the intensity of migration, the pace of residential construction and the salary level. The most typical scenarios of further development of suburban areas in the regions of Russia were identified.

Keywords: population geography, suburban zones, rural areas, spatial transformation, settlement system, deagrarianization, regions of Russia.

INTRODUCTION

The size and spatial diversity of Russia determine significant scientific interest in the problems of rural areas. In the Soviet period, researches were focused on the study of zonal types of rural settlement systems. The population of rural settlements and the nature of rural employment, closely related to the geographical landscape of different territories, were the basis of developed zonal rural typology [8]. The suburban type of rural area was distinguished as the azonal one. It was considered rather as an additional type that has a more diverse set of functions and a more complex system of connections between rural settlements [7].

Over the past decades, the factors of the transformation of the rural settlement systems in many countries of the world and in Russia have changed a lot. The rapid deagrarianization

of rural areas, the increased volume and diversity of return migrations to rural areas have stimulated a rapid transformation of rural functions and the restructuring of rural settlement systems [2, 3, 10, and 14]. Meanwhile, the concentration of the population in suburban areas has accelerated - the suburban type of rural area quickly turned into one of the leading ones.

However, these processes have not been fully covered yet. The issues of further development of suburban areas in Russian studies are usually considered in two cases: during the analysis of the suburbanization problems (rural-urban fringe) or the discussion of the issues of so-called "Dachas" (recreational, mainly summer type of rural development) [4, 9, and 16].

The situation was developed in this way mostly because in the 1990s Russian rural researchers faced issues that had long been discussed by specialists in other countries. “What can become the basis for the allocation of different types of rural areas at the present stage of development of society? Traditional settlement characteristics or socio-economic?”. There are different points of view. For densely developed territories, the level of socio-economic development may be more [1]. For sparser and contrasting settlement systems, researchers suggest relying on parameters of density and average population of rural settlements [6, 15]. Furthermore, we can combine both approaches for countries with contrasting natural conditions [5, 11]. This option is the most adequate for Russia where distances and topology continue to play an important role in the spatial development of rural areas [13].

The growing influence of cities on the development of rural settlement systems and the increased return migrations and backward linkages between residents of urban and rural areas allow researchers to speak more confidently about models of the rural-urban continuum applied to developed countries. But still, the role of transition zones between urban and rural areas is one of the most complex and contradictory problems [17, 18]. This scientific approach allows us to take a fresh look at the problems of suburban rural areas but at the same time does not remove the relevance of studying the suburban settlement system as an independent unique and specific element of the settlement system.

Research problem. Low population density, sparsity and low connectivity of the settlement system, relatively low level of motorization, high transport tariffs and the condition of suburban transport against the background of low incomes of the population do not allow us to talk about the rural-urban continuum in Russia as a holistic and established system. The only exceptions are the suburbs of the two capitals. For other cases, we can say that the socio-economic distance and inequality of opportunities between urban and rural areas is only increasing.

Furthermore, differentiation processes occur within the rural areas themselves. The suburban type of rural areas is gaining more and more weight. Neither by the peculiarities of the lifestyle of the population nor by many socio-economic indicators this type can no longer be attributed neither to any zonal type of rural areas nor to the urban settlement system. The purpose of this study is to evaluate the rate of rural population overflow to suburban areas, to identify regional differences of this process and main socio-economic characteristics of this azonal type of rural settlement system.

Materials and methods. This research is based on the materials of censuses and current population count. The dynamics of the suburban population are considered on the regional level during the whole post-Soviet period. The features of the settlement system patterns are analyzed on individual settlements level based on the last published Population Census of 2010. The calculation of indicators of the socio-economic situation in suburban

municipalities of key regions was carried out based on the materials of the Rosstat Database of Indicators on Municipalities.

The existing problems of accounting for the suburban population in conditions of widespread labor and recreational migrations of various duration are minimal [12]. According to the field research data, the number of permanent residents in suburban municipalities is mostly stable. Moreover, its deviations from current population count data usually do not exceed 10-15%.

The distinctive obstacle to the analysis of the dynamics and socio-economic development of the suburban population and settlement system in Russia was the transition of Russian statistics to a municipal grid of data collection and provision. It does not allow to clearly distinguish rural population from urban and to define their characteristics. Formally, this brings Russian statistics closer to the practices of statistical accounting in developed countries, for example, the EU. It reminds local administrative units (LAU), built on the basis of municipalities and communes, which only in general terms takes into account the rural-urban structure of the population. However, in Russia`s conditions of a very sparse settlement system and a large area of many municipalities, this approach statistically combines elements of the settlement system that differ seriously in development. Therefore, it requires an additional selection of key municipalities when comparing indicators of the socio-economic situation.

In this article, **the suburban area** refers to rural municipalities that directly border the city limits of regional capitals and large cities (>200 thousand inhabitants) that are able to form a stable zone of attraction connected by regular commuter public transport as a suburban area. With the exception of two capitals, the zone of noticeable influence of most urban centers on the surrounding territory is usually limited to the neighboring municipalities. Outside of them and away from the main transport routes, the daily influence of cities on the rural population is rapidly weakening. Moreover, it should be noted that nowadays small urban settlements of modern Russia, in their turn, do not have the adequate resources to maintain municipal transport routes to the surrounding countryside and are also not attractive enough as the labor market or as the provider of services to the rural population.

RESULTS

Dynamics of suburban population.

In 2021 the share of rural residents living in suburban municipalities was more than 25% of the total rural population of Russia. Since the last Soviet population census conducted in 1989 it has increased by more than 7 percentage points. It is noticeably higher than the rate of urbanization in Russia. The growth rate of the absolute number of suburban population gradually increased and in 2010-2021 was slightly higher than in the previous two decades. The suburban population has grown by almost 20%, almost 1.5 million people, while the whole rural population has decreased since the last Soviet census.

Although the relative growth of the share of the suburban population is typical for almost all regions of the country, it follows two different scenarios. In some cases, it occurs against the background of an increase in the absolute number of residents of suburban areas and indicates the real development of suburban rural areas. These are cases of the largest, most developed cities of Russia. In other cases, the relative concentration is caused by a decrease in population. The second one is typical for peripheral, primarily Far Eastern and northern, regions.

The differentiation of regions by the share of the suburban population is significantly influenced by zonal natural factors. They significantly determine the pace of rural deagrarianization that manifests itself as the liquidation of large collective agricultural producers and the decline of the importance of personal subsidiary farming for rural residents. Therefore, in the more northern and eastern regions the rural population concentration in suburban areas is usually faster. Nowadays we can state that in some regions the share of the suburban population has already exceeded 40% (Fig. 1).

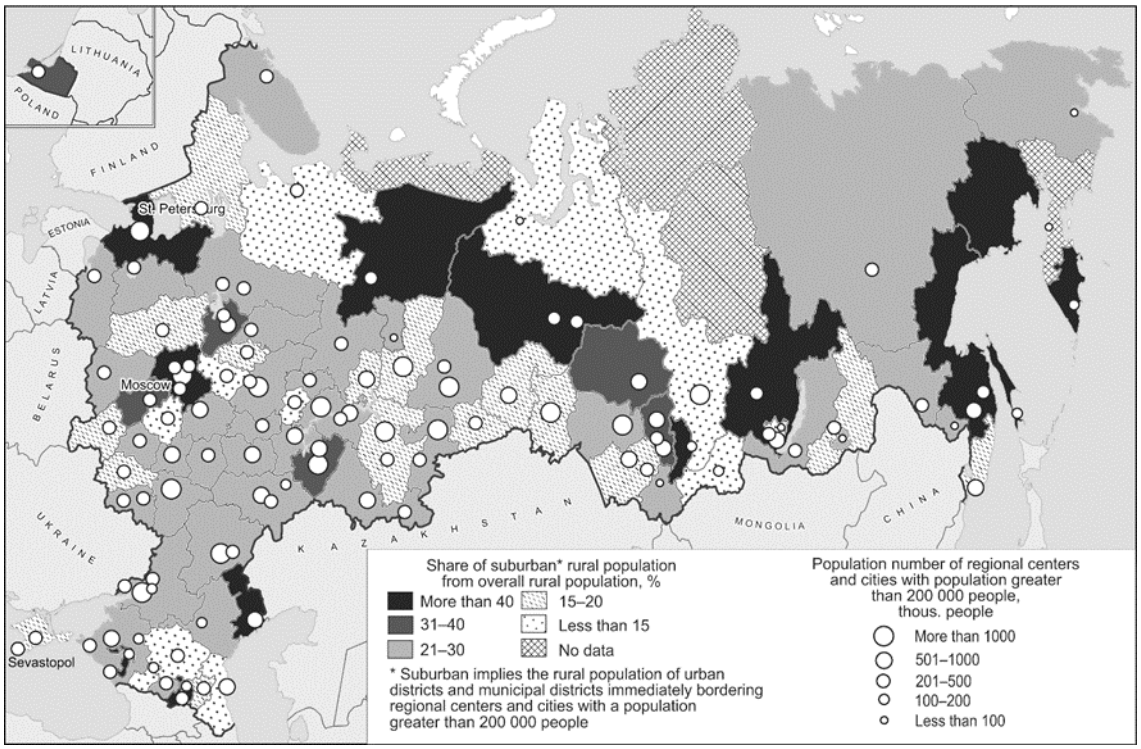

Figure. 1. Share of suburban population in Russian regions in 2021, % of the total rural population (Compiled based on Rosstat data).

The maximum **increase in the share of the suburban population** in the post-Soviet period was shown by the subjects of the Russian Federation with difficult and least comfortable natural geographical conditions and sparse settlement system (including some semi-peripheral regions of the Non-Chernozem zone of Russia). In the south, in the steppe and forest-steppe zones, the process of concentration of rural population in the suburbs is slower. The share of the suburban population in most southern regions is slightly lower than the national average.

The **political and administrative factor** has a multidirectional influence on the process of concentration of the suburban population. Expansion of administrative boundaries of regional centers leads either to an underestimation of the suburban population as a result of the "statistical" absorption of surrounding rural areas (cases of Voronezh Region and the Komi Republic) or to its overestimation as a result of an increase in the number of suburban municipalities (case of Kaluga). The size and **economic potential** of the regional capital, which determine its attractivity, as well as the development of the urban settlement system affect primarily in regions with large urban agglomerations.

The density of the rural population is a traditional indicator that characterizes the population and development of the territory in the first approximation. As a lower criterion for the inclusion of administrative units in the so-called Main Settlement Strip1

at the end of the Soviet period, the rural population density of 10 people per km2 was used (Alekseev). This value is several times lower than the average population density of ordinary Predominantly rural regions of the vast majority of Eastern European countries (Eurostat).

Besides it, Russia, which has a very sparse settlement system, is characterized also by strong intraregional differences in the population level. The density of residents in suburban and other rural areas of most regions differs by 3-5 times (Fig. 2).

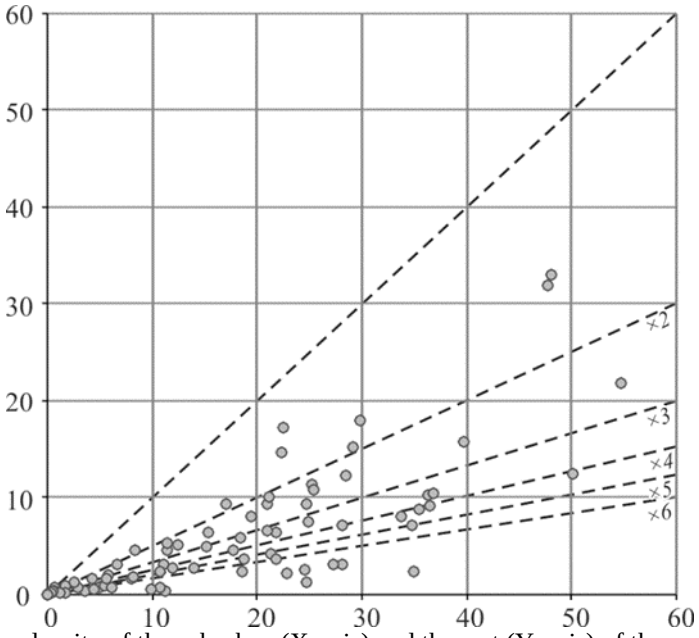

Figure. 2. The density of the suburban (X-axis) and the rest (Y-axis) of the rural population in the regions of Russia in 2021, people per km2 (Compiled based on Rosstat data).

Only suburban municipalities of the most developed regions of European Russia, usually with large urban agglomerations, are comparable in population density to rural areas of Eastern European countries. There are only five such subjects of the Russian Federation in the Asian part of the country: all of them are located in the steppe zone and have large urban agglomerations. If we proceed from the fact that the development of rural areas is unlikely with a low, and especially declining, population density, then of all the rural areas of Russia only suburban municipalities have any real prospects in terms of development among all shrinking rural areas.

The differences between suburban and the rest of rural areas, as a rule, are manifested in their **settlement structure**. The relatively large-scale populated suburban settlements are especially noticeable in the more urbanized regions of the European Center and the Volga region, where large urban centers form extensive zones of influence, attracting the rural population primarily by a more diverse labor market and high-quality social services, that greatly transform the lifestyle of rural residents (Fig. 3B, C).

Only in the south, primarily in the more traditionalist republics of the North Caucasus, the center-peripheral differences in the structure of rural settlement are not so noticeable. Small-sized regional capitals have less attractive power, so they significantly less transform rural settlement and do not create such strong contrasts in the lifestyle between urban and rural population. Moreover, good transport development and accessibility of urban service centers, as well as more agrarian employment structure and the desire to

live in one's own house as an indicator of a person`s status are additional factors of underdevelopment of suburban areas.

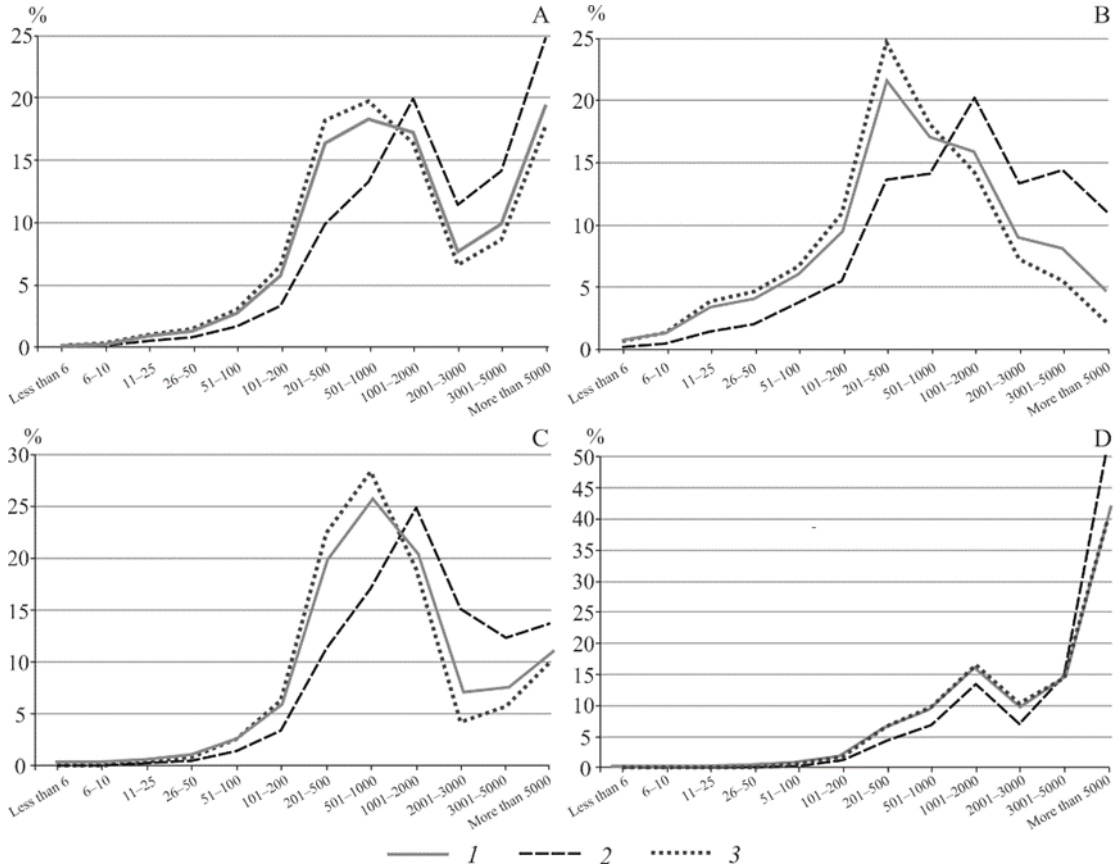

Figure. 3. The proportion of the population living in rural settlements of the corresponding population, % (rural population: 1 - in general, 2 - suburban, 3 - the rest; A - Russia; economic regions: B - Central, C - Volga, D - North Caucasus) (Compiled from: the microdata of 2010 population census [Available at: http://vpnmicrodata.gks.ru (accessed 12 January 2018)]).

Socio-economic gradients. The differences between suburban and other rural areas are shown up not only in the density of residents and the characteristics of settlement systems. In recent decades, the socio-economic differentiation of rural municipalities has been steadily increasing. As rural areas become deagrarianized, suburban rural areas receive unconditional advantages in terms of the diversity of the labor market and the availability of social services.

As an example, Table 1 shows data on three types of municipalities (regional centers, their suburban areas, other rural areas) of some regions of the steppe zone with similar characteristics of the zonal rural settlement system. The attractiveness of suburban municipalities is marked primarily by the positive balance of migration. In terms of per capita migration growth, they are ahead not only of the rural semi-periphery but in some cases also of regional capitals. Since the migration attractiveness of suburbs is largely related to the general situation in the region, the maximum values of the coefficient are typical for suburban areas of large interregional centers with a diversified economy.

Although suburban municipalities fall short of regional capitals in terms of salaries, and in weaker regions even to the average regional level, their advantage over the rest of rural areas is usually at least 20%. Additionally, it should be taken into account that a significant part of suburban residents work in cities and has the appropriate salary level.

In general, the stronger the region and its capital, the lower the gap in the level of nominal salaries with suburban municipalities is.

Table 1. Average annual indicators of the socio-economic situation of municipalities in some regions of Russia in 2017–2020.

Region (oblast, republic, krai)	Migration growth rate, people per 1 thousand inhabitants			Average monthly salary, % of the regional average			Residential construction per capita, % to the average regional level		
	Regional center	Rural municipalities		Regional center	Rural municipalities		Regional center	Rural municipalities	
		Suburban	Other		Suburban	Other		Suburban	Other
Rostov oblast	0,4	13,0	-0,5	141	95	79	180	152	42
Voronezh oblast	5,2	1,6	0,0	125	103	86	142	240	25
Samara oblast	-1,6	48,5	-5,5	127	112	81	98	494	72
Orenburg oblast	4,2	15,6	-11,1	132	124	82	163	355	44
Resp. Bashkortostan	2,5	21,5	-8,8	138	116	84	105	292	89
Chelyabinsk oblast	-1,2	23,1	-6,5	118	98	76	126	574	57
Tumen oblast	17,1	20,3	-6,3	131	85	76	115	236	44
Omsk oblast	-5,6	-0,8	-6,5	121	88	76	110	275	56
Novosibirsk oblast	3,6	22,6	-4,2	129	103	76	108	299	32
Altay krai	1,0	-0,1	-7,0	136	97	88	215	194	29

Compiled based on Database of municipalities.

The best available indicator of the processes of the rapid transformation of suburban rural areas is the per capita rate of residential construction. Almost everywhere values of it for suburban areas exceed values for the rest of rural areas by 3-6 times. The maximum values are typical for regional capitals, where due to the deficit of greenfield lands or the environmental situation part of the multi-apartment housing construction is carried out outside the city limits (Samara, Chelyabinsk). The minimum gap between suburban and typical rural municipalities is observed in the more demographically prosperous and less urbanized Bashkortostan.

The situation in suburban areas located around large cities that are not regional capitals looks significantly less optimistic. Many of these centers are among the industrial monocities. Their economic and environmental problems negatively affect suburban areas. If such centers are located relatively far from regional capitals, then their attractiveness is further reduced, and the potential of such a secondary city may not be enough to keep the population in suburban municipalities. Thus, at least two types of suburban municipalities are formed: the first is developing areas around large regional centers, and the second, less optimistic in terms of further development, is around other large industrial cities.

CONCLUSIONS

Russian geography has traditionally focused on the zonal typologization of rural settlement systems. The territorial structure of zonal types of settlements was formed in the pre-industrial and industrial periods of the development of society primarily under the influence of natural geographical factors. However, since the 1990s, the azonal, suburban

type of rural settlement has become increasingly important. It stands out both in terms of growth rates and the number of inhabitants.
Suburban population is by far the most dynamic element of the Russian settlement system. In most Russian regions, the relative concentration of the rural population in the suburban area corresponds with an increase in its absolute number, which indirectly indicates the socio-economic development of this type of rural area.
Low and rapidly declining population density has become a serious problem for the functioning of social infrastructure in rural areas in recent decades. In most Russian regions, only suburban areas that exceed the rural semi-periphery by 3-5 times in terms of population density have a chance to maintain or increase their population. This fact seriously affects perspectives for further socio-economic development of vast shrinking, peripheral rural areas.
The biggest differences in the structure of suburban and rural settlement systems are noted in the regions of forest and forest-steppe zones. They are manifested primarily in the proportion of residents living in large rural settlements. As we move to the south of European Russia, certain differences remain but become less significant.
Socio-economic gradients between rural areas of suburban areas and other rural municipalities primarily appear in the pace of housing construction and income levels. The migration attractiveness of specific rural municipalities is additionally influenced by other local factors, primarily the level of accessibility to the central city, its specialization and the environmental situation.

Acknowledgments
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CHANGES IN ETHNIC STRUCTURE OF POPULATION IN CENTRAL BAČKA REGION OF AP VOJVODINA (SERBIA) IN THE PERIOD 1948-2011

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ABSTRACT

The subject of this paper is the analysis of changes in ethnic structure of the population in the central part of Bačka - the region of the Great Bačka Canal, comprising the areas of municipalities through which this canal flows, after the World War II. Natural conditions, war events, political and historical circumstances that led to emigration and immigration have resulted in the ethnic structure as it is today. The paper contains a comparison of changes in the ethnic structure in the region of the Great Bačka Canal, Bačka and Vojvodina. The paper uses descriptive statistics research method and data from the post-war censuses of the Statistical Office of the Republic of Serbia. In the observed period Serbs became the biggest ethnic group, the share of Hungarians in the total population was halved, and the share of Croats was reduced threefold.

Keywords: Great Bačka Canal, Bačka, Vojvodina, ethnic structure

INTRODUCTION

Region of Vojvodina, in geographical terms, includes the northern part of Serbia, northwards from Sava and Danube. Vojvodina covers one quarter of Serbia, and about 27% of the population of Serbia lives on its territory. It consists of three mesoregional units: Banat, Bačka and Srem [1]. Bačka occupies the area of 9,244 km², which makes for 42.89% of the territory of Autonomous Province of Vojvodina (APV), or 10.44% of the territory of the Republic of Serbia.

Determining the region of the Great Bačka Canal (GBC region) is complex procedure. It could only be roughly determined based on the borders of the municipal areas in the central part of Bačka through which this canal flows, connecting its western and eastern landscapes. These are the territories of the city of Sombor and the municipalities of Kula, Vrbas, Srbobran and Bečej, whose total area is about 2,804 km², which is about 13.04% of the area of APV [2].

According to the 2011 Census, this region has 224,764 residents, which is 11.63% of the total number of residents of APV, with the noted decrease of this region's share in the total population of APV – from 13.48% in 1948 to 11.63% according to the 2011 Census [3].

Due to the physical-geographical features, but also the strategic position of migrations in the area of APV have always been extremely important, greater than in any area of the former Yugoslavia, and very often they were extremely turbulent. Namely, the periods of mass immigration and emigration changed, which often completely changed the demographic and ethnic picture of APV in a short period of time. Most often, economic and political factors were the cause of both immigration and emigration.

The greatest influence on today's ethnic structure of APV has been made by migrations from the beginning of the 18th century to the present. War events, natural conditions, political and historical circumstances that led to emigration and immigration have resulted in the ethnic structure as it is today [1].

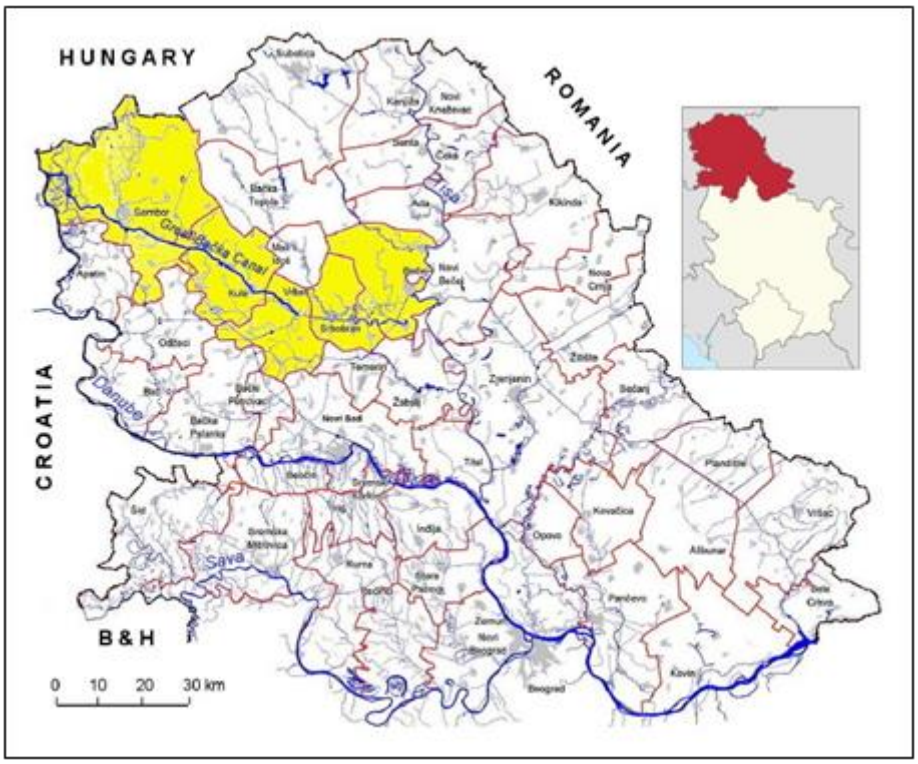

Figure 1. Location of the Grand Backa Canal Region.

The GBC region is located in the central part of Bačka, where at the end of the 17th century there was about 40% of the area under ponds and swamps. By digging GBC, drainage has increased the area of fertile land, improved living conditions and this region has become a very desirable area for living and business, so that throughout history it has been the subject of settlement by members of different ethnic groups. As the countries to which it belonged changed, there were mechanical movements of the population. During the Austro-Hungarian Empire, the majority of the population were Germans, then Hungarians, and after the First and Second World Wars and the formation of new states, the South Slavic population was colonized. The disintegration of Yugoslavia and the formation of nation-states caused new migrations.

In the second half of the 20th century, periods of immigration, industrialization, emigration for economic reasons, and political turmoil took turns. In the 1990s, with the breakup of Yugoslavia and the creation of new ethno-national states, new mass migrations took place, in which mostly Serbs from the former republics of the Yugoslavia immigrated, and Hungarians and Croats emigrated. Common to all the ethnic groups in this area is the depopulation due to the consequences of negative natural increase, which is a result of their unfavourable age structure, increasingly pronounced need to move to larger city centres for education and employment, emigration for economic reasons [1].

Unlike other parts of APV and Bačka, the GBC region is characterized by the influence of colonisations caused by the construction of the canal, more intensive development of agriculture, significant industrialization and development of the entire area. Because of

that, the migration processes were more pronounced - immigration in favourable periods, emigration of Germans and parts of Hungarians after the world wars, arrival of colonists, rural-urban migration. Fewer and fewer inhabitants were engaged in agriculture, and the transition and the breakup of Yugoslavia had a very unfavourable effect on the economic status of the entire region. From the once leading municipalities in the APV, and even in the entire Republic of Serbia, the entire region has become an exodus area.

RESEARCH METHODOLOGY AND DATA SOURCES

The subject of this paper is the analysis of the changes in ethnic structure of the population in the region of the GBC. The descriptive statistics research method was used in this paper for analysis of the population by national groups. The graphic method was used to display comparative statistical records in the regions of GBC, Bačka and APV.

Changes in the population of Bačka were frequent because the periods of demographic and economic prosperity alternated with the periods of recession and depopulation. Frequent migrations of peoples, numerous wars, epidemics, changes in states and cities, different economic changes, industrialization and urbanization processes caused huge demographic changes. Some of these factors had a stimulating effect, while others had a depressing effect on the number and ethnic structure of the population of Bačka. All these changes are interesting for geographic research, with significant difficulties caused by rare, irregular, incomplete and unreliable censuses [4].

Modern statistics on the territory of today's Vojvodina appeared in the second half of the 19th century, but frequent changes of administrative borders and changes in the methodology of data processing don't offer sufficient opportunities for research and comparison. In the paper, we used data from, post-war censuses of 1948, 1961, 1971, 1991, 2002 and 2011 on the territory of Vojvodina, Bačka and the municipalities belonging to the GBC region.

It is necessary to emphasize here that the question of ethnicity is formulated as an open-ended question with a legal instruction that, according to Article 47 of the Constitution of the Republic of Serbia, citizens are not obliged to declare their ethnicity. Thus, in the 2011 Census, the highest international standard was met, according to which every person was guaranteed the right to free expression of his/her ethnicity [3].

Apart from socio-political events and demographic factors (migrations and natural growth), it should be stressed that non-demographic variables were important determinants of changes in the ethnic composition and territorial distribution of Serbia's population. Above all, it is the principal of free declaration on national affiliation which enables change of nationality, namely a temporary one (due to political, social, psychological reasons) or a permanent one (due to assimilation processes), which influences the population dynamics of ethnic communities. Ethno statistical data ranges may also be conditioned by applied (or changed) census – methodological solutions regarding certain nationalities, which are often a result of political circumstances and decisions [5].

RESEARCH RESULTS AND DISCUSSION

In ethnic sense, Republic of Serbia is a multinational community. The final results of the 2011 Census showed that there are 21 ethnic communities in Serbia with more than 2,000 members. Besides Serbs, the most numerous are Hungarians, followed by the Roma and Bosniaks. In terms of multi-ethnicity, the region of Vojvodina stands out, where besides

Serbs (66.8%), members of a number of national minorities live as well. They are very different in regards to their origin, tradition, culture, mother tongue, religion and demographic features. Because of their ethnic, religious and cultural differences, the region of Vojvodina became a unique area.

Of the national minorities in APV, the most numerous are Hungarians (13.0%), Slovaks (2.6%), Croats (2.4%), Roma (2.2%), Romanians (1.3%), Montenegrins (1.2%), while members of other minorities individually make up less than 1% of the population of APV [3].

At the level of Bačka, Serbs are the most numerous (62.5%), and of the national minorities, more than 1% of the population are Hungarians (14.3%), Croats (3.6%), Slovaks (2.6%), Montenegrins (2.0%), Roma (1.8%), Bunjevci (1.6%) and Ruthenians (1.2%) [3].

In the GBC region, besides the most numerous Serbs (57.4%), the Hungarians (14.3%), Montenegrins (5.5%), Croats (3.8%), Ruthenians (3.6%) and Roma (1.4%) are the most represented, and about 1% are Ukrainians and Bunjevci.

The size of categories of residents who did not express their national affiliation is interesting - at the level of APV there are 4.19% of such citizens, in Bačka 5.08%, and in the region of GBC 5.77%. In the 1971 Census, the category Yugoslav - nationally undecided was represented by 2-3%, and in 1981 it was 8.5-9.5%, and in 1991 by 8.4-10%. After the breakup of Yugoslavia, in the 2002 Census, the percentage of those who declared themselves as Yugoslavs and those who did not declare themselves or were undecided was approximately the same: 2.5-3.5%. In the 2011 census, the category of Yugoslavs practically disappeared (less than 1%).

Whether they were a specific political category or an equal ethnic entity, the issue of the Yugoslav category depended to a great extent on the political background and social circumstances. Yugoslavs do not have a special ethnic origin, and their mutual frame of reference is identification with the country in which they live [6].

What's obvious is that Serbs and Hungarians together make for 73.61% in the region of the GBC, 76.77% in Bačka and 79.76% in APV [3].

As noted, during the early Middle Ages there was a great migration of people across the territory of today's Bačka. After the Huns, Goths, Alans, Sarmatians, Gepids, Francs, Pannonian Avars and Slavs, only the Hungarians created a more permanent state in these areas. Hungarians dominated Bačka until the arrival of Turks. During Turkish reign, the devastated areas were inhabited with Serbs and Bunjevci, and during the rule of Austria-Hungary, colonization of Hungarians, Germans, Slovaks and Ruthenians followed. The Serbs who were border guards and stock-keepers weren't included in the colonization to a greater extent, but instead they inhabited the area mostly spontaneously. These and all the subsequent migrations determined the ethnic mosaic of this region [4].

In the first half of the 20th century, the dominant ethnic group on the territory of Bačka were the Hungarians (34-42%), followed by Germans (20-25%) and Serbs (19-26%). Two world wars conditioned new migrations and colonisations, and so, from the 1953 Census, Serbs became the biggest ethnic group, while the Germans made for an insignificant ethnic group. With the departure of Germans, a mass colonization of Serbs from passive regions took place in the GBC region, and they became the most numerous ethnic group

Table 1. Changes in the ethnic structure of the population of the GBC region (1948-2011).

Censuses	Total	Serbs	Hungarians	Croats	Ruthenians	Montenegrins
1948	251,193	102,882	79,310	28,295	12,283	18,427
		40.96%	31.57%	11.26%	4.89%	7.34%
1953	257,873	105,115	79609	26,805	12,877	17,959
		40.76%	30.87%	10.39%	4.99%	6.96%
1961	241,022	110,280	70,375	23,678	...	22,361
		45.76%	29.20%	9.82%	...	9.28%
1971	254,867	113,567	67,940	22,415	11,667	21,926
		44.56%	26.66%	8.79%	4.58%	8.60%
1981	257,638	111,125	59,889	18,262	11,202	24,148
		43.13%	23.25%	7.09%	4.35%	9.37%
1991	251,553	115,811	51,921	11,041	10,484	25,430
		46.04%	20.64%	4.39%	4.17%	10.11%
2002	251,871	115,159	51,565	11,062	10,418	24,642
		45.72%	20.47%	4.39%	4.14%	9.78%
2011	224,764	129,018	36,436	8,607	8,069	12,422
		57.40%	16.21%	3.83%	3.59%	5.53%

Source: Authors' computations based on the Statistical Office of the Republic of Serbia data.

The paper is presented an analysis of changes in the ethnic structure in the GBC region, with special emphasis on the groups that are most represented, namely Serbs, Hungarians and Croats. According to results of the 2011 Census, specificity of the GBC region in ethnic composition in relation to the entire territory of Bačka and APV is the noticeably higher presence of Montenegrins and Ruthenians, significant presence of Ukrainians and Bunjevci and practically a symbolic number of Slovaks and Romanians.

Table 1 shows the change in the number and percentage of the most represented ethnic groups in the GBC region, noting that Croats should take into account the fact that starting from the 1991 Census, the Bunjevci and Šokci categories appear, and in previous Censuses they mostly declared themselves as Croats. Until the 1971 Census, Ruthenians and Ukrainians were one category, and since 1971 they became separate categories.

Serbs

Serbs held absolute majority (50.58%) in the first post-war census in 1948. They didn't have even a relative majority (37.55%) in Bačka, while they were a relative majority (40.96%) in the GBC region. Increase of a share in total population is the consequence of emigration of the German population and the result of colonization, which was more intense in other mesoregions of APV than in Bačka, especially its northern part, where the Hungarians, who didn't conduct major emigrations after the war, dominated.

According to records from the census, the absolute number of Serbs during the observed period in Bačka was on a constant rise (from 302,000 that were registered in 1948 to 559,000 from, the 2002 census), while their number fluctuated for years around 110,000-115,000, i.e. around 45% in the GBC region. On the level of the entire AP Vojvodina, absolute number of Serbs at the beginning of the observed period was between 800,000 and 900,000, to be more than one million (1,018,000) for the first time in 1961. After that, a mild growth was recorded, but within the limits around 1.1 million, which made for

around 55-57% of the population. In the last intercensal period, markedly depopulated in all the three regions, the number of Serbs increased significantly, which was reflected in the relative share, which reached 62% in Bačka, 67% in APV, and in the GBC region, for the first time the Serbs had the absolute majority of 57.4% of the population. Serbs became an absolute majority (55-65%) in all the municipalities of the region except in Bečej, where they don't have even a relative majority (41%) [6].
The graph (Figure 2) shows the change in the share of Serbs in the total population in the region of GBC, Bačka and APV. The share of Serbs in the total population at the level of APV is about ten percent higher than the share in Bačka and in the GBC region. In all three regions during the observed period, except in the inter-census period from 1971-1981, the increase was constant and especially pronounced in the last inter-census period (2002-2011).

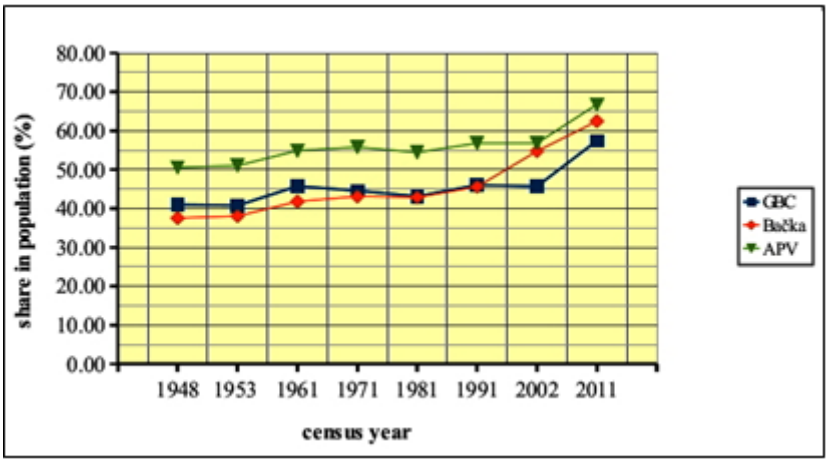

Figure 2. Change in the share of Serbs in the total population of the region GBC, Bačka and APV
Source: Authors' computations based on the Statistical Office of the Republic of Serbia data.

Even though the beginning of the observed period coincides with the end of the planned colonization of Serbs and to a lesser extent other South Slavic peoples (Croats, Montenegrins, Macedonians) from the passive mountainous regions of Yugoslavia, the further increase was influenced by spontaneous immigration. The decline in the period from 1971-1981 is explained by the decline in natural increase, and the positive migration balance which mostly referred to Serbs became negative. Also, a number of Serbs began to declare themselves as Yugoslavs [4], which is probably the key moment in this analysis of the decline in relative share.
However, the 1991 census recorded a significant increase in the absolute number of Serbs. This is a consequence of the national homogenization caused by the general political situation in the former SFR Yugoslavia. The 2011 census directly reflects the large immigration of refugees from the war-torn parts of the former Yugoslavia. The record increase in the relative number of Serbs in the GBC region is also a consequence of the emigration of Hungarians and Croats, as well as changes in the declaration of certain ethnic groups (Montenegrins, Croats). The great depopulation is also a result of internal migrations (emigration to Novi Sad and other industrial centres), as well as the reliefs that the residents of this region used in obtaining the citizenship of the countries of the EU, primarily Hungary.

Hungarians

Hungarians were the most numerous people in Bačka until the 1953 census, and after that census they took second place. Their share in the total population of Bačka in the observed period decreased from 38% (1948) to 14.3% (2011). The Hungarians from Bačka recorded their absolute highest population in the 1961 census: 307,307. In the GBC region, the share of Hungarians in the total population has halved - from 32% to 16%. The number of Hungarians decreased 2.17 times. The largest was 79,609. It gradually decreased to 51,565, which is the result from the 2002 Census, and the absolute minimum (36.436) was recorded in the 2011 Census. At the level of the entire APV, the number of Hungarians in the 1946-1961 censuses was about 400,000, with a steady decline after 1953. The largest decline was recorded in the inter-census period from 2002-2011, dropping from 339,491 to 251,136, with a decrease in the relative share of the total population from 26% to 13% [6].

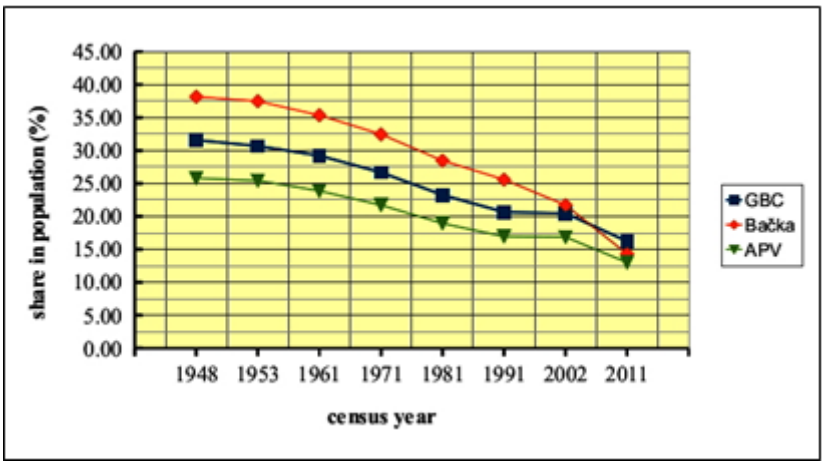

Figure 3. Change in the share of Hungarians in the total population of the region GBC, Bačka and APV
Source: Authors' computations based on the Statistical Office of the Republic of Serbia data.

After the emigration of Hungarians from this area after World War I and the negative natural increase, their number has stabilized. After the occupation of Bačka, Hungarian authorities colonized the Hungarians from Bukovina in place of the expelled Serbian colonists. Just before the end of World War II, most of these colonists emigrated to Hungary. The 1948 census registers a significant increase in the number of Hungarians in Bačka, which is an indication that there were no major emigrations of Hungarians after the war, and also that there was relatively little suffering during the war. In addition, 20,000 to 30,000 Germans declared themselves as Hungarians. The next census in 1953 recorded a slight increase in the number of Hungarians, but also a decrease in their share, which will continue in all subsequent censuses. This is explained by the worsened biological structure and the decline in the birth rate, as well as the constantly negative migration balance due to going to work abroad [4]. The GBC region is also characterized by emigration to other parts of Bačka (primarily to industrial centres of Novi Sad and Subotica, as well as areas where Hungarians are the dominant ethnic group).

In the period from 1992-2011, there was a significant emigration of Hungarians to their parent country due to the political and economic circumstances in which Serbia found itself after 1992. Also, we can expect a decrease in the number of Hungarians after 2011, when they were given the opportunity to take Hungarian citizenship, which greatly facilitated their path to resettlement and employment in EU countries, which is significant

in the years of difficult economic situation and significantly reduced employment, especially for the younger population.
In the GBC region, Hungarians in the municipality of Bečej, where they had an absolute majority according to the 2011 census, have a relative majority (41%), in the municipality of Srbobran and the city of Sombor they are second in share, in the municipality of Vrbas third (after Serbs and Montenegrins), and fourth in Kula municipality (after Serbs, Ruthenians and Montenegrins) [3].

Croats

Croats are the third largest ethnic group in Bačka in the post-war period. Until the end of World War I, they were very few in Bačka. At that time, most of the future Croats declared themselves as Bunjevci and Šokci. Only after the end of World War II did the 1948 census provide the first data on the number of Croats. As with most other ethnic groups, the number of Croats grew until the 1961 census, after which it started to decline. In addition to the unfavourable age structure and the decline in natural growth, the decline in the number of Croats is also influenced by going abroad to work. Also, in the 1981 and 1991 censuses, the declaration of Croats, Bunjevci and Šokci as Yugoslavs was noticeably increased [4].
The Croatian national minority is characterized by two long-term and general demographic processes - total depopulation (inter-census population decline) and demographic aging (reduction of the young contingent and increase of the old population). Changes in the number and structural characteristics of the Croatian population in APV during the second half of the 20th century, and especially since the early 1960's, were strongly influenced by demographic (endogenous) and non-demographic (exogenous) factors, among which particularly significant were the long-term emigration trends, increasingly unfavourable bioreproduction (low birth rate and higher mortality), rapid population aging, assimilation processes and census ethnomimicry, unfavourable political and social conditions in Serbia, especially in the late 1980s and 1990s (de-Croatization of Croats and the 'Bunjevci-Šokci" issue), the unresolved issue of Croatian minority, including the non-recognition of the status of (new) national minority after the breakup of Yugoslavia, the bad economic situation in Serbia, which has also encouraged emigration and the like [7].
To these factors of demographic dynamics of Croats in APV should be added the general determinants of modern social and demographic development of Serbia, above all the fact that "in the last decade of the 20th century there were radical political and economic changes in Serbia that significantly affected all segments of social life. The breakup of Yugoslavia and the creation of new ethno-national states, war and ethnic cleansing, a large number of refugees and displaced persons, voluntary and forced ethnocentric migrations have led to great changes in the demographic development and ethnic structure of the Serbian population" [8].
Total depopulation is the dominant dynamic demographic process in the Croatian minority community in Serbia, and has been uninterrupted since 1961. The number of people in APV who declared themselves as Croats in the census decreased in only fifty years (1961-2011) from 145,341 to 47,033 inhabitants or by 67.6%, or absolutely by 98 thousand people, with an average annual rate of -1.34%. In the same period, their share in the total population of the AP Vojvodina decreased from 7.84% to 2.43%. In Bačka in the same period, the number of registered Croats dropped from 96,098 to 35,437, i.e. by 60,661 or 63.1% or -1.26% per year, with a decrease of the relative share from, 11.62%

to 3.58%. In the GBC region, depopulation was present throughout the post-war period and the number of Croats decreased from 28,295 (when they accounted for 11.26% of the total population) to 8,667 or 69.3% or -1.10% per year. The intensity of depopulation was different in certain inter-census periods, which is indicative depending on the basic causes and factors of depopulation [6].

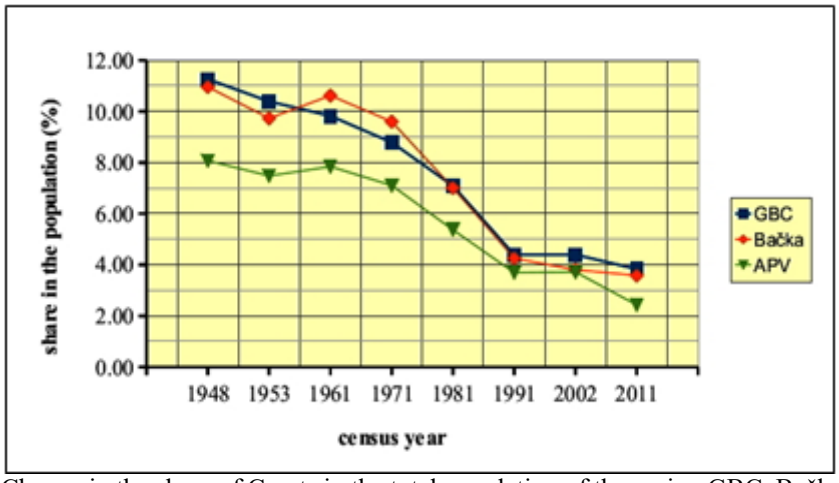

Figure 4. Change in the share of Croats in the total population of the region GBC, Bačka and APV
Source: Authors' computations based on the Statistical Office of the Republic of Serbia data.

In the region of the GBC, most Croats live in the city of Sombor, where their share went from around 23% down to 8.2%, with a significant number of those who declared themselves as Bunjevci or Šokci. In the municipalities of Kula and Vrbas, the share of Croats in the same period decreased from about 3% to 1.3%, while the municipalities of Srbobran and Bečej never had a significant number of Croats living there and their share was about 1.4%, while now it is below 1% [3],[6].

Other ethnic communities

The specificity of ethnic structure of the GBC region are the Ruthenians, Montenegrins and Ukrainians, whose population is significantly smaller in other parts of Bačka and APV.

Ruthenians and Ukrainians

Although represented in smaller numbers from other ethnic communities in Vojvodina, with a very small population resources, Ruthenians and Ukrainians have a very interesting folklore heritage and a variety of common, but different characteristics. Unlike the Ruthenians, who have migrated from the north-eastern counties of former Hungary in the eighteenth century, the current Ukrainians in Serbia, which mainly live in Vojvodina originate from migrations of Ukrainians from Bosnia, from the time when Bosnia and Herzegovina and Serbia were in the common state of Yugoslavia most mid-twentieth century [9].

Until the 1971 Census, Ruthenians and Ukrainians were collectively presented, so changes in the number of individual ethnic groups can be analysed in the period from 1971-2011. At the 1971 Census, there were 20,109 Ruthenians in the APV, who made up 1.03% of the total population, and 5,006 Ukrainians or 0.26%. In the same period, 16,802 Ruthenians (1.75%) and 3,441 Ukrainians (0.36%) lived in Bačka. In the GBC region in 1971, 11,667 people declared themselves as Ruthenians, which was 4.58%, while there

were 2,520 Ukrainians (0.99%). Over the next 40 years, the number of Ruthenians and Ukrainians decreased, so that in 2011 - 13,928 (0.72%) Ruthenians and 4,202 (0.22%) Ukrainians were listed in the APV. On the same list, there were 12,148 (1.23%) Ruthenians and 3,591 (0.36%) Ukrainians in Bačka, and 8,069 (3.59%) Ruthenians and 2,199 (0.98%) Ukrainians in the GBC region. So, the number of Ruthenians in the mentioned period decreased by 30%, and the number of Ukrainians at the level of APV by 16%, while at the level of Bačka it increased by 4%, which is a consequence of migration from Srem to Novi Sad [6].

The centres of the Ruthenian population concentration in APV were central parts of Bačka and western part of Srem. According to the 2011 census, the Ruthenians did not make the majority in any of the municipalities. Majority of the Ruthenians in APV (88%) live on the territory of the municipalities of Kula (10.6%), Vrbas (8.0%), Žabalj (5.1%), and Šid (3.4%) and the town of Novi Sad.

Territorial concentration of the Ukrainians differs partly from the Ruthenian population, although most of them live in the central part of Bačka in the municipalities of Kula (making almost 3% of the total population) and Vrbas (about 2% of the total population). In the GBC region, there is Ruski Krstur (Kula municipality) in which the Ruthenians have an absolute majority and Kucura (Vrbas municipality) where they have a relative majority.

Despite relatively favourable conditions for further development in all areas of social and public life, there has been a visible decreasing trend of population within these two communities, which is highly prominent with the Ruthenians. We may expect further decrease in the number of the Ruthenians and the Ukrainians in the future, due to the negative natural population growth, unfavourable age structure, prominent need for migrations to urban centres in search for education and employment opportunities, where there is possibility of exposure to assimilation and acculturation processes, mixed marriages and emigration of educated professionals to foreign countries [9].

Montenegrins

The traces about colonization of Montenegrins on the territory of APV dated from the time after the First World War, 1918, when the king Alexander I Karađorđević gave a prize by the land in APV to the volunteers and warriors of the Balkan wars and the First World War. About agrarian reform after the World War I and the arrival of people from Montenegro, there are numerous sources [10]. The Second World War interrupted this land reform and colonization. At the end of the Second World War, new authority conducted new colonization [11].

Montenegrins were colonized in the central part of Bačka. The biggest migrations of Montenegrins happened in the period from 1947-1948, but the waves of colonization continued later on as well.

Montenegrins have been settling in Serbia for decades. APV (besides Belgrade) is considered the most desirable area for immigration. They would adapt to the new environment quickly and easily, taking massive and active roles in social and political processes. Causes of migrations can be distinguished: an economic nature, the cultural, individual emancipation, the political, the emotional (planning a marriage). The most frequent cause for migration to Serbia was enrolment into high schools or universities. Some of the cases of migrations were inspired by the example of friends or relatives [12].

Number of Montenegrins in APV was increasing with different intensity until disintegration of Yugoslavia. After that, it started to reduce. The most intensive fall was

noticed according to data of census 2011. The greatest intensity was between the years 1971 and 1981. In that period the number of Montenegrins in Vojvodina was increased for 16.2%.

Around 90% of Vojvodinian Montenegrins live in Bačka, around 60% in the GBC region. The biggest population of Montenegrins in the APV was recorded in 1991, when 41,721 members of this ethnic group were registered, and they made for 2.22% of province's population. From this number, 38,138 of them lived in Bačka, where their relative share was 3.79%. In the GBC region, there were 25,430 of them, and with 10.11% they formed the third largest ethnic group per share in the population of this region.

After census in the year 1991, number of Montenegrins decreased for one-fifth (20.8%). From the census 2002 until census 2011 number of Montenegrins decreased for more than one third (37.7%). This decade will be remembered, as it was constituted independent Montenegro, 2006.

If it is compared the greatest number of Montenegrins registered in APV (1991) with the number when they were registered as minimum (2011), it may be said that the size of this ethnic group was divided into halves for only twenty years.

The analysis of the age structure of Montenegrins in APV in the second half of 20th century and during 21st century has shown that they were "slowly" getting old together with the majority of population in the Province, so that is not the main reason.

Proclamation of Montenegro's independency in the year 2006 opened the question of identity. There are some opinions, which are based on the language characteristics, religion, etc. that the Montenegrins are the Serbs who originate from the territory of Montenegro. However, those understandings according which they make a special ethnic group are also evident. According to census 2011, the Montenegrins in APV make two groups of people. One group make those who feel ethnic characteristic in the sense that they speak the Montenegrins language and support the idea of existence of Montenegro's Orthodox Church, according to the government policy of Montenegro. The second one, who make the majority of Montenegrins in APV are those whose origin is from the territory of Montenegro, so they declare uch because of traditional or economic reasons, emphasizing that the most appropriate name for them would be "Serbian-Montenegrin". In the 2011 census, they decided to declare themselves as Serbs or as "other", "did not declare", "regional affiliation" or "unknown" [13].

CONCLUSION

The greatest influence on today's ethnic structure of APV has been made by migrations from the beginning of the 18th century to the present. War events, natural conditions, political and historical circumstances that led to emigration and immigration have resulted in the ethnic structure as it is today [1].

Due to the specific territorial distribution and ethnic dominance of relevant national minorities in the border areas of the country, ethnocentric migration in the observed regions led to an increase in the share of Serbs and a decrease in the share, especially the largest national minorities in these border areas of Serbia.

Ethnocentric migrations (both voluntary and forced) were the driving force behind the change of the country's ethnic structure in terms of creating more nationally homogeneous regions, not only with regard to the national structure of the refugee-population, but also taking into account the emigration of other nationalities as well (Hungarians and Croats) who migrated to their mother countries for political and economic reasons [14].

Serbs held absolute majority (50.58%) in the first post-war census in 1948. They didn't have even a relative majority (37.55%) in Bačka, while they were a relative majority (40.96%) in the GBC region. In all three regions during the observed period, the increase in the share of Serbs is constant and especially pronounced in the last inter-census period (2002-2011), so that the share of Serbs in APV in 2011 reached 67%, in Bačka 62%, and in the GBC region for the first time, Serbs have an absolute majority and make up 57.4%. In the observed period, the share of Hungarians in the total population was halved, and the share of Croats was reduced threefold. For other national minorities, not so many changes in the relative share are evident, except for the categories of Yugoslavs and Montenegrins, where after the disintegration of Yugoslavia and the separation of Montenegro, the right to free expression of ethnicity came to the fore.

Generally observed, it may be concluded that ethnic homogenization and spatial distribution of population at the end of the 20th and beginning of the 21st century were influenced by massive migrations, ethnically differentiated natural growth, national-religious "awakening" of many ethnic communities, more or less pronounced assimilation and integration processes, as well as a complex political and socio-economic situation in that period. It is justifiably assumed that the tendencies of changes in ethnic population structure are not finished, nor the processes which condition them. However it is not possible to foresee what the changes in ethnic composition will be in the forthcoming period, primarily because of unknown trends in population reproduction, and the even more unclosed questions of the direction and intensity of future internal and external migrations, stability of national determination of certain ethnic communities and similar [5].

Despite all these processes, the regions of GBC, Bačka and APV represents a real ethnic mosaic of various nationalities exceptionally differentiated by their ethnic-cultural characteristics, so good majority-minority relations. National minority rights protection and ethnic tolerance are the key to stability in this province.

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EQUALITY AND QUALITY IN EDUCATION. A MULTIDIMENSIONAL ANALYSIS OF THE RESULTS OF THE 2021 NATIONAL ASSESSMENT EXAMINATION IN THE NORTH-EAST REGION, ROMANIA

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ABSTRACT

This study aims the analysis of the academic performance indicators related to the 2021 National Assessment Examination. The subject has a growing interest in the context of the fluctuations of the teaching methods and social interactions in the previous school year between physical and online classroom, but also from the perspective of the digitization level in urban versus rural areas. The chances of school un(success) are built during the middle school years, being influenced by a multitude of socioeconomic variables, amplified by territorial discrepancies. This examination is the key-method of assigning students to the next level of education, the high school, which has a crucial role in outlining the career prospects of future adults. The competition between the averages scores at this school level increases the value of the exams of the National Assessment, which is being seen as an important step to access a prestigious educational institution. Generally speaking, the urban areas offer the ingredients of the school performance in a much easier way than the rural areas, where certain challenges and preconceptions related to the quality of education must be overcome.

The study is based on official statistics, at the level of territorial administrative unit (LAU), throughout the middle school cycle of the 2021 graduates, respectively 2017-2020. This interval focuses on the analysis of the temporal and spatial evolution of the indicators that (in)directly influenced these results.

The conclusions reveal major discrepancies between the results obtained by students from urban and rural, while pointing out the importance of spatial accessibility and economic wealth, as essential elements for ensuring the chances of school success. These differences highlight the spatial dysfunctions between city-village relationship, which makes it unlikely for society and education system and to ensure an equal start for all children.

Keywords: geography of education, social equity, school dropout, academic performance, gender inequality

INTRODUCTION

The efficiency of an education system is determined equally by the resources allocated and the results achieved [12]. Financial contributions in education determine the development of human capital, therefore they must be regarded as long-term investments that ensure the development of society - the higher the state expenditure on education, the lower the level of inequality in the future [32]. It is recognized, however, that education is becoming increasingly expensive and its share of the household expenses is becoming

higher, with more parents having an interest in providing children with the necessary skills in an increasingly competitive society [21],[26]. In many developed countries, education has become a business, with the state transferring part of the costs to families that have readiness and the desire to contribute to higher levels of education for their descendants. This educational process dynamic also involves the issue of equal opportunities, since families have different access to educational services, depending on the place of residence, the standard of living, income and the level of education of adults (their previous form of education).

In general, it is considered that the main causes hindering access to education are the type of residential area in which the child lives (the rural environment is more vulnerable in this respect) [1],[33], the stereotypes in society [22], and, most importantly, the level of poverty. Human capital (parents' education, income, professional status) and physical, material capital (resources used for educational purposes) are positively associated with achieving a satisfactory level of education [10].

As with other Central and Eastern European countries, the Romanian education system has undergone profound transformations since 1990, going through a period of change that can be classified as a process of educational transition. It can be characterized by the fusion of three main components: the shift from a totalitarian to a democratic political system; overcoming the deep structural economic crisis, going through a difficult period (transition period) and achieving the status of an emerging economy today; the ongoing updating and adaptation of society to global change [25].

What is specific to Romania is the vulnerability of the education system (especially highlighted in the past two years in the pandemic period), which is linked to the quality of human resources, the material conditions and existing facilities, lack of accessibility to educational institutions [33]. Unequal access to education and the profound implications of this phenomenon are a highly debated topic over the past 50 years and continue to be discussed, especially as it influences the success rate of young people's integration into the labor market and society, despite the officially declared equality, at ideological level [6].

Vulnerabilities are particularly visible in rural areas, which face serious problems of functional illiteracy, massive early school absenteeism, difficulties in learning, poor performance or lack of motivation, all of which increase as they move from primary to secondary school and playing a decisive role in the transition from secondary to high school [20]. The concept of equity, which is theoretically guaranteed by the application of compulsory education, is closely linked to accessibility, but which in reality is difficult to ensure, even in the most advanced societies [28].

In terms of the sustainability of education, the success of this process depends on all parties involved: pupils (who benefit from the educational process), parents (who operate a selection between different schools but also contribute very much to the education of their children), teachers (who define the strategy and guidelines, but also implement them). Lastly, the local community (which supports the system by providing funds and benefits from an increase in overall educational attainment) [7].

The focus of this article is the National Assessment, which marks the transition of pupils from secondary school to high school. All students who completed secondary education that year or who did not pass the exam in previous years can take this assessment. Its value is crucial for access to high school and later, university studies. The rate of promotion, the marks obtained at the two disciplines (Romanian language and maths),

absenteeism, school dropout, the distribution of marks by areas and gender, all these elements contribute to the shaping of the socio-economic level of a region.
The aim of our study is to highlight the educational disparities that exist in one of the poorest and most populated regions of the country – the North East region, highlighting certain types of behavior and their distribution as being strongly influenced by the place of residence, and along the lines of social, economic or cultural origin [5], [16].
The working hypotheses are as follows:
H1: The distribution of results can be highlighted along distinct axes (rural / urban, boys/ girls).
H2: Children attending rural schools are at a disadvantage to their urban colleagues from the start, reducing their long-term chances of ensuring a high level of quality of life.
H3: Gender inequality is perceived in favor of boys, who are seen as more ambitious and talented.
The article is structured as follows: the next section is dedicated to the methodology used, then the results (exam's scales distribution, urban-rural gap, gender inequality, school dropout) and the conclusions.

METHODOLOGY

The results of the National Assessment, which marks the transition from secondary to high school (8th grade), involve multiple manifestations of social conditions and their geographical analysis is an essential element for distinguishing similar territories and delimiting spaces where certain economic dynamics manifest. The study is based on the official government data sources (www.data.gov.ro), which provides a series of statistical data on the Romanian education system. The National Assessment scores database 2021 for the North-East region is composed of 540 communes (LAUs [38]) with secondary school graduates, out of a total of 552 (including cities) with 25359 enrolled pupils, of which 23840 participated in both exams. In one LAU the percentage of exam attendance was 0%.
Therefore, the statistical analyses in this article take into account 539 entries. In order to cartographically represent the gross results of the students' scores, an additional database of the school network from the same area was used, from which the units of interest, respectively the secondary schools were selected. The data of the two sources were aggregated according to the SIIIR code (a unique code for each educational unit in Romania).
The most relevant parameters for this study are: Romanian language exam, maths and final scores for every LAU, the number of pupils enrolled at the beginning of the school year and those present or absent at the National Assessment; the data was also split by areas (urban-rural) and gender (male-female). For the last classification, the differences between the groups were analysed according to the Cohen model (1988) and for the statistical approach of the rural / urban and female / male dual relationships, the XLSTAT-Student Extension software was used, which facilitated the creation of boxplots, histograms and scattergrams.

[38] Local Administrative Unit, comprised of communes and municipalities

RESULTS AND DISSCUSIONS

Exam's scores distribution

The starting point of the analysis consisted of the mapping of the two exams: Romanian language and maths, as well as the final average (figure 1). Firstly, the defining factor in the spatial distribution of the secondary schools is the demographic size of the localities, especially the proportion of children between 11-14 years as the age structure determines the temporal stability of schools and classes. Secondary schools are individualized by the intermediate level they undertake, both in terms of educational and distribution within the territory; they are found where the demographic characteristics of the territory allows the support of such the institution, for example, in communes with a low school population there is usually only one school in the the main village: 231 rural localities are in this situation and 6 small towns (Darabani, Buccea jud. Botoșani, Cajvana, Solca, Suceava county, Podu Iloaiei, Iaşi county, Slănic Moldova, Bacău county). Most of the small towns in North-East Region (Murgeni, Negrești, Vaslui county, Broșteni, Frasin, Millișăuți, Suceava county) have 2-3 secondary schools and the most numerous are concentrated in county city-residences: 132 secondary schools out of 1082, which have the highest density of the school age population and the highest level of accessibility to the educational unit in relation to transport and distance-time options [15].

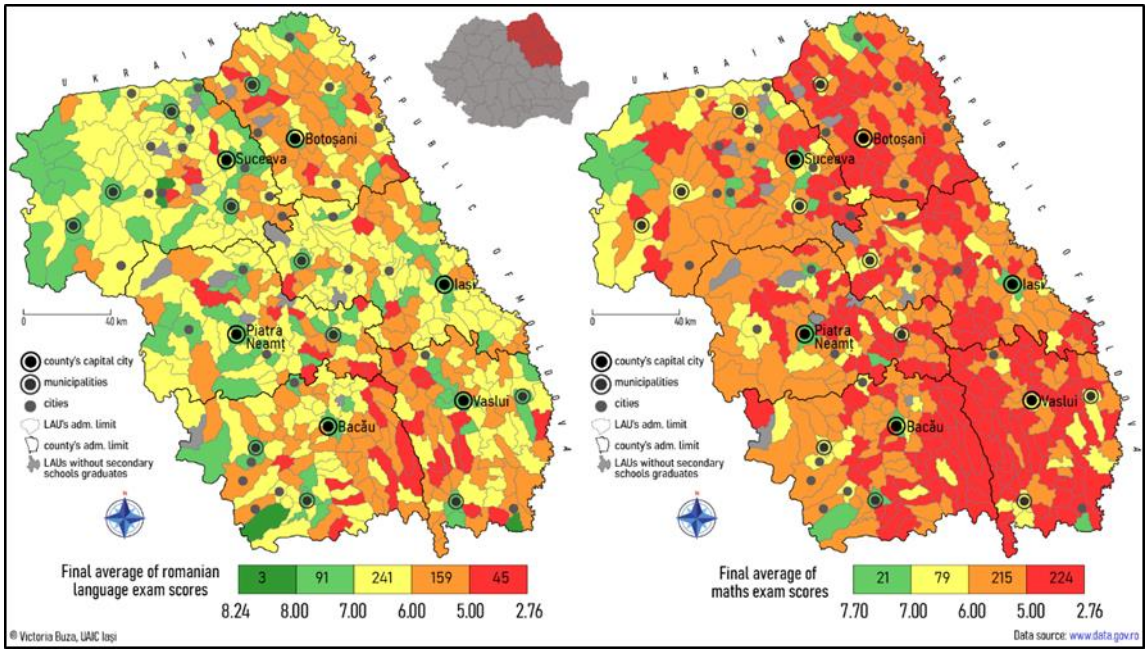

Figure 1 Distribution of the final average scores for Romanian language and maths exams.

In 2021 only 12 LAUs did not have pupils enrolled in the national evaluation, although they all have secondary schools, due to poor training of pupils and lack of interest in continuing education, either high school or attending a vocational school - which would allow them to be qualified in a profession / obtain a professional certificate. This situation is also common in agricultural-based villages, far from urban centers, where the majority of the population is economically instable. For disadvantaged children going to school and high school (which are in cities) represents a financial burden for parents and overcoming these challenges and is done with a lot of sacrifices. Thus belonging to a

vulnerable environment makes it nearly impossible to ensure school equity, as differences in educational performance between pupils occur very early.
As regards the distribution of the final average scores for Romanian language and maths exams (figure 2), the preservation of the same color classes allowed the comparasion between them and the highlighting of certain territorial configurations, most of which are explained by factors mentioned above: road accessibility, proximity to urban areas.

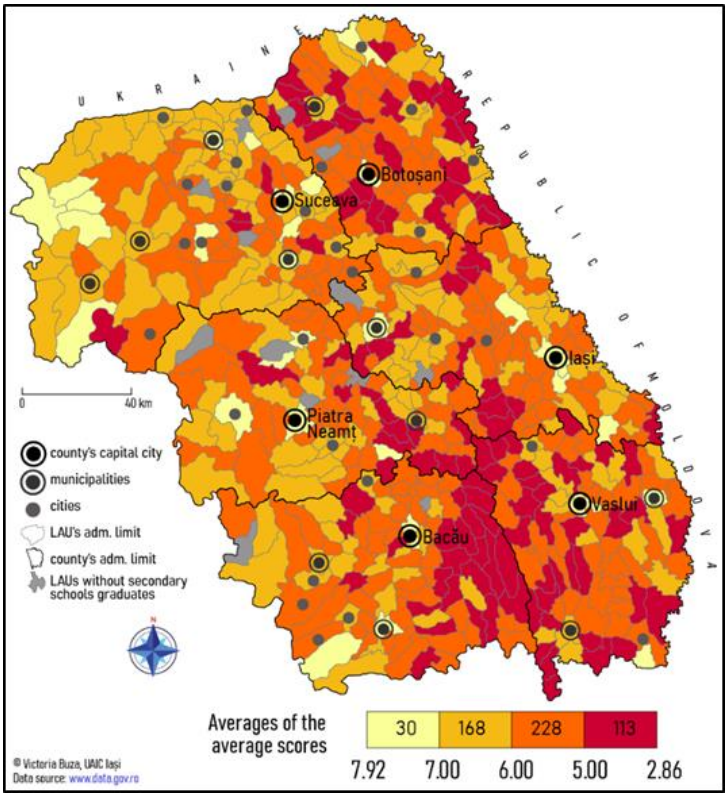

Figure 2 Distribution of the averages of the final average scores.

The element that stands out is the major discrepancy between the final scores at the Romanian language exam compared to the maths, where most LAU's (81.44%) achieved results below 6.00. The poor educational outcomes for maths exam which are almost uniform throughout the North-East region, (with few specific exceptions, in the Dornelor Depression and some urban centers) confirm serious problems with the quality of the teaching staff, teaching methods, exam preparations and insufficient communication between parents and teachers. On the other hand, the higher grades at the Romanian language exam are explainable through the flexibility of the subjects, which implies the creativity and originality of the answers, compared to the rigid and exact nature of maths correct answers. The territorial distribution of the Romanian language scores proves that urban areas are not a guarantee of the good scores, even if they are more advantageous terms of concentration of highly qualified human capital, but rather these are related to conjunctural factors such as the connection to online resources (especially important in 2021), the quality of teachers (Romanian language teachers are easier to find than maths) and the financial availability of families for extra hours [2]. In the northwesten part of the study area (Bucovina Hills, Suceava Plateau) are concentrated the LAUs with high scores at the Romanian language, areas coinciding with higher accessibility indicators because

the secondary schools are concentrated in the main villages and the quality of the road network allows to quickly cover the distances to school [15] [34].
Furthermore, the two exam averages (figure 2) underline a clear distinction of the dysfunctional disparities between urban - deep rural relationship. Therefore, in cities and towns the general average was 7.23 (Iași, 7.78, Bacău, 7.56, Piatra Neamț, 7.41), while in rural while the figures are much lower, with an average of 5.66. Regarding small cities (Gura Humorului, Târgu Neamț, Onești, Darabani), which had between 63 and 311 students, achieved better grades than some of the counties' capital cities. On the other hand, rural communities that have excelled with scores over 6.00 are unevenly distributed across the territory, mostly in the north of the Suceava county and in the Neamț Subcarpathians, areas known with a tradition of high school attendance [34].
In Vaslui and Botoșani counties the geographical distribution of the average scores over 6.00 expresses a dependency relationship between small cities and the LAUs located in the immediate proximity where values are higher than compared to the LAUs exceeding 30-35 km (Dorohoi, Darabani, Ștefănești, Bârlad). On the other hand, a compact area with low final scores are concentrated in the area of Tutova and Bașeu Hills, which is explained by a deep rural character and by poor road infrastructure, which leads to reduced accessibility to educational services as many villages have only primary school. Additionally, there are few trained adults and the average time to reach to the nearest secondary school is over 20 minutes. In this socially distressed area, the conditions for school failure are emerging: the economy based mainly on traditional agriculture, low education and household-quality indices, poverty, labor emigration of parents and neglect of children left at home. Of course, there is no doubt that the LAU's administrative classification between urban and rural does not reflect all the hierarchy levels of the two areas and the multiple features of the geographical territory, but sketches a clear separation of the theoretical school succes chances between urban/rural pupils.

Urban - Rural gap

Starting from the concept of "equal chances" and "social justice" [5], [27], we state that it is purely theoretical, based an ideal educational system, where all students begin from the same start level, with the same educational resources, at every school in a territory. The analysis below confirms that this is not possible: actually, the best results belong to those already who are already the most advantaged. Firstly, at the 2021 National Assessment, pupils from urban and rural areas did not have the same training, those form cities always benefited due to a series of interdependent factors such as: higher family incomes that have allowed more educational (online) resources, internet conection, smaller family nucleus, which allowed the individualization of the study time, parental education and the cultural capital of the family, higher in urban than in rural areas. [36]. Social differences, reflected through high poverty rates among the rural population and the concentration of the highly educated population in urban settings, are linked to the uneven distribution of the economic value of the territory. This is a natural phenomenon and discrepancies cannot be avoided: the urban areas will always provide more opportunities to develop and attract human capital compared to what rural can offer. Thereby, the gaps and challenges related to the financial vulnerability of the family, the low quality of teaching act, where a teacher is given several subjects or some children can afford school materials, in rural (isolated in urban), are reflected at the end of the academic year by significant discrepancies in academic performance between areas.

The scores's distribution at Romanian language, maths and final averages of the 23841 students present at both exams (figure 3) indicate sharp inequalities in the educational outcomes, which result in a tough competition to the detriment of the children from rural areas [19], [24], namely restricted opportunities and motivation to access the high school level. First of all, at the Romanian language exam the interquantilic range for urban area is lower compared to the rural one and has a superior position corresponding to higher grades, suggesting the clustering of the averages between 6.60 and 8.90, with the median of 7.95, compared to the rural distribution: Q1 = 5.00, Q2 = mean = 6.30, Q3 = 7.65. In contrast, there is an interesting special feature of the distribution of grades at the Romanian language and the final averages: the agglutination of the outliers corresponding to low scores, found in the small towns: Murgeni, Dolhasca, Bucecea, Solca, Slănic Moldova, Negrești. The scaterrgames shape the crowding of the large averagess, between 8.50 and 9.50 for urban, which corresponds to a narrow area for rural: few rural pupils have achieved this performance.

Secondly, the distribution of grades at maths exam presents the most dramatic urban / rural gap, both in terms of the position of the medians (6.9/5.16), Q1 (5.25/3.60) and Q3 (8.75/6.45), as well as their dispersion in scattergrams: while the number of scores over 5.00 is gradually increasing in urban, a relatively constant density is maintained in rural areas, with a slightly higher agglomeration between 5.00 and 6.00. At the same time, for low-performing students, the rigidity of the scale has led to the concentration of averages at the 5.00, 4.50, 4.00, 3.50, 3.00, 2.50 barriers, an absent condition at the Romanian language exam or the final averages, where the flexibility of teachers and the scoring system allowed the uniform dissemination of the media below the 5.00 barrier.

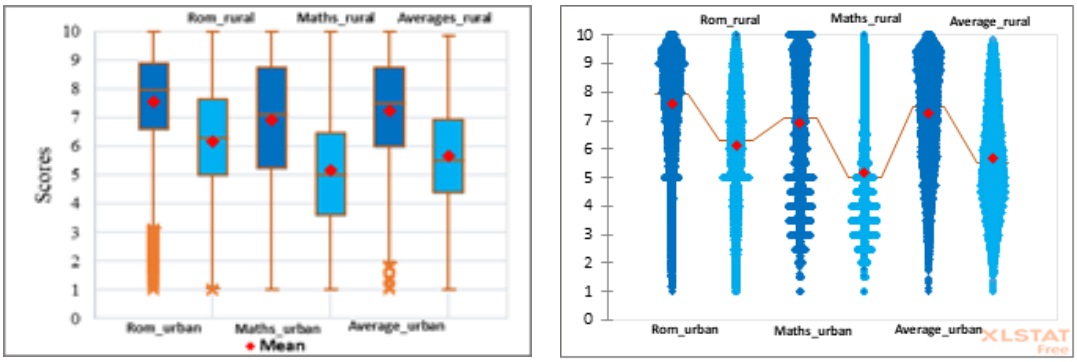

Figure 3 Distribution of the final averages scores, urban vs rural pupils in boxplots (1) and scattergrams (2).

The dispersion of the final averages is expected to improve the disparity between the two exams; it draws an upward diffusion of the urban pupils' scores, with a strong concentration between the thresholds 8.00-9.50 (mean = 7.50), while in rural interquantilic range is between 6.92 and 4.40 (mean = 5.52). Suceava county stands out with most villages where students managed to achieve very good results, especially in Rădăuți Depression (the highest scores), the Suceava Plateau and the Bucovina Hills, a related situation in the Neamț Depression and the middle course of Siret river, area with where young people are very well integrated in the school system [34]. On the other hand, the rural localities including the majority of pupils with final averages below 4.00 are in the Tutova Hills, an area where very low academic performance is connected to low values of school accessibility, accentuated by the lack of a catalytic urban center of human capital.

Gender inequality

Statistical analysis of the Romanian language and maths exam results devided by gender in histograms (figure 4) shows specific dissonances for each of them. In the first place, at the Romanian language exam the girls achieved higher grades, with an overall average of 7.31 and 11129 of them with averages over 5.00, compared to 10086 boys. Although there is not very big difference, the histogram corresponding to the scores obtained by the girls is strongly asymmetrical to the right, SKEW.P = -0.83, compared to boys, SKEW.P = -0.452, where there are small differences in the distribution of grades over 5.00. These graphic representations confirm the many psychological studies: generally speaking, girls exceed at subjects such as literature or art, even though, in essence, these fields are male-dominated. Moreover, female pupils tend to constantly underestimate their mathematical skills and overestimate their language/literature ones, while boys overestimate their maths but have a neutral attitude toward language and literature [8], [11], which subconsciously practiced throughout 5-8 grades leads to visible differences at the National Assessment.

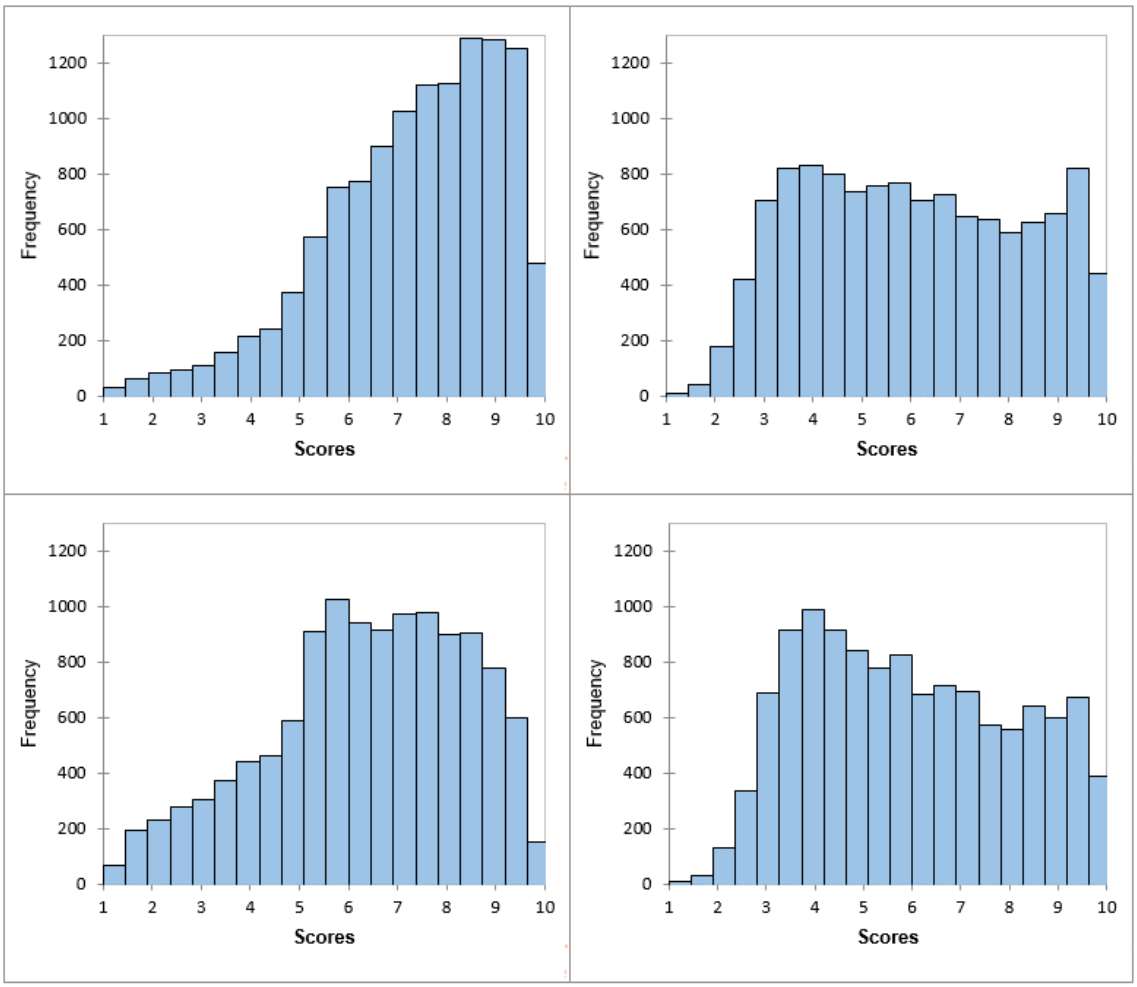

Figure 4 Distribution of the final grades for Romanian language (1) and Maths exam (2). Girls' scores (up) and boys' (down).

As regards the results of the maths exam, the discrepancies are much more faded: the girls obtained an average of 6.05 and the boys, 5.95, with a higher frequency between 3.00 - 5.00 cohorts (with 473 more pupils). Unlike the Romanian performances, the scores' asymetry at maths is extremely low to the left, SKEW.P = 0.064 for girls and SKEW.P

=0.168 for boys. In the case analyzed by this article, girls scored higher in maths than their peers, but many studies show that boys tend to perform better than the girls [14], [30], [31]. The key factors that favours them are gender stereotypes, perceptions and expectations of parents, teachers and employers, closely linked to the trust that this "protective barrier" provides, in dissonance with the low confidence of girls towards achieving the same analytical capabilities. Math gender gap manifests since primary school [31] and prejudices about language / literature vs. maths are more pronounced among girls and are accentuated in teenage years.
In order to calculate the strength of interaction between the two groups of pupils, girls and boys, the statistical method of analyzing the magnitude of gender differences was used, proposed by the psychologist Cohen in 1988 [9]

$$\text{Cohen's } d = \frac{A_g - A_b}{\sigma_t}, \text{ iar } \sigma_t = \sqrt{\frac{\sigma_f^2 + \sigma_m^2}{2}},$$

where Ag and Ab are the rows averages of girls and boys, and σg and σb are the standard deviations of the same range, accessible for values having the same distribution, (the grades from 1 to 10). Thus, for the English language exam d = 0.487, for maths d = 0.046, and the differences of the final scores d = 0.267 (table 1). According to the same author, all these values fall within small size impact [39], and in order to determine possible discrepancies between pupils in urban / rural versus girls / boys in the same areas, the same procedure has been applied:

Table 1. d - values for each group of individuals for same area, different gender (1), different area, same gender (2).

area	girls (1)/boys(2)	exam
urban/urban	0.441	Rom. language
	0.049	Maths
	0.235	Final average
rural/rural	0.601	Rom. language
	0.057	Maths
	0.035	Final average

area	girls	boys	exam
urban(1)/ rural (2)	0.731	**0.868**	Rom. language
	0.855	**0.897**	Maths
	0.858	**0.944**	Final average

The simplest method of understanding these indicators is by reporting the overlap rate between the group (1) and (2); values very close to zero indicate the high similarity between the groups (maths scores between girls and boys in urban and rural and the between rural final averages), and the discrepancies increase between urban final averages, where d = 0.235, indicating that 83,5% of the boys' and girls' scores overlap. This value can be analysed from two perspectives: in terms of the differences in the quality and accessibility of education between large cities compared to small towns (Murgeni, Dolhasca, Bucecea), which registered low scores, and also because girls tend to spend more hours on homework and exam training than boys. The magnitude of the differences between boys and girls at the Romanian language exam is slightly lower in urban than in rural (31.21% vs. 26.43% of boys had higher scores than the median of girls' scores). Thereby, this analysis emphasizes that within-gender differences are much greater than between gender [14]. For this particular case, the values from Table 1(b) for girls point out major discrepancies between urban / rural, the last ones showing

[39] According Cohen's guide for the interpretation of the effect size, 0.01 - very small impact, 0.2 - small, 0.5 - medium, 0.8 - large, above 0.8 - very large.

shortcomings regarding knowledge assimilation, learning skills and transposing them into the test sheet. All d values in the urban / rural relationship have very large effect size: only 28.16% of rural girls achieve their urban peers performance at Romanian exam, and 20.87% at maths. For the boys the ratio is 22.53% at Romanian exam and 18.95% at maths.
Therefore, the results of the distribution of girls' and boys' scores, analysed from intra- and inter-groups perspectives, support the idea of relative closeness between same residential area values compared to high dissimilarities between same gender. The girls, regardless of the area (urban/rural) surpass boys in both exams, but do better in Romanian language, which is also supported by numerous psychological researches [13], [18], [29]. Although both adults and children have assumptions about boys' math skills, as their good results are seen as normal, while for girls are perceived as exceptional, in 2021 girls managed to outperform their peers by a difference of 0.1.

School dropout

Early school leaving is analysed from two distinct perspectives: school drop-out (figure 5 (1)), which is the percentage ratio of the number of pupils enrolled at the end of the school year compared to the number at the beginning of school year [37]. The absenteeism rate (figure 5 (2)) refers to the percentage of pupils reaching the end of the school year but missing the National Assessment, hence failing to obtain a full qualification, respectively, not being able to attend high school. Studies from previous years show that in rural areas both phenomena have been more pronounced than in urban areas [3], [4], [23], Romania having some of the highest school drop-out rates in the EU [17], [24] and within the country, the North-East region ranks first positions [20].
In these circumstances, the issue of early leaving compulsory education correlates with a variety of factors, which can be classified as follows:
1. educational factors: low attendance during the school year, learning difficulties, lack of teacher encouragement (a good teacher / pupil relationship has a positive effect on academic success [35]), poor relationships with colleagues, bullying.
2. family factors: low income, single-parent families or children left in the care of grandparents / relatives, numerous families, i.e. lack of individual study spaces, hard household chores. In rural communities school drop-outs are more pronounced among families where parents have also given up compulsory school. [36].
3. community factors: quality of life, expressed in terms of unemployment, economic profile of the community, emigration of adults.
The spatial distribution of the two indicators highlights broad areas facing very high levels of early school leaving (Jijia Plain, Western Moldovan Central Plateau, Tutova Hills, Fălciu Hills, Ibănești Hills, although Botoșani county has the lowest school drop-out rate of 6%. Most of the LAUs with low final averages are associated with high school dropouts and absenteeism. In the same time, in the northwest of the study area there are villages with very low school drop-out values, which are positively linked to high school performance in both exams (former Habsburg area with a strong educational tradition). There is a similar situation in the Subcarpathians area of the Neamț county, which has the lowest rate of absenteeism, 2.29%), explained by the presence of highly qualified human capital communities [34].

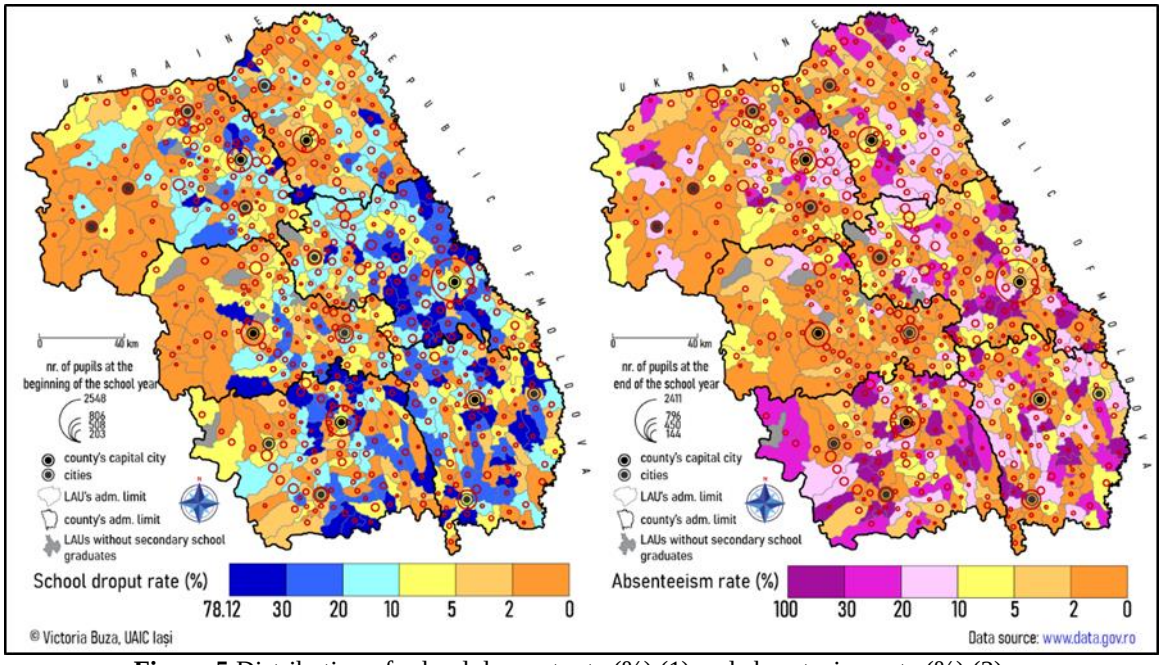

Figure 5 Distribution of school dropout rate (%) (1) and absenteeism rate (%) (2).

Splitting the data on the rural-urban axis supports the idea that the worst cases of early school leaving and absenteeism are manifest in rural areas, which, combined with poor academic outcomes, lead to an increase in educational gaps compared to urban pupils [23]. Differences in school performance are getting higher for the children living in isolated rural areas, far from the cities. Difficult living conditions often involve both spending less time on homework (aggravated if there is no adult capable of extra help) and the need to get immediate sources of income, in particular, from agriculture, to the detriment of the time that could have been allocated to learning / attending school. In the meantime, students belonging to advantaged backgrounds (urban and periurban) are able to excel thanks to better-trained teachers and paying for extra hours, a tool that is accessible to families with above-average incomes, providing much better training for examinations and improving their future life opportunities. In this context, the start of urban/rural children in secondary school is no longer fair, as schools have standardized tests and poverty accentuates gender gaps [17]. Thus, the data show that the average percentage of early school leavers in rural areas is 11.33% (absenteeism rate, 9.28%), compared with 6.48% in cities (absenteeism rate, 5.37%).

CONCLUSIONS

This study has shown that there are significant differences in the quality of education, expressed in this case by the results of the national assessment, supplemented by the drop-out rate and the rate of absenteeism, all calculated and represented graphicly for the North-East Romanian Region (Moldavia), one of the poorest and most populous regions of Romania. The analysis has shown that social, economic and educational faults are present, thus confirming the H1 hypothesis. The lower scores in the National Assessment exams registered in rural areas emphasize the precarious nature of school infrastructure, the lack of human resources (of well-trained teachers), poverty and the precarious nature of living conditions, all of which lead to the unfairness of access to education. The chance for students from rural areas to study high school is quite low, only 66.1% of them successful in passing the exam, comparing to urban passing rate: 87.44% .

The existence of high urban scores, especially in county capital cities, can be explained by the concentration of material and human resources in a prosperous urban environment and the availability of a selection of pupils at the best schools, what entitles us to appreciate that the notions of "equity" and "quality" in education remain, for the time being, at levels of desideratum, not reality. Another highlighted element is the academic gap between girls and boys, thus confirming the H3 hypothesis, as well as the magnitude between the Romanian and the mathematics scores, the latter being closely linked to the quality of the education and a certain relaxation to the exact sciences.
The results of the study can be a starting point for more in-depth studies at local level, able not only to identify the vulnerabilities of the educational system, but also to provide solutions to reduce the reported disparities. A forward-looking education system must promote a balance between students' theoretical and practical knowledge and facilitate the transition from education to professional life by ensuring the quality of technical and vocational education, especially in rural areas.

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SECTION

CARTOGRAPHY, GIS

& SPATIAL PLANNING

QUESTIONING URBAN SPACE EVOLUTION IN ROMANIA'S SMALL AND MEDIUM-SIZED CITIES - A DEEP LEARNING CASE STUDY

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ABSTRACT

Automation processes grew vigorously in GIS-driven analysis and became more and more popular in the last decade. Deep learning and GIS are now used more and more often in all areas, from agriculture, hydrology to urbanism, offering the researcher a quick yet detailed and complex analysis and output. To give a quick overview, deep learning works similarly to traditional supervised classification on satellite images, except that with each iteration, the model becomes more adept at identifying patterns, such as land use, and the samples collected for the classification can be later used for another area..

The small and medium-sized cities of Romania, that are facing serious dificulties nowadays, are shifting now from their classical role to a more peripheral role, by losing their main industrial functions in the last three decades, since the fall of communism.

In our analysis, deep learning object classification is used to detect the extent of Romania's urban built-up areas in the small and medium-sized towns. Our main purpose is to underline the method which uses deep learning analysis,with emphasis on understanding the real extent of built-up places of the above-mentioned cities. The main output of the study is a clear overview of how the urban space is structured in our cities and how they changed in the last decade. Of course, there are studies and analyzes that showed how land use changed, such as Corine Land Cover, but the scale of the studies done are not relevant in our area of study, hence the necessity to have a detailed scale to underline precisely the changes.

Keywords: deep learning, small and medium cities, urban growth

INTRODUCTION

Small and medium sized cities always played a substantial role in every country’s urban system. They are meant to be the main binder between urban and higher urban, their hinterlands are supposed to overlap all the rural areas of a country, to fulfil the basic and immediate needs of the population. Still, the debates circling the academic sphere are not yet focused on the study of the small and medium sized cities, the latest being largely neglected [1].
Urbanization is a complex process of change of rural lifestyles into urban ones [2]. Romania’s urban system did not make an exception in this effort – from the late 1960’s, the total number of cities rose from 188 to 320, a tendency shared by other east European countries [3]. From the grand total of 320 cities, more than 86% (278 towns) have less

than 50.000 inhabitants – according to the 2021 National Statistical Institute, counting in our analysis as small and medium sized.
Over the last three decades, Romania's transition from a centralized to a market economy has resulted in a significant chaotic reorganization of urban land use, facilitated by the phenomena of urban sprawl with hardly any regulation. As a result, scholars and policymakers must work together to better understand the spatial evolution of these cities, which serve as a cornerstone for integrating rural space with urban functionality.
Previous papers regarding the urbanization process [4-6] showed that the phenomenon integrates four stages – urbanization and suburbanization in the growth process and desurbanization and reurbanization. Mostly, this classification is used the Functional Urban Areas (FUAs) but in Romania's context, more than half of our cities fall in the hinterland of regional cities (more than 50.000 inhabitants).
Hence it is crucial to understand if there is a causality between proximity to a big city and urban space evolution of our small and medium-sized cities and if the growth is not caused by the suburbanization phase of a FUA.

DATA AND METHODS

One would argue that in order to measure the spatial extent of a city during a given period of time, is it enough to only look at the % of the urban sprawl but to fully underline the extent of space evolution in our small and medium sized cities, we have to take into consideration a broader number of indexes and methods. Our paper uses both statistical data, such as population dynamic, the rate of urban sprawl growth but most important, satellite imagery.

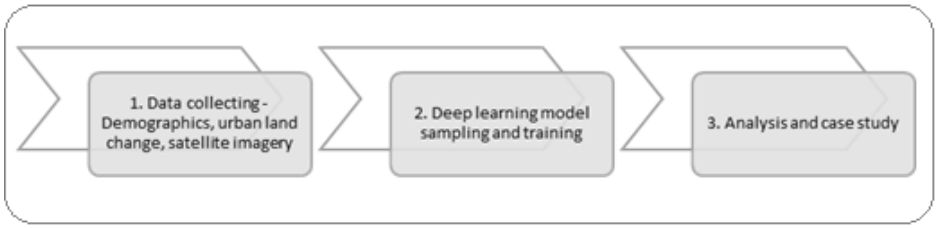

Figure 1 - Phases of the methodology

As the above figure states, our methodology consists of three main steps: 1. data collecting, in which we obtained all our data and indices that we used for our analysis, 2. gathering samples for later training our deep learning model to detect changes and the last step, 3. A100nalysis of the results and detailing of a case study to have a better understanding of the outcome of our work.
The period of time chosen was 2010-2018, due to the availability of data, time consistency varying for satellite imagery due to the duration of a full flight to be completed (+- 1 year differences for the full surface of Romania).The data regarding the population dynamic was extracted from the National Statistical Institute of Romania in the interval stated earlier and the rate of urban sprawl growth was extracted from Copernicus Land Monitoring Service for our cities. There are also some limitations regarding the data used – the changes in land use provided by Copernicus Land Monitoring are mapped only if they are larger than 5ha, so it may be difficult to have mapped all the changes for a small community.
In order to minimize the errors that can show up from the indexes collected, we use our deep learning model to fully identify the constructions that rose in our chosen period of

time. For this particular case, we used Mask R-CNN, a Convolutional Neural Network (CNN) and state-of-the-art in terms of image segmentation and instance segmentation, used mainly for object detection that has two outputs for each candidate object, a class label and a bounding-box offset [7] that fits best our purpose.
There have been some previous papers that used the same methods regarding the deep-learning model, varying from general land-use classification [8], housing [9] and other applications [10][11]. The vast majority of papers cover overwhelmingly physical geography subjects so is it paramount to try to cover our field of study.
Our deep-learning model was trained with the help of around 2000 samples, taken from both 2010 and 2018 images with 0,5m pixel dimension to accommodate changes of color given by different seasons in which the images were collected. The backbone of the model chosen was RESNET50, the resolutions of the chips (the samples collected) being 224x224 pixels. For the number of trainings carried out by our model (7) we managed to obtain a confidence score of roughly 85%, the model stopped itself when there was no more improvement left. [Figure 1].

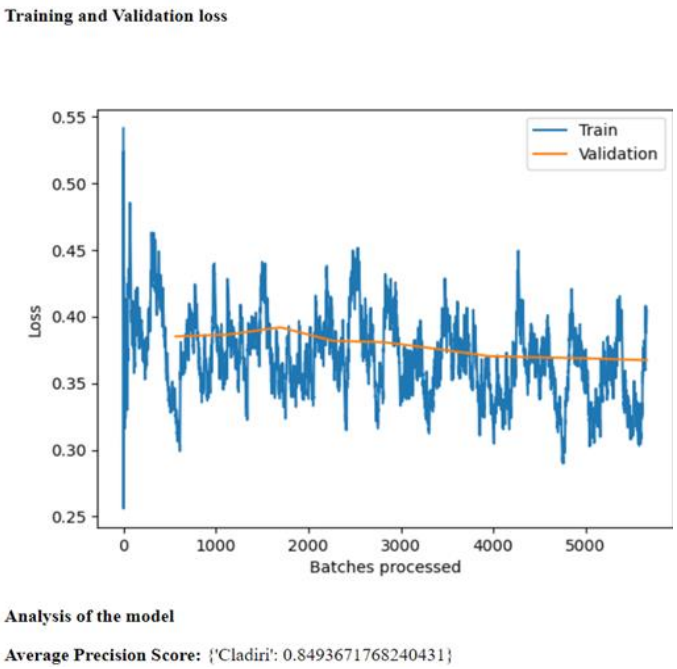

Figure 2 – Snapshot of the model metrics showing the batches processed and the average precision score

The samples collected for our model were grouped into a single class, called buildings which incorporated both building blocks and individual houses, so our model can identify only the buildings that are intended for living. All the data collecting and deep-learning analysis was carried out with ESRI ArcGIS PRO.
The main purpose of our study is to – 1) find is there is any correlation between population dynamic and urban space growth rate to see if the process is indigenous or exogenous, 2) how much of the urban space growth rate is given by the living space and 3) what category of cities registered the most growth in the period of time chosen.

RESULTS

Looking up to Romania's demographics for the last 15 years, there was a constant decrease in terms of population both for small and medium-sized towns and the other bigger cities. In percentages, our cities lost roughly 5% when it comes to residents [Figure 2] but gained an overall 6% increase in built-up areas [Figure 3]. The logic would dictate that the expansion of the built-up areas is sign of urban development, but it cannot lack the demographic raise in numbers.

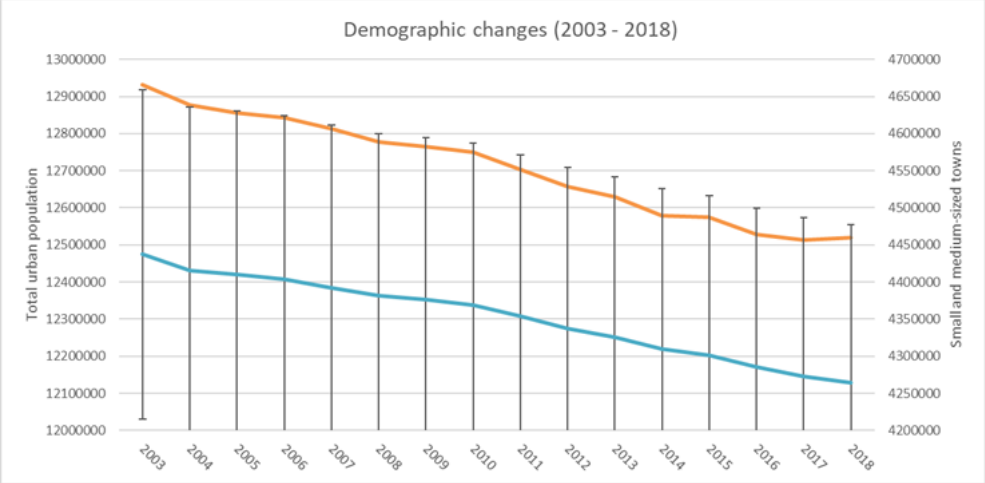

Figure 3 – Demographic dynamic between 2003 – 2018 of small and medium-sized towns.
Source: National Institute of Statistics1*

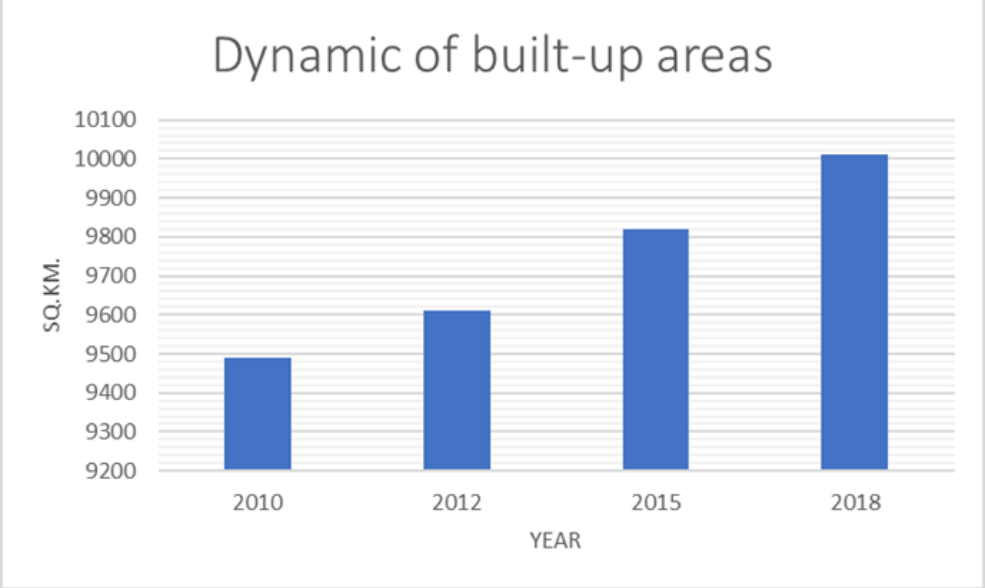

Figure 4 – The dynamic of built-up areas in small and medium sized towns (2010-2018)
Source: Copernicus Land Monitoring Services2*

In order to underline our main goals of our paper, we ran a series of regression analyzes to try to find a link between our indices. Our dependent variable was the urban growth rate and we confronted it with population dynamic and travel distance to a higher ranked city. First, we carried out the regression among all of our cities and in both cases, with 95% confidence, we found little to none causality between the beforementioned data, the

Multiple R resulted was 0,44. Second, we narrowed our analysis to the sattelite cities of Bucharest, finding even less causality, with a Multiple R score of 0,42.
In our case, it is arguable that one general measurement fits all of the 278 cities or even 8 cities, that is why we have to apply a bottoms up approach to best describe the local context. Thus, we selected a city that scored an increase in population and built-up areas in the last 15 years.

Figure 4 – Old buildings and new buildings in the city of Chitila.

The city of Chitila is one of Romania's latest cities, which was a rural commune until 2005. It is one of Bucharest's satellite cities, being only 9 km away from the capital city's center. According to our data, the city had an increase of 31% in population and around

38% increase in built-up areas. It is common that a sattelite city of one metropolis to actually act as a typical neighborhood, going by the name of commuter town or exurbs [12][13].This typology of city is less probably to develop its own industry or a dense network of services turning the focus to expand urban sprawl, both individual and collective housing. Altogether, in our opinion, this is the propitious setup to further investigate if there are strong correlations between the factors investigated.

As a last part of our analysis, we ran our deep learning model that was trained to identify housing buildings from both 2010 and 2018 images, the main output being the boxes that frame the buildings. In the map above [Figure 4] we mapped the buildings that were identified through our analysis. The ones colored with red, as the legend of the map says, are the buildings found by 2010 and, on the other hand, the blue color highlights the new buildings that were built by 2018. There is a clear demarcation between the old urban core which lies on both parts of the main road that connects the city to the country capital and the new communities that rose like suburbs of the city, in the south-western and northern outskirts of the city. There are also some interstitial spaces that were filled during this period of time, furthering the densification of the city.

In quantitative terms, the housing surface increased with nearly 21%, from 2721 buildings in 2010 to 3356 in 2018, the biggest majority of them being represented by individual houses grouped in new neighborhoods. We strongly believe that in this case, the proximity to Bucharest heavily influenced population growth and urban space evolution. As we mentioned in the beginning of this chapter, in the evidence of Copernicus Land Monitoring Service the city of Chitila had registered a growth of 38% in built-up area. As our results mentioned more than half of this percent is represented by housing buildings

CONCLUSIONS

The transition from a centralized economy and authoritarian regime to a market economy and democracy in Romania was swift and brutal, accompanied by dramatic changes in the social and economic environment that had a significant impact on the spatial evolution and transformation of small and medium city spatial structures.[14]

Urban space evolution can be sometimes difficult in terms of choosing the right scale of study, data and methods. As we saw earlier, the data available can not describe the local context and it is necessary to adapt our framework to find out the precise numbers behind the situation.

Regarding the deep learning procedures, there are of course advantages and disadvantages: the main advantages consist of the versatility of the deep learning model, that can perform better and better by each iteration, it can work with any type of images, but most importantly is the most precise and cost-effective technique that it is known by this moment to rapidly identify structures from satellite imagery. We should also name the disadvantages of using deep-learning, that can come along with using the technique. The procedures require technical proficiency, it is resource consuming (both time and hardware) and lastly, can underperform when the satellite imagery has different color palettes, being highly required to pre-process the imagery data.

As we saw from the results, the city of Chitila had registered quite a significant urban expansion in just 15 years. It was quite clear from the beginning that increase in population and proximity to Bucharest would generate a higher demand on the real estate market, the future-urban spaces being a great future perspective. We should also underline the fact that, as a former rural community and part of a county that was formerly known as the Agricultural Sector of Bucharest, the city had vast fields that were occupied by

crops that were supplying Bucharest. Of course, the real estate projects benefited first, the prices after the economic crisis from 2008 that were at a historical minimum paved the way to fast urbanization, as we can see the expansion especially in the northern part of the city [Figure 4].
Last, this article opens the way for a future study that searches deeper for the factors that influenced the urban expansion in small and medium-sized cities but also the problems that emerged in terms of spatial planning and urban landscape.

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THE ROAD TOWARDS POLYCENTRIC DEVELOPMENT IN ROMANIA'S FUNCTIONAL URBAN AREAS. A GEOSPATIAL APPROACH

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ABSTRACT

Polycentrism, studied at any geographical scale, local, metropolitan or regional, represents a sustainable perspective of development regarding the settlements, employment and facilities systems. It is usual to find this kind of development in Western Europe, in contrast with the Eastern part of the continent. The context is an accelerated economic and demographic development of the main Romanian cities and of the communes adjacent to it, but unbalanced in relation to the nearby settlements. Socialist ideologies left their traces in the urban planning of cities built completely in the XXth century or through the systematization of historical centers and street configuration. The study areas that we chose for this paper are the functional urban areas of the main cities from Romania. We hereby study the distribution of the secondary nuclei within FUAs through a geostatistical perspective, using methods such as spatial autocorrelation and GIS tools. Among the explanatory variables that we take into account, there is the employment rate, number of commuters, density of facilities etc. The main issue that we are answering is whether these secondary centers have the potential to transform the FUA into a polycentric structure and therefore, to achieve an even economical, spatial and transport system development.

Keywords: polycentric development, OLS, functional urban area, commuters

INTRODUCTION

Polycentric development is a concept of territorial planning that is being discussed more and more in many parts of the world. This happens mostly in the more economically developed countries (MEDCs), the so-called Global North, as well as in today's emerging countries, such as China or South Africa. Polycentrism can be used not only in the subject of geography, but also in economics, politics or society, all referring to an even, balanced development of more than one entity.

In a polycentric structure, the spatial dimension plays a critical part from a geographical approach. This kind of structures can be viewed at different scales, as various authors emphasized [1]: local (inside a city), regional (a metropolitan area, a functional urban area, a county, a region), national or even international. In this article we are approaching the urban development centres compared to their adjacent regions. Even though this topic is not commonly discussed in Romania, academics and policymakers are taking steps to address it.

Through a geostatistical approach, the goal of our paper is to determine what led to a rather monocentric or polycentric development within the functional urban areas of

Romania's secondary tier cities. Several variables will be used in an Ordinary Least Squares linear regression to model their importance as indirect factors that led to this kind of development.

CONCEPTUAL FRAMEWORK

Polycentrism regarding urban structures can be seen from two points of view, as many authors noticed [2, 3]. The first one is the morphological aspect of the settlements, meaning population, facilities, enterprises, as absolute values or as densities. The second one is the functional aspect, i.e. the relationships among settlements. This could be the mobility, number of commuters, connectivity or money flow. Besides these, there are also qualitative factors, such as preferences for a certain job, school, supermarket, social habits, or the will to use public transportation instead of personal car. According to Halleux (2021) [1], polycentrism is achieved when a clustering of centres are sufficiently close to develop synergy through functional connections and, at the same time, sufficiently separated to avoid the merging of their labour markets.
During the last decades, a trend of transformation of the monocentric regions into polycentric ones can be noticed. This happened at different times in different regions of the world. Some have experienced rapid and natural polycentric growth since the coal mining industry (Midlands in the UK, Rhine-Ruhr in Germany), while others are still under the effect of the monocentric strategies imposed by the socialist regimes. Today, polycentric structures can be carried out with implemented territorial planning strategies and policies. Moreover, as Anas, Arnott & Small (1998) explains, "the spatial structure of modern cities was shaped, in large measure, by advances in transport and communication, as mobility between settlements is playing a key role when talking about polycentricity" [4]. Now, with improper management, the transport system is the one that can bring many problems to monocentric cities [5]. In comparison with Western Europe, where evidence of polycentric development policies is everywhere, Romania and many former socialist countries do not benefit as much. The importance of this kind of development has only become discussed recently, with the introduction of European policies. For example, the new Territorial Development Strategy of Romania is entitled "Polycentric Romania 2035" and other strategic projects regarding enhancing the relationships between settlements are expected to be implemented. Also, more and more cities have established metropolitan areas associations as legal entities, ensuring a uniform development inside them.

METHODOLOGY. STUDY AREA

The functional urban regions are among the least studied areas in terms of policentricity, as evidenced by the scales and instances listed above (FUAs). Its definition varies depending on each national coordinate, but general European guidelines say that "the Functional Urban Area is a geographic entity that consists of one or more urban centres and their commuting area" [6]. We believe that FUAs are the best areas to study polycentricity because they are based on the number of commuters and represent the entire area's workforce. We chose the FUAs for six of Romania's secondary cities: Iași, Cluj-Napoca, Timișoara, Craiova, Constanța and Brașov (figure 1). All of these cities have populations from 250 000 to 400 000 inhabitants and very dynamic economies (IT, administration, finance, tourism, heavy and light industry).

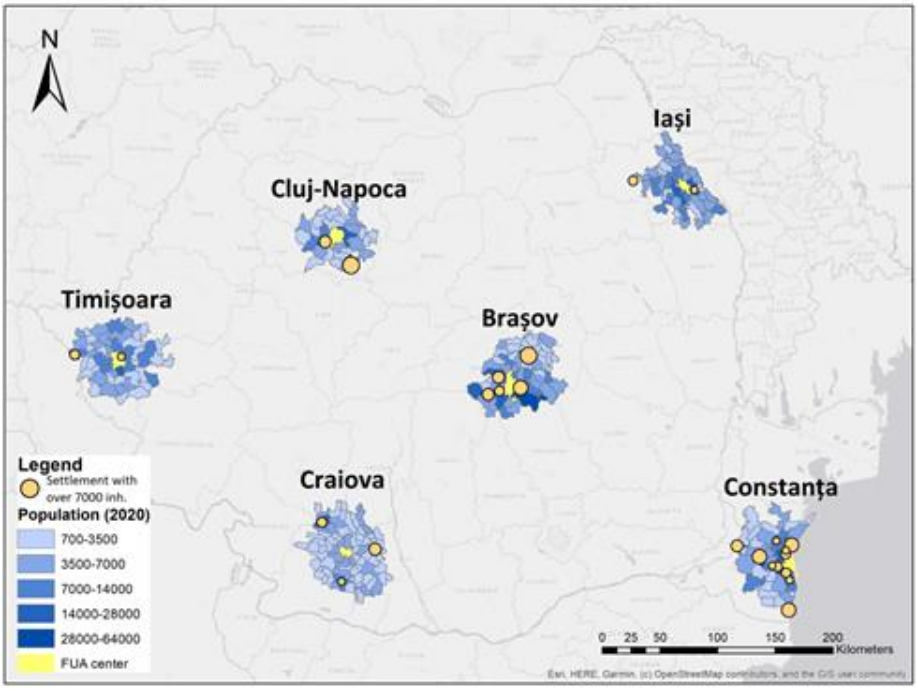

Figure 1. Study area: FUAs of the six secondary tier cities in Romania.

We worked with the LAU2 administrative units scale from these areas (communes, towns and municipalities). The studied FUAs do not intersect, and each LAU2 is inseparably linked to one of the six above-mentioned urban centers. Because of the large imbalances in the sizes of the FUAs calculated solely on the number of commuters of each LAU2, we adjusted these areas by enforcing a 45-minute (average) driving time to the FUA's urban center, resulting in the following areas. A number of 289 communes (LAU2s) were studied, with noticeable differences regarding population, facilities and economic development. At a first glance, if we were to take into consideration only the population, several sub-centers would be delimited (especially the cases of Constanța and Brașov).

POLYCENTRICITY INDEX

Because of the complexity of the factors determining such an area, no general index for assessing how polycentric it is has yet been identified, no unique index for assessing how polycentric it is has yet been identified. Suggested methods use population, spatial proximity among settlements [7], GDP, connectivity [8] or standard deviation based methods [9]. As a consequence, we propose an index that integrates two parameters: the population of a LAU2 and the mean time spent commuting to the urban center. The average time was calculated through the Network Analyst tool in ArcGIS 10.4.1, using a network dataset containing the roads, their lengths and their average speed. When these two are multiplied, the index represents the total energy consumed by the entire population of a LAU2 to get to the urban center, indicating how that LAU2 could contribute to a polycentric structure. For example, the communes adjacent to FUA centers that have very high populations (as it happens in the situations of Iasi or Cluj-Napoca) would rather contribute to a monocentric development, compared to communes or towns with high populations that are spread around the whole FUA.

DATA

In addition to policies and initiatives that will be implemented, the present research is trying to determine which variables contribute the most to the development of a polycentric settlement structure. In this respect, the paper is using an OLS (Ordinary Least Squares) model based on quantitative data collected at the LAU2 scale. The data was compiled using information gathered from the National Institute of Statistics, census databases from 2011, and personal data processing. The Box-Cox technique was preferred with various settings to standardize the data in order to get the best results from the OLS.

The number of employees who work in the LAU2s, according to our initial hypothesis, defines polycentricity. We calculated the working population by dividing the number of employees by the total population of each LAU2. In addition, the number of commuters was taken into consideration (who have their jobs inside the FUA). We evaluated the ratio between the number of building authorizations issued in 2020 and the number of existing buildings in order to determine the dynamism of the LAU2s which also defines polycentricity.

The amount of facilities is also important: the more concentrated they are in a single area, the more monocentric the region will become, and people will have to travel to a single location for schools, hospitals, supermarkets, parks, and other amenities. We took into account the total number of educational units (kindergartens, primary and secondary schools, universities) as well as the total number of sanitary units (dispensaries, healthcare centers, hospitals).

Finally, the paper investigates a psychological factor: preferences for a certain school. Parents in the study area are known to prefer sending their children to the highest rated school over the closest school. In terms of educational quality, there are significant variations between rural and urban schools. We used data like the average number of students per teacher, the number of laboratories, and the number of technical devices in this way (computers, tablets etc.).

RESULTS AND DISCUSSION

The map above is describing the study area based on the population attribute. Though, this wasn't the only things that we thought about regarding centrality and we also considered distance (expressed as time). In this way, a LAU2 with a great population that is further away from the center of the FUA will lead to a higher centrality index than one that is adjacent to this main urban nucleus. Throughout the six FUAs that have been studied, we can distinguish various types of centrality. The most noticeable polycentric trends are in Constanța FUA, which has the main oil refinery and harbour in our country, and most of the resorts on the Black Sea have emerged over time, and in Brașov, which has been an industrial hub ever since the communist era (airplanes, trucks, tractors, industrial parts), and that also includes the main city of the neighbouring county, Covasna. FUAs such as Iași and Cluj proved to be more monocentric, with a great difference in development between the main city and their hinterlands. These differences consist in life quality, number and possibilities of jobs, education quality, infrastructure and so on. A trend of fast development of the communes adjacent to the urban nucleus is noticed (Florești near Cluj, Miroslava near Iași), and this can significantly get the situation worse, in case that only residential buildings are constructed. If, on the other hand, the new housing comes along with jobs and facilities, the traffic will be more evenly distributed

and the benefits of the phenomenon might spread further to the next row of communes as well.

The OLS analysis performed in ArcGIS 10.4.1 resulted in a model telling which of the discussed variables mattered the most in the polycentric development of the studied FUAs (table 1). First of all, to determine the validity and the significance of the model, we will need to interpret the obtained statistical values. The first thing that has to be checked is the distribution of the residuals. The Jarque-Bera test provided the value of 0,138519, meaning that it is not statistically significant (<0,01), so the model is not biased (residuals are normally distributed). The Koenker (BP) test is statistically significant (0,006598), meaning that we should rely on the Robust Probabilities to determine coefficient significance and on the Wald Statistic (0,000000*) to determine overall model significance. Next, the Variance Inflation Factor (VIF) shows no redundancy among our variables (all of the values are <7,5). After we checked all of these conditions, we can take a look at the measures of the model performance: adjusted R-squared = 0,608154 and Akaike's Information Criterion (AICc) = -2062,716573.

Table 1. OLS analysis results.

Variable	Coefficient	Probability	Robust_Pr	VIF
Intercept	2,738161	0,000000*	0,000000*	-
Employees	-0,000188	0,841593	0,849345	1,483281
Commuters	-0,000610	0,000002*	0,000000*	1,620882
Building authorizations	-0,001053	0,000527*	0,000486*	1,528846
Education institutions	0,006832	0,000913*	0,000150*	1,867286
Sanitary facilities	0,000081	0,647719	0,497749	1,760970
School equipment	0,004816	0,000000*	0,000000*	1,922171
Pupils / teacher	0,002261	0,000000*	0,000020*	1,170476

The model provided significant values for most of the chosen variables. Sanitary facilities and the number of employees didn't seem to influence the polycentriciy that much, given the fact that their coefficients in the model's equation are the lowest too. For the sanitary facilities (hospitals, dispensaries, communal healthcare centers), the results are surprising, as they are included in the same hypothesis as the education facilities (institutions), that turned out to have the highest coefficient. The most significant variables are the number of commuters, as expected (they move the most inside a FUA and this is how this type of area is defined after all), and also the equipment of schools (showing how likely is for someone to choose a high rated school over a school situated in proximity) and the number of pupils per teacher (showing indirectly the quality of the education and where future teachers are willing to seek for jobs).

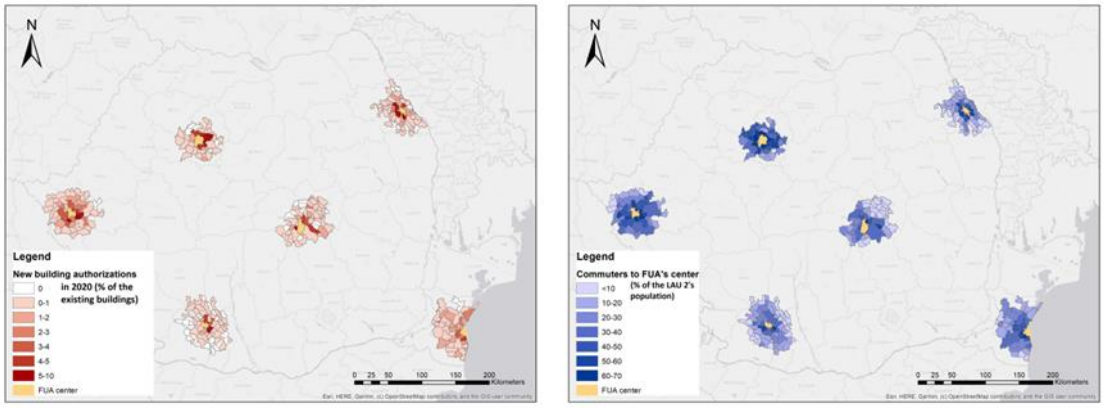

Figure 2. Left: New building authorizations per LAU2, compared to existing buildings. Right: Number of commuters who work in the urban nucleus of the FUA, compared to the total population of the LAU2.

The spatial distribution of the variables shown above (figure 2) shows a clear inverse proportionality between the value of the variable (either rhythm of construction, or number of commuters) and the distance from the urban nucleus of the FUA. Besides this, we can distinguish several sub-centers, being under the influence of the main city. This influence was shown in the low statistical coefficients resulted from the analysis.

LIMITATIONS

Among the limitations that we encountered and the things that made it difficult to reach a perfect analysis is the available data. There are some more factors that we could use in the model, such as the number of supermarkets in each LAU2 or the number of enterprises, but unfortunately there are no open source databases containing this information. Moreover, the data obtained had several outliers, but we couldn't remove them either because they represented other cities within a certain FUA, or because the values were relevant and the chosen LAU2s had to remain the same.

From a geographical point of view, we think that the discontinuous study area also led to errors in the calculation of the indicators mentioned above, and that's why a study over a single FUA or over more FUAs with less empty spaces among them would result in models with a better performance.

CONCLUSION

The polycentric type of development is an essential strategy that should be implemented at different scales. Today' Romanian biggest cities face a fast development of the periurban residential areas, but usually this is not happening for the daily basis facilities as well. While many people get tired of the downtown's agglomeration and move in the city's outskirts, the schools, parks, swimming pools, and most important, their jobs, remain inside the city. This process only leads to a monocentric trend, and that's why bringing the facilities to the periurban (or even metropolitan) area is a great solution for this.

The results proved that some of the most important factors for which a functional urban area becomes rather polycentric are the number of commuters, the pace of new buildings construction and the quality of education, which is very different from the urban to rural area. This validates some of our hypotheses. Others didn't turn out as true: not all the facilities seemed to have the same importance (sanitary institutions had a very small

coefficient in the final equation), and the number of employees is not significant as long as we don't know where exactly they work.
For a further analysis, we plan to obtain the data exemplified above (supermarkets, number of enterprises) through methods like web crawling, and to extend the study area for other cities in Romania as well, cities with a lower population but that still have a strong influence on their surrounding areas. Also, a comparison with other ex-socialist countries would be suited and would generate results related to the planning strategies that this regime brought.
Thus, the quantifiable variables that can lead to a polycentric development have been measured and discussed, to serve as a starting point for thinking planning strategies. In this way, the urban traffic would be more evenly distributed, the overall motion would be more varied and there would be less discrepancies in the development of cities and villages.

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MODELLING THE SPATIAL PATTERNS OF SUBURBANISATION IN THE POST-SOCIALIST STATES: A ROMANIAN CASE STUDY

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ABSTRACT

The uncontrolled urban sprawl in the post-communist European states represents a phenomenon that caught the interest of Urban Geography researchers as well as architects and sociologists. The transition to the capitalist economy in Central and Eastern Europe determined a chaotic spatial distribution of new residential, industrial and commercial developments in the suburbs, which recorded an unprecedented accelerated pace, due to the continously increasing demand. The built-up areas of the post-socialist cities are currently extending over their administrative limits, forming heterogeneous territories which in most cases connect the urban core with the surrounding villages.
In order to elaborate adequate policies that should provide solutions to the issues caused by the unsustainable suburbanisation, it is imperative to monitor the spatial patterns of this process. Using land cover data from 1990 and 2006, as well as the digital elevation model and the road network, the Machine Learning techniques computed the transition potentials of each land use class to convert into built-up area. After validation, the prediction tools provided by Geographic Information System software revealed an overview of the suburbanisation patterns of the following years, based on the current evolution. The study highlights the areas that should receive a more dedicated focus from the authorities, in order to prevent a disorganized evolution of the city and also to provide a sustainable development of the suburbs. This way, more informed decisions could be made by the stakeholders, who will be aware of the suburbanisation dimensions and also collaborative solutions could be set up.

Keywords: urban sprawl, suburbs, CA-Markov, Machine Learning, spatial patterns

INTRODUCTION

Since the communist regimes collapsed at the beginning of the last decade of the 20th Century, the states that formed the Eastern Block have faced numerous challenges in their transition to a market economy. One of the most notable changes has been recorded in what concerns land use management. The harsh socialist planning regulations were abolished and the state-owned lands were restored to the initial private owners [1], [2]. As a consequence of the liberalisation, private interests outpaced the public ones [3], leading to the so-called process of "urban sprawl". The precise and compact land use patterns were rapidly turned into a mosaicked pattern as a result of the fragmentation of the arable land in the proximity of the cities, which became the arena of an unprecedented

transformation into built-up land in order to fulfil "the demand for housing that had accumulated during the socialist years" [4].
As second-tier cities exert a considerable influence on the region, they attract numerous people, implicitly increasing the demand for housing. As a result, the new individual and collective suburban residential developments, alongside with industrial and commercial buildings have emerged along the main roads, creating heterogeneous areas connected to the urban core [4] which in most cases link cities and villages, inheriting features of both settlement types. Initially perceived as territories of open green areas, offering opportunities of relaxation and leisure [5], the suburbs fail in most cases to provide basic urban facilities (health, education, transport, infrastructure etc.) and impact the environment [6]. While the urban growth rate records high levels, leading to a densification of residential space, this paper aims to predict the patterns of suburbanisation for the year 2030 in the city of Iași by monitoring the post-socialist trends of built-up area expansion, using Machine Learning algorithms. This way, it will be possible to forecast the future situation if no action is taken in order to improve the spatial planning documents and management, while the legislative void is being maintained. Therefore, planners and public authorities would get an insight of the areas that are at the risk of suburbanisation and will be able to act consciously in order to impose restrictions and plan future investments in various facilities [6], while creating or modifying policies and processes that will diminish the negative effects of unsustainable urban growth [4].

THEORY

The predictions of the urban growth patterns are performed using various techniques of forecasting land use changes. As the suburbanization represents a complex process, triggered by a series of politic, economic, social, cultural and spatial drivers that shaped the landscape in an unprecedented manner, the models that have been used by scholars take into consideration spatial data as land use raster maps on one side and explanatory factors that determined the past and current built-up space patterns on the other side [6]. Therefore, the model is trained by learning the input and the output data, in order to provide the desired results in accordance with "all possible inputs" [7]. The most common models used in forecasting land use changes are represented by statistical models, neural networks and cellular models [8] [9].
Artificial neural networks, designed after the neurons' interconnecting system and the brain's capacity to "observe relationships in data" [10]. Pijanowski et. al. [10] performed this type of model in Michigan's Grand Traverse Bay Watershed, placing it in the category of regression-type models. Using 10 predictor variables, the model had a 46% predictive ability, while the preliminary tests revealed that the high quality views represented the most decisive factor of the urbanisation in the given study area [10].
Cellular Automata models are focused, as the name suggests, on the interaction between cells that incorporate temporal and spatial information, making it a reliable option for "dynamic simulation" [11]. Moreover, these cells also take into account the values recorded in the neighbourhood [11] being one of the most used urban growth models [9]. The results of the CA model implemented by Iacob et. al. [12] on two Romanian second-tier cities (Cluj-Napoca and Iași) reveal the perpetuation of the chaotic urban sprawl patterns, leading to the incorporation of some municipalities into the surface of Iași city [12].
Markov analysis is able to perform predictions of the future state of the land by taking into consideration "the states", as well as "the rates of conversion between land-use types"

[8], [11]. As being a statistical tool [9], with a quantitative focus in prediction by analysing trends, but lacking spatial capabilities [8], [9], [11]. Markov analysis is combined with Cellular Automata, developing the CA-Markov which is widely used in urban growth studies. Being a hybrid method, it inherits the capabilities of monitoring the temporal dynamic and probabilities of the land use change from the Markov model, while the Cellular Automata offers a spatial context, all in a GIS environment, which indicates the initial states, "parameterize M-CA model, to calculate transition probabilities and determine the neighbourhood rules" [9] Using land use maps from satellite images of 1989 and 2011, Nouri et. al. [9] use the CA-Markov model in order to predict the land use patterns for 2021, which reveal the necessity of implementing policies for environmental protection.

DATA & METHODS

The city of Iași and its metropolitan area houses around 500 thousands people, being one of Romania's second-tier cities. The capitalist economic development completely reshaped the strict urban borders, creating a scattered pattern of the built-up area in most of its peripheral zones, mostly former agricultural lots (cereals, orchards, vineyards etc.) being converted into built-up areas. Being the second most populous city at the end of the communist era, Iasi has maintained its rank by continuously attracting people from the North East Region due to the social, economic and educational facilities [13]. Awarded as the "Emerging City of the Year" in 2018, it has experienced numerous investments in industrial, residential and commercial sites, mostly located outside the administrative limits and along the main roads and extending further from these main transport routes.

As the chaotic development is the result of the lack of local spatial planning documents and the lack of respecting the national laws, developers being driven by the profit opportunities, the new created areas are far from being sustainable. The inexistence of basic urban facilities increases the dependency to the urban core, generating daily traffic flows from the suburbs to the city, which leads to a monocentric system rather than to a polycentric one [14].

Considering all of the above, this study analyses the suburbanization trends of Iasi city in order to predict the future patterns of this phenomena. We will then be able to detect the next real estate "booms" and authorities will be able to prevent the risks of conflicts similar to the ones that nowadays govern this area.

In order to reach the goal of the study, two types of data were needed to perform the CA-Markov Model, which will set the probability of a pixel belonging to a specific land use type to change its category [8].

First of all, two past land use raster data were required as a base for implementing the model. We have selected the Corine Land Cover data from Copernicus for the years 1990 and 2006. Then, the same type of data was acquired for the year 2012 in order to validate the prediction results. Using ArcGIS Pro software, the land use subclasses were merged and reclassified in order to obtain 5 main land use classes as follows: built-up areas, arable land, forests, wetlands and water bodies. Then, the vector data was converted into raster data, which is mandatory in performing the CA-Markov model as data at pixel level needs to be provided.

Secondly, as urban sprawl patterns are driven by several factors, some of them were included in our simulations as explanatory variables in order to improve the accuracy [15]. It is important to mention that only spatial drivers were taken into account as they could be represented at pixel level:

- Proximity to roads: each pixel were given a specific value as urban sprawl probability decreasing within the distance from the transport routes. Euclidean Distance tool was used in ArcGIS Pro;
- Proximity to built-up area: the same geoprocessing as for the proximity to roads;
- Digital Elevation Model: ASTER Global DEM was obtained from NASA's Earth Data which is used to explain the probability of built-up development depending on the terrain's features;
- Transition potential of selected land use classes to convert into built-up area, assessed by the Multi-Layer Perceptron (MLP) neural network in TerrSet.

All the rasters obtained were further processed using ERDAS Image in order to prepare the data to be included in the Land Change Modeller tool provided by TerrSet. The last mentioned software represents the GIS environment that uses the CA-Markov model in order to predict the spatial land use patterns for 2012. Using the above-mentioned data as input, relationships between layers were assessed and established using Multi-Layer Perceptron (MLP) neural network [16], generating trends that aided in achieving the goal of the study. These trends depend on the identified rates of transition potential which were calculated from the observed patterns of conversion of the selected land use classes into built-up land. Once the predicted land use is obtained, the software compares it with the actual land use data from 2012 to validate it, while images for the year 2030 are further being generated following the same trend.

RESULTS & DISCUSSION

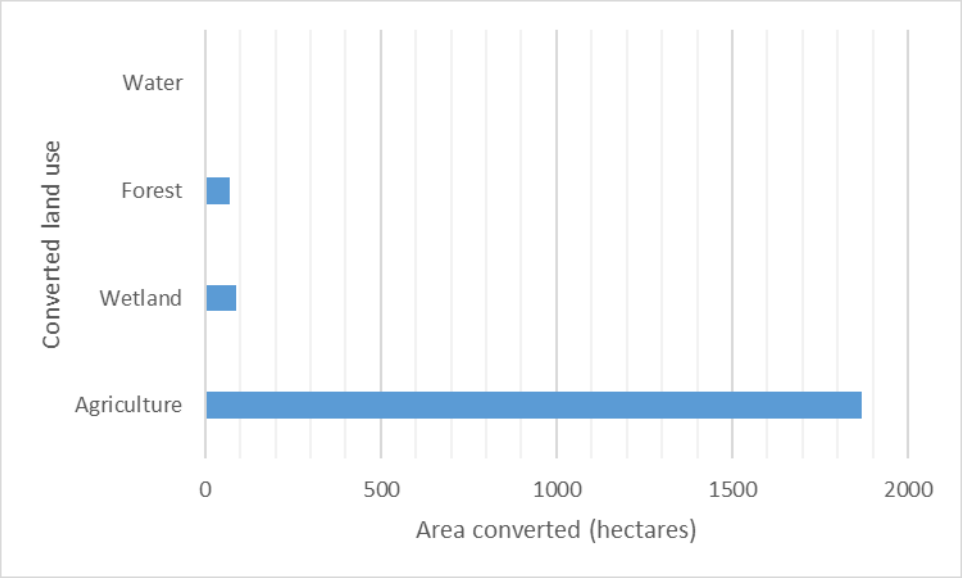

Figure 1. Land use conversion into built-up area in Iași city.

Analysing the land use classes that have contributed more to the conversion into built-up land, former agricultural areas have represented the arena of land trading since the last decade of the previous century, with 1790 hectares out of almost 1950 that were transformed into artificial surface. This represents the result of the land restitution to private owners, who chose to sell their lots rather than investing into agriculture. It could be easily observed that the most traded areas are located in the southwestern as well as in the western parts of the city. Most of these converted lots tend to form clusters in the vicinity of main roads and extend along them, linking the urban core with adjacent rural

municipalities, which recorded spectacular increases in terms of population. The high availability of this type of land and the ease of conversion compared with the wetlands (less than 90 hectares converted into urban land), forests (70 hectares that were adjacent to the border of the built-up area in 1990) or water, which is impossible or requires major investments for conversion into built-up land. It is a high probability that the above mentioned surface areas may differ as a result of different pixel classification as well as the technology of surface generalisation of Corine Land Cover data.

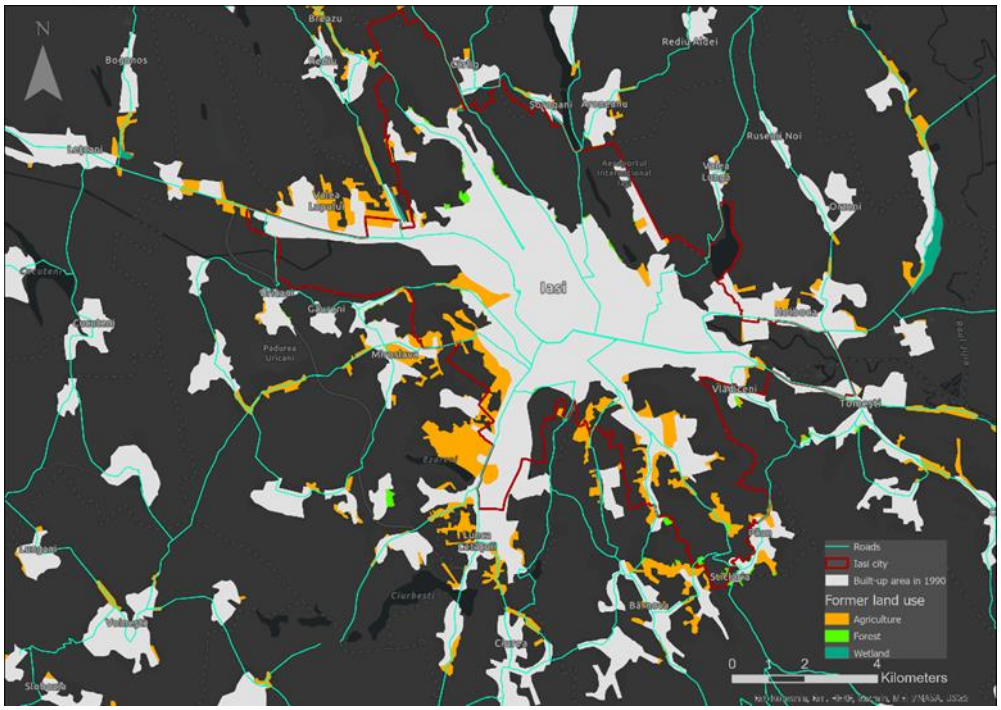

Figure 2. Former land use in 1990 which transformed into built-up land in 2006.

Table 1. Variables used in the Multi-Layer Perceptron (MLP) neural network.

Model	Accuracy (%)	Skill measure	Influence order
With all variables	60.84	0.4778	N/A
Proximity to roads	60.61	0.4748	6 (least influential)
Agriculture land transition potential	55.23	0.4031	4
Overall transition potential	35.09	0.1346	1 (most influential)
Proximity to built-up area	60.45	0.4727	5
Forest transition potential	53.79	0.3838	3
Digital Elevation Model	51.96	0.3594	2

The above table accounts for the variables included in the Multi-Layer Perceptron (MLP) neural network, which is used in the training of the model in order to prepare it for the possible outputs in terms of prediction. Based on the changes recorded by land use classes (which are the dependent variables) between 1990 and 2006, the neural network is able to make connections by assessing the transition potential for each raster cell. Therefore, each explanatory variable is evaluated and gets assigned a rank, depending on its role and importance in determining a land use change into urban. Several models (over 15) were

run by including and excluding variables in order to obtain the best accuracy (60.84% in this case).
As expected, the transition potentials computed by the MLP based on the land use data from 1990 and 2006 represent the base of the model training, ranking 1, 3 and 4 within the explanatory variables. The absence of only one of these 3 variables could reduce the overall accuracy of the model with 5 to 25 percent. The transition potentials were calculated by analysing the trends of change recorded by land use cells that experienced conversion into built-up land, considering the values of the neighbourhood as well in order to gain spatial coherence for the possible outputs that will be generated. Trends of potential transition were generated for the other variables, the most notable influence being exerted by the Digital Elevation Model, which is relevant in explaining the patterns of urban sprawl depending on the particularities of the terrain. Even if the roads have guided the directions of urban growth, their proximity have the lowest influence in this process because of the lower availability of land bordering them, spatial patterns of built-up area tending to scatter chaotically further from roads, in undeveloped and inaccessible sites, which lack basic infrastructure in terms of transport and utilities due to the inexistent spatial management. The lack of spatial coherence is also proven by the low influence of the proximity to the built-up area.

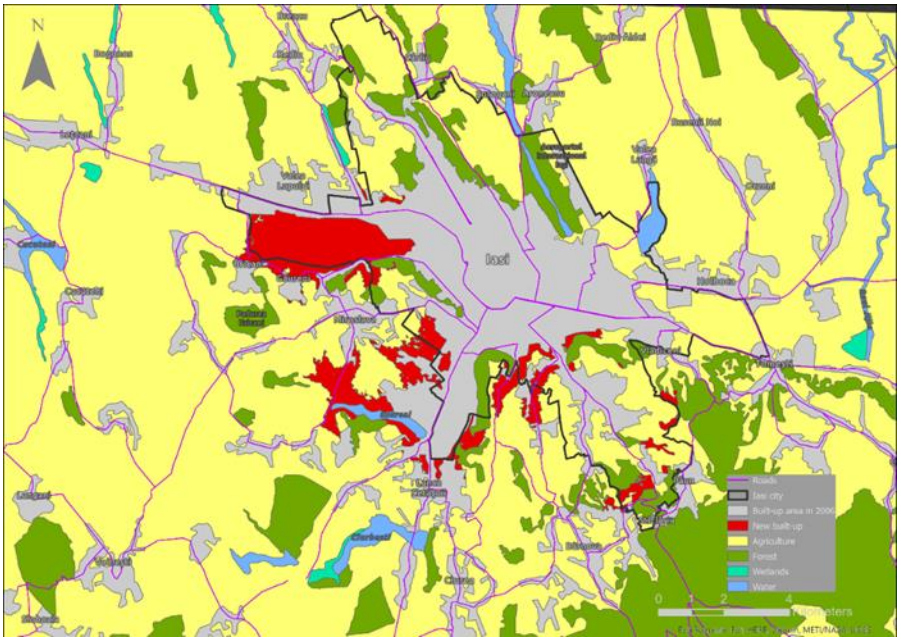

Figure 3. Predicted urban sprawl for 2030.

The land use prediction results for 2012 has revealed quite accurate results of built-up area expansion in the vicinity of the existent urban core in 2006. More precisely, it has performed the best accuracy in predicting expansion into the gaps of the built-up space (either between the urban and rural surface or inside rural areas), which have been reported as filled by the model, overlapping the 2012 land cover data. However, it showed modest results in predicting growth in some areas, focusing its highest potential in the western suburban area, which tended to be overestimated. Overall. The estimated built-up area was 4.5% higher than in reality. Therefore, the prediction for 2030 depicts a considerable growth in this direction, which might be confirmed by the ongoing and future private developments into industrial platforms and also the announced public

investments into a new road that will improve the accessibility. The other categories of land use changes have been considered by the model but haven't recorded considerable amounts of conversion, as confirmed by the land use data (differences between 1-5%).
As it could be seen in the map that was generated for the year 2030, the city will continue to expand in areas that were formerly occupied by land for agriculture. The model predicts that the scattered pattern will perpetuate and the competition for the undeveloped lots of arable land between already built sites will intensify due to the increasing demand for land for buildings. As a result, the suburban land will become a contiguous extended area. Therefore, rural municipalities in the southern, western and southwestern parts will be completely absorbed by the city, even though they present completely different features, landscape and facilities.
The role of the roads in suburbanisation is also confirmed in this case as two stripes of potential development are identified in the southern part of the city, extending over the administrative limit of Iasi municipality by following the transport routes. In the south of Miroslava village, the built-up area is sprawling along the road and scatters on multiple sides, connecting in the end with three other rural settlements. This case is relevant to be mentioned as this type of suburbanisation process is displayed completely outside the urban area, questioning the availability of land lots in the proximity of the urban core in the southern, western and southwestern parts.
One of the limitations of the model is that it may concentrate the highest transition potential on some areas, focusing on the territories with high suitability as in the case of the western part of the city, in the vicinity of Valea Lupului municipality, where a large portion of flat agriculture land was identified. Therefore, other areas (for example, the northwestern part of the city) which recorded a high pace of development between 1990 and 2006 has almost been neglected by the model.

CONCLUSION

Having all of the above considered, the CA-Markov model predicted a considerable amount of changes for the year 2030. Computed by accounting the trends of land use change to built-up area from 1990 to 2006 and then validated using the land use data from 2012, it offers an overview of the consequences implied by the lack of spatial management for suburban areas. Therefore, in order to prevent unsustainable urban development, public policies especially designed for these emerging territories must be enacted.
As the private investments in housing, industrial and commercial sites are continuously being developed due to the high demand, the weight center of population will tend to slide to the southwest, while the weight center of the facilities will stagnate if no action from local authorities is taken in order to anticipate these movements. The people that will inhabit the sites foreseen by the model will need to depend on the city's facilities as health and educational services, leisure activities or even daily needs (groceries or other types of shops). In a society where the tendency to the 15-minute city is becoming more clearly visible, pointing on the necessity of reaching a wide range of facilities within 15-minute walking or cycling from the resident's home, the suburbs are not able to provide these facilities without the intervention the authorities or the collaboration between them and private actors. Moreover, these territories currently lack pedestrian amenities, therefore the use of personal cars is indispensable, leading to an increasing pressure on the road network. The pressure is also exerted on the utilities networks, which are limited and cannot satisfy the increasing demand without prior investments. The actual situation

shows that buildings are built before connection to utilities. If this process continues its unsustainable path, it will likely become impossible for the new areas to benefit from these amenities in the near future.
The expansion of the built-up area in the vicinity of the forests is forecasted by the CA-Markov model for 2030. As the ratio between artificial and natural surfaces is constantly increasing, environmental policies are fundamental to protect the forests and to encourage the implementation of green belts, which will also prevent the urban sprawl as well as the risk of landslides.
As the suburbs are disposed between the city and the surrounding rural municipalities and the model predicts a contiguous rural-urban territory, the collaboration between local authorities should become a priority in order to elaborate mutual policies that will harmonize the development of the territory in order to achieve the sustainability of suburban areas.

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REGULATION OF STREAMS IN THE SKOPJE REGION WITH MEASURES FOR REGULATION AND REHABILITATION OF THE RIVER BEDS

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ABSTRACT

The hydrography in the Skopje valley consists of several springs with Rasce and Studenciste as the most characteristic, and the river Vardar with its tributaries Treska, Markova Reka, and Kadina Reka on the right and Lepenec, Serava, and Pchinja on the left. This research identified an additional 115 streams in the appropriate classification of rivers, drainage canals, and torrents that are grouped and analyzed according to their river basin. Geographical, cartographic, hydrographic and methods of geographical information systems have been used, from which appropriate documentation has been prepared in vector form of the entire river and network of torrents. It is created in a geo-referenced model, whereas a referenced background is used from a raster topographic map with a scale of 1: 25000. The documentation process in the next phase of the research identifies the forms of the existing regulation of the recorded streams and river beds in an appropriate classification. Following the process of recording the hydrographic facilities and the forms of their regulation, recommendations for regulation and rehabilitation of specifically defined zones of the riverbeds in the Skopje region are defined. The synthetic materials, thematically, are presented in cartographic and tabular form with a textual explanation.

Keywords: streams, regulation, Skopje, GIS

INTRODUCTION

The Skopje Region is located in the northern part of the RN Macedonia. It covers the territory of the Skopje valley. To the north it stretches to the state border with Kosovo, to the east it borders the Kumanovo and Ovce Pole valleys, to the south it stretches along the heights of the mountain branch Goleshnica, and to the west along the heights of the mountains Karadzica, Suva Gora and Zeden. More specifically, the Skopje valley covers the territory, which is limited by the waterline along the mountains: Goleshnica, Karadzica, Suva Planina, parts of Suva Gora, and Zeden (the border intersects the Matka canyon on the river Treska near the newly built dam Kozjak) on the right side of Vardar, and then through the Dervenska Gorge of Vardar through the water section of Shar Mountain (via the gorge of the river Lepenec), Skopska Crna Gora and Gradishtanska Mountain joins the water section along the mountain Goleshnica near the confluence of the river Pchinja in Vardar in the Taorska Gorge. Within this framework, the valley covers

1,924.2 km2. According to the administrative-territorial division, the Skopje Region covers a territory of 1,814.54 km2 or 7% of the territory of RN Macedonia.
The relief of the Skopje valley consists of two major morphostructural forms, namely the mountains that limit the valley and the plain of the Skopje valley. It is about the mountain massifs Skopska Crna Gora in the north and northeast, which rises to about 1600 m asl (Ramno peak, 1658 m asl), mountain Gradishtanska Planina in the east (Venec 853 m asl. c.), the mountain Kitka (Kitka, 1589 m asl), the mountain Goleshnica (Lisec, 1935 m asl), mountain Mokra Planina with peak Solunska Glava 2539 m asl. from the south, the mountain Karadzica (Milenkov Kamen 2217 m asl), Suva Planina with Vodno (Krstovar, 1066 m asl), parts of the mountain Suva Gora (Tabahon 1748 m asl), mountain Zeden (Golem Zeden 1259 m asl) and lower branches of the mountain Shar Planina. The relative altitude of the relief in the Skopje valley ranges from 150-2540 m. The relative altitude of the plains is 150-300 m. Therefore, in a hypsometric sense, the relief in the Skopje valley consists of 344.0 km2 of plains, 778.9 km2 of hilly relief, and 801.3 km2 of typical mountain relief. The flats in the Skopje region are mainly spread in the Skopje Field (on the move from Gjorce Petrov, Aracinovo, Miladinovci, Katlanovo, Dracevo and the foot of Vodno). In the lower parts of the mountains (Skopska Crna Gora, Kitka, Goleshnica, Karadzica, Suva Gora with Osoj, Zeden, and Shar Planina up to about 750 m) there is a hilly relief, and in the higher parts (mainly over 750 m) there is a typical mountain relief.
The climate in the Skopje valley is characterized by an average annual temperature of 12.20C, an average annual rainfall of 515 mm, average annual sunshine of 2101 sunny hours, and, average relative humidity of 70%. According to these characteristics, in the plain part of the Skopje valley, there is a continental climate with mild Mediterranean influences. In the higher mountainous areas (Mokra Planina, Karadzica, Goleshnica, Skopska Crna Gora, and others) the climate is changing and there is a typical mountain climate.
The hydrography in the Skopje valley consists of several springs with Rasce (from which Skopje is supplied with water) and Studenciste (in the Matka canyon) as the most characteristic, and the river Vardar with its tributaries Treska (with the Fush tributary), Markova Reka and Kadina Reka on the right and Lepenec, Serava and Pchinja on the left. In the southeastern parts of Skopsko Pole, there are territories with high groundwater and accordingly the presence of wetlands (Aracinovo Swamp, Katlanovo Swamp) due to which several drainage canals have been built. In the Skopje Region, there are several accumulations, the most important of which are the accumulations Kozjak, Sv. Petka and Matka. It is rare that near Skopje there are several larger springs such as Rasce, Vrelo, and others.

METHODOLOGY

For the needs of the research regarding the regulation of streams in the Skopje Region, the following methods were used: geographical, cartographic, hydrographic, and geographical information systems.
By applying the stated methods, appropriate documentation for the territory of the Skopje Region has been prepared. A vector form of the entire network of rivers and springs is created in a geo-referenced model, whereas a substrate (from which information on the position and length of the subjects is predominantly drawn) is used Raster from a topographic map with a scale of 1: 25000 [1]. The synthetic materials, thematically, are presented in cartographic and tabular form with a textual explanation.

In the publication in the international journal Geografie, the analyzed are maximum, average, and minimum monthly flows of 13 natural watercourses in RN Macedonia, including HS Krusha on Kadina Reka [2]. According to the standard methodology using the Mann-Kendall test and the Sen's test. With this, the systemic results of the climate change in the Skopje Region of the only watercourse, which is included in the FFR group. Besides this stream, the Lepenec River belongs to the same group, without significant human influence on the water regime.

This research problem also aroused interest in interdisciplinary cooperation based on which several studies have been prepared and published that touch on the state of river flows and their need for regulation [3], [4], [5], [6]. For the needs of this paper, two strategic documents issued in 2017 were consulted as an already conducted studies regarding the erosion and action plan for the city of Skopje [7] and the establishment of green corridors along the rivers Serava and Lepenec [8].

In addition to the passive and active measures by the OECD recommendations and the chapter on North Macedonia published in Springer, it is crucial to increase the level of knowledge on the issue, free and open-source meteorological and hydrological data for the scientific community, more funding by the state in the field of hydrology and water management, restarting the existing and inactive and establishing new measuring stations by the HMA, which will provide timely and accurate results, which will be publicly available [9]. Although the annual coefficient of runoff in the nearby catchments is 23%, the daily extreme precipitation could be an extraordinary hydrological event as happened in Stajkovci, Skopje Region, significantly rising the surface runoff [11]. The modern used techniques are 3D printing of the extreme hydrological events about the different return periods [11].

CLASSIFICATION OF STREAMS IN THE SKOPJE REGION

The network of rivers in the Skopje region belongs to the river basin of the river Vardar, where it receives 5 major tributaries. Three of them flow from the right side: Treska, Markova Reka, and Moranska Reka, and two from the left: Lepenec and Serava. Here, especially downstream from Skopje to the entrance to the Taorska Gorge, due to the deposited material, the flow of Vardar is slow, and the riverbed has a curved shape, where except bends, meanders are also present.

The research identified an additional 115 streams in the appropriate classification of rivers, drainage canals, and torrents that are grouped and analyzed according to their river basin (with Vardar as the main recipient and on the level of its subsets) in the following order:

1. Vardar (id: 100);
   - a) Upper Vardar,
   - b) Vodno torrents,
   - c) Kisela Voda - Dracevo,
   - d) Skopsko Pole,
   - e) Skopska Crna Gora.
2. Treska (id: 200);
3. Lepenec (id: 300);
4. Serava (id: 400);
5. Markova Reka (id: 500);

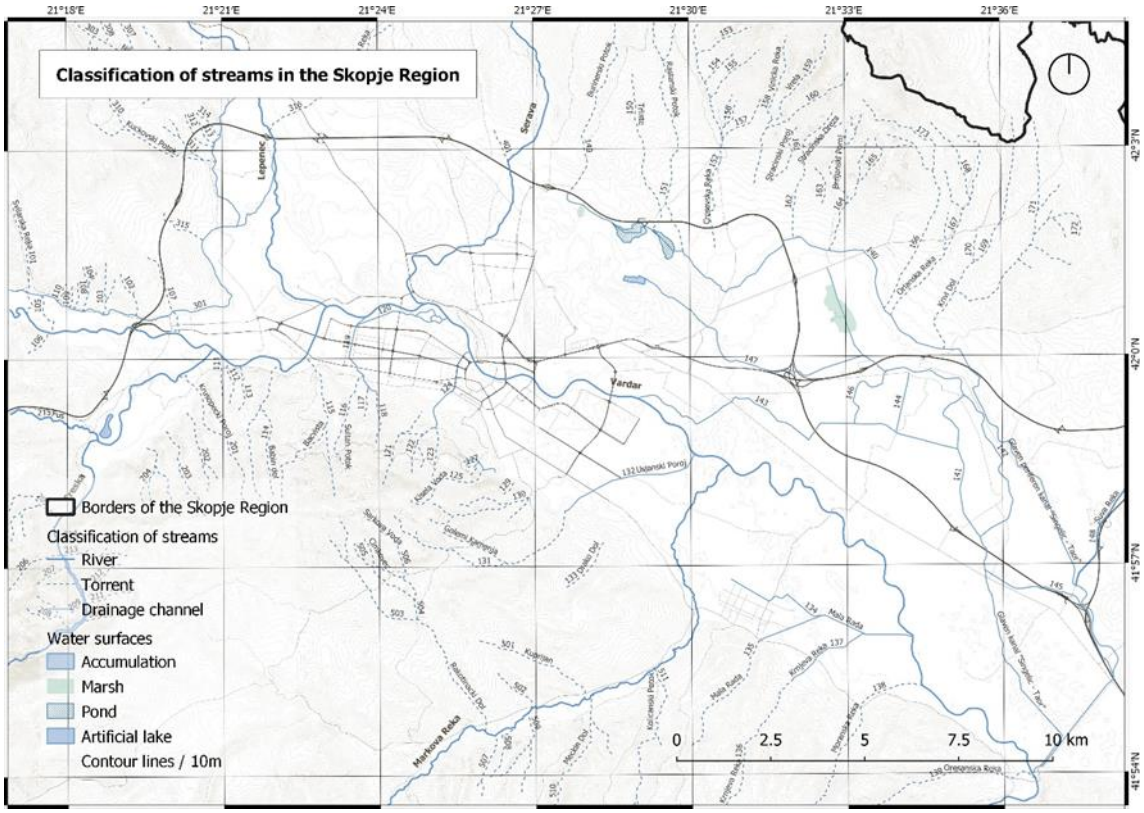

Figure 1. Classification and names of the streams in the Skopje Region.Data source: Agency for real estate cadastre. Topographic map 1:25000. sheets (681-4-3.; 681-4-4.; 682-3-3.; 731-2-1.; 731-2-2.; 732-1-1.) Skopje, AREC, 2004;

Transferred to an appropriate spreadsheet, each hydrographic unit representing a separate river basin, has its id number where the first number assigns the affiliation to a river basin (100) and the other 2 are ordinal numbers (102).

Consequently, a database is created as operational documentation through direct cartographic processing in which the following characteristics are developed for each of the registered hydrographic objects:

- id number that expresses their affiliation and order,
- Type of stream according to the classification,
- Name of the stream recorded from the cartographic substrate or the literature,
- River basin to which they belong,
- Subset to which they belong more specifically, and
- Stream length expressed in kilometers (km), obtained by digital processing

This structured database is tabularly processed and presented for each of the listed river basins and subsets for which physical distribution (length) separate and aggregate data are obtained.

The table shows the main streams of the river basins in the Skopje region and their lengths within the region. Consequently, the network of streams is elaborated for each river basin separately.

Table 1. Main streams of the river basin in the Skopje Region

id	Type	Name of the stream	Stream length in km (in the study area)	Stream starting point	Streams endpoint
100	River	Vardar	42.19	42° 0'42.93", 21° 16'54.06"	41° 53'32.13", 21° 35'42.78"
200	River	Treska	10.44	41° 57'8.409", 21° 17'54.31"	42° 0'8.156", 21° 20'50.22"
300	River	Lepenec	10.65	42° 4'59.20", 21° 20'14.78"	42° 0'44.90", 21° 23'0.559"
400	River	Serava	11.10	42° 4'58.02", 21° 26'31.82"	42° 0'47.24", 21° 24'51.42"
500	River	Markova Reka	16.78	41° 53'31.60", 21° 24'2.581"	41° 58'26.68", 21° 30'44.37"

1) Vardar

Vardar is the largest and most important river in RN Macedonia. It springs from a karst spring near the village Vrutok in the southwestern part of the Polog Valley at the foot of the mountain Shar Planina at an altitude of 683 m. It leaves our country near Gevgelija at an altitude of 43 m and flows into the Aegean Sea. The total length of the river is 388 km, of which 301 km belong to our country where it covers a river basin of 20,535 km2. Of the total length of the Vardar valley, two-thirds (207 km) is flat, and one-third (94 km) is a gorge valley. Through our country, it flows through five valleys and four gorges, including the Skopje valley where its length is 51km.

Within this research, the riverbed of the river Vardar is documented in a length of 42.19 km, with a starting point from the inflow of the Svilarska River in Vardar (near the village Dolno Svilare) in the west to the inflow of the Main Peripheral Canal "Singjelic - Taor" in Vardar near the village of Taor in the south-east. At that length, the river Vardar is a river basin of 73 streams (excluding the rivers Treska, Lepenec, Serava, and Markova Reka), which are classified according to their geographical-hydrographic unit and are divided into the following subsets: Upper Vardar, Vodno torrents, Kisela Voda - Dracevo, Skopsko Pole and Skopska Crna Gora.

Table 2. Classification of the Vardar river basin streams in the Skopje Region.

id	Type	Name	River basin	Subset	Length (km)
101	Torrent	Svilarska Reka	Vardar	Upper Vardar	3.22
102	Torrent		Vardar	Upper Vardar	1.42
103	Torrent		Vardar	Upper Vardar	2
104	Torrent		Vardar	Upper Vardar	1.77
105	Torrent		Vardar	Upper Vardar	1.19
106	Torrent		Vardar	Upper Vardar	0.81
107	Torrent		Vardar	Upper Vardar	2.38
108	Torrent		Vardar	Upper Vardar	0.8
109	Torrent		Vardar	Upper Vardar	0.58
110	Torrent		Vardar	Upper Vardar	0.54
		Total		**Upper Vardar**	**14.71**
111	Torrent	Krusopecki Poroj	Vardar	Vodno torrents	1.08
112	Torrent	Krusopecki Poroj	Vardar	Vodno torrents	1.16

113	Torrent	Krusopecki Poroj	Vardar	Vodno torrents	1.29
114	Torrent	Babin Dol	Vardar	Vodno torrents	6.57
115	Torrent	Bacvista	Vardar	Vodno torrents	6.71
116	Torrent	Sultan Potok	Vardar	Vodno torrents	2.72
117	Torrent	Trnodol	Vardar	Vodno torrents	0.73
118	Torrent	Kamen Dol	Vardar	Vodno torrents	1.33
119	Drainage canal	Western Vodno	Vardar	Vodno torrents	2.29
120	Drainage canal		Vardar	Vodno torrents	4.22
121	Torrent	Murtinec	Vardar	Vodno torrents	2.96
122	Torrent	Gornodnjanski Poroj	Vardar	Vodno torrents	2.12
123	Torrent	Gornodnjanski Poroj	Vardar	Vodno torrents	1.31
124	Drainage canal	Gornodnjanski Poroj	Vardar	Vodno torrents	2.59
125	Torrent	Kisela Voda	Vardar	Vodno torrents	2.55
126	Drainage canal	Eastern Vodno series	Vardar	Vodno torrents	0.89
127	Torrent	Przino	Vardar	Vodno torrents	0.73
128	Torrent	Przino	Vardar	Vodno torrents	0.39
129	Torrent		Vardar	Vodno torrents	0.41
130	Torrent		Vardar	Vodno torrents	5.95
		Total		**Vodno torrents**	**48.00**
131	Torrent	Golemi Kamenja	Vardar	Kisela Voda - Dracevo	8.31
132	Drainage canal	Usjanski Poroj	Vardar	Kisela Voda - Dracevo	3.96
133	Torrent	Drako Dol	Vardar	Kisela Voda – Dracevo	1.57
134	Drainage canal	Mala Rada	Vardar	Kisela Voda – Dracevo	7.18
135	Torrent	Mala Rada	Vardar	Kisela Voda – Dracevo	3.83
136	Torrent	Krnjeva Reka	Vardar	Kisela Voda – Dracevo	5.29
137	Drainage canal	Krnjeva Reka	Vardar	Kisela Voda – Dracevo	2.39
138	Torrent	Moranska Reka	Vardar	Kisela Voda – Dracevo	5.72
139	Torrent	Oresanska Reka	Vardar	Kisela Voda – Dracevo	5.88
		Total		**Kisela Voda – Dracevo**	**44.13**
140	Drainage canal	Main peripheral canal	Vardar	Skopsko Pole	28.46
141	Drainage canal	Main canal	Vardar	Skopsko Pole	17.29
142	Drainage canal		Vardar	Skopsko Pole	4.78
143	Drainage canal		Vardar	Skopsko Pole	10.17
144	Drainage canal		Vardar	Skopsko Pole	1.6
145	Drainage canal		Vardar	Skopsko Pole	5.06
146	Drainage canal		Vardar	Skopsko Pole	2.31
147	Drainage canal		Vardar	Skopsko Pole	7.15
148	River	Suva Reka	Vardar	Skopsko Pole	9.07
149	Torrent	Burinerski Potok	Vardar	Skopsko Pole	5.17
		Total		**Skopsko Pole**	**85.89**
150	Torrent	Trliste	Vardar	Skopska Crna Gora	4.55
151	Torrent	Rastanski Potok	Vardar	Skopska Crna Gora	8.2
152	Torrent	Cresevska Reka	Vardar	Skopska Crna Gora	6.81
153	Torrent	Straska Reka	Vardar	Skopska Crna Gora	1.7
154	Torrent		Vardar	Skopska Crna Gora	1.09
155	Torrent		Vardar	Skopska Crna Gora	1.88
156	Torrent		Vardar	Skopska Crna Gora	1.9

157	Torrent		Vardar	Skopska Crna Gora	1.63
158	Torrent	Vinicka Reka	Vardar	Skopska Crna Gora	4.23
159	Torrent	Vrela	Vardar	Skopska Crna Gora	3.21
160	Torrent		Vardar	Skopska Crna Gora	2.82
161	Torrent	Stracinski Poroj	Vardar	Skopska Crna Gora	1.73
162	Torrent	Stracinska Dreza	Vardar	Skopska Crna Gora	5.24
163	Torrent		Vardar	Skopska Crna Gora	1.09
164	Torrent	Brnjarski Poroj	Vardar	Skopska Crna Gora	5.24
165	Torrent		Vardar	Skopska Crna Gora	3.6
166	Torrent		Vardar	Skopska Crna Gora	6.52
167	Torrent	Orlanska Reka	Vardar	Skopska Crna Gora	6.13
168	Torrent		Vardar	Skopska Crna Gora	4.8
169	Torrent	Krivi Dol	Vardar	Skopska Crna Gora	7.89
170	Torrent		Vardar	Skopska Crna Gora	0.86
171	Torrent		Vardar	Skopska Crna Gora	6.28
172	Torrent		Vardar	Skopska Crna Gora	5.66
173	Torrent		Vardar	Skopska Crna Gora	3.32
		Total		**Skopska Crna Gora**	**101.55**
		Total (km)	**Vardar**		**294.28**

2) Treska

The river Treska is a right tributary of the Vardar. Its total length is 132 km, and the river basin covers 2,350 km2. The springs of Treska are Elovechka Reka, on the eastern side of the mountain Stogovo and Belichka Reka on the northern slopes of the mountain Ilinska Planina. The stream of Treska starts near the village Izvor in the Kichevo region. Through the Kichevo valley the river is called Golema Reka, and through Porece, Velika Reka. It is called Treska from the village of Zdunje to Skopje. Along the stream from Zdunje to the Skopje valley, in a length of 28 km, Treska flows through a steep canyon in which is the artificial lake Kozjak, formed by the dam built-in 2005. At the entrance to the Skopje valley, there is the artificial lake Matka created by the dam built-in 1937. Treska is flowing into the river of Vardar in the settlement Gjorce Petrov in the western part of Skopje.

Within this research, the riverbed of the river Treska is documented in a length of 10.44 km, with a starting point from the accumulation "Matka" of the Hydropower Plant Matka in the south to the confluence of the river Vardar near the village Krushopek and sports and recreation center Saraj. At that point, the river Treska is a river basin of 15 recorded streams.

Table 3.Classification of the Treska river basin streams in the Skopje Region.

id	Type	Name	River basin	Length (km)
201	Torrent	Krusopecki Poroj	Treska	4.62
201	Torrent	Krusopecki Poroj	Treska	4.62
202	Torrent		Treska	2.96
203	Torrent		Treska	2.91
204	Torrent		Treska	4.34
205	Torrent		Treska	4.05
206	Torrent		Treska	1.79
207	Torrent		Treska	0.88
208	Torrent		Treska	2.27
209	Torrent		Treska	0.36
210	Torrent		Treska	0.78
211	Torrent		Treska	2.17
212	Torrent		Treska	1.26
213	Torrent		Treska	3.17
214	Torrent		Treska	0.76
215	River	Fus	Treska	2.98
		Total (km)	**Treska**	**35.3**

3) Lepenec

The river Lepenec is formed in Kosovo by two rivers: Tisova Reka and Cerenacka Reka, whose spring areas are at an altitude of 1125 m, ie 1858 m, below the Shar Planina massif. It has a length of 75 km and extends over the territories of Kosovo (2/3 of the river basin) and North Macedonia (1/3 of the river basin). The river forms the border between the two countries in a length of 5 km. Within the Macedonian borders, the river basin of the river Lepenec extends to the northern part of the Skopje valley in a length of 15 km. It flows into the river Vardar near the Skopje settlement Zlokukjani at an altitude of 262 m. The river basin, up to the inflow into the river Vardar, is covering 770 m2 and the average height is 955 m asl. The river Lepenec in North Macedonia flows in a typical flat terrain where it leaves all sedimentary materials and creates a changeable bed that often meanders, especially before and after the village of Orman.

The riverbed of the river Lepenec is documented in a length of 10.56 km, with a starting point near the villages Orman and Nikishtane in the north to the inflow into the river Vardar. On that stretch, the river Lepenec is a river basin of 17 recorded watercourses with a total length of 48.28 km.

Table 4. Classification of the Lepenec river basin streams in the Skopje Region

id	Type	Name	River basin	Length (km)
301	Drainage canal		Lepenec	11.86
301	Drainage canal		Lepenec	11.86
302	Drainage canal		Lepenec	5.83
303	Torrent	Nikustanska Reka	Lepenec	5.32
304	Torrent		Lepenec	1.98
305	Torrent		Lepenec	1.35
306	Torrent		Lepenec	0.96
307	Torrent		Lepenec	1.37
308	Torrent		Lepenec	0.82

310	Torrent	Kuckovski Poroj	Lepenec	6.76
311	Torrent		Lepenec	1.97
312	Torrent		Lepenec	1.28
313	Torrent		Lepenec	0.76
314	Torrent		Lepenec	0.99
315	Torrent		Lepenec	1.44
316	Torrent	Banjanska Reka	Lepenec	4.85
317	Torrent		Lepenec	0.74
		Total (km)	**Lepenec**	**48.28**

4) Serava

The river of Serava is a left tributary of Vardar in the Skopje valley. The river basin extends on the southern slopes of the central area of the mountain Skopska Crna Gora and part of the Skopje valley. It is formed by two streams, which spring are at the peaks of Skopska Crna Gora, Jazirska Reka, northeast of the village Ljuboten at an altitude of 1500 m, and Radiski Potok which is formed by three streams: Pobushka, Turcevska and Ljubanska Reka, whose springs are located in the localities Przar and Crni Kamen at an altitude of 1300 m. All streams unite under the village of Ljubanci and form the Radishka River. After leaving the village of Radishani, the river enters the flat and fertile valley of Butelsko Pole and changes its name to the river Serava. Serava passes through Topaansko Pole and flows into the Vardar River just below the Ilinden Barracks to the south. Following river regulations, the river basin covers 94.5 km2. Serava in Vardar flows at an altitude of 243 m, and its total length is 21 km.

Within this research, the riverbed of the river Serava is documented in a length of 11.1 km, with a starting point north of the village Radishani in the north to the inflow of the river Vardar. In this move, Serava is regulated by a canal and is not a catchment area for any watercourse.

5) Markova Reka

Markova Reka is a right tributary of Vardar. It springs under the peak Ubava on Karadzica mountain at an altitude of 1,400 m, and it flows into Vardar between the villages of Gorno and Dolno Lisice at an altitude of 231 m. It is 29 km long and covers a river basin of 352 km2 and a slope of 1,169 m or 40 ‰. Its main tributary is Patishka Reka which sinks under the village Patishka Reka, so in its lower course, it is known as Suva Reka.

Within this research, the riverbed of Markova Reka is documented in a length of 16.78 km, with a starting point near the monastery Markov Manastir and the village of Markova Susica in the southwest to the inflow in the river Vardar between the villages of Gorno and Dolno Lisice in the north-east. On that move, Markova Reka is a river basin of 11 recorded streams.

Table 5. Classification of the Markova Reka river basin streams in the Skopje Region

id	Type	Name	River basin	Length (km)
501	Torrent	Kurpijan	Markova Reka	3.46
502	Torrent	Lokva Popova	Markova Reka	1.48
503	Torrent	Rakotinacki Dol	Markova Reka	8.51
504	Torrent	Cimkovec	Markova Reka	2.93
505	Torrent		Markova Reka	2.41
506	Torrent	Sarkova Voda	Markova Reka	2.2
507	Torrent		Markova Reka	1.91

508	Torrent		Markova Reka	1.69
509	Torrent		Markova Reka	3.6
510	Torrent	Meckin Dol	Markova Reka	4.95
511	Torrent	Kolicanski Potok	Markova Reka	5.87
		Total (km)	**Markova Reka**	**39.01**

REGULATED STREAMS IN THE SKOPJE REGION

Due to the specific genesis of the great waters with a coincidence of the flood waves in Upper Vardar, Treska, and Lepenec, Vardar very often flooded the city of Skopje. The greatest floods occurred in 1778, 1858, 1876, 1895, 1903, 1916, 1935, 1937, 1962, 1979. After the floods of 1895 and 1897, the then governor Hafus Mehmed-Pasha ordered the construction of defensive walls, which together with the development and expansion of the city were built. Such flood protection activities without other aesthetic and ecological aspects that would enrich the urban space, continued until 1937. The concept lasted until the great flood of 1962 when the need for a more studious approach to riverbed regulation emerged. The project for regulation of the riverbed of the river Vardar with a relatively successful hydro-technical conception was realized in the period 1970-1975. [12]

Apart from the floodwaters from the rivers, the cause of large floods and damage in the Skopje Region are the torrential floods. The great torrential flood was recorded in the 55s from the Krusopek torrent. Gornovodnjanski torrent constantly flooded houses in the lower part of the mountain Vodno. Mala Rada in the settlement of Dracevo, Strachinski Poroj, a river of Serava, and other streams also caused great damage in the area of the city of Skopje and the Skopje region. After the Second World War, exactly after the biggest floods in the XX century, caused by the torrents from Vodno, activities for intensive control of the erosion of the mountain Vodno started and they are realized in the second half of the XX century. The last major torrential floods occurred in 1951 when there was one dead case, many injured, and significant property damage. The measures taken after this catastrophe include afforestation, repair of the old ones, and construction of new drainage canals in the Vodno mountain. In recent history, the city of Skopje was affected by the storm on August 6, 2016, which led to a huge torrential flood in the northeastern part of the city, where part of the foothills of Skopska Crna Gora, including part of Skopsko Pole were most affected by the flood. Various inappropriate human activities (inappropriate urbanization, construction of facilities in the area of risk, usurpation of agricultural land, illegal logging on the mountain, engineering errors related to the Skopje ring road, absence or lack of activities of competent institutions for protection against erosion and torrents or activities during the occurrence of the danger - the event) significantly contributed to the magnitude of the damage. [7]

Such intensity of historical and recent disasters justifies the objectives of this research to create detailed documentation of the current situation of the regulated streams which conclusions will be drawn for further in-depth studies as a basis for future technical actions.

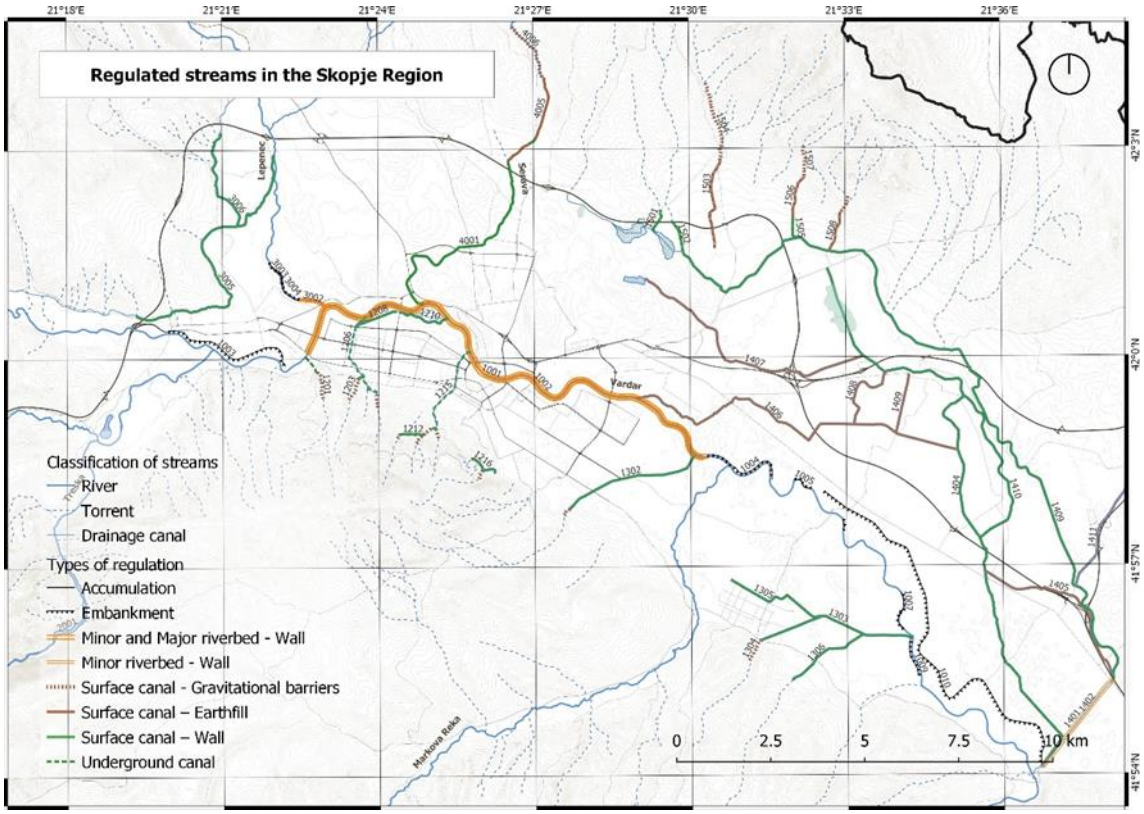

Figure 2. Regulated streams in the Skopje Region.
Data source: Agency for real estate cadastre. Topographic map 1:25000. sheets (681-4-3.; 681-4-4.; 682-3-3.; 731-2-1.; 731-2-2.; 732-1-1.) Skopje, AREC, 2004;

The documentation process of this phase of the research identifies the forms of the existing regulation of the recorded streams in an appropriate classification. Analyzed and grouped according to their river basin (with Vardar as the main recipient and on the level of its subsets) the forms and conditions of regulation are presented in the following order:
1) Vardar (id: 1000);
- a. Upper Vardar,
- b. Vodno torrents,
- c. Kisela Voda - Dracevo,
- d. Skopsko pole,
- e. Skopska Crna Gora.

2) Treska (id: 2000);
3) Lepenec (id: 3000);
4) Serava (id: 4000);
5) Markova Reka (id: 5000);

Transferred to an appropriate tabular representation, each hydrographic unit representing a separate river basin has its id number where the first number assigns the belonging to the river basin (1000), the second the assignment to the subsets (1100), and the last 2 are ordinal numbers (1002).

Consequently, a database is created as operational documentation through direct cartographic processing in which the following characteristics are developed for each of the registered hydrographic objects:
- **id** number that expresses their affiliation and order,
- **Type of stream** according to the classification,

- **Name of the stream** recorded from the cartographic substrate or the literature,
- **River basin** to which they belong,
- **Subset** to which they belong more specifically,
- **Type of regulation** observed in the field or the literature,
- **Regulation starting point**
- **Length of regulation** expressed in kilometers (km), obtained by digital processing,
- **Regulation endpoint**

This structured database is tabularly processed and presented for each of the listed river basins and subsets for whose condition and form of regulation separate and aggregate data are obtained.

1) Vardar

Capital interventions and forms of regulation have been performed on the riverbed of the river Vardar. Due to the capacity, it possesses as a hydrographic object, on a larger scope of its riverbed, a type of regulation is performed from the minor and major riverbed - a wall of stone and mortar. The length of this regulation is about 14 km on both sides of the riverbed, and it starts from the bridge at the former factory Kuprom in the Skopje settlement Hrom, passes through the entire city and central area, and, ends after the village Gorno Lisice.

Additional regulations in the form of an embankment as a defensive line are made in the western and eastern parts of the river Vardar in the Skopje region. An embankment was built on the left side of the river Vardar in the western part of the city which starts at the bridge between the settlement Gjorce Petrov and the settlement Saraj and as a defensive line meanders at different distances from the riverbed of Vardar to the end of the settlement Hrom. An identical regulation facility was built in the eastern zone of the Skopje Region, starting at the end of the regulation with the minor and major riverbeds near the village of Gorno Lisice and ending at the village of Taor.

Table 6. Forms of regulation of the river Vardar in the Skopje Region

id	Type	Name	Type of regulation	Length (km)	Regulation starting point	Regulation endpoint
1001	River	Vardar	Minor and Major riverbed - Wall	14.03	42° 0'4.662", 21° 22'38.49"	41° 58'33.31", 21° 30'14.07"
1002	River	Vardar	Minor and Major riverbed - Wall	14.18	42° 0'5.514", 21° 22'36.96"	41° 58'34.78", 21° 30'20.20"
1003	River	Vardar	Embankment	3.74	42° 0'23.47", 21° 19'57.93"	41° 59'53.46", 21° 22'10.27"
1004	River	Vardar	Embankment	2.34	41° 58'34.78", 21° 30'20.20"	41° 58'14.56", 21° 31'32.10"
1005	River	Vardar	Embankment	0.57	41° 58'14.75", 21° 31'59.42"	41° 58'7.313", 21° 32'18.51"
1006	River	Vardar	Embankment	0.32	41° 57'39.95", 21° 32'56.93"	41° 57'30.59", 21° 32'57.06"
1007	River	Vardar	Embankment	0.64	41° 56'37.13", 21° 34'3.295"	41° 56'18.40", 21° 34'1.660"
1008	River	Vardar	Embankment	0.55	41° 56'20.36", 21° 34'1.133"	41° 56'4.786", 21° 34'3.386"
1009	River	Vardar	Embankment	1.05	41° 55'57.66", 21° 34'14.25"	41° 55'25.54", 21° 34'23.16"

1010	River	Vardar	Embankment	11.34	41° 58'2.927", 21° 32'33.72"	41° 54'6.387", 21° 36'41.11"
	Total (km)	**Vardar**		**48.76**		

a) Upper Vardar

In the streams belonging to this part of the river basin of the river Vardar, no form of regulation has been identified.

b) Vodno torrents

Due to the already mentioned natural disasters and phenomena that caused damage in the past in this part of the Skopje Region, technical and constructive interventions were necessary to regulate most of the torrential water streams from Mount Vodno. In this subset 20 regulated watercourses are registered in appropriate classification and form of regulation. Their regulation dates back to the 50s and 60s of the XX century, based on the project documentation (forest reclamation works, barriers, and regulations) from Poroj Projekt - Skopje. (Blinkov, Trendafilov, Minchev, Peshevski, 2017) According to the location characteristics, the torrents are grouped in the following hydrographic units: western, central, and eastern Vodno torrent series.

In the western series, forms of regulation are observed in the following torrential water streams: Bachvishta, Trnodol, Sultan Potok, and Kamen Dol. The regulation of the torrents is performed in the form of surface canals made of stone in cement mortar, wherein the steep parts of the streams additionally are performed by vertical gravitational barriers of the same material. A part of the regulated torrent Bachvishta has a constructed and covered canal. The other torrents such as Trnodol, Sultan Potok, and Kamen Dol are connected to a drainage canal that collects the water from the torrents and conducts it underground through the settlements Kozle, Taftalidze, and Karposh into the river Vardar.

In the area of the central series of torrents, forms of regulation have been observed in the following torrential watercourses: Kapishtec, Murtinec, and Gornovodnjanski torrents. The regulation of the surface canals is performed on the same principle from stone to cement mortar, with gravity partitions at specific positions in the field. The waters of the whole torrential series are occupied by an underground collection canal and conducted to the river Vardar.

The area of the eastern series is formed by the regulated Usjanski torrent, which was dimensioned to accept all torrential watercourses from the eastern series. But due to an incompletely implemented project, the waters of this series (torrential watercourses from Priporski Dol) flow down the streets through the regulated surface canal

Table 7. Forms of regulation of the Vodno torrents as a part of the river basin of Vardar in the Skopje Region

id	Type	Name	Type of regulation	Length (km)	Regulation starting point	Regulation endpoint
1201	Torrent	Bacvista	Surface canal - Gravitational barriers	0.74	41° 59'26.77", 21° 22'55.76"	41° 59'48.44", 21° 22'48.85"
1202	Torrent	Bacvista	Covered canal	0.52	41° 59'48.44", 21° 22'48.85"	42° 0'1.884", 21° 22'35.40"
1203	Torrent	Sultan Potok	Surface canal - Gravitational barriers	0.63	41° 59'25.48", 21° 23'25.94"	41° 59'43.09", 21° 23'36.96"
1204	Drainage canal	Sultan Potok	Surface canal - Walls	0.15	41° 59'43.09", 21° 23'36.96"	41° 59'46.13", 21° 23'41.85"
1205	Torrent	Kamenov Dol	Surface canal - Gravitational barriers	0.4	41° 59'14.30", 21° 23'59.42"	41° 59'32.80", 21° 23'57.32"
1206	Drainage canal	Western Vodno series	Covered canal	2.29	41° 59'32.80", 21° 23'57.32"	42° 0'27.81", 21° 23'34.07"
1207	Drainage canal	Western Vodno series	Surface canal - Walls	0.36	42° 0'27.81", 21° 23'34.07"	42° 0'35.81", 21° 23'45.10"
1208	Drainage canal	Western Vodno series	Surface canal - Walls	1.05	42° 0'27.81", 21° 23'34.07"	42° 0'40.44", 21° 24'16.32"
1209	Drainage canal	Western Vodno series	Covered canal	0.29	42° 0'40.44", 21° 24'16.32"	42° 0'39.39", 21° 24'28.93"
1210	Drainage canal	Western Vodno series	Surface canal - Walls	1.32	42° 0'39.39", 21° 24'28.93"	42° 0'34.72", 21° 25'20.14"
1211	Torrent	Murtinec	Surface canal - Gravitational barriers	0.14	41° 58'51.90", 21° 24'21.87"	41° 58'54.89", 21° 24'25.38"
1212	Torrent	Murtinec	Surface canal - Walls	0.63	41° 58'54.89", 21° 24'25.38"	41° 58'54.71", 21° 24'52.08"
1213	Torrent	Gornodnjanski Poroj	Surface canal - Gravitational barriers	0.56	41° 58'47.61", 21° 24'44.06"	41° 58'59.70", 21° 25'1.294"
1214	Torrent	Gornodnjanski Poroj	Surface canal - Gravitational barriers	0.3	41° 58'49.11", 21° 25'8.650"	41° 58'58.57", 21° 25'6.218"
1215	Torrent	Central Vodno series	Covered canal	2.59	41° 58'58.57", 21° 25'6.218"	42° 0'5.468", 21° 25'45.69"
1216	Torrent	Kisela Voda	Surface canal - Walls	0.85	41° 97'60.15", 21° 43'04.98"	41° 97'33.09", 21° 43'66.81"
1217	Torrent	Priporski Dol	Surface canal - Gravitational barriers	0.26	41° 58'16.89", 21° 25'56.14"	41° 58'23.28", 21° 26'0.817"
1218	Torrent	Priporski Dol	Surface canal - Gravitational barriers	0.04	41° 97'57.10", 21° 42'95.97"	
	Total (km)	**Vodno torrents**		**13.2**		

c) Kisela Voda - Dracevo

The following 3 torrential watercourses have been documented in this area: Usjanski Poroj (Golemi Kamenja), Mara Rada, and Krnjeva Reka. Usjanski Poroj (Golemi Kamenja) is formed opposite the village Usje, flows through the village Usje, settlement

Usje, settlement Gorno Lisice and through a regulated riverbed flows into the river Vardar. The regulation was performed in the same period as the Vodno torrents, using the same construction principles and building materials.
Mala Rada is a regulated riverbed with vertical gravitational barriers that collects water from the settlement of Dracevo, the village of Studenicani, and the village of Zelenikovo. The riverbed is regulated to the inflow into the river Vardar.

Table 8. Forms of regulation of the Kisela Voda - Dracevo torrents as a part of the river basin of the Vardar in the Skopje Region

id	Type	Name	Type of regulation	Length (km)	Regulation starting point	Regulation endpoint
1301	Torrent	Golemi Kamenja	Surface canal - Gravitational barriers	0.24	41° 57'43.96", 21° 27'33.74"	41° 57'49.21", 21° 27'39.43"
1302	Drainage canal	Usjanski Poroj	Surface canal - Wall	3.84	41° 57'49.21", 21° 27'39.43"	41° 58'36.42", 21° 30'4.555"
1303	Drainage canal	Mala Rada	Surface canal – Wall	4.29	41° 55'55.88", 21° 31'19.99"	41° 55'57.47", 21° 34'15.43"
1304	Torrent	Mala Rada	Surface canal - Gravitational barriers	0.65	41° 55'37.98", 21° 31'6.904"	41° 55'55.88", 21° 31'19.99"
1305	Drainage canal	Mala Rada	Surface canal – Wall	2.86	41° 56'48.09", 21° 30'46.11"	41° 56'16.20", 21° 32'29.92"
1306	Drainage canal	Krnjeva Reka	Surface canal - Wall	2.39	41° 55'21.68", 21° 31'56.55"	41° 55'59.79", 21° 33'21.16"
	Total (km)	**Kisela Voda - Dracevo**		**14.27**		

d) Skopsko Pole

The drainage system "Skopsko Pole" consists of the main peripheral canal Singelic-Taor, two main canals, and a tertiary network. The total length of all canals is about 40 km. The total drainage area is 6600 ha. The drainage system consists of two subsystems "Upper Zone" with 4500 ha and "Lower Zone" with 2100 ha and a peripheral canal. The collection canals are regulated either in the form of a stone wall in cement mortar or the form of eartfill surface canals. The "Skopsko Pole" system, in addition to its drainage function for the northeastern part of the Skopje Region, is important because it accepts all torrential watercourses from Skopska Crna Gora and through its main peripheral canal, Singelic-Taor leads them to the river Vardar.

Table 9. Forms of regulation of the Skopsko Pole drainage canals as a part of the river basin of the Vardar in the Skopje Region

id	Type	Name	Type of regulation	Length (km)	Regulation starting point	Regulation endpoint
1401	Drainage canal	Main peripheral canal "Singelic-Taor"	Minor riverbed - Wall	2.97	41° 55'20.12", 21° 38'5.263"	41° 54'6.165", 21° 36'43.38"
1402	Drainage canal	Main peripheral canal "Singelic-Taor"	Minor riverbed – Wall	2.95	41° 55'19.35", 21° 38'6.102"	41° 54'5.602", 21° 36'44.92"
1404	Drainage canal	Main canal	Surface canal – Wall	17.22	42° 1'15.99", 21° 32'38.96"	41° 54'6.551", 21° 36'42.73"
1405	Drainage canal	Tertiary network	Surface canal – Earthfill	5.06	41° 56'54.81", 21° 35'39.13"	41° 55'22.72", 21° 38'6.665"

1406	Drainage canal	Tertiary network	Surface canal - Earthfill	10.17	41° 59'24.99", 21° 28'56.91"	41° 58'39.19", 21° 35'8.554"
1407	Drainage canal	Tertiary network	Surface canal – Earthfill	7.15	42°1'7.660", 21° 29'7.849"	42° 0'0.525", 21° 33'20.08"
1408	Drainage canal	Tertiary network	Surface canal – Earthfill	2.31	41° 59'47.46", 21° 33'48.21"	41° 59'1.538", 21° 33'9.420"
1409	Drainage canal	Main peripheral canal "Singelic-Taor"	Surface canal – Wall	21.27	42° 1'31.47", 21° 29'52.26"	41° 55'19.58", 21° 38'5.815"
1409	Drainage canal	Tertiary network	Surface canal – Earthfill	1.6	41° 59'44.57", 21° 34'12.40"	41° 58'53.99", 21° 33'57.14"
1410	Drainage canal	Tertiary network	Surface canal – Wall	4.78	41° 59'25.88", 21° 35'15.45"	41° 57'23.07", 21° 35'33.56"
1411	River	Suva Reka	Surface canal - Earthfill	6.95	41° 59'49.24", 21° 38'56.17"	41° 56'40.86", 21° 37'24.00"
	Total (km)	**Skopsko Pole**		**82.43**		

e) Skopska Crna Gora

In this area, 5 regulated forms of torrential watercourses have been recorded: Cresevska Reka, Stracinska Dreza, Brnjarski Poroj, and Trliste.

Creshevska Reka, as the largest stream of this torrential series, was regulated in the 50s, and 60s of the XX century, when most of Skopsko Pole was agricultural land. The regulated riverbed passes through the villages of Bulacani and Cresevo and downstream crosses the ring road, where the regulation ends. The riverbed is made of a surface earthfill canal with gravity partitions built of stone in cement mortar.

Stracinska Dreza was regulated in the same period. In the upper gorge, the torrential watercourse is arranged with gravity barriers from stone to cement mortar. Downstream, through the village of Stracinci to the collection-peripheral canal, the riverbed is regulated as a surface earthfill canal with gravity partitions.

Opposite the village of Brnjarci, the torrential watercourse Brnjarski Poroj is regulated with gravity barriers made of stone in cement mortar. Downstream, through the village, up to the inflow into the collection canal, the riverbed is regulated as a surface earthfill canal with gravity partitions.

Table 10. Forms of regulation of the Skopska Crna Gora torrents as a part of the river basin of the Vardar in the Skopje Region

id	Type	Name	Type of regulation	Length (km)	Regulation starting point	Regulation endpoint
1501	Torrent	Trliste	Surface canal – Wall	0.63	42° 2'6.626", 21° 29'27.31"	42° 1'48.85", 21° 29'18.38"
1502	Torrent	Rastanski Potok	Surface canal – Wall	0.86	42° 1'57.04", 21° 29'39.76"	42° 1'31.47", 21° 29'52.26"
1503	Torrent	Cresevska Reka	Surface canal – Earthfill	2.51	42° 2'50.26", 21° 30'35.73"	42° 1'34.44", 21° 30'29.04"
1504	Torrent	Cresevska Reka	Surface canal - Gravitational barriers	2.29	42° 3'56.77", 21° 30'18.22"	42° 2'50.26", 21° 30'35.73"
1505	Torrent	Stracinska Dreza	Surface canal – Wall	0.66	42° 1'59.33", 21° 31'59.70"	42° 1'42.95", 21° 32'7.319"
1506	Torrent	Stracinska Dreza	Surface canal – Earthfill	1.19	42° 2'34.79", 21° 32'13.00"	42° 1'59.33", 21° 31'59.70"

1507	Torrent	Stracinska Dreza	Surface canal - Gravitational barriers	0.87	42° 3'0.629", 21° 32'12.43"	42° 2'34.79", 21° 32'13.00"
1508	Torrent	Brnjarski Poroj	Surface canal – Earthfill	1.1	42° 2'4.268", 21° 32'54.50"	42° 1'30.96", 21° 32'41.67"
1509	Torrent	Brnjarski Poroj	Surface canal - Gravitational barriers	0.46	42° 2'17.29", 21° 33'3.196"	42° 1'30.96", 21° 32'41.67"
	Total (km)	**Skopska Crna Gora**		**10.57**		

2) Treska

No form of riverbed regulation is identified on the Treska River. This condition is because two artificial accumulations have been built on their course in the high gorge, which is a sufficient regulatory factor for the river. Additionally, with the construction of the artificial lake Treska, the riverbed gets an additional moment of regulation taking into account the lake as an accumulation capacity in case of bigger water inflows.

3) Lepenec

The Lepenec riverbed is regulated only in the lower course, before the inflow into the river Vardar, in a length of 800 meters. The width of the riverbed with meanders, sand springs, and vegetation ranges from 400 meters wide near the village of Orman and the ring road to 70-40 meters near the confluence with the Vardar. Before the inflow into the river Vardar, two cascades were made to reduce the longitudinal fall of the riverbed. Although the river of Lepenec is one of the three rivers that can bring huge flood waves in Skopje, as well as overflow the river, still no serious technical and construction approach has been approached in the context of regulation of its riverbed.

Table 11. Forms of regulation of the river Lepenec in the Skopje Region

id	Type	Name	Type of regulation	Length (km)	Regulation starting point	Regulation endpoint
3001	River	Lepenec	Minor riverbed – Wall	0.79	42° 0'51.95", 21° 22'27.74"	42° 0'45.85", 21° 23'0.439"
3002	River	Lepenec	Minor riverbed – Wall	0.75	42° 0'50.99", 21° 22'27.63"	42° 0'44.89", 21° 22'58.63"
3003	River	Lepenec	Embankment	0.77	42° 1'22.60", 21° 21'53.86"	42° 1'2.413", 21° 22'8.947"
3004	River	Lepenec	Embankment	1.12	42° 1'17.93", 21° 21'59.88"	42° 0'51.95", 21° 22'27.74"
3005	Drainage canal		Surface canal - Wall	8.12	42° 2'55.77", 21° 21'59.58"	42° 0'37.67", 21° 19'20.61"
3006	Drainage canal		Surface canal - Wall	2.94	42° 3'14.52", 21° 20'58.18"	42° 1'54.55", 21° 21'16.55"
	Total (km)	**Lepenec**		**14.49**		

4) Serava

The river of Serava as a torrential river in the past caused damage and losses in its old stream that passed through the central city area of the city (Old Bazaar). For these reasons, with the deviation of the riverbed, its flow was changed and today, through an openly

regulated riverbed, the river flows into the river Vardar. Its riverbed was subject to regulation through 3 stages. The projects defined the arrangement of the riverbed to the village Radishani in a length of 10 km. The regulation started after the flood of the city of Skopje in 1962 and the earthquake in 1963. In the first phase, the riverbed in the length of 1.9 km was regulated, at the foot of the settlement Butel. Then, the second phase is realized with a deviation of the river flow to the west of a total length of 3.7 km. The third phase includes regulation in the length of 1.6 km and a determined riverbed with gravity barriers in the length of 2.6 km. From the settlement Butel to the confluence of the river Vardar, the regulation is performed as a canal with a trapezoidal profile, with a coated bottom and slopes. (Source: Main project for regulation of Serava river - III stage, Institute for Water Economy of RM).

Table 12. Forms of regulation of the river Serava in the Skopje Region

id	Type	Name	Type of regulation	Length (km)	Regulation starting point	Regulation endpoint
4001	River	Serava	Surface canal – Wall	6.1	42° 2'43.65", 21° 26'32.33"	42° 0'47.24", 21° 24'51.42"
4003	River	Serava	Surface canal – Wall	0.21	42° 3'8.819", 21° 27'2.223"	42° 3'4.661", 21° 26'55.41"
4005	River	Serava	Surface canal – Earthfill	2.44	42° 4'0.021", 21° 27'12.72"	42° 2'49.11", 21° 26'30.70"
4006	River	Serava	Surface canal - Gravitational barriers	1.74	42° 4'44.82", 21° 26'35.91"	42° 4'0.021", 21° 27'12.72"
	Total (km)	**Serava**		**10.49**		

5) Markova Reka

Markova Reka is a typical torrential river that in the past on several occasions caused damage and consequences on a larger scale (floods, collapsed bridges, damaged buildings, etc.), but in the scope of its riverbed are not yet recorded forms of regulation.

RECOMMENDATIONS FOR REGULATION AND REHABILITATION OF THE RIVERBEDS IN THE SKOPJE REGION

Following the process of documentation of the streams and the forms of their regulation, recommendations for regulation and rehabilitation of specifically defined zones of the riverbeds in the Skopje region are defined. This step is aimed at deepening the observation and improving the conditions in the riverbeds by noticing various anthropogenic influences and reducing the intensity of maintenance of existing regulation facilities.

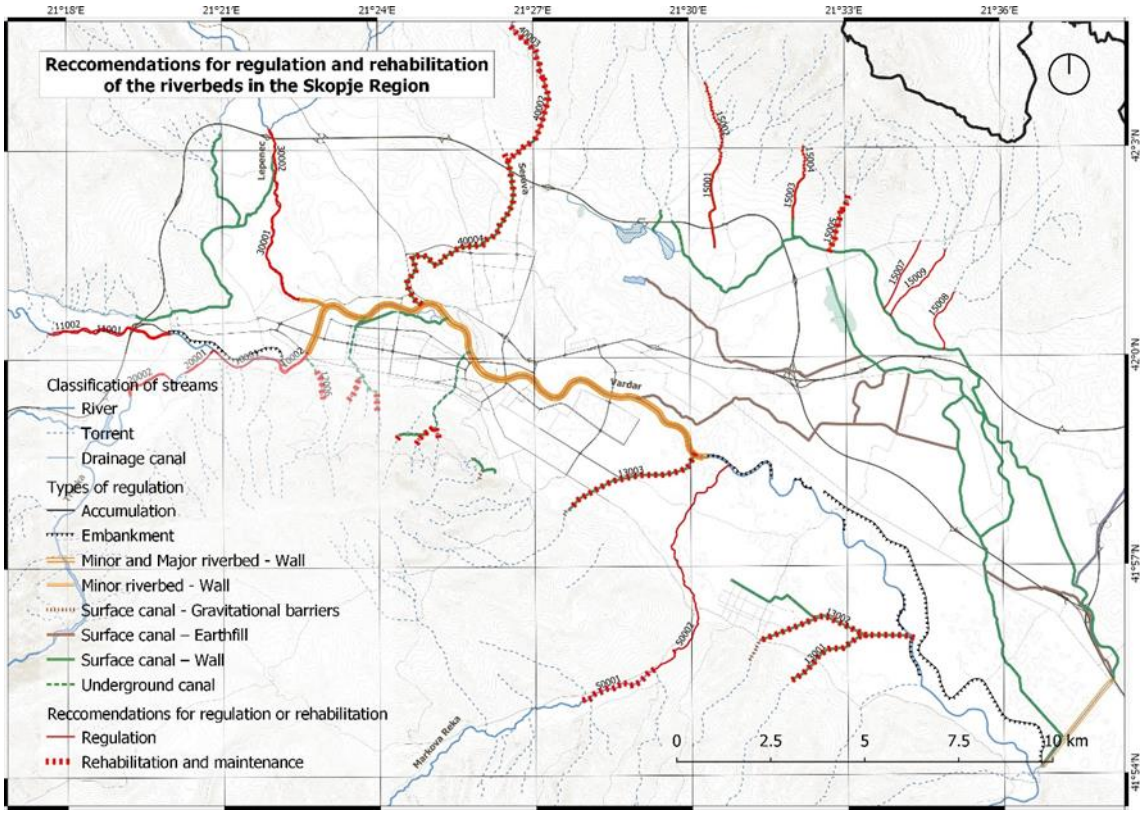

Figure 3. Recommendations for regulation and rehabilitation of the riverbeds in the Skopje Region
Data source: Agency for real estate cadastre. Topographic map 1:25000. sheets
(681-4-3.; 681-4-4.; 682-3-3.; 731-2-1.; 731-2-2.; 732-1-1.) Skopje, AREC, 2004;

This phase of the research identifies the positions in the watercourses for which regulation or rehabilitation and maintenance are proposed in their appropriate classification. Analyzed and grouped according to their river basin (with Vardar as the main recipient and on the level of its subsets) the recommendations are presented in the following order:

6) Vardar (id: 10000);
- a. Upper Vardar,
- b. Vodno torrents,
- c. Kisela Voda - Dracevo,
- d. Skopsko pole,
- e. Skopska Crna Gora.

7) Treska (id: 20000);
8) Lepenec (id: 30000);
9) Serava (id: 40000);
10) Markova Reka (id: 50000);

Transferred to an appropriate tabular representation, each hydrographic unit representing a separate river basin has its id number where the first number assigns the belonging to the river basin (10000), the second the assignment to the subsets (11000), and the last 3 are ordinal numbers (10003).

Consequently, a database is created as operational documentation through direct cartographic processing in which for each recommendation for regulation or rehabilitation of hydrographic facilities the following characteristics are developed:

- • **id** number that expresses their affiliation and order,
- • **Type of stream** according to the classification,

- • **Name of the stream** recorded from the cartographic substrate or the literature,
- • **River basin** to which they belong,
- • **Subset** to which they belong more specifically,
- • **Status of regulation** observed on the field or in the literature,
- • **Condition of the regulation** observed on the field or in the literature,
- • **Recommendations for regulation** or rehabilitation
- • **Length of recommendation for regulation** expressed in kilometers (km), obtained by digital processing,
- • **Recommendation starting point**
- • **Recommendation endpoint**

This structured database is tabularly processed and presented for each of the listed river basins and subsets for whose recommendations for regulation or rehabilitation separate and aggregate data are obtained.

1) Vardar

The riverbed of the river Vardar, as the main hydrographic element and river basin, has the highest degree of regulation within the Skopje valley. However, there are zones in which the continuity of regulation is interrupted, and thus the possibility of movement along the riverbed. As well as anthropogenic influences are observed stimulated by the development and expansion of the surrounding settlements, which lead to damage and direct interventions on the riverbed. In the western part of the city of Skopje, the river Vardar divides the settlements Gjorce Petrov and Hrom on the left side of the stream and Saraj and Karpos on the right side. The left side, which belongs to the settlement Gjorce Petrov is regulated by a defensive line - an embankment that is in good condition. This type of regulation ends in the settlement of Hrom, where next to the bridge, at the former factory Kuprom, no type of regulation is observed, and at the same time, the movement along the riverbed is interrupted. For that reason, it is recommended to continue the regulation of this part of the riverbed to connect with the main quay of the river Vardar regulated by the Major and Minor riverbeds.

On this part of the river, on the right side which belongs to the settlements Saraj and Karpos, and in which the villages Krushopek, Laka, and Dolno Nerezi exist, there is an intervention in the riverbed of anthropogenic influences, primarily waste and debris that is delayed for a long time on the edge of the riverbed and as such settles or plums directly into the river. For that reason, it is necessary to initially rehabilitate with regulation the riverbed along its entire length from the recreation center Saraj to the settlement Dolno Nerezi, where it is connected to the main quay of the river Vardar.

Table 13. Recommendations for regulation or rehabilitation of the riverbed of the Vardar

id	Type	Name	Status of regulation	Condition of regulation
10001	River	Vardar	Unregulated	Anthropogenic influences
10002	River	Vardar	Unregulated	Anthropogenic influences
id	**Recommendation**	**Length (km)**	**Recommendation starting point**	**Recommendation endpoint**
10001	Regulation	3.19	42° 0'7.517", 21° 20'48.66"	42° 0'4.662", 21° 22'38.49"
10002	Regulation	1.01	41° 59'56.41", 21° 22'6.902"	42° 0'5.514", 21° 22'36.96"
	Total (km)	**4.2**		

a) Upper Vardar

In the part of the riverbed of Vardar known as Upper Vardar, the presence of anthropogenic influences that date from recent times is noticeable. Significantly dominant built content is visible next to the right bank of the riverbed, where facilities have been built and operated for light industry and production. The intervention on the riverbed is also noticeable, where the green protection zone that existed before the appearance of these buildings has been completely annulled. For that reason, it is proposed to regulate the riverbed in the indicated move in the length of 3.61 km, which would be regulated on both sides of the flow.

Table 14. Recommendations for regulation or rehabilitation of the riverbed of the Vardar in the part of Upper Vardar

id	**Type**	**Name**	**Status of regulation**	**Condition of regulation**
11001	River	Vardar	Unregulated	Anthropogenic influences
11002	River	Vardar	Unregulated	Anthropogenic influences
id	**Recommendations**	**Length of (km)**	**Recommendation starting point**	**Recommendation endpoint**
10001	Regulation	3.61	42° 0'22.67", 21° 17'38.54"	42° 0'21.84", 21° 19'59.81"
10002	Regulation	3.34	42° 0'23.71", 21° 17'44.23"	42° 0'23.14", 21° 19'57.50"
	Total (km)	**6.95**		

b) Vodno torrents

In the torrential watercourses belonging to the Vodno torrents subsets as part of the river basin of Vardar, a state of insufficient maintenance of the built forms of regulation has been observed, which include surface channels of stone in cement mortar with gravity barriers at certain positions. Due to the absence of continuous maintenance, their functionality is drastically reduced and noticeable are overgrown on the longitudinal and vertical buildings with vegetation of all types, including trees. For that reason, it is recommended to rehabilitate and further maintain all buildings for regulation of this type, which include the torrential watercourses Kamenov Dol, Murtinec, Sultan Potok, Gornovodnjanski torrent, and Bachvishta.

Table 15. Recommendations for regulation or rehabilitation of the Vodno torrents as a part of the river basin of Vardar in the Skopje Region

id	**Type**	**Name**	**Status of regulation**	**Condition of regulation**
12001	Torrent	Kamenov Dol	Gravitational barriers	Overgrown floodplains
12002	Torrent	Murtinec	Gravitational barriers	Overgrown floodplains
12003	Torrent	Sultan Potok	Gravitational barriers	Overgrown floodplains
12004	Torrent	Gornodnjanski Poroj	Gravitational barriers	Overgrown floodplains
12005	Torrent	Gornodnjanski Poroj	Gravitational barriers	Overgrown floodplains
12006	Torrent	Bacvista	Gravitational barriers	Overgrown floodplains

id	Recommendation	Length (km)	Recommendation starting point	Recommendation endpoint
12001	Rehabilitation and maintenance	0.45	41° 59'14.30", 21° 23'59.42"	41° 59'28.44", 21° 23'57.66"
12002	Rehabilitation and maintenance	0.14	41° 58'51.90", 21° 24'21.87"	41° 58'54.89", 21° 24'25.38"
12003	Rehabilitation and maintenance	0.63	41° 59'25.48", 21° 23'25.94"	41° 59'43.09", 21° 23'36.96"
12004	Rehabilitation and maintenance	0.3	41° 58'49.11", 21° 25'8.650"	41° 58'58.57", 21° 25'6.218"
12005	Rehabilitation and maintenance	0.56	41° 58'47.61", 21° 24'44.06"	41° 58'59.70", 21° 25'1.294"
12006	Rehabilitation and maintenance	0.74	41° 59'26.77", 21° 22'55.76"	41° 59'48.44", 21° 22'48.85"
	Total (km)	**2.82**		

c) Kisela Voda - Dracevo

The torrents built in the section Kisela Voda - Dracevo, which belongs to the river basin of Vardar noticeably is significantly reduced water flow as a result of the overgrown riverbed with the ground, shrubby and woody vegetation, waste of any nature, and deformed slopes of the riverbeds. For that reason, it is proposed cleaning, rehabilitation, and continuous maintenance of the collection canals Krnjeva Reka, Mala Rada, and the crucial Usjanski Poroj.

Table 16. Recommendations for regulation or rehabilitation of the Kisela Voda - Dracevo torrents as a part of the river basin of Vardar in the Skopje Region

id	Type	Name	Status of regulation	Condition of regulation
13001	Torrent	Krnjeva Reka	Surface canal – Wall	Overgrown with vegetation
13002	Torrent	Mala Rada	Surface canal – Wall	Overgrown with vegetation
13003	Torrent	Usjanski Poroj	Surface canal – Wall	Overgrown with vegetation

id	Recommendations	Length (km)	Recommendation starting point	Recommendation endpoint
13001	Rehabilitation and maintenance	2.39	41° 55'21.68", 21° 31'56.55"	41° 55'59.79", 21° 33'21.16"
13002	Rehabilitation and maintenance	4.29	41° 55'55.88", 21° 31'19.99"	41° 55'57.47", 21° 34'15.43"
13003	Rehabilitation and maintenance	3.84	41° 57'49.21", 21° 27'39.43"	41° 58'36.42", 21° 30'4.555"
	Total (km)	**10.52**		

d) Skopsko Pole

The public enterprise for water management within its regional office "Skopsko Pole" is an important entity that has legal competencies for flood control and continuous maintenance. Currently, all activities for the management of drainage canals in the part of Skopsko Pole that belong to the river basin of Vardar are maintained from this institution, and as such is evident good conditions of the drainage system with a satisfactory functionality.

e) Skopska Crna Gora

In the torrential series of Skopska Crna Gora, there are various forms of regulation in the moves of the torrents Cresevska Reka, Stracinska Dreza, and Brnjarski Poroj.

It is necessary to rehabilitate and continuously maintain the earthfill surface canal of Brnjarski Poroj, which is overgrown with vegetation, and therefore with reduced functionality. Downstream, throughout the village, up to the inflow into the peripheral drainage canal, anthropogenic influences have been observed, in its regulated form of earthfill surface canal with gravity partitions. Several makeshift bridges and culverts drastically reduce the canal profile. Therefore, the proposed is complete rehabilitation with the regulation of this torrential watercourse.

Stracinska Dreza contains the same forms of regulation, but also the same anthropogenic influences and lack of maintenance due to which there are floods on the gravitational barriers, as well as overgrowth with vegetation of the earthfill channels. Due to the great damage caused by the floods in 2016, the recommendation for this regulated flow of torrent watercourse to be subject to the new regulation.

Cresevska Reka riverbed deserves the greatest attention during its future treatment. It has the same forms of regulation that mainly occur damage from the last floods in 2016. A detailed analysis of the condition of the watercourse and arrangement of the riverbed of the Cresevska Reka to a permanent recipient in the peripheral collection canal is necessary. Its riverbed currently ends up in agricultural land that can easily be flooded by large floods.

There is also a need to regulate the unregulated torrential watercourses Krivi Dol and Orlanska Reka near the village Aracinovo, primarily in the part of the plain.

Table 17. Recommendations for regulation or rehabilitation of the Skopska Crna Gora torrents as a part of the river basin of Vardar in the Skopje Region

id	Type	Name	Status of regulation	Condition of regulation
15001	Torrent	Cresevska Reka	Surface canal - Earthfill	Overgrown with vegetation
15002	Torrent	Cresevska Reka	Gravitational barriers	Overgrown floodplains
15003	Torrent	Stracinska Dreza	Surface canal – Earthfill	Overgrown with vegetation
15004	Torrent	Stracinska Dreza	Gravitational barriers	Overgrown floodplains
15005	Torrent	Brnjarski Poroj	Surface canal – Earthfill	Overgrown with vegetation
15006	Torrent	Brnjarski Poroj	Gravitational barriers	Overgrown floodplains
15007	Torrent		Unregulated	Anthropogenic influences
15008	Torrent	Krivi Dol	Unregulated	Overgrown with vegetation
15009	Torrent	Orlanska Reka	Unregulated	Overgrown with vegetation

id	Recommendations	Length (km)	Recommendation starting point	Recommendation endpoint
15001	Regulation	2.51	42° 2'50.26", 21° 30'35.73"	42° 1'34.44", 21° 30'29.04"
15002	Regulation	2.29	42° 3'56.77", 21° 30'18.22"	42° 2'50.26", 21° 30'35.73"
15003	Regulation	1.19	42° 2'34.79", 21° 32'13.00"	42° 1'59.33", 21° 31'59.70"
15004	Regulation	0.87	42° 3'0.629", 21° 32'12.43"	42° 2'34.79", 21° 32'13.00"
15005	Rehabilitation and maintenance	1.1	42° 2'4.268", 21° 32'54.50"	42° 1'30.96", 21° 32'41.67"
15006	Rehabilitation and maintenance	0.46	42° 2'17.29", 21° 33'3.196"	42° 2'4.268", 21° 32'54.50"
15007	Regulation	3.23	42° 2'13.09", 21° 34'47.78"	42° 0'40.81", 21° 33'44.13"

15008	Regulation	3.5	42° 1'36.37", 21° 35'47.61"	42° 0'5.645", 21° 34'52.76"
15009	Regulation	3.29	42° 1'57.46", 21° 35'13.72"	42° 0'34.95", 21° 33'51.96"
	Total (km)	**18.44**		

2) Treska

The riverbed of the river Treska is in a constant form of regulation and protection from flooding in the surrounding areas through the already installed accumulations. For that reason, no additional forms of regulation have been observed in the riverbed. However, there is a significant occurrence of anthropogenic influences in certain zones and areas of the riverbed, in the part where pressure is created by the expansion of the existing settlements Krushopek and Grcec. Similar to the riverbed of the river Vardar, there is a noticeable delay in the huge amount of waste on the edge of the riverbed and the destruction of the existing protective vegetation, which poses a risk to water quality and visible destructive habitats in nature. Therefore, it is recommended to clean the existing condition and regulations to protect from further destructive actions along the river Treska.

Table 18. Recommendations for regulation or rehabilitation of the riverbed of the Treska

id	Type	Name	Status of regulation	Condition of regulation
20001	River	Treska	Accumulation	Anthropogenic influences
20002	River	Treska	Accumulation	Anthropogenic influences
20003	River	Treska	Accumulation	Anthropogenic influences
20004	River	Treska	Accumulation	Anthropogenic influences

id	Recommendations	Length (km)	Recommendation starting point	Recommendation endpoint
20001	Regulation	0.95	41° 59'48.59", 21° 20'17.38"	42° 0'7.517", 21° 20'48.66"
20002	Regulation	1.25	41° 59'28.92", 21° 19'12.31"	41° 59'47.77", 21° 19'52.10"
20003	Regulation	1.37	41° 59'28.99", 21° 19'13.84"	41° 59'43.70", 21° 19'57.81"
20004	Regulation	0.37	41° 59'49.19", 21° 20'17.25"	41° 59'55.86", 21° 20'30.34"
	Total (km)	**3.94**		

3) Lepenec

The river of Lepenec has large changes in water quantities that affect the occurrence of floods that occur not only along the river but also in various parts of the Skopje valley. During the occurrence of flood waves on the river Lepenec, the overflow occurs most often in the belt from the entrance of the river on the Macedonian border, to the village Orman and downstream, most often along the right bank of the river.

The recommendations for regulation of the Lepenec riverbed refer to both banks and as such are double calculated in the table. The recommendation covers the area from the ring road where Banjanska Reka flows into the river Lepenec, all the way to before the inflow into the river Vardar where Lepenec has a small part which is regulated by the Minor riverbed. The regulatory plan for this move must be particularly carefully planned and must be subject to a series of studies by interdisciplinary teams. This is primarily due to

the existing dense riparian vegetation, diversity of animal species and riparian vegetation, as well as diversity of vertebrates and invertebrates in the valley of the river.
There is a need for regulation and arrangement of the banks of the river Lepenec, especially in the downstream part of Gjorce Petrov, where the industrial zone is formed, in which the river loses its importance and becomes a channel for wastewater from production facilities. Its landscape values become invisible and marginalized from the occurrence of illegal landfills along the river, which are a direct threat to the water quality in the river, especially visible near the settlements of Bardovci, Zlokukjani, and Momin Potok.

Table 19. Recommendations for regulation or rehabilitation of the riverbed of the Lepenec

id	Type	Name	Status of regulation	Condition of regulation
30001	River	Lepenec	Unregulated	Anthropogenic influences
30002	River	Lepenec	Unregulated	Anthropogenic influences

id	Recommendations	Length (km)	Recommendations starting point	Recommendations endpoint
30001	Regulation	5.29	42° 3'17.96", 21° 21'53.75"	42° 0'50.99", 21° 22'27.63"
30002	Regulation	5.22	42° 3'17.46", 21° 21'55.30"	42° 0'51.95", 21° 22'27.74"
	Total (km)	**10.51**		

4) Serava

We can notice a proper form of regulation of the river Serava, but the need for continuous maintenance and cleaning is also evident. In many parts, the existing riverbed is overgrown with woody vegetation, which indicates a discontinuity in its maintenance and thus reduced flow capacity of the riverbed and opportunities for flooding, followed by the waste of various kinds. In the part at the end of the village Radishani, where the riverbed is regulated as an earthfill surface channel with gravity barriers, there is a risk of flooding as a consequence of the high potential of erosion in the riverbed which is covered with erosive sediment and with reduced useful height. It is necessary to clean them and further maintain the riverbed.

Table 20. Recommendations for regulation or rehabilitation of the riverbed of the Serava

id	Type	Name	Status of regulation	Condition of regulation
40001	Torrent	Serava	Surface canal - Earthfill	Overgrown with vegetation
40002	River	Serava	Surface canal - Earthfill	Overgrown floodplains
40003	River	Serava	Gravitational barriers	Overgrown floodplains
40004	River	Serava	Surface canal – Wall	Overgrown with vegetation

id	Recommendations	Length (km)	Recommendations starting point	Recommendations endpoint
40001	Rehabilitation and maintenance	0.45	42° 2'57.37", 21° 26'25.73"	42° 2'43.65", 21° 26'32.33"
40002	Rehabilitation and maintenance	2.44	42° 4'0.021", 21° 27'12.72"	42° 2'49.11", 21° 26'30.70"
40003	Rehabilitation and maintenance	1.74	42° 4'44.82", 21° 26'35.91"	42° 4'0.021", 21° 27'12.72"
40004	Rehabilitation and maintenance	6.1	42° 2'43.65", 21° 26'32.33"	42° 0'47.24", 21° 24'51.42"
	Total (km)	**10.73**		

5) Markova Reka

Markova Reka in the past on several occasions caused damage and consequences of torrential floods. The recommendations are due to its clearing and repair of the riverbed in the part where it passes through weekend settlements with dense construction such as Batinci village, but above all the anthropogenic influences that directly affect the unregulated riverbed caused by intensive construction activity from the newly built industrial complexes opposite the bridge in front of the Dracevo settlement. From the same factors, usurpations of the riverbed on a larger scale, such as waste disposal and sand storage, are also visible. In this section, as a reaction to the intensive urbanization in the continuation of the eastern urban zone, it is necessary to clear and restore the riverbed and regulate it with protection from further impacts.

Table 21. Recommendations for regulation or rehabilitation of the riverbed of the Markova Reka

id	Type	Name	Status of regulation	Condition of regulation
50001	River	Markova Reka	Unregulated	Anthropogenic influences
50002	River	Markova Reka	Unregulated	Anthropogenic influences

id	Recommendations	Length (km)	Recommendations starting point	Recommendations endpoint
50001	Rehabilitation and maintenance	2.26	41° 55'5.451", 21° 27'55.23"	41° 58'26.68", 21° 30'44.37"
50002	Regulation	7.22	41° 55'5.451", 21° 27'55.23"	41° 58'26.68", 21° 30'44.37"
	Total (km)	**9.48**		

DISCUSSIONS AND CONLUSIONS

Reflecting in a hierarchical order, this study documented the main network of rivers in the Skopje Region which belongs to the river basin of Vardar with its 5 tributaries. In the analyzed area their total length is 91.16 km of which 42.19 km belong to the river Vardar. The research identified an additional 115 streams in the appropriate classification of rivers, drainage canals, and torrents that are grouped and analyzed according to their river basin. Their total length is 396.9 km of which 294.28 km belong to the river basin of Vardar, 35.3 km to the river basin of Treska, 28.28 km to the river basin of Lepenec, and 39.01 km to the river basin of Markova Reka.

The objective of this research is to create detailed documentation of the current situation of the regulated streams and identify the existing forms of regulation of the streams in an appropriate classification. Analyzed according to their river basin we can conclude that the river of Vardar is regulated in a total length of 48.76 km of which 28.21 km with major and minor wall riverbeds and 20.55 km with an embankment. The river of Lepenec is regulated in a total length of 14.49 km and the river Serava in the length of 10.49 km. Torrential water streams from the Vodno mountain according to this study area are regulated in a total length of 13.12 km in an appropriate form of regulation, but dominantly as a wall or earthfill surface canal with gravitational barriers. In the same form of regulation, the torrential water streams of the area Kisela Voda – Dracevo are regulated in a total length of 14.27 km. The drainage system "Skopsko Pole" is consisted of 82.43 km regulated canals regulated either in the form of a stone wall in cement mortar or in the form of eartfill surface canals. Torrential water streams from the area of Skopska Crna Gora are regulated in a total length of 10.57 km.

Following the process of documentation of the streams and the forms of their regulation, recommendations for regulation and rehabilitation of specifically defined zones of the

riverbeds in the Skopje region are defined. This phase of the research identifies the positions in the watercourses for which regulation or rehabilitation and maintenance are proposed in their appropriate classification according to their river basin. The riverbed of Vardar, as the main hydrographic element and river basin, is recommended to be additionally regulated in a total length of 11.15 km, mainly in its western part. Recommendations for regulation are defined for the other rivers in a length of 3.94 km for the river of Treska, 10.51 km for the river of Lepenec, and 7.22 km for the river of Markova Reka. An additional recommendation for regulation is defined for the torrential water streams in the area of Skopska Crna Gora with a total length of 16.8 km. Recommendations for rehabilitation and maintenance are defined for the torrential water streams of Vodno in a length of 2.83 km, of the area Kisela Voda – Dracevo in a length of 10.52 km, and of the area Skopska Crna Gora in a length of 1.56 km. In the same manner, this type of recommendation is defined for the river of Serava in a length of 10.73 km and the river Markova Reka in a length of 2.26 km.

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GIS ASSESSMENT OF LAND COVER FLOWS IN NORTH MACEDONIA USING CORINE LAND COVER DATABASE IN THE PERIOD 2000-2018

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ABSTRACT

The land use (LU) and land cover (LC) categories in the North Macedonia are characterized with great heterogeneity. Dominantly present are forests and semi-natural areas with 60%, and agricultural areas with 35%. Based on the Corine Land Cover (CLC) database, analyzed are the changes in three periods, 2000-2006, 2006–2012, and 2012-2018. Quantified are basic input information which are analyzed on the total territory of the country and separately for the eight planning regions of the country: Skopje (I), Eastern (II), Southeast (III), Northeast (IV), Pelagonia (V), Vardar (VI), Southwest (VII) and Polog (VIII). A number of 2522 types of change (CLC classification level 3) were identified across North Macedonia for the three-time period or if we consider them as aggregate data in 18 years we can see LC change processes of around 900 km2 which is 3.53% of the total area of the country. Applying them to the conversion table, seven major change processes (LC flows) were identified such as urbanization, intensification, and extensification of agriculture, afforestation, deforestation, water bodies' construction and management, and other changes of which three main directions of change have been of interest. As a dominant change, deforestation is a result of two destructive factors: illegal woodcuts and forest fires. Following is afforestation, which as a process of expansion of the forest area is due primarily to the activities of the Public enterprise for forestry. Urbanization was marked by the process of decentralization (2005) and initiated by the Law on Local Self-Government (2002), legal acts by which many of the competencies of the central government have been transferred to the local level, a level that affects cities and urban regions. Observing the spatial distribution of CLC change processes most conversions from LULC to another took place in the Pelagonia, Southwest, and Vardar planning region, and the least affected are Northeast, Eastern, and Polog planning regions. As such, the main purpose of the present study was to document major LULC trends in North Macedonia during the three periods..

Keywords: GIS, Land cover Flows, LC changes, CLC; North Macedonia

INTRODUCTION

Land cover represents a concrete set of natural and anthropogenic features, resulting largely from its use [1] and of being an indivisible part of the landscape [2]. Land use (LU) and land cover (LC) changes can be considered relevant information sources on landscape processes [3]. Land cover and land use are important datasets in the research

methodologies of geo and environmental research [4] and the decision-making process. Also, the land cover data provides useful information for many GIS and Remote Sensing based applications for determinations and assessment of the natural hazard risk, suitability analysis, flood plain risk, etc. [5]. Thus, it is useful to determine measures and monitor actual and further land cover changes, but also the availability of appropriate and comparable data for different periods. Timely detection and precise information about land-use and land-cover changes are extremely important for understanding the relationships and interactions between human and natural phenomena if the management of decision-making is to be improved [6]. Based on GIS processing of the CORINE Land Cover data layer some studies at the national, as well as regional level have been achieved [7], [8], [9], [10], [11], [12]

STUDY AREA

The Republic of North Macedonia is situated in South-Eastern Europe on the southern part of the Balkan Peninsula. The total area of the country is 25713 km and according to the last Census of the population in 2021, it has 1836713 inhabitants. Administratively it is divided into the eight planning regions: Skopje, Eastern, Southeast, Northeast, Pelagonia, Vardar, Southwest, and Polog Region.

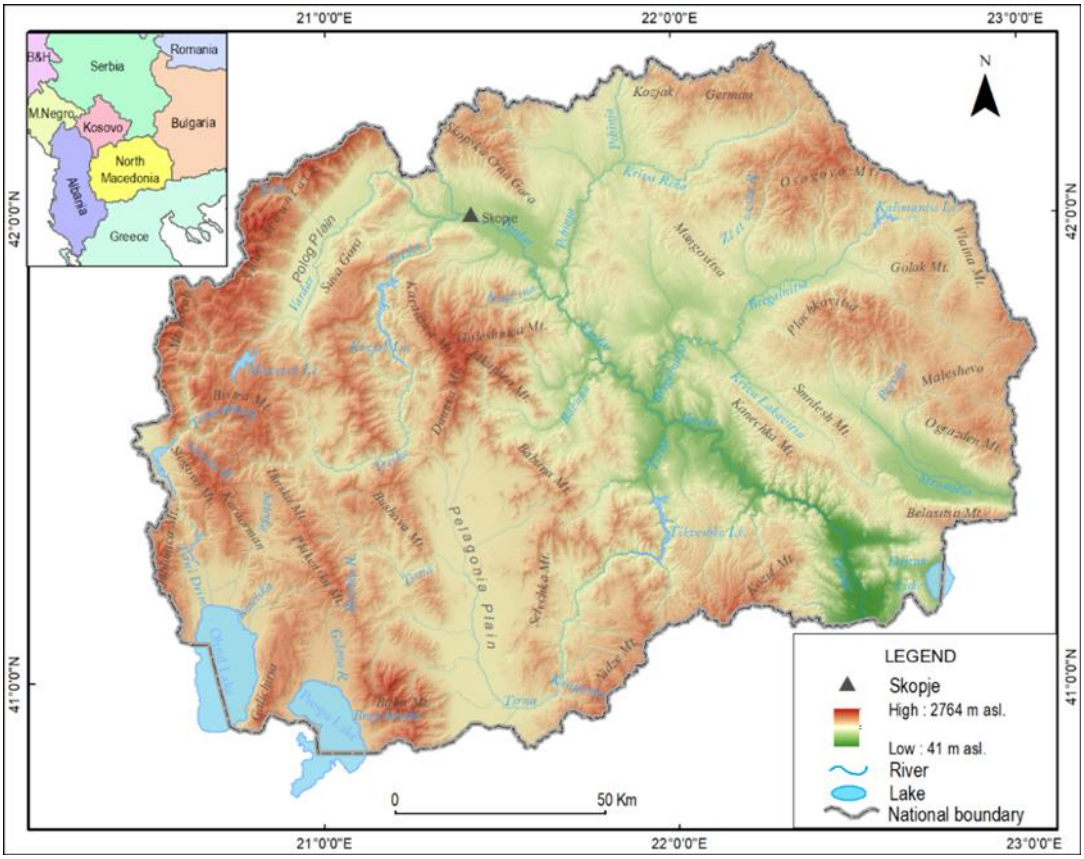

Figure 1. Map of North Macedonia

The capital city is Skopje with 526502 inhabitants or almost 1/3 or 27.6 % of the country's population. The country has a very complex geology with geological formations from almost all geological periods. Climatic characteristics are diverse. In the southern part, widely open to the Aegean Sea prevails a modified Mediterranean climate, in other parts

of the country prevails continental climate. On the high mountains prevails mountain climate. The relief characteristics are also diverse, the lowest altitude is approximately 40 m.a.s.l. and the highest altitude is on the Korab mountain peak 2764 m.a.s.l.

MATERIALS AND METHODS

The assessment of the Land-use flows has been conducted in the following order: literature research, data collecting, and adoption of a suitable methodological approach.
During the phase of literature research, we have found several similar studies and papers such as the treatment of Landscape changes in the region of Skalica [13], the region of Trnava in Slovakia [14], the municipality of Bansko in Bulgaria [15], region of Plovdiv in Bulgaria [16], the comparative study between the regions of Trnava and Plovdiv in Slovakia and Bulgaria [7] the assessment of land cover changes in Romania [11], the overview of Changes in Land Use and Land Cover in Eastern Europe [9], etc.
Based on the literature review and the available datasets the methodological approach developed by the Institute of Geography at the Slovak Academy of Sciences has been adopted and applied [17], [18], [7].

Table 1. Example of Conversion table (CLC classes into Land cover flow processes)

		2006 classes (2012, 2018)														
2000 classes (2006, 2012)		**11**	**12**	**13**	**14**	**21**	**22**	**23**	**24**	**31**	**32**	**33**	**41**	**42**	**51**	**52**
	11	**0**	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	12	7	**0**	7	7	7	7	7	7	7	7	7	7	7	7	7
	13	7	7	**0**	7	7	7	7	7	7	7	7	7	7	6	7
	14	7	7	7	**0**	7	7	7	7	7	7	7	7	7	6	7
	21	1	1	1	1	**0**	2	3	3	4	4	7	7	7	6	7
	22	1	1	1	1	3	**0**	3	3	4	4	7	7	7	6	7
	23	1	1	1	1	2	2	**0**	2	4	4	7	7	7	6	7
	24	1	1	1	1	2	2	3	**0**	4	4	7	7	7	6	7
	31	1	1	1	1	5	5	5	5	**0**	5	5	5	7	6	7
	32	1	1	1	1	2	2	2	2	4	**0**	5	7	7	6	7
	33	1	1	1	1	2	2	2	2	4	4	**0**	7	7	6	7
	41	1	1	1	1	2	2	2	2	4	4	7	**0**	7	6	7
	42	1	1	1	1	2	2	2	2	4	4	7	7	**0**	6	7
	51	1	1	1	1	7	7	7	7	4	4	7	7	7	**0**	7
	52	1	1	1	1	7	7	7	7	4	4	7	7	7	7	**0**

0-Unchanged class; 1- Urbanization; 2- Intensification of agriculture;
3- Extensification of agriculture; 4- Afforestation; 5- Deforestation;
6-Water bodies construction and management and 7- Other changes

The dataset used in the research has been produced by the EEA. For most of the European countries, Corine Land Cover datasets were produced for the five referenced years (1990, 2000, 2006, 2012, and 2018). In the case of the Republic of North Macedonia, the first reference year (1990) has not been produced. Besides the CLC dataset for the country, we have used the dataset with detected changes between the different periods. The dataset with CLC changes is for the period of 2000-2006, 2006-2012, and 2012-2018. The territory of the Republic of North Macedonia is administratively divided into eight planning regions: Skopje (I), Eastern (II), Southeast (III), Northeast (IV), Pelagonia (V), Vardar (VI), Southwest (VII) and Polog (VIII).

The standard CLC nomenclature includes 44 land cover classes. These are grouped in a three-level hierarchy. The five main (level 1) categories are: 1) artificial surfaces, 2) agricultural areas, 3) forests and semi-natural areas, 4) wetlands, and 5) water bodies [19]. At level 2 fifteen types of land cover were distinguished, and at level 3, 44 land cover classes were distinguished. In North Macedonia, a number of 33 out of the 44 classes in the CLC nomenclature were identified.
The analysis of LULC categories has been facilitated in MS Excel, ArcGIS, and QGIS.
The transformation process from Corine land cover changes into Land cover flow processes was performed by the transformation of the second level of CLC classes through conversion table (Table 1). This conversion table, i.e., the "matrix of changes" groups LC changes of the same type. There are 15 x 14 = 210 possible combinations of one-to-one changes between the 15 CLC classes at the second level [20]
According to this referenced methodology, the 210 possible combinations of LUCC classes are grouped into seven major LCFs that represent seven major LULC change processes (LC flows):

- Urbanization: conversion from agricultural (CLC classes 21, 22, and 23), forest lands (CLC classes 31, 32, and 33), wetlands (classes 41 and 42), and water bodies (51 and 52) into urbanized land (CLC class 11) and industrialized land (class 12);
- Intensification of agriculture: transition of LC classes associated with lower intensity use like natural areas (CLC classes 32, 33, except forest class 31 and wetland class 4) into higher intensity agricultural use (classes 21 and 22);
- Extensification of agriculture: transition of LC types from a higher intensity agricultural use (classes 21 and 22) to a lower intensity agricultural use (classes 23 and 24);
- Afforestation: forest regeneration, i.e., the establishment of forests by planting and/or natural regeneration in other natural areas or agricultural lands (change of classes 21, 22, 23, 24, 33, 41, and 42 into classes 31 and 32);
- Deforestation: involving forestland (class 31) changes into another LC or damaged forest (classes 21, 22, 23, 24, 32, 33 and 41);
- Water bodies construction and management: the change of mainly agricultural (classes 21, 22, 23, and 24) and forest land (classes 31 and 32) into water bodies and the consequences of the management of water resources and the water surface area of reservoirs;
- Other changes: changes resulting from various anthropogenic activities, such as the recultivation of former mining areas, dump sites, unclassified changes, etc.

RESULTS

A number of 950 types of change (CLC classification level 3) were identified across North Macedonia during the 2000-2006 period covering an area of 349.18 km2, which represents 1.36% of the total study area. Almost 1/3 less from the first period, a number of 647 types of change (level 3) were identified over the 2006-2012 period covering an area of 250.43 km2 which represents 0.97% of the total study area. During the 2012-2018 period identified are 925 types of change (level 3) which is again similar to the first period, but now covering an area of 271.86 km2, which represents 1.06% of the total study area similar to the second period.
Through this empirical analysis, we can confirm a uniform trend of LU change processes with a slight decline in value that varies from 1.36% to 0.97% of the total area of the case study (Table 2.), or if we consider them as aggregate data for the three comparative

periods (2000-2018) in 18 years we can see LU change processes of a total of 871.47 km2 which is 3.39% of the total area of North Macedonia.
Subsequently, these changes were generalized to CLC classification level 2 and used to establish and analyze the 13 classes of change and according to their change processes to undermine the 7 LU flows (Table 2). Apart from their change classes, they are also sorted according to the three periods through which the equal degree of change is confirmed for each of the classes that go into a significant decline in value (Fig.2.).

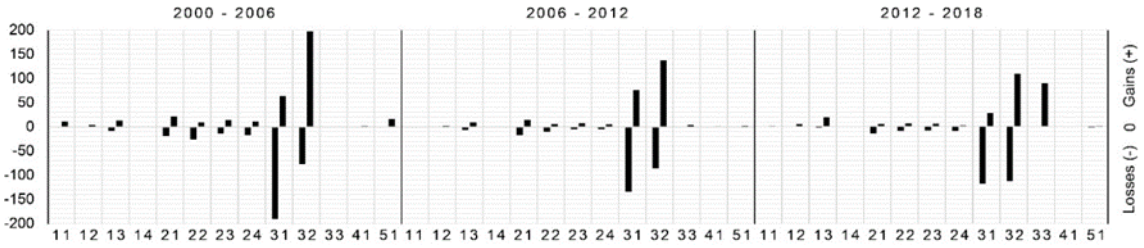

Figure 2. Gains and losses by land use and land cover classes (level 2) over the periods 2000-2006, 2006-2012, and 2012-2018 (values in km2)

Artificial surfaces (CLC classes 11, 12, 13, 14) are noting constant gains in the three-time period. In the first period of 2000-2006, they are having the highest gain of 26.961 km2. The second period of 2006-2012 is noting a gain of 12.669 km2 which is a double lower value compared to the first one, but the third period of 2012-2018 is again noting a similar value of gain as the first period of 25.939 km2. Loses of this LULC class are dominantly lower than the gains and summed for the three-period are noting 17.554km2.
Agricultural areas (CLC classes of 21, 22, 23, and 24) during the first-period note almost double losses than gains evidencing 78.084 km2 losses and 53.067 km2 gains. In continuation visible are almost equal values of losses and gains during the second period of 2006-2012, noting 37.68 km2 losses and 31.919 km2 gains. The third period of 2012-2018 again is noting double losses than gains of 40.131 km2 losses and 19.716 km2 gains.
The forests and semi-natural areas (CLC classes of 31, 32, and 33) during the first period note slightly bigger losses than gains noting 268.48 km2 losses and 260.25 km2 gains. In continuation visible are almost equal values of losses and gains during the second and third periods, noting 219.63 km2 losses and 217.48 km2 gains for the 2006-2012 time period and 231.53 km2 losses and 228.38 km2 gains for the 2012-2018 time period.
Wetlands (CLC class of 41) during the tree period time 2000-2018 are noting almost equal values for losses and gains evidencing 1.5 km2 for losses and 1.8 km2 for gains.
Water bodies (CLC class of 51) are noting drastically higher gains than losses which are dominantly evident in the first period of 2000-2006 where losses are 0.7 km2 but gains have a value of 15.5 km2. The other two periods are characterized by a more smooth difference between the losses and gains having 0.6 km2 for losses and 1.9 km2 for gains in the second period of 2006-2012 and 1.3 km2 for losses and 1.5 km2 for gains in the third period of 2012-2018.

Table 2. LC flow types in North Macedonia for the periods 2000-2006, 2006-2012, and 2012-2018

	2000 - 2006 period			2006 - 2012 period			2012 - 2018 period		
LC Flows	Total changes (km^2)	% of study area	% of total changes	Total changes (km^2)	% of study area	% of total changes	Total changes (km^2)	% of study area	% of total changes
Urbanization	26,9	0,10	7,7	11,81	0,05	4,72	24,75	0,10	9,1
Intensification of agriculture	15,4	0,06	4,4	9,96	0,04	3,98	10,32	0,04	3,8
Extensification of agriculture	27,7	0,11	7,9	9,87	0,04	3,94	7,96	0,03	2,9
Afforestation	69,5	0,27	19,9	77,21	0,30	30,83	66,59	0,26	24,5
Deforestation	184,6	0,72	52,9	133,01	0,52	53,11	155,47	0,60	57,2
Water bodies construction	15,5	0,06	4,4	1,89	0,01	0,75	1,53	0,01	0,6
Other changes	9,6	0,04	2,7	6,69	0,03	2,67	5,25	0,02	1,9
Total changes (km^2)	349,18	1,36	100,00	250,43	0,97	100,00	271,86	1,06	100,00
Total study area (km^2)	25713			25713			25713		

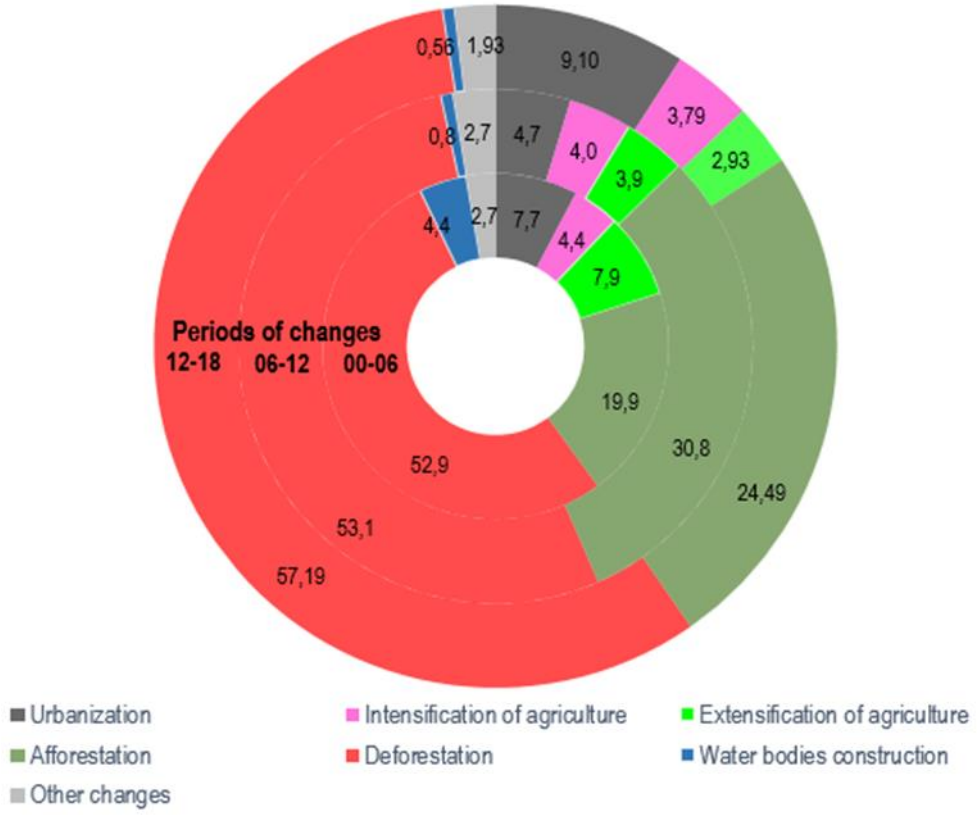

Figure 3. Land cover flows change through three periods (chart values in %)

Observing the spatial distribution of CLC change processes (Fig. 4), the most frequent LU flows in North Macedonia over the 2000-2018 periods were deforestation with 53% and afforestation with 24% of the total LUCC area. Following are the processes of

urbanization characteristic of the outskirts of the large cities in North Macedonia transforming the agricultural land use categories covering 7% of the total LUCC area. The rest is covered by the change processes of extensification of agriculture with 5% and intensification of agriculture with 4% of the total LUCC area, and a 7% of the area in total for the processes of water bodies' construction and management, unchanged classes and other changes.

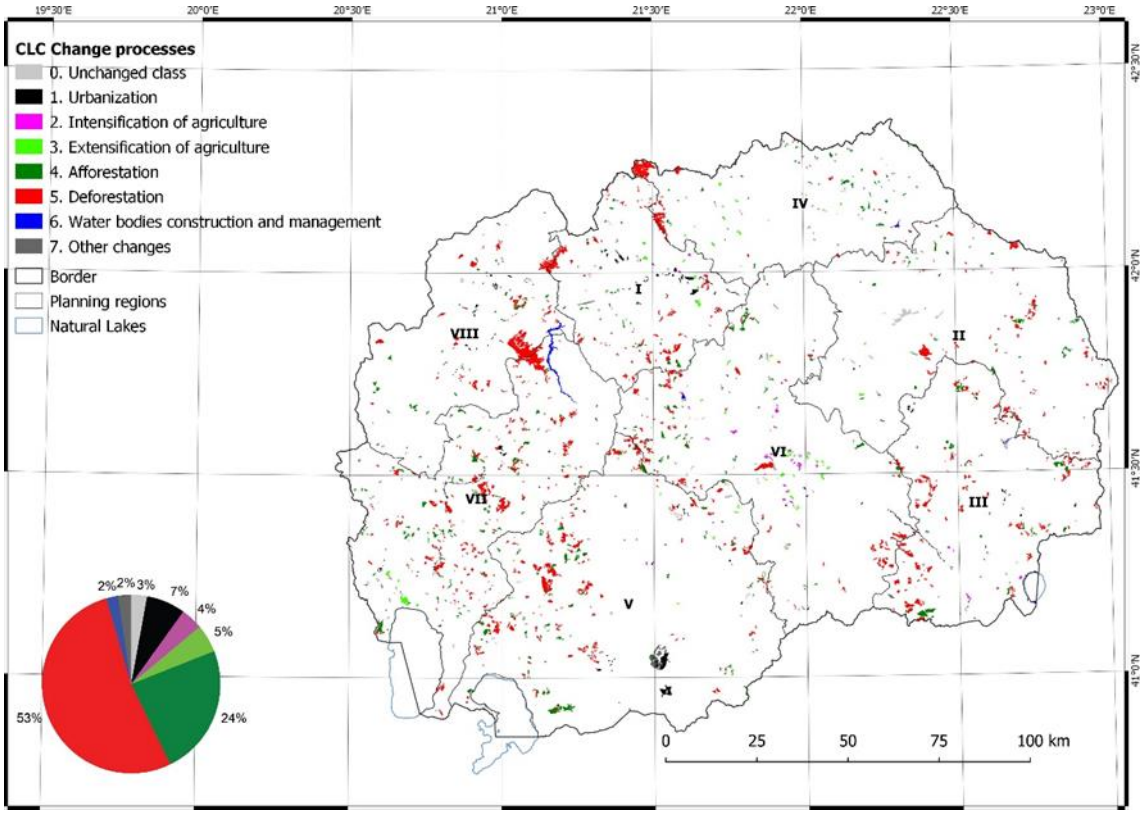

Figure 4. Spatial distribution of land use and land cover change processes in North Macedonia over the 2000-2018 period (Data source: CLC 2000-2006, 2006-2012, 2012-2018).

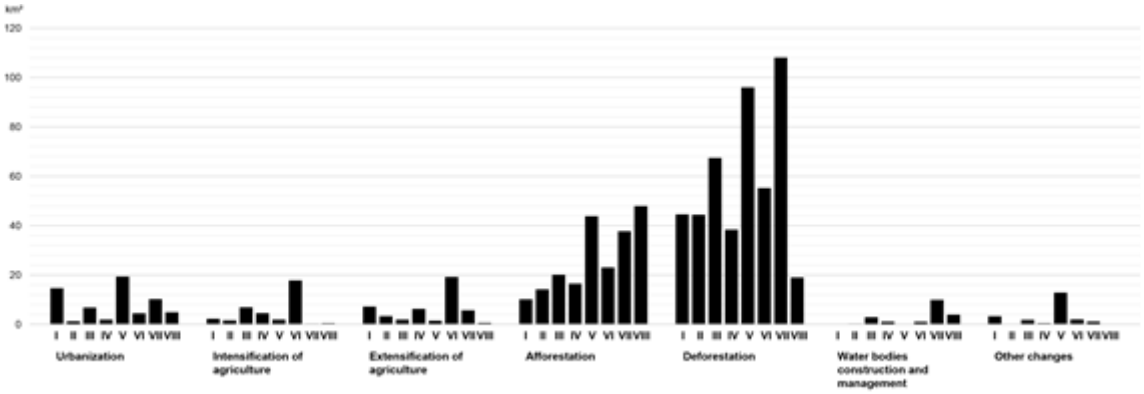

Figure 5. Land use flows in the period 2000-2018 by region (values in km2)

Table 3. LU flows in North Macedonia over the 2000-2018 period by planning region

	Urbanization		Intensification of agriculture		Extensification of agriculture		Afforestation		Deforestation		Water bodies constriction		Other changes		Total	
	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%	km^2	%
I	14,6	17,8	2,3	2,8	7,2	8,8	10,1	12,3	44,6	54,3	0	0	3,3	4,0	82,0	100,0
II	1,2	1,8	1,6	2,5	3,3	5,1	14,2	21,9	44,4	68,5	0,2	0,3	0,0	0,0	64,8	100,0
III	6,8	6,3	6,9	6,4	1,9	1,7	20,1	18,6	67,4	62,6	2,9	2,7	1,8	1,7	107,8	100,0
IV	1,9	2,7	4,6	6,6	6,3	9,1	16,5	23,9	38,4	55,6	0,9	1,4	0,4	0,6	69,1	100,0
V	19,4	11,0	1,9	1,1	1,5	0,8	43,8	25,0	96,0	54,7	0	0	12,9	7,3	175,4	100,0
VI	4,5	3,7	17,8	14,4	19,7	16,0	23,0	18,7	55,2	44,8	0,9	0,7	2,0	1,6	123,2	100,0
VII	10,2	5,9	0,2	0,1	5,7	3,3	37,7	21,8	108,1	62,5	10	5,7	1,1	0,6	172,9	100,0
VIII	4,9	0,6	0,4	0,1	0,6	0,1	47,9	6,0	19,0	2,4	4	0,4	0,0	0,0	795,2	

I. Skopje, II. Eastern, III. Southeast, IV. Northeast, V. Pelagonia, VI. Vardar, VII. Southwest, and VIII. Polog planning region

Most conversions from one land use and land cover category to another took place in the Pelagonia, Southwest, and Vardar planning region, and the least affected are the Northeast, Eastern, and Polog planning regions. (Fig. 5 & Table 3.).

Urbanization expansion is most visible in Skopje, Pelagonia, and Southwest planning region notes covering 44.23 km2 or 70% of the total changed area.

Intensification of agriculture is most characteristic of the Vardar planning region where we can identify 17.75 km2 or 50% of the total changed area. Extensification of agriculture is visible in Skopje, Northeast, and Southwest planning region transforming an area of 19.15km2 or 42% of the total changed area.

Afforestation changing processes were most successful in Polog, Pelagonia, and Southwest planning region regaining the forestland of 129.45 km2 or 61% of the total changed area.

Deforestation processes applied their destructive repercussion the most in the Southwest, Pelagonia, and Southeast planning regions with 271.54 km2 or 57% of the total changed area.

Water bodies' construction and management influenced the most in the Southwest and Polog planning region with 13.82 km2 or 73% of the total changed area.

LAND COVER FLOWS BY REGIONS

The following part is an overview of the analysis of land use processes by planning regions. For that purpose, an analysis was made of the data obtained from GIS by individual regions for the three periods by region.

In the Skopje region, the dominant process for the three periods is deforestation, which has a decreasing trend. The second more important process is afforestation tends to increase, although in the last period it has decreased compared to the middle period. An important process in this region is urbanization which is constantly growing, especially in the last period of change.

In the Eastern region, as in others, the most important process is deforestation, followed by afforestation. There is a slight increase in the last period of changes in the urbanization process.

Table 4. LU flows in North Macedonia over the 2000-2018 period by planning region

Skopje region	2000-2006	2006-2012	2012-2018
Urbanization	7,7%	4,7%	9,1%
Intensification of agriculture	4,4%	4,0%	3,8%
Extensification of agriculture	7,9%	3,9%	2,9%
Afforestation	19,9%	30,8%	24,5%
Deforestation	52,9%	53,1%	57,2%
Water bodies constr. & manag.	4,4%	0,8%	0,6%
Other changes	2,7%	2,7%	1,9%

Eastern region	2000-2006	2006-2012	2012-2018
Urbanization	0,3%	0,0%	4,7%
Intensification of agriculture	0,6%	10,1%	1,8%
Extensification of agriculture	3,0%	0,0%	10,5%
Afforestation	20,6%	25,1%	22,2%
Deforestation	74,7%	64,8%	60,8%
Water bodies constr. & manag.	0,7%	0,0%	0,0%
Other changes	0,0%	0,0%	0,0%

Southeast region	2000-2006	2006-2012	2012-2018
Urbanization	3,5%	4,2%	12,5%
Intensification of agriculture	5,3%	0,0%	13,9%
Extensification of agriculture	0,5%	2,1%	3,2%
Afforestation	11,3%	27,1%	22,4%
Deforestation	74,9%	63,5%	42,5%
Water bodies constr. & manag.	3,0%	2,8%	2,1%
Other changes	1,4%	0,2%	3,4%

Northeast region	2000-2006	2006-2012	2012-2018
Urbanization	2,5%	3,5%	2,1%
Intensification of agriculture	1,5%	18,2%	1,9%
Extensification of agriculture	11,8%	5,1%	9,1%
Afforestation	26,1%	16,2%	28,9%
Deforestation	57,5%	56,2%	51,8%
Water bodies constr. & manag.	0,0%	0,6%	4,7%
Other changes	0,6%	0,0%	1,5%

Pelagonia region	2000-2006	2006-2012	2012-2018
Urbanization	11,0%	8,7%	17,6%
Intensification of agriculture	0,5%	0,0%	5,6%
Extensification of agriculture	1,9%	0,0%	0,0%
Afforestation	25,3%	31,1%	7,2%
Deforestation	50,9%	54,8%	66,3%
Water bodies constr. & manag.	0,0%	0,0%	0,0%
Other changes	10,4%	5,5%	3,3%

Vardar region	2000-2006	2006-2012	2012-2018
Urbanization	1,7%	1,4%	8,5%
Intensification of agriculture	20,0%	12,7%	8,4%
Extensification of agriculture	19,0%	21,7%	5,6%
Afforestation	25,7%	10,5%	16,5%
Deforestation	33,7%	49,7%	56,6%
Water bodies constr. & manag.	0,0%	3,0%	0,0%
Other changes	0,0%	1,1%	4,4%

Southwest region	2000-2006	2006-2012	2012-2018
Urbanization	7,6%	0,3%	9,8%
Intensification of agriculture	0,2%	0,0%	0,2%
Extensification of agriculture	9,8%	0,4%	0,1%
Afforestation	14,0%	46,1%	5,4%
Deforestation	49,4%	53,2%	83,3%
Water bodies constr. & manag.	18,2%	0,0%	0,0%
Other changes	0,7%	0,0%	1,2%

Polog region	2000-2006	2006-2012	2012-2018
Urbanization	15,7%	5,6%	0,2%
Intensification of agriculture	1,0%	0,6%	0,2%
Extensification of agriculture	0,0%	3,9%	0,0%
Afforestation	18,0%	49,0%	99,6%
Deforestation	50,0%	41,0%	0,0%
Water bodies constr. & manag.	15,3%	0,0%	0,0%
Other changes	0,0%	0,0%	0,0%

In the Southeast region, as in the previous ones, deforestation is the dominant process, followed by afforestation. In the last period of changes, there is an intensification of the process of urbanization and the intensification of agriculture.

The Northeast region has a high growth rate of the deforestation process. There is also an increase in the afforestation process. It is worth mentioning the intensification of agriculture in the second period.

In the Pelagonija region, the dominant process is deforestation, which is constantly growing. Afforestation is growing in the first two periods, after which it significantly decreases in the third. On the other hand, urbanization tends to grow in the three periods.

For the Vardar region, in addition to the deforestation which is in constant growth, the processes of intensification and extension of agriculture are characteristic, which have significant growth in the first two periods.

The steady growth of deforestation is also noticeable in the Southwest region. Specifically, afforestation is in significant growth only in the second period.

The Polog region is the only one in which the growth of afforestation has an advantage over deforestation. There is growth in urbanization, but with a strong tendency to decrease in the second and third periods.

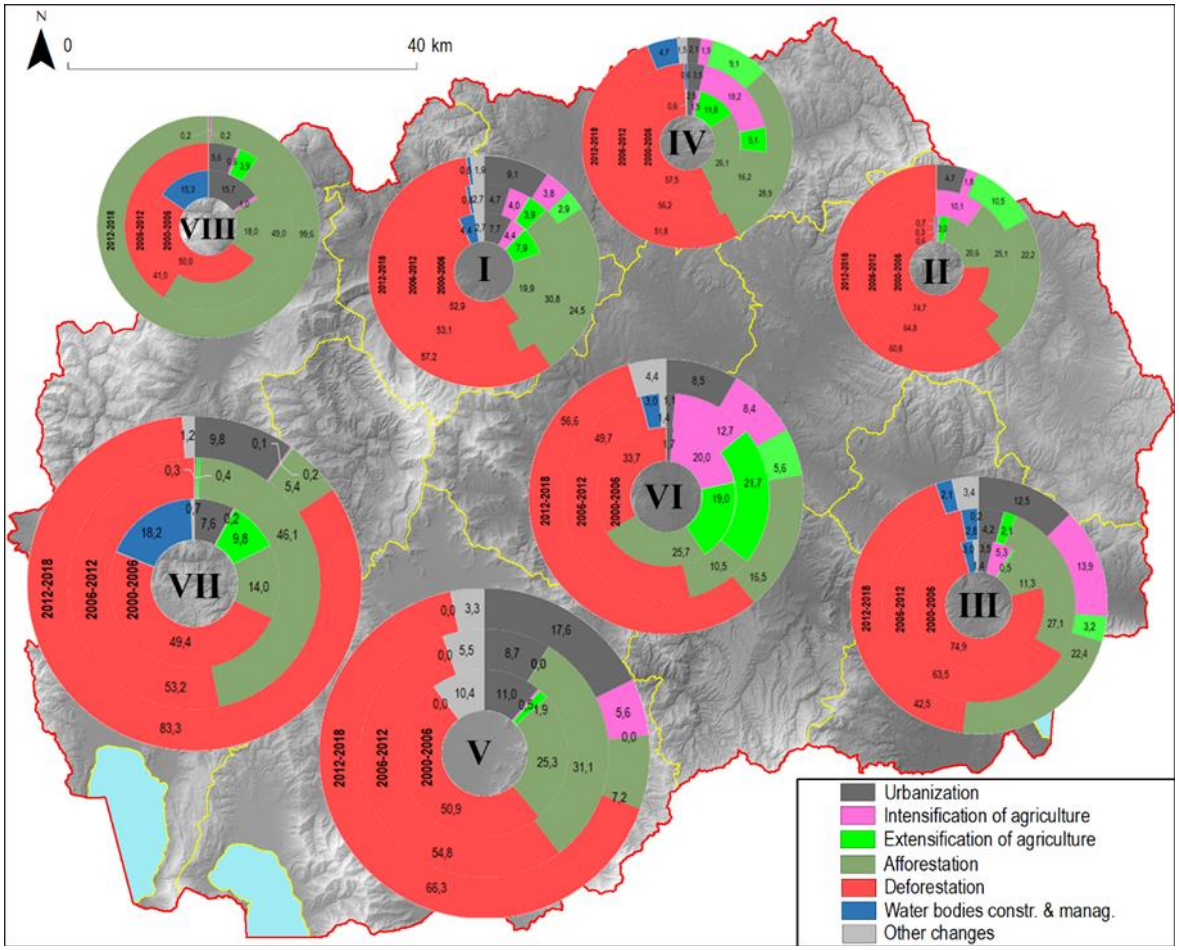

Figure 6. Land cover flows in North Macedonia by planning regions (chart values in %)

DISCUSSION

The process of deforestation is in general the result of two destructive factors: illegal woodcuts and forest fires. State and private forests in the Republic of North Macedonia are integrally managed by the Public enterprise for forest management PE "Makedonski Sumi". According to the State Statistical Office, 88.88% of the total area under forests is state-owned and 11.2% belongs to private forests.

Illegal woodcut is one of the biggest problems for forestry. According to the data of PE "Makedonski Sumi" [21] on the territory of North Macedonia in 2002, illegally was cut about 177.000 m3 of wood on an area of 0.06 km2. This situation was similar in 2003 and 2004 affecting the forests in Skopje, Southeast, Pelagonia, Southwest, and Polog planning regions. In 2004, according to the amendments to the Law on Forests Public enterprise formed a Forest guarding Service working in two cities covering the western and eastern regions. This service in 2004 had submitted Reports for illegal logging against 2.793 persons. Fort the first period (2000-2006) according to the statistic from the Sector for forest protection, supervision, and internal control two forest fires are detected. The one in 2000 counted 476 fires with 0.46 km2 size of burned area and the one in 2007 counted 652 fires with 0.35 km2 burned area.

In this way, the deforestation process is a leading one in the first period (2000-2006) covering a territory of 184.565 km2 which represents 51.76% of the total LUCC area or 0.73% of the case study (Table 3.). Most conversion phenomena involved forest land

(class 31, level 2) and its transition to Scrub and/or herbaceous vegetation associations (class 32, level 2).

In 2009, new Law on Forests came into force, according to which the forest police is the unique institution authorized to protect the forests from illegal logging, forest fires, diseases and pests, and other disasters. It is authorized to intervene, legitimate, and take into custody persons who have been caught doing illegal or criminal activities according to the Law, both in the state and private-owned forest areas. For the second period (2006-2012) two forest fires are also detected. The one in 2011 counted 302 fires with 0.17 km2 size of burned area and the one in 2012 counted 476 fires with 0.16 km2 burned area.

Subsequently, in the second period of 2006-2012, the deforestation processes have lower usurpation on the territory compared with the first period with 133.011 km2 with 0.52% of the study area but are still leading one compared to the others with 50.24% of the total LUCC area (Table 3.).

To increase the efficiency of forest protection, in 2014 the Law on Forests was amended, according to which the authority for forest guarding and protection was given back to the subject managing the forests. According to the new amendments, there are two levels of security of the forests: control patrol carried out by the forest police and regional executed by the forest guarding department of PE "Makedonski Sumi". With this, the Public enterprise received more authorizations to control the regions they are in charge of. Another change in the system was the inclusion of the Ministry of Interior, as an institution that is over the top of all the institutions involved in forest guarding. For the third period (2012-2018) one forest fire is detected. The one in 2017 counted 364 fires with a 0.13 km2 size burned area.

For the third period of 2012-2018, the deforestation processes have again increased the usurpation of the territory with 155.47 km2 and 0.61% of the study area and are the leading process with 56.35% of the total LUCC area (Table 3.).

Afforestation is the second significant process that took place in North Macedonia during the studied period, representing over 24% of the total LUCC area (Fig. 3 & Fig. 4). According to the CORINE Land Cover database (2018), the forests and semi-natural areas of North Macedonia amounts to 15273.07 km2 or 60.06% of the total territory of the country.

The expansion of the forest area is due primarily to the activities of the Public enterprise "PE Makedonski Sumi" through their programs for simple and expanded forests reproduction of the state-owned forest. Simple forest reproduction means breading and protection of the existing forests, besides the preservation. The activities of the Public enterprise in this area are in accordance with the Special forest management plans. Expanded forest reproduction is a long-term program of the Public enterprise for forestry that represents afforestation of new forests by planting bare fields and erosive areas, melioration of non-productive degraded forests and bushes, nurturing and preventive protection of the culture of the forest, etc.

Within the long-term program for afforestation in North Macedonia PE "Makedonski Sumi" in the period of 2008-2016 had implemented the project of the government, the Action "Tree day – plant your future". Within this action for the period of 2008-2016 total area of 0.13 km2 has been afforested. In 2018 the enterprise made a field and financial analysis for this action after which it was determined that the percentage of success of this action is 21% i.e. 7.394.518 out of 35.211.985 seedlings have survived. Before the beginning of this action, the state enterprise has been executing regular afforestation of the expanded forest reproduction program. In the period 2002-2007, the

total area of 0.13 km2 has been afforested with a total of 34.514,800 seedlings showing even more successful statistics than the ones of the campaign "Tree day-plant your future".

In this way change process of afforestation is having some dominant values in the three-time period, covering a very similar surface in the first and third periods with 69.54 km2 for the first period (2000-2006) representing 19.5% of the total LUCC area or 0.27% of the case study and 66.59 km2 fort the third period (2012-2018) representing 24.14% of the total LUCC area or 0.26% of the case study. We can notice a slight enlargement of this change process in the second period (2006-2012) with 77.2 km2 representing 29.16% of the total LUCC area or 0.3% of the case study. The most common type of transition was from Scrub and/or herbaceous vegetation (class 32, level 2) associations to forests (class 31, level 2).

Examining the reasons for the phenomenon of urbanization visible as the third significant LU change process in North Macedonia, we started with an analysis of the democratization process transmitted through European perspectives and incorporated into national legislation. A process that is undoubtedly one of the key initiators of this spatial reprogramming, and in North Macedonia it is marked by the process of decentralization (2005) and initiated by the Law on Local Self-Government (2002), legal acts by which many of the competencies of the central government have been transferred to the local level, a level that affects cities and urban regions. Decentralization of government, fiscal decentralization, territorial organization, and capacity building of municipalities were key segments of the decentralization process, competencies that enabled municipalities to implement several processes at the local level, including urban (urban and rural) planning and local economic development.

Urban planning has become one of the pillars of local autonomy, and at the same time, it is among the most complex competencies that have been transferred to the municipalities with the introduction of decentralization. Stimulated, but not completely confident in their intention, the municipalities reached for the regulations that directly visualized this strategic commitment and mostly focused on the urbanization process. The urbanization of their urban areas and rural settlements have taken a back seat to the perceived opportunity for economic development in areas that do not belong to urban units. Applying the guidelines set by the Law on Spatial and Urban Planning (2005 and 2014), a series of urban plans for out-of-town settlements were prepared and adopted for groups of buildings and complexes, larger buildings, or infrastructure buildings of local importance, which are treated neither by the general urban plan nor by the urban plan for the village. The permanent conversion of agricultural into construction land is still legally regulated if it enters the planning scope of the new urban plan.

All this has contributed to the emergence of intensive urban sprawl in the outlying rural areas and new local economic zones and economic complexes on the territory of municipalities, outside their urban centers. And except in a form initiated and implemented at the local level, such phenomena are further strengthened by the emergence of the Directorate for Technological Industrial Development Zones (TIDZ), which began operations in January 2002. Their spatial repercussion caused the usurpation of territories near large urban centers in all parts of the country, areas that possessed specific soil characteristics and up to that time with constant agricultural activity. Their positioning is based on two aspects, the first is state ownership, and the second is the proximity and extension of the regional transit axes. In the form of urbanized units, with

highly developed infrastructure within their borders, they significantly complement the emergence of partial positioning and the formation of independent spatial-program units. Over the first period (2000-2006) artificial surfaces would enlarge by 28,866 km2 which represents 7.5% of the total change-affected area or 0.11% of the study case, especially to the detriment of all agricultural land-use categories. This change process is halfway lowering its intensity in the second period (2006-2012) covering an area of 11.8 km2 which represents 4,4% of the total LULC area or just 0.05% of the case study. In the third period (2012-2018) this change process is again enlarging its visibility covering an area of 24.75 km2 representing 8.9% of the total change-affected area or 0.1% of the case study. This expansion in the third period is due to the construction of new highways and regional roads in the Skopje, Southeast, and Southwest planning region, as well as mining activities in the largest coal mine in the Pelagonija planning region.

Water bodies' construction and management during the three-time periods encompassed a total of 18.926 km2 which is 2.11% of the total changed area, or 0.07% of the study case. Although it's a high percentage compared to the others it's important to state that the largest amount of transformation of the land use for this category is made in the first period (2000-2006) with a total of 15.511 km2 which is 4.35% of the total LUCC area or 0.06% of the study case. This is due to the construction activities connected with the dam and hydropower plant "St. Petka" are located on the river Treska, located in Polog and Southwest planning regions. The plant is located between the larger HPP Kozjak and the smaller HPP Matka, which completed the hydro system "Kozjak-Matka" and fully used the hydro potential of the river Treska. The hydropower plant was put into operation on August 1, 2012, with a capacity of 36.4 megawatts. The first construction works for the plant started in February 2004. According to initial plans, the plant was to be completed in 2009. The contract for the construction of the hydropower plant was signed in 2005, and the construction of the hydropower plant began in 2006 and lasted for six years. The hydropower plant was put into operation in 2012 on a trial basis.

CONCLUSION

The main purpose of the present study was to document major Land Use Cover trends in North Macedonia during the periods 2000-2006, 2006-2012, and 2012-2018.

For the first period in 2000-2006 was identified LULC area of approximately 349.18 km2 or 1.36% of the total country area, 271.86 km2 for the second period of 2006-2012 or 1.06% of the total country area, and 250.86km2 or 0.97% of the total country area, comprising a total area of 25,444.2 km2. The most frequent LU flows in North Macedonia over the 2000-2018 periods were deforestation with 53% of the total changed area, afforestation with 24% of the total changed area, and the processes of urbanization with 7% of the total changed area. The rest is covered by the change processes of extensification of agriculture with 5% and intensification of agriculture with 4% of the total changed area, and a 7% of the area in total for the processes of water bodies' construction and management, and other changes. We can confirm a uniform trend of LU change processes with a slight decline in value that varies from 1.36% to 0.97% of the total area of the case study, or if we consider them as aggregate data for the three comparative periods in 18 years we can see LU change processes of a total of 871.47 km2 which is 3.39% of the total area of North Macedonia.

Apart from their change, classes are also sorted through their equal degree of change which is confirmed for each of the classes through the analysis of gains and losses for level 2 classes. Artificial surfaces note constant gains in the three-time period. From 2000

to 2006 they are having the highest gain. Loses of this class are dominantly lower than the gains and summed for the three-time period. Agricultural areas during the first period note almost double losses than gains evidencing. In continuation, visible are almost equal values of losses and gains during the second period. The forests and semi-natural areas during the first period note slightly bigger losses than gains. In continuation visible are almost equal values of losses and gains.

Using the CORINE land cover database through this GIS-based assessment of land use and land cover change for the period 2000-2018 we highlighted a various range of modifications in North Macedonia. This analysis can be taken as a reliable source for monitoring and qualifying spatial and temporal LULC changes, but we should count on possible limitations or uncertainties, having in mind that the minimum mapping area of the CLC database is 25ha. The main purpose of this study was to document major Land Use Cover trends in North Macedonia during the periods 2000-2006, 2006-2012, and 2012-2018. Further analyses could be developed based on the obtained results and cartographical and tabular materials. The most important conclusion of this study is the continuity in this process using the same or more advanced materials as resources for developing the results. In that way, we could stay informed about the crucial tendencies and the causalities of the changes.

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SECTION

TEACHING & EDUCATIONAL GEOGRAPHY

THE MULTILINGUAL NATURE OF GEOGRAPHY FINAL EXAMINATIONS IN HUNGARY – ACHIEVEMENTS AND CHALLENGES

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ABSTRACT

In Hungary, Geography final examinations can be taken in ten foreign languages within bilingual and nationality (ethnic minority) secondary education. This linguistic diversity is one of the less-studied, often neglected values of the Hungarian public education system. Around 20,000 students in more than 120 schools take part in dual language education, in which Geography is offered in Croatian, English, French, German, Italian, Romanian, Russian, Serbian, Slovakian or Spanish.

Since the introduction of the two-tier Matura examination system in the mid-2000s, Geography has been one of the most common choices in foreign language, showing the subject's prestige and popularity among students. Preparing students for final exams is quite challenging as it requires teachers to align subject teaching goals of the Geography curriculum with language skills development, while the contexts and pedagogical practices of foreign language Geography teaching greatly vary among the school programmes. The distribution of exams by location and language reveals not only some key demographic trends and patterns of Hungary but the nationwide success of dual language education as well.

As final exam requirements are about to change soon, it is worth reflecting on the achievements and challenges of 17 years of foreign language Geography teaching within the two-tier examination system. This paper and presentation will explore the factors influencing the practice of teaching Geography in foreign languages in Hungarian secondary schools through the geographical analysis of intermediate and advanced level exam data provided by the Educational Authority of Hungary, supported by thematic maps and the presenter's pedagogical experience.

Keywords: foreign language, Geography teaching, final examination, bilingual education, nationality education

INTRODUCTION

In Hungary, Geography is not a mandatory final exam subject, but has been a popular choice for tens of thousands of students so far – it had been the case even before the introduction of the two-tier examination system –, regardless of type of institution, region or language. However, curriculum changes over the last 15 years have left a negative mark on the image of this subject [7] [9]. As a result of the decline in the total number of lessons and recurring changes of the weekly number of lessons, covering all topics described in the curriculum has become a major challenge for teachers. With the recent transformation of the vocational school system, both Geography as an independent subject and geographical content in general have been marginalized in vocational schools, remaining relatively intact only in vocational schools with Economics and Tourism

profiles. (However, a complex science subject recently introduced in vocational schools involves various geographical content, but taking final exam from this new subject is not possible at the moment and this subject is not taught in foreign languages.).

Studying Geography in a foreign language has a wide range of benefits/advantages. This subject helps students understand the environmental, social and economic processes and interactions from global to local scale, offering synthesis between social and physical sciences [7] [8]. Compared to that of other science subjects, the terminology of Geography is relatively easy to access and digest even for students with lower level of language competence, while the topics covered in Geography lessons are closely connected to several everyday discussion topics such as transport, economy, society or environment. Studying Geography in foreign languages greatly contributes to the development of all language skills from vocabulary building to communication skills. This might be one of the reasons why Geography is a common subject choice to be taught in foreign languages in dual language programmes.

Foreign language Geography teaching has a double purpose. Teachers need to align the subject teaching goals of the Geography curriculum with language skills development, which requires methodological depth and years of teaching experience. Recent trends in content and language integrated learning (CLIL) offer a great alternative, but the application of CLIL methodologies and dissemination of its good practices in Geography teaching – and subject teaching in general – have not really been discussed in professional teacher communities [1] [12].

Geography education must follow the guidelines and requirements set in the curriculum, regardless of the language of instruction. Neither the curriculum, nor the exam requirements are available in languages other than Hungarian. Therefore, exam preparation poses a greater challenge to teachers and students alike, as different goals need to be aligned in a relatively short timeframe (due to relatively small number of lessons) to be able to take exams successfully. Topographic map requirements and the list of key expressions are provided only in Hungarian, forcing teachers to translate expressions or borrow phrases from foreign language textbooks. The public database of past examination papers and marking schemes available on the website of the Educational Authority of Hungary also contribute to exam preparation and guidance, but teachers who teach this subject in a foreign language might feel a vacuum they need to fill with individual self-developed solutions, practices and resources adapted to the situation.

In terms of printed study materials, foreign language Geography teaching has been facing challenges from the beginning. There are no textbooks available to fulfil the methodological requirements of the double purpose mentioned above. Only a narrow selection of previously translated versions of Hungarian textbooks are available for schools to buy, but as they were written for a previous curriculum, they contain expressions and topics now considered less relevant. There is no plan for revising and publishing updated editions, even though a new exam structure is about to be introduced soon [6]. Study materials are available predominantly in ethnic minority languages, but in limited numbers. Textbooks in English, for instance, need to be imported or to be made available in online versions. However, Geography atlases have recently become available in three languages, developed with the clear purpose of supporting bilingual education.

Bilingual centres may rely on cultural institutions or previously gained experience in ordering resources, but obviously those materials do not fit the purposes and curriculum of Hungarian Geography teaching, although they show similarities along a selection of

topics, mainly in physical geography. For minority education, importing materials from abroad might be easier.

AIMS AND METHODS

One way of measuring the effectiveness of subject teaching in secondary schools is the analysis of final exam results. Since the introduction of the two-tier final examination (Matura) system in the mid-2000s, examinations have been available in intermediate and advanced levels. Both examinations include a written and an oral component. Examinations can be taken during spring (May-June) and autumn (October-November) exam periods. Intermediate exams are assessed internally by teachers, while advanced level exams are assessed externally. Final exams can be taken only in subjects that were taught for at least two years – and Geography belongs to these subjects [7] [8]. Students taking foreign language subject examinations might work on their written papers (as eam time for each component is slightly extended), but in terms of the oral exam component, there is no difference between exams taken in Hungarian and in foreign languages.

The aim of this research was to build a database of foreign language Geography exam statistics. A wide range of information is available in the public databases of the Educational Authority of Hungary, including gender, result, language, county, type of institution (secondary grammar school or vocational secondary school), type of examination and level of examination [4]. The website of the authority also hosts a public inventory of past examination papers and marking schemes in all languages [5]. Both databases are updated after each examination period. During the research, the two databases were matched to identify any discrepancy among the selected data.

In addition to the analysis of statistical data, two interviews were conducted with officials supervising Geography examinations – including those in foreign languages – were concluded to support assumptions formulated on the basis of patterns and trends. (The pedagogical experience of the author of this paper in preparing and examining students is also added.) Findings of the research were processed into a variety of diagrams and maps to visualize spatial distribution and temporal change patterns of foreign language examinations over a period of 15 years and more than 30 examination periods [4] [5].

This research is relevant as no similar studies have been concluded in this field so far. Publications dealing with dual language programmes mainly cover linguistic aspects, but they rarely explore subject-specific problems, while most studies in Geography methodology do not tend to pay enough attention to the practices and achievements related to foreign language Geography education [2].

RESULTS AND DISCUSSION

Over the last 15 years, more than 150 dual language programmes have been present in 120 different schools. The range of institutions showed minimal fluctuation (certain schools introduced, others abandoned or suspended such programmes for a variety of reasons). There are eleven languages in which bilingual or ethnic minority programmes are available in secondary education. The majority of these dual language programmes are Hungarian-English and Hungarian-German bilingual programmes. In terms of bilingual education, Geography is offered in English (dozens of schools across the country), French (ten schools, two in Budapest and eight outside the capital), Spanish (seven schools, one in Budapest and six in major towns) and Italian (two in Budapest, one in Debrecen and one in Pécs) [3].

In terms of languages falling under the ethnic minority language provisions set by the government, Slovakian (one school in Budapest, one in Békéscsaba), Croatian (one school in Budapest, one in Pécs), Russian (two schools in Budapest), Serbian (one school in Budapest) and Romanian (one school in the border town of Gyula) bilingual education has also been present for years. Hungarian-German dual language programmes are available in both bilingual and nationality education, adding up to around 50 schools. (In addition to these, Chinese – as an eleventh language – is also present in two schools in Budapest, but neither of them offer Geography, therefore no such final examination has been held so far.) It is important to note that English and German language programmes and most of the minority language programmes can rely on students coming from primary schools with similar profiles, while in the case of Spanish, French and Italian, dual language primary school education is not present at the moment.

Table 1. Intermediate (green boxes) and advanced (red marker) Geography final exams by exam period and foreign language (2005-21), based on the public database of the Educational Authority of Hungary [4] [5].

exam periods		foreign languages									
		Eng	Fre	Cro	Ger	Ita	Rus	Rom	Spa	Ser	Slo
2005	spring	■	■	■	■					■	
	autumn	■		■	■						
2006	spring	■◆	■	■	■	■	■		■		■
	autumn	■◆	■	■	■	■			■		
2007	spring	■◆	■	■	■◆	■			■		■
	autumn	■	■	■	■◆	■			■		
2008	spring	■◆	■	■	■	■			■		
	autumn	■	■	■	■	■			■		
2009	spring	■◆	■	■◆	■	■			■	■	
	autumn	■	■		■	■			■		
2010	spring	■	■	■	■	■	■		■		
	autumn	■◆		■	■	■			■◆		
2011	spring	■	■	■	■◆	■	■		■		
	autumn	■◆	■		■	■					
2012	spring	■	■	■	■◆	■	■		■	■	
	autumn	■	■	■	■◆	■			■		
2013	spring	■◆	■	■	■◆	■	■		■		
	autumn	■	■		■◆	■			■		
2014	spring	■◆	■		■◆	■					
	autumn										
2015	spring	■◆	■		■◆	■		■			■
	autumn				■						
2016	spring	■	■	■	■◆	■			■		■
	autumn	■									
2017	spring	■	■		■◆	■		■	■		
	autumn										
2018	spring	■◆	■	■	■◆	■			■		■
	autumn				■						
2019	spring	■	■	■◆	■	■			■		
	autumn										
2020	spring	■◆	■	■	■◆	■		■	■		■
	autumn	■	■		■	■			■		
2021	spring	■◆	■		■	■			■		
	autumn	■	■		■◆	■					
exam periods		29	26	19	30	26	5	3	22	3	6

According to public data, more than 7,100 intermediate level Geography final exams have been taken in a foreign language between 2006 and 2021, constituting 3.5% of all intermediate level exams. Since the introduction of the two-tier system, 34 exam periods have been held (two per year). There were three exam periods in which students selected Geography in eight different foreign language – a similar range of language use was observable only in the case of Mathematics and History, two mandatory final exam subjects. Nearly all exam periods have had at least one exam taken in foreign language (Table 1). Based on the data, it can be clearly stated that Geography has been the most popular and most common choice for an optional science subject to take in foreign languages.

Table 2. The number of intermediate and advanced level examinations in Hungarian and in foreign languages respectively, 2006-2021. (Source of data: the public database of Educational Authority of Hungary.) [4]

Year (spring and autumn exam periods are combined)	**Intermediate level**		**Advanced level**	
	the number of exams taken in Hungarian	the number of exams taken in foreign languages	the number of exams taken in Hungarian	the number of exams taken in foreign languages
2006	22,024	not specified	569	3
2007	21,040	692	677	4
2008	19,710	641	452	3
2009	19,012	621	296	2
2010	14,386	740	270	3
2011	16,233	776	414	3
2012	15,260	750	516	2
2013	17,361	953	509	5
2014	8,031	137	320	5
2015	9,913	224	254	2
2016	9,068	292	328	6
2017	6,497	227	207	2
2018	5,772	191	174	6
2019	5,124	187	219	1
2020	4,801	218	827	5
2021	6,207	217	1,221	6

The impact of exam regulation changes – like the suspension and reintroduction of early examination (held before the final year of secondary education) – has been observable in the fluctuations of exam numbers both in Hungarian and foreign languages [10]. Peak exam numbers of the late 2000s and the early 2010s were followed by a decline, which was also visible in the falling number of exams in foreign languages (Table 2). While total intermediate exam numbers reached a low point in 2020, foreign language exam numbers stabilised at around 200 exams per year.

The gradual decline of advanced level exams stopped a few years earlier, showing unprecedented record-breaking numbers recently, mainly due to the recognition of Geography as a potential advanced exam subject at a wider range of universities, including faculties of Economics [10] [11]. However, the majority of candidates studying Geography in foreign languages choose this subject at intermediate level. Advanced level foreign language Geography exams are still very rare and occasional (exam numbers per year never exceeded 6).

Considering languages, German and English are outstanding in terms of both exam numbers and exam periods. 82.5% of all intermediate exams have been taken in German

and English. Ethnic minority languages (excluding German) add up to only 2% of all foreign language exams, with Croatian being significantly more often selected than Romanian, Russian, Serbian, Slovakian combined. Exam numbers taken in minority languages are proportionate to the number of programmes of the given language.
By geographical distribution, almost 30% of all foreign language intermediate exams were taken in Budapest. It is not surprising as the capital city has the most multicultural population and the most colourful range of dual language programmes, with all of the above listed languages except for Romanian.

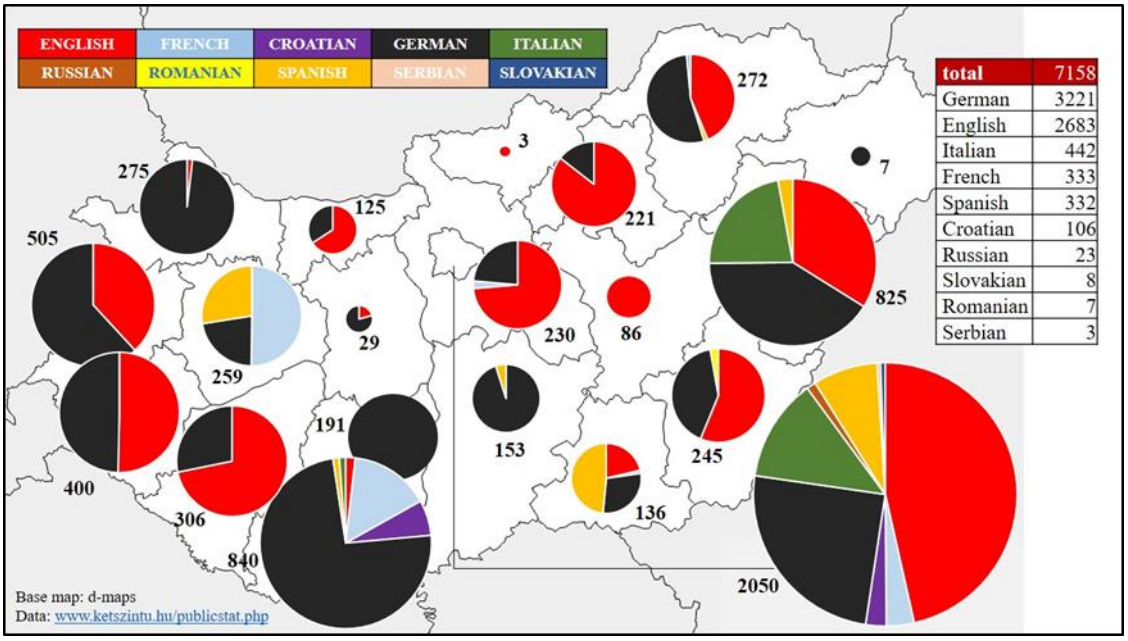

Figure 1. The distribution of foreign language intermediate exams in Geography by county and language (2007-2021), based on the public database of the Educational Authority of Hungary.

Geography exams were taken in at least one foreign language in every county. (Figure 1.).While Budapest, Pest county and counties with major educational centres (for instance, Baranya, Hajdú-Bihar, Csongrád, Veszprém or Borsod-Abaúj-Zemplén) have a much wider diversity of languages in which Geography exams were held, certain counties (Nógrád, Szabolcs-Szatmár-Bereg, Jász-Nagykun-Szolnok, Tolna) had exams in only one foreign language and in significantly lower numbers. This can be justified by the lower number of institutions – and an even lower number of schools offering Geography in that particular foreign language.
Exams in German have been held in Budapest and 17 counties, while exams in English have been held in Budapest and 15 counties, which explains the greater share of German language examinations. Around 20% of all German-language exams were taken in Baranya county, which in general shows a great linguistic diversity with five other language options (of which, English was the least common choice). Transdanubia has a slightly higher number of Geography exams in German, mainly due to significantly high exam numbers in Baranya and Tolna (home to a larger number of inhabitants of German ethnicity) and counties along the Austrian border.
Baranya and Hajdú-Bihar counties (with Pécs and Debrecen as county seats and university towns with very diverse educational profiles) represent around two-thirds of total foreign language examination numbers. Exams taken in French, Italian and Spanish have similar numbers, slightly exceeding 1,100 combined. Budapest is the only place with

exams in Russian and Serbian, but no exams in this languages have been held since 2013. In Romanian, only one school in Békés country has organized Geography examinations, but only since 2015 [4].

CONCLUSION

Students across the country have an opportunity to join dual language programmes and study Geography (among other subjects) in a multitude of languages. This linguistic diversity of secondary schools is a very valuable and peculiar feature of the Hungarian public education – and the result of various demographic and socioeconomic factors. The location of schools with dual language programmes greatly determines the distribution patterns of foreign language examinations, while exam numbers follow the fluctuations caused by changing regulations and the steadily narrowing space of Geography education. Even with declining exam numbers, marginalized treatment, lack of relevant resources and relative loss of subject prestige, these dual language programmes have managed to prove the success of Geography teaching and contribute to the popularity of this subject as a final exam subject choice. Although foreign language exams make up only a tiny segment of total exam numbers, they represent a network of educational programmes in which Geography teaching is combined with the goals and practices of language teaching – and in which thousands of students are enrolled year after year. Behind these exam achievements, there are well-prepared students, experienced and dedicated teachers and well-developed school practices, which would be worth studying further to explore differences exam preparation methods and disseminate the most effective teaching practices.

As more than 15 years have passed since the introduction of the two-tier final exam system, this analysis might be timely as exam requirements (e.g. content and exam structure) are about to change from May 2024, including the introduction of project assignment as a potential alternative to the present oral exam component [6]. Currently, these changes seem to be beneficial for students of dual language programmes as they provide more freedom and more room for creativity than present-day exam requirements, but schools and teaching communities need to revise their strategies for exam preparation both language-wise and content-wise to maintain the success of foreign language examinations.

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HISTORICAL HERITAGE, GEOGRAPHY AND EDUCATIONAL TOURISM: EXAMPLES OF FOUR SITES FROM BOSNIA

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ABSTRACT

The basic values of certain cultural and historical sites in Bosnia and Herzegovina, in addition to tourism valorization, have a strong educational component in terms of primary, secondary and higher education. The presented historical monuments with their content represent a real potential in the aspect of developing positive moral and cultural attitudes towards the homeland and its past. Their use in education has a double value: it develops perceptual abilities, as well as awareness of the importance of cultural heritage. The historical heritage in Bosnia and Herzegovina is generally not adequately protected today. For that reason, this paper will present the basic characteristics of historical sites of Gornji Kotorac, Arnautovići, Breza and Bobovac, which are to some extent incorporated into the educational processes.

Keywords: Historical heritage, education, Gornji Kotorac, Arnautovići, Breza, Bobovac

INTRODUCTION

The basic values of certain cultural and historical sites in Bosnia and Herzegovina, in addition to tourism valorization, have a very pronounced educational component in terms of education in almost all segments of schooling (primary, secondary and higher education). The presented cultural and historical monuments with their content represent a real potential in the aspect of developing positive moral and cultural attitudes towards the homeland. Their use in education has a double value: it develops perceptual abilities, as well as awareness of the importance of cultural heritage (positively directs the attitude towards culture). The cultural and historical heritage in Bosnia and Herzegovina is generally not adequately protected today. Predominant cause should be sought in political and administrative division of Bosnia and Herzegovina, which is recognized as crucial limiting factor that affects multiple problems for more dynamic development of tourism sector according to existing resources and potentials [14]. For that reason, we will present the basic characteristics of medieval sites of Gornji Kotorac, Bobovac, Breza and Arnautovići, which are to some extent incorporated into the contents of textbooks and other literature in the educational process, and their state in terms of promotion, articulation and presence in tourism offer.

Education is becoming an increasingly important component of tourism activities and the tourist experience. A large part of tourism activities includes a certain form of formal or informal education, and educational tourism is becoming an increasingly important part of the tourism market. Consumers of tourism contents meet their educational needs through visiting destinations, and many destinations have the image of a place with

developed infrastructure of this type. Educational tourism is activity of a tourist for whom education at the destination is the primary or secondary motive for visitation. These activities include study tours, school excursions, student education at foreign universities and exchange programs.

The period of postmodernism (since the late 1980s) is characterized, among other things, by the growing interest of tourists in various alternative types of tourism.Educational tourism as a modern form is based on motivational factors where elements such as raising awareness of the importance of education for self-affirmation, curiosity and analytical skills, the need for active stay at the destination, as well as socializing with people who share similar interests, or belong to the same generation. Therefore, in our opinion, professional and scientific inclusion of educational institutions (especially universities, as well as professional associates in primary and secondary schools) is necessary in the formation of the educational tourism product, related to study trips.Educating tourists about the cultural characteristics of the destination (e.g. local communities) is extremely important as a means of contributing to the elimination of various predictive stereotypes, which also enhance the establishment of intercultural dialogue.

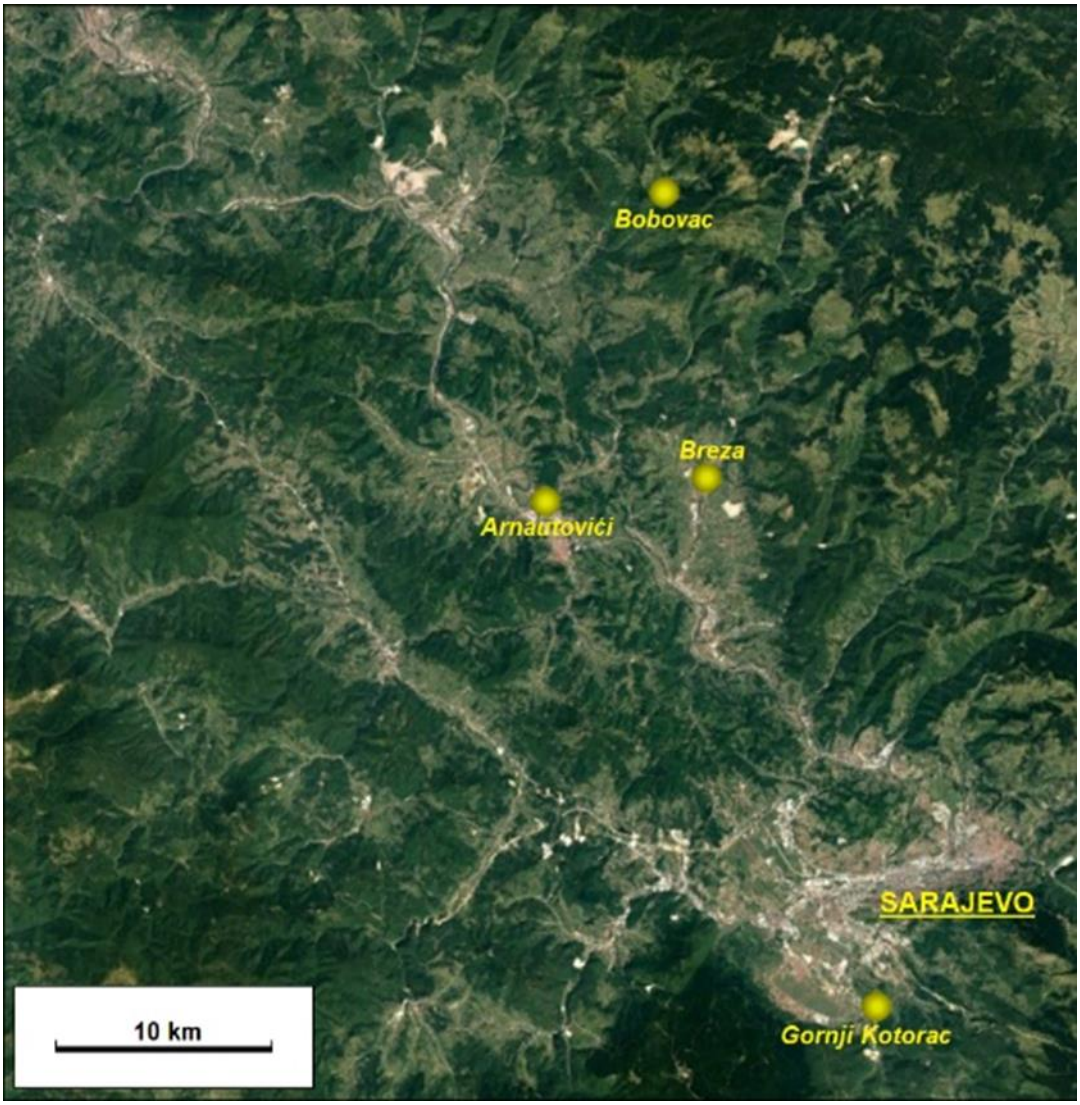

Figure 1. Location of researched localities. Source: Google Earth.

On the example of case studies of these cultural and historical monuments in Bosnia and Herzegovina, which are characterized by exceptional symbolic values, originality, uniqueness and representativeness, this paper seeks to present the recent situation that can be defined as a process of marginalization in terms of their articulation in tourism offer.

- Several segments specifically point to this process, and above all the following:
- Small number of agencies that include educational tours in their offers;
- Insufficient or non-existent presentation in the media;
- Very rare inclusion of visits to the mentioned localities in formal education system (primary, secondary and higher education);
- Considering that these are exceptional contents of the cultural and historical heritage of Bosnia and Herzegovina which in the process of education have exclusive significance within the state, the intention of this paper is to draw attention to their potentials in the process of education, but also possible affirmation in tourism trends.

In this part paper will present the basic characteristics of historical sites of Gornji Kotorac, Arnautovići, Breza and Bobovac (Figure 1), which are to some extent incorporated into the educational processes.

ARCHAEOLOGICAL SITE GRADAC ON ILINJAČA IN GORNJI KOTORAC

In November 2004, the Commission to Preserve National Monuments of Bosnia and Herzegovina (hereinafter: the BiH KONS Commission) issued a decision declaring this site a National Monument of Bosnia and Herzegovina. This area is dominated by the remains of a prehistoric hillfort, the remains of a late antique fortress and of a contemporary church, archaeological finds kept in the National Museum in Sarajevo and the Museum of the City of Sarajevo, and various archaeological finds in the country.

The most valuable literary information about this period was provided by Constantine VII Porphyrogenitus (905-959) in the closing sections of XXXII Chapter of his work „De administrando imperio“ (149 - 151), where he relates that: “In baptised Serbia are the inhabited cities of... and in the territory of Bosona Katera and Desnik“ [9]. At this point it would worth pointing out that the above sentences of the Eastern Roman emperor represent (for the time being) the oldest reference to the name of the country of Bosnia [13]. Archealogical site of Gradac at Ilinjača in Gornji Kotorac is located in the municipality of Istočna Ilidža (part at the City of Istočno Sarajevo), and is thought to be abovementioned location of medieval Katera.

Archeological site is in a very poor condition, practically with any designation, endangered by human activities (TV tower), and currently without any tourism related infrastructure. Gradac (Ilinjača), Gornji Kotorac is so far the most extensively examined archaeological site in the Kotorac zone. A fairly large and a more significant prehistoric and perhaps protohistoric hillfort settlement was situated at this site, characterised by a long continuity of development. The existence of a late antique refugium with a church was recorded in the southern half of the former hillfort. The walls of the refugium covered the entire upper plateau of the former hillfort. Samples of ancient ceramic material were found in the entire area, while an ancient castle was also found to be in secondary use in the church, according to Archaeological Lexicon of Bosna and Herzegovina.

The following protection measures have been designated as permissible in this area: only archaeological research and conservation works are allowed, including those aimed at presenting the monuments, with the approval of the Ministry of Republika Srpska responsible for spatial planning, including the expert supervision carried out by a relevant department in charge of protecting the cultural heritage at the level of Republika Srpska.

This decision specifies that no construction of any new buildings will be allowed, nor the installation of any temporary or permanent structures whose purpose is not exclusively the protection and presentation of monuments, including the ban on any construction or execution of works that could potentially affect the area and change the environment, and any infrastructure works (other than those approved by the competent ministry and accompanied with the expert opinion of the competent protection service). The monument facility will be open and accessible to the public and can be used for educational and cultural purposes. In order to undertake the urgent measures aimed at protecting the National Monument, it would be necessary inter alia to remove the PTT relay and arrange the access road on the east end of the site ranging from the last village houses to the top of Ilinjača [5].

Figure 2. PTT relay and vegetation hide the walls of Gradac.
Photo: Ranko Mirić.

Based on a series of field research exercises, the presence of a relay equipped with a number of telecommunications devices was detected, while access to the site was made difficult by a narrow and highly inaccessible road which is intensively covered with shrub-like vegetation and trees, which have „masked“ the remains of the walls and ramparts beyond recognition.

ARCHAEOLOGICAL SITE MILE

In July 2003, Commission to Protect the National Monuments of Bosnia and Herzegovina issued a decision declaring this site a National Monument of Bosnia and Herzegovina. The archaeological site formerly known as Mile (its official name has been Mili since

2009) is situated in the municipality of Visoko. It is situated in a part of the settlement called Arnautovići, which is situated in Visočko polje (Visoko Field), near the Goruša River confluence to the Bosna River. The site itself is ajcacent to the high railway embankment, a local road and the riverbed of the Bosna River. In its immediate vicinity, there are several famous historical and cultural sites of medieval Bosnia (the old town of Podvisoki, and Biskupići and Moštre). To the north, there are the well-known historical and cultural medieval places of Sutjeska and Bobovac, while to the south there are the places called Milodraž and Fojnica. The site covered by archaeological remains is known as Zidine (or Crkvina), and it is placed next to the northern part of the settlement called Arnautovići, along the right bank of the Bosna River [6].

The construction of a railway line back in 1947 had a special influence on the current landscape of the area. At that time, the site ruins were roughly levelled and some barracks were built on them to accommodate a number of communist youth work brigades. A narrow-gauge railway was also built, which was later turned into a road cutting this site together with the church into two parts. Along the way, some private residential buildings were built, one of which is situated next to the site [3].

Figure 3. Archeological site of Mile – crown and burial place of medieval Bosnian kingsPhoto: Ranko Mirić.

The examined section of the Mile site (in literary sources known as: Mile, St. Nicholas, Visoko, Mileševo) is situated in the area of a former rich Neolithic settlement which dates back to the period from around 2600-2400 BC. It is first mentioned in the Charter of Bela IV in 1244 as the property of the Bosnian Diocese („in Mel apud eclesiam Cosme et Damiani“, i.e. in Mel near the Church of St. Cosmas and Damian) [3]. In the 14th century,

near Kraljeva Sutjeska, in Mili, there was the seat of the local governor or ban and the centre of the country's life. On the land of the Bosnian Diocese, which is mentioned in the Charter from 1244, Bosnian governor or Ban, Stjepan (Stephen) II Kotromanić, built the first Franciscan Monastery of St. Nicholas [1].
Mile is one of the places where Bosnian state and ecclesiastical synods were held. An old and large cemetery, together with the graves of Stephen II and Tvrtko I, emphasize the importance of Mili as the centre of the posthumous cult of these rulers. The complex archaeological area in Mili is made of four architectural units that stand out in specific spatial and chronological relations. These are remains of a Romanesque and Gothic church, and the tombs of King Tvrtko I Kotromanić and King Stjepan II. The highly valuable finds of remnants of material culture are exhibited in the medieval collection of the National Museum in Sarajevo (parts of the royal cloak of King Tvrtko I, made of brocade canvas with representations of the royal coat of arms, four gold rings, seal rings, etc.)
Unlike Gornji Kotorac, the current condition of this site is partly better, but it is far from what is required. The space is fenced on three sides, with a clearly displayed site notice board that shows the basic historical data. A small panel was built, which provides the space for a larger number of visitors in the context of their education. However, due to the accommodation within the settlement, the site is visually degraded by residential buildings and by a road situated in the immediate contact area, and is thus exposed to a number of associated risk factors (such as, e.g. traffic, pollution, noise), while despite its regular maintenance, the area is potentially exposed to higher deterioration due to a number of adverse circumstances.

ARCHAEOLOGICAL SITE OF LATE ANTIQUE BASILICA IN BREZA

Similar to the previous sites, and on the basis of the criteria used for declaring an asset a National Monument, in November 2004, the BiH KONS Commission issued a decision declaring this site a National Monument of Bosnia and Herzegovina. It was included in the Spatial Plan of BiH applicable until 2000 as a Category I monument. The basilica itself is situated in the municipality of Breza (about 27 km northeast of Sarajevo), in a valley extension on the right bank of the Stavnja River (right tributary of the Bosna River), at the site called Crkvina. With its location, the basilica makes one part of the immediate town centre area and it is surrounded by a number of housing units. This national monument is made of an archaeological site with the remains of a late antique basilica and artifacts found in the archaeological site which are exhibited in the National Museum in Sarajevo, all of which is listed in the inventory books of the Museum [7].
Due to its specific position within the urban settlement, specific protection zones have been identified in order to preserve the National Monument. The first zone (Figure 4) is a fenced area where only research and conservation-restoration works are allowed (including those aimed at presenting the monument), following the approval of the competent ministry. Due to the existence of a great number of housing units and land estates, it still remains evident that the provisions about the second and particularly the third protection zones are inapplicable (establishment of a 50 meters wide zone along the boundaries of an area occupied by the I and II protection zones, where it is exclusively permitted to build the structures whose purpose is the presentation of the National Monument).

Figure 4. Crkvina – remains of late antique basilica in Breza. Photo: Ranko Mirić.

The site setting and signage combined make this national monument easily accessible, since the site markings and information panel are displayed in plain sight. In the Spatial Plan of BiH until 2000, it was included as a category I monument. In prehistoric and ancient times, the area of Breza belonged to the Central Illyrian area and the ethnic area of the Daesitiatis tribe. This tribe lived in the area that included the upper valley of the Bosna River, west to the upper valley of the Vrbas River and east to the town of Rogatica. The Daesitiates were one of the most important and one of the largest Illyrian tribes. They had 103 decuries (fraternities) and belonged to the Naronian Convent (CONVENTUS NARONITANUS – a judicial and administrative centre of the region or district). They were often mentioned in antique sources, especially after the uprising of the 6th century AD staged against the Romans [10]. This is also evidenced by a Roman inscription found at this site, which contains the references to Valens, son of Varon, (princeps Daesitiatium), or a nobleman of the Illyrian tribe of Daesitiates and a castle (castellum Daesitiatium). According to various sources, the origin of the basilica is dated back to the 6th century, during the reign of Emperor Justinian. A tomb was discovered in its compounds, where a bronze shield boss or umbo was found, a Byzantine work dating back to the 6th century.

The distinctiveness and originality of the structure is not only its spatial concept, but also the rich stone plastic. The pillars are made on a lathe and decorated with rings made of shallow grooves. The column capitals, which are in terms of their shape similar to imposts, consist of two plinthes between which sharp arches are placed. Other, smaller types of pillars were also found, which are presumed to have belonged to the frontal triforium [4]. Inspection into the location of the monument itself shows that the basilica

area is surrounded on three sides with a number of private land plots and individual residential buildings (particularly on the south side). A particular problem appears to be the concrete pillar in the first protection zone, which visually degrades the unique ambience of the basilica. The construction itself (walls, pillars) is in good condition, given the age of the building. One of the authors of this study used the basilica space as a football field nearly half a century ago. According to the 2004 BiH Commission to Protect National Monuments of Bosnia and Herzegovina. Commission report about the current condition of this monument (based on statements given by local residents), local children use this space occasionally to play football matches. History repeats itself, regardless of the extent to which this site is protected.

MEDIEVAL ROYAL FORT OF BOBOVAC

Commission to Preserve Natural Monuments made a decision in November 2002., to declare this site as a national monument of Bosnia and Herzegovina. The area is located in the west side of municipality of Vareš, along the border with municipality Kakanj. The site can be found above the mouth of Mijakovska River to Bukovica, on the mountain slopes of Dragovske and Mijakovske Poljice. Arrival from the direction of Kakanj leads across the settlement of Kraljeva Sutjeska where the royal court dating from XIV. and XV. century is located (national monument of Bosnia and Herzegovina). These two monuments were the most important centres of cultural life of the medieval or so-called Upper Bosnia in between of these two listed periods with specific intensity, stylistic and regional characteristics (so called medievalbosnian cultural cycle). Access to Bobovac is also possible from the urban center of Vareš from the east.

In the protection zone with a minimum width of 2 km from the boundaries of the protected complex the construction of industrial objects, highway infrastructural objects, quarries or locating potencial environmental pollutants is not allowed. Royal town of Bobovac represented complex architectural object of impressive size, on an area of around 2,20 hectres, with 1.100 meters fortified ramparts 100-150 centimetres thick. This area is home to artifacts dating from the Bronze age and Early Iron Age (II millenium to 400. year before Christ) and from an ancient period. Information from written sources during medieval Bosnian country cover the period from 1350.-1463. For the Ottoman period documents date to 1626. when it was definitely abandoned because of Ottoman advancement to the north and spreading of the occupied territory, it lost its strategical value [2], [12].

As the royal headquarter, the town was a administrative-military center of Bosnian country and the royal Bosnian crown was kept in it. As the seat of Bosnian ban Stjepan II Kotromanić, who took the first steps on its construction some time before the half of XIV. century, then to the Bosnian kings from Tvrtko I to Tomaš, i.e. until year 1461. Bobovac was the key to Bosnian kingdom. The Bosnian kings Ostoja, Tvrtko II and Stjepan Tomaš were burried there. Last Bosnian king Stjepan Tomašević (1461.-1463.) because of imminent danger from the Ottomans transferred the royal court to Jajce. After the occupation, the town of Bobovac was destroyed in 1463. for justified, strategic reasons, which was confirmed by the archeological research and then the Ottomans built necessary objects for their stay in the town on the ruins of royal court (1463-1626) [8].

Bobovac, in all its components, is a expressive example of one unique specifical medieval urban agglomeration, characteristic of the whole of continental Europe. The royal palace which dominates in the architecture of this site is located on physically the best fortified area of Bobovac, on five karst reefs. Inside the walls of royal court was kept Bosnian

crown. The tomb chapel of Bosnian kings and the great church form the second part of this complex. It is assumed that king Ostoja repurposed the old Bobovac church into the royal tomb chapel. Three royal tombs and panels which belonged to kings Ostoja, Tvrtko II and Tomaš were found in the chapel. The artistic value of these panels is above the European average of its kind af the time, and within the former Hungarian-Croatian state they stand at the very top [2].

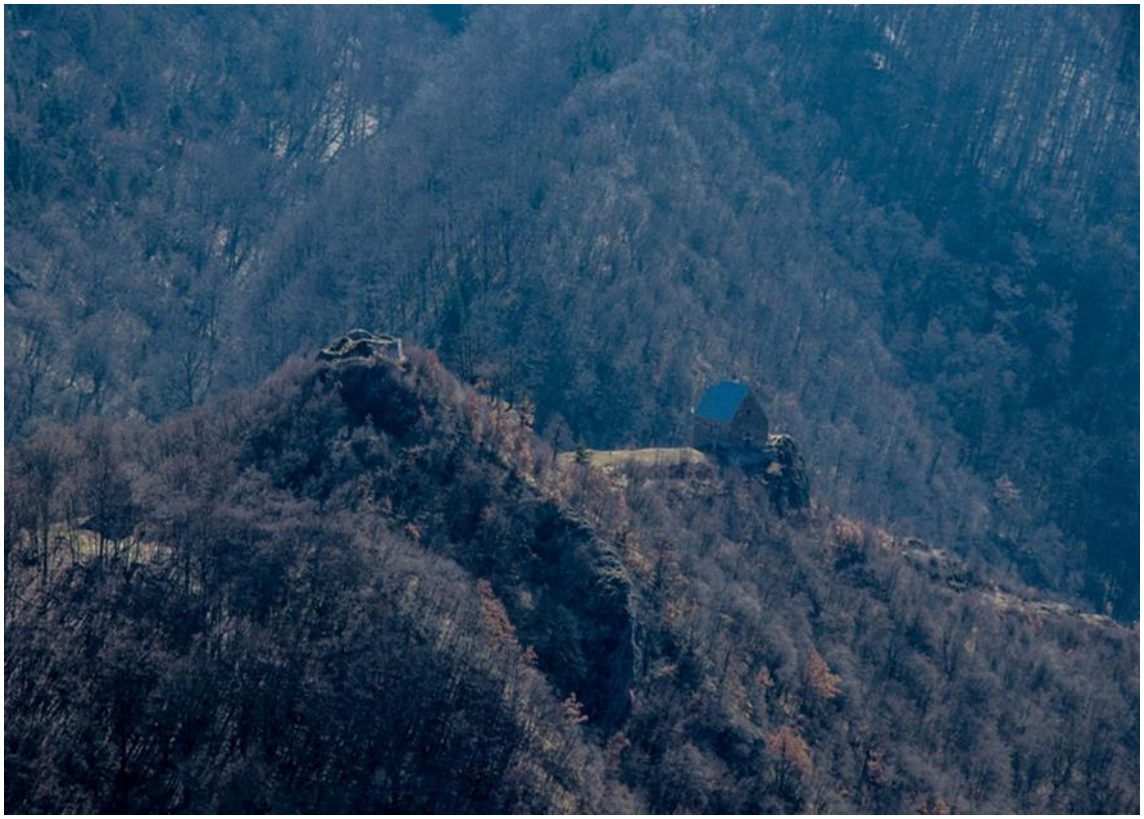

Figure 5. Remains of medieval fort Bobovac. Photo: Slaviša Vračar.

It is extremely important to mention that Bobovac is the only medieval town -fortification in Bosnia and Herzegovina whose royal court has been fully investigated and is a characteristic example of medieval architectural and urban ensemble which is perfectly blended into the natural environment. The educational valorization of this monument is extremely high because it represents the potential to acknowledge elements of material culture and historical and political development of medieval independent Bosnian state. Unlike other presented localities, at the very entrance to royal town Bobovac there is a souvenir shop of the Tourist info centre of the municipality Vareš, where since 2014. there is a daily tourist guide. Entrance fee to Royal town Bobovac is is charged in the amount of 2 convertible marks. In order to promote tourism, since 2017. the event "Gastro Fest" is organized by non-government organisations („Čuvari bosanske krune Bobovac", "Progresivni razvoj organizacija i individua", and "Alterural") with the support of the Municipality of Vareš and the French Embassy in BiH.

DISCUSSION - ASSESSMENT OF THE TOURISM AND EDUCATION VALUE OF THE PRESENTED CULTURAL AND HISTORICAL SITES

Tourist valorisation denotes the process of identification or evaluation of tourist attractions, i.e. an assessment of tourist attractions for all those phenomena, facilities and spaces, which, in addition to other characteristics, also have the property such as attractiveness, i.e. the quality of being interesting to tourists and which ensures that through such attractions the tourists can meet their tourism-related (cultural or recreational) needs. The most important method of tourist valorisation is a combined qualitative-quantitative and comparative method whose basic principles are synthesized through the possibility of comparing tourist attractions of the same type (cf. monument-to-monument), determining the elements on the basis of which to evaluate and compare, by making comparison that includes a greatest deal of well-established motives, plus the applicability and principle of complementarity by including other types of motives in the overall evaluation. The process of tourist valorisation of medieval fortified cities was carried out through the assessment of tourist-geographical position, artistic value, tourism value of the environment, tourist attractiveness and recognizability, and the extent to which the site is built and equipped but also integrated into tourist wealth [11]. The particular scores for each specific parameter of tourist valorisation are ranging from 1 to 5. Having in mind the affirmation of the selected destinations in the process of education, the study has also used some cultural and tourism related sub-indicators according to the model designed by McKercher and du Cros, which are instrumental primarily in defining the value of market attractiveness, designing a tourist product and its educational and cultural significance.

In an analysis of the selected cultural and historical monuments, one may conclude that all these monuments belong to the cognitive and educational types, and that their tourist function is focused primarily on the cognitive, educational and contemplative aspects. With these functions in mind, seasonality can be observed readily from the point of view of their year-round consumption regime, which is still partly subject to local climate conditions.

As a result, the evaluations of certain parameters that valorized the aspect of educational-cultural and social values (ex.: important national symbol, historical and scientific-research value, rare cultural property, etc.) according to the authors deserved the highest evaluations. Some cultural and tourism sub-indicators, which are primarily in the function of defining the value of market attractiveness and designing a tourist product, received very low marks, which is realistically confirmed by field research. This was especially evident in the valorization of sub-indicators such as the level of utilization for tourist purposes and tourist attendance, which, apart from the Bobovac site, have the lowest scores.In this part, the authors created valorization parameters that are primarily aimed at assessing their inclusion in the education process in terms of the presence of content in electronic and print media at different levels of organized education.

Table 1. Evaluation of parameters and average scores for the general tourist values of the selected tourist facilities.

Tourist site/ National Monument of Bosnia and Herzegovina	**KOTORAC – ISTOČNO SARAJEVO**	**BAZILIKA - BREZA**	**BOBOVAC - VAREŠ**	**ARNAUTOVIĆI - VISOKO**
Subindicators:				
Tourist-geographical position	3	4	3	3
Artistic (aesthetic) value	2	4	5	3
Environmental qualities	2	3	4	2
Attractiveness	3	3	5	3
Levels of construction and equipment	1	3	4	2
Level of integration in tourist wealth	1	2	4	3
Degree of utilization for tourist purposes	1	1	4	1
Access to anthropogenic tourist motifs	1	3	4	2
Representativeness	4	4	4	4
Tourist attendance	1	1	4	1
Recognizability outside the local area	1	2	4	2
An important national symbol	4	4	5	4
An interesting narrative about the locality	5	5	5	5
The destination is associated with culture	5	5	5	5
Service-related benefits	1	3	4	2
Historical value	5	5	5	5
Educational value	5	5	5	5
Social value	5	5	5	5
Scientific research value	5	5	5	5
Rare cultural good	5	5	5	5

Based on the previous valorization according to the mentioned sub-indicators, the conclusion is that there is no adequate offer that would include the selected sites in the tour arrangements. According to available sources, the number of travel agencies that include visits to these sites is minor. It should be noted here that, apart from Bobovac, none of the remaining three destinations are directly included in the offers of travel agencies.

Presentation in electronic media is insufficient or non-existent in terms of tourism and educational values. In this aspect as well, the exception is Bobovac, which, thanks to the agility of the local community, has a quality presentation with extensive educational content. The most pronounced absence of adequate educational and tourist content in the electronic media is related to the site of Kotorac. A search on the Internet (Google search) showed that Bobovac has the most connections for general information (6.250), and in combination with the terms "tourism" and "education", that number is somewhat lower (4.270 that is 2.920). An interesting result is related to Gornji Kotorac, which is mentioned in 2.270 connections for general information, but in combination with the term tourism only 9 times.

Table. 2. Evaluation of parameters and average scores for the general tourist values of the selected tourist facilities – aspect of education and presentation.

Turistički objekat	KOTORAC – ISTOČNO SARAJEVO	BAZILIKA – BREZA	BOBOVAC – VAREŠ	ARNAUTOVIĆI –VISOKO
Subindicators:				
Involvement of the destination in tourist arrangements	1	1	3	1
Presentation in electronic media	1	1	4	1
Inclusion in the process of organized educational contents:				
Primary education	1	1	4	2
Secondary education	1	1	4	2
Higher education	1	1	4	1
Presence in literature:				
Textbooks and books - primary education	5	1	3	1
Textbooks and books - high school education	5	1	3	1
Textbooks and books - higher education	5	2	4	2

The inclusion of visits to the mentioned sites in the system of organized educational contents (primary, secondary and higher education) and so on is also very rare. Bobovac is an exception here as well, because this national monument is intensively included in the system of organized educational visits by primary and secondary schools in the close neighborhood (Vareš, Kakanj, Visoko) and already traditional visits in the higher education system (eg. University of Sarajevo). Certain types of the educational aspect are also present at the Mili site (also in the teaching process in primary and secondary schools, and for the City Day of Visoko).

In terms of presence in the literature at different levels of education, the site of Gornji Kotorac is due to its historical and geographical significance (the first written mention of Bosnia and its settlements) incorporated in textbooks from primary and secondary (mostly in subjects Geography and History) to higher education. However, despite the fact that this site is an outstanding example related to the cultural, historical and state-building development of Bosnia and Herzegovina, its potentials in education and tourism are extremely little used. Bobovac is also mentioned relatively often, while the Basilica in Breza and Mile/Mili are mostly more related to literature at higher education institutions (tourism orientied studies).

CONCLUSION

Based on previous considerations on the example of case studies of listed cultural and historical monuments in Bosnia and Herzegovina, their objectively high level of cultural and educational potentials characterized by exceptional symbolic values, originality, uniqueness and representativeness is determined. Applying an adequate methodology, the general conclusion is that the recent state of these monuments can be defined as a process of marginalization from the aspect of their articulation in the field of educational tourism. The main shortage, in addition to the permanent aggravating factors in the tourism sector

of Bosnia and Herzegovina (unfavorable political and economic situation, lack of strategic development documents, insufficient investment in infrastructure), are represented by the institutional absence of necessary professional and scientific inclusion of educational institutions (especially universities/faculties, and professional associates in primary and secondary schools).

This lack is related to several factors that have negatively affected the recent situation. There are a negligible number of travel agencies with arrangements for visits to these sites, insufficient presentation in electronic media, and very rare inclusion of visits to these sites in the system of organized educational content (primary, secondary and higher education). Bobovac should be mentioned here as a positive example, which according to a number of indicators is an example in the efforts to develop positive tourism and educational processes

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MODERN CONCEPTUAL FRAMEWORKS AND IDEAS OF THE GEOGRAPHY TRAINING OF COUNTRIES IN THE BULGARIAN SCHOOL

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ABSTRACT

The situational analysis of the geography training of the countries is based on new normative documents, laws, regulations, state educational standard, learning plans and curricula. The structural-content framework, the conceptual level, the horizontal and vertical links and synthesis, the conceptual ideas in the curricula for the realization of the learning purposes, the algorithm, the innovations and the traditions in the training for the countries in the new realities as a result of the educational reform in Bulgaria have been researched. The article presents the results of the complete and complex study of the field of competence „Geography of the continents and countries" according to the state educational standard and curricula. As an onto-didactic core of the analyzed is the complexity of the system in geographic training.

Applying a systematic and complex approach to unity in order to systematize learning content and expanding and deepening it, developing and building continuity between grades and stages of education. The article summarizes the cause-and-effect relationships between the individual components at the class level, stages and degrees of education and the overall geographic characteristics of the country-specific chronological unit. The didactical support for countries' geographic training is also related to the European educational framework, with curricula having a disparate structural pattern of vision and content.

The study of the geographic regions, their countries and typical representative regions, the tracking of the complex influence of natural, historical, economic, demographic and political factors on the formation of the regions, their differentiation in Europe, Asia, America, Africa, Australia and Oceania and assessing the importance of countries by region is an up-to-date and modern geographic trend - regionalization. The didactic and methodological aspects of the geography training of the countries in the context of the new educational changes and conditions were studied and outlined, outlining the objectives, the school content, the expected results and other didactical elements.

The place and role, importance and choice, the way of presentation and the algorithm for country characterization are studied, as traditional for the Bulgarian school geographic education and as a model for teaching a country. The spiral synthesis of the school content in the curriculum and its mixed model of construction require and enforce the intradisciplinary model of geographic integration and synthesis based on the introduced rules and algorithms in the training. In the study are applied content-analysis, situational and functional analysis, systematic and complex approach, authoring schemes have been developed.

For the overall analysis of the real and normative educational framework in the training for the countries in the Bulgarian school geography are applied the following methods – content-analysis, situational analysis, functional - system analysis, conceptual and

constructive analysis, complex - integrative analysis, causal analysis, comparative analysis, etc.

Keywords: school geographic education, Geography of the countries, structural-content framework, normative framework, curricula.

INTRODUCTION

An educational reform at all levels and educational degrees has been started in Bulgaria since 2016, covering the whole system of pre-school and school education and involving all participants in the educational process and institutions, as well as the relations and connections between them in order to achieve the goals of education. As a national priority, education brings together the participants in the educational process for unanimity and a three-way situated learning process for the training, upbringing and socialization of the young people. The macro framework of participants in the educational process has been expanded and decentralized to include children, students, teachers, principals, other pedagogical specialists, parents and etc.

In the conditions of educational changes, the school education system provides conditions for early development and preparation of students for school, for the acquisition of primary and secondary education and/or profesional qualifications, as well as for the validation of competences acquired through non-formal training and through informal studying. [1]

The modern general education preparation in the Bulgarian schools after 2016 is carried out through the whole system of school preparation and through the study of 21 general education subjects, 10th in the sequence of the regulatory framework is the subject - geography and economics. The state educational standard for general geography preparation is a set of requirements for the training outcomes at the end of each stage and degree of education and defines

- „the aims, content and characteristics of the general education preparation;
- general education school subjects;
- the requirements for the results of training in each general education school subject for the acquisition of general education preparation".[2]

As a consequence of the educational reform and the normative act of the unified state educational policy are introduced state educational standards (DOS) in the system of pre-school and school education - a total of 19 (Fig. 1). DOS are interdependent, complementary and mutually for different stages and degrees of education, and in the context of studying the geography of the countries in the Bulgarian school, this article examines the fourth DOS - for general education preparation in the subject of geography and economics.

The overall procedural framework of the general education preparation for the school subjects in the Bulgarian school is bound by 9 groups of key competences, with the place of the school subject geography and economics among the school subjects - Homeland studies, Man and society, History and civilizations, Philosophy, Civic education, which in functional - system unity and integration synthesis form the basis of social and civic competences (Fig. 2).

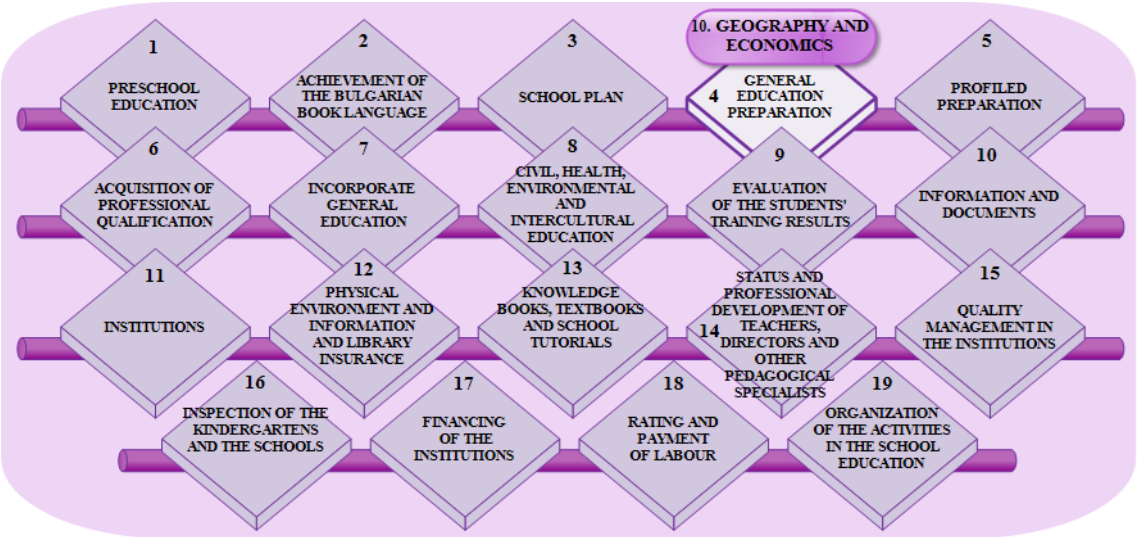

Figure 1. Macro-frame of the state educational standards in the Bulgarian school.

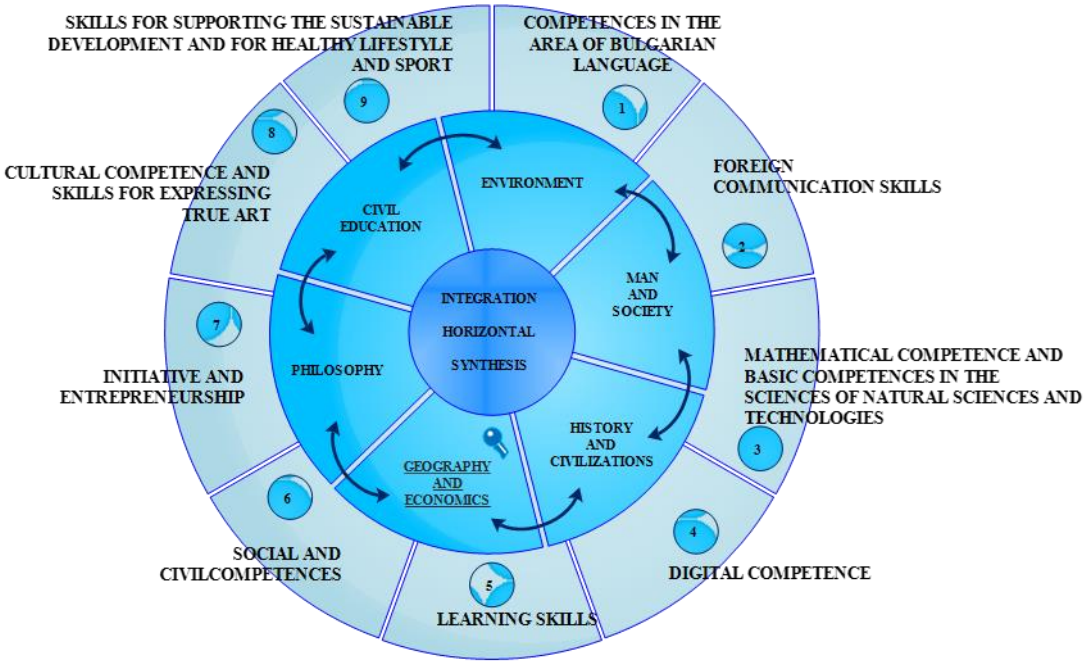

Figure 2. Integrative attachment of school subject matter and key competences groups.

Geography and economics training is part of the national educational concept for acquiring common integrative competences for:

- acquiring of key competences in learning skills, which includes understanding of the personal needs in the learning process and identifying opportunities and abilities to overcome learning difficulties, both individually and in groups;
- support for sustainable development principles, including environmental, economic and social dimensions and aiming at outlining a long-term vision for society, as well as building the ability to take personal responsibility for a sustainable future;
- acquiring competencies for critical thinking, problem - solving, decision - making, initiative, creativity, responsibility, teamwork. [2]

The last educational reform in Bulgaria continues for the sixth school year and is oriented towards diffuse unity and equalization, in which new educational elements, phenomena and processes are catching up and overlapping. Geography training is constructed on the basis of normative state educational standards, curricula and school programs in geography and economics. In the educational changes may also seek to influence the concepts and trends of global education and geographical education.
The training in geography of the countries in the Bulgarian school is constructed through a three-year phased introduction of the content vector for the curricula of the compulsory preparation in grades V, VI, VII and IX (Fig. 3, Fig. 4). The curricula for grades VII and IX are introduced in one school year. In specialized training, country training is constructed in grade XI and will be in force from the 2020/2021 school year, but is not a subject of study in this article. [3] We support the thesis that the study of the native country is part of the ideological structural - meaningful framework of regional geography and country training, but it is also not the subject of research in this article.
In two consecutive school years there are new amended and supplemented curricula in geography and economics in V and VI grade:

- 2021/2022 school year: curriculum in geography and economics for V grade;
- 2022/2023 school year: curriculum in geography and economics for VI grade (Fig. 3).

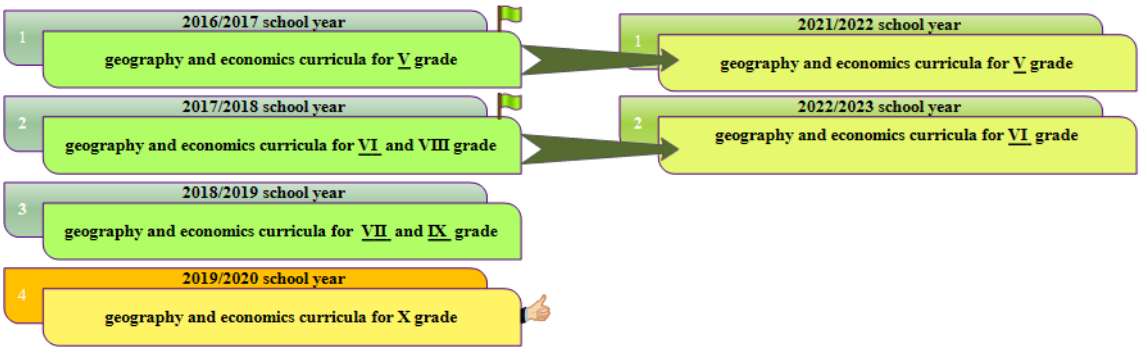

Figure 3. Chronological-educational dynamics in training for countries in the curriculums

The school content themes of the curricula and the four classes are structured in six areas of competence under the DOS, with the structural model of school geographic education 3+3, country training present in four compulsory education preparation classes, and the structural model 3+1 (Table 1).

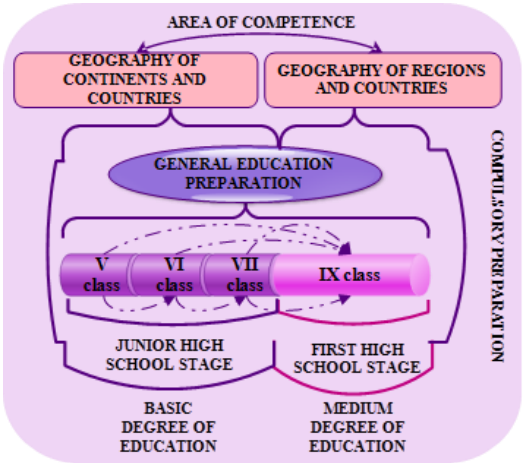

Figure 4. Geography of countries by classes, stages and degrees of education

Table 1. Place of training in geography of the countries of geography and economics by area of competence.

№	AREA OF COMPETENCE	JUNIOR HIGH SCHOOL STAGE BASIC DEGREE OF EDUCATION			FIRST HIGH SCHOOL STAGE AVERAGE DEGREE OF EDUCATION		
		GRADE					
		V	VI	VII	VIII	IX	X
1.	The planet Earth	x			x		
2.	Geography of nature	x			x		
3.	Geography of society and economy	x				x	
4.	Geography of the continents and countries	X	X	X		X	
5.	Geography of Bulgaria			x			x
6.	Geographic information	x					x

The conceptual model of studying the continents and countries was introduced by the V grade when the subject began to be studied in the Bulgarian school as independent. The study of the countries is based on several ontodidactic bases: ways for independent acquisition of geographical information; organizing geographic knowledge through prevailing dialogues in the educational process; analyzing (critical perception of information from different sources); formulating geographical questions and answering geographical questions.

DOS for competence training Geography of continents and countries and Geography of regions and countries is situated by groups of key competences, by expected results for knowledge, skills and attitudes as a result of the training - Table. 2. [3] The expected results are formulated through B. Bloom's Taxonomic active verbs and contain the following didactic determinants of training:

- characterization of selected countries;
- characterization of a country as a rule;
- representation of a country through information technology;
- presentation of a country through text, poster, presentation;
- presentation of a country of choice;
- formulated expected results with active verbs: characterizes, explains, groups, presents, compares countries;
- characterization of countries typical of representatives of regions in the world;
- presence of the rule in the curricula in the expected results;
- commenting on the features of the natural, demographic and economic appearance of countries;
- presence of the rule in the curricula in the methodological guidelines: characteristics of the country, as a rule, the following sequence can be used: determines the geographical location; characterizes: the natural environment, government, population and economy; indicates major cities. [4, 5, 6, 7, 8, 9].

Table 2. National educational standard in the training of countries by stages and degrees of education.

EXPECTED RESULTS OF KNOWLEDGE, SKILLS AND ATTITUDES IN RESULT OF THE TRAINING	
BASIC DEGREE OF EDUCATION	**MEDIUM DEGREE OF EDICATION**
Junior high school stage	**First high school stage**
Defines what geography studies and **describes** important discoveries about exploring the world and developing the geographical knowledge.	**Describes** the regional division of the world: **names** the division sign and **defines** the geographical location of the relevant regions.
Characterizes the geographical location and boundaries of the continents, oceans and *selected countries*.	**Demonstrates** knowledge of the political changes in the continents; **knows** the activities of international organizations and **assess** their meaning.
Characterizes the features of nature of the continents and oceans.	**Characterizes** by *algorithm* the specific features of the regions in the world.
Characterizes the political map, the population, the economy on the continents and in *selected countries*.	**Comments** the features in the natural, demographic and economic appearance of countries typical representatives of regions in the world.
1, 3, 5, 6, 8, 9	**1, 3, 4 , 5, 6, 8, 9**
GROUPS OF KEY COMPETENCES	
GEOGRAPHY OF THE CONTINENTS AND THE COUNTRIES	**GEOGRAPHY OF REGIONS AND COUNTRIES**
AREA OF COMPETENCE	

The DOS and curricula normatively integrate, relate and link areas of competence and expected training outcomes for knowledge, skills and attitudes with individual groups of key competences. The lack of links with two groups of key competences - groups 2 and 7 - is not justified. The two groups are in close interrelated and interact with the school content of geography and economics and present in the overall compulsory preparatory course.

The mixed model of the new curricula has traditionally been preserved when constructing the school content, configuration of the basic knowledge, skills and attitudes of grades V, VI, VII and IX, which have been expanded and deepened by cyclic integration geographic synthesis. [11]

In the first high school stage, geography training in countries is based on an empirical basis, which in the IX grade is generalized and in depth, but with a smaller number of deterministic countries to study. [12] The vertical link between the school content of the four classes at the two stages and the degrees of education is a reflection of the mixed model of curriculum construction (Fig. 5, Fig. 6).

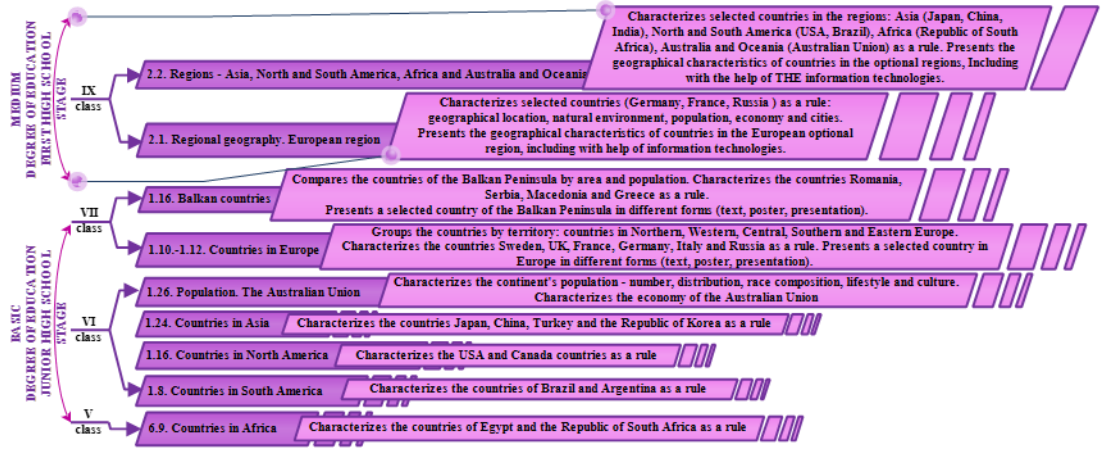

Figure 5. Macro-framework of the training geography of the countries on curricula – vertical structural-content section (at the beginning of the educational reform – from school year 2016/2017) [4, 6, 8, 9].

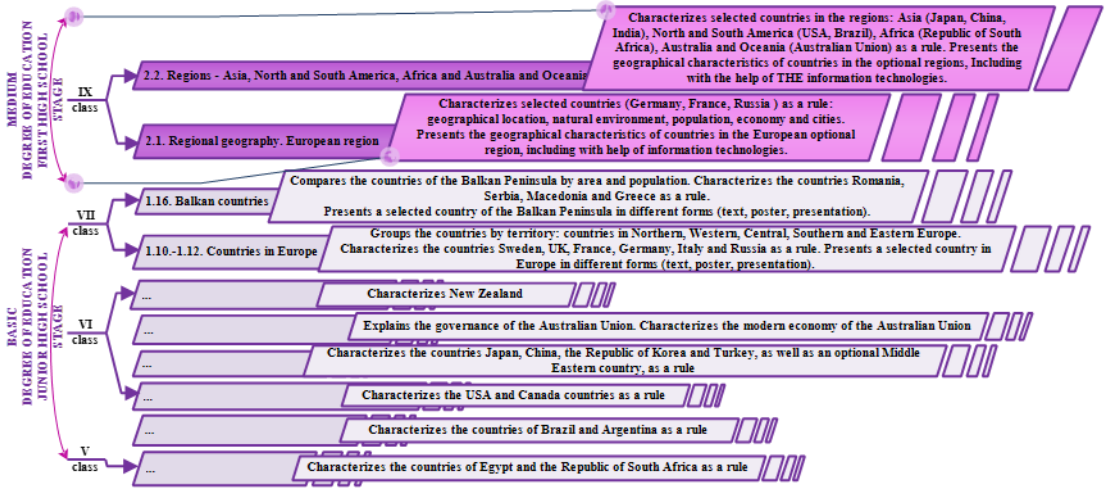

Figure 6. Macro-framework of the training geography of the countries on curricula – vertical structural-content section (in force since the school year 2022/2023) [5, 7, 8, 9].

The thematic content on the geography of continents and countries is synthesized and problematically organized around three complementary perspectives:

- the habitat of the students and its interconnections with the studied territories;
- space as an opportunity to perceive habitat in a wider context;
- environment and sustainable development - the role of everyone as to their opportunities, restrictions and geographical perspectives at local and global level.

Geography curricula for the four classes and in the overall vertical structure of country training declared a total of 32 countries for study. It is written in the curricula that there may be additional presentation of countries through text, poster, presentation and with the help of IT. For three of the classes, the same number of countries are studied and only in the first grade - V, in which geography is studied as a separate subject, only two countries are defined for study(Fig. 7). Before the educational changes in the geography curricula do not feature examples of specific countries for study, such as typical representatives for a continent or a region.

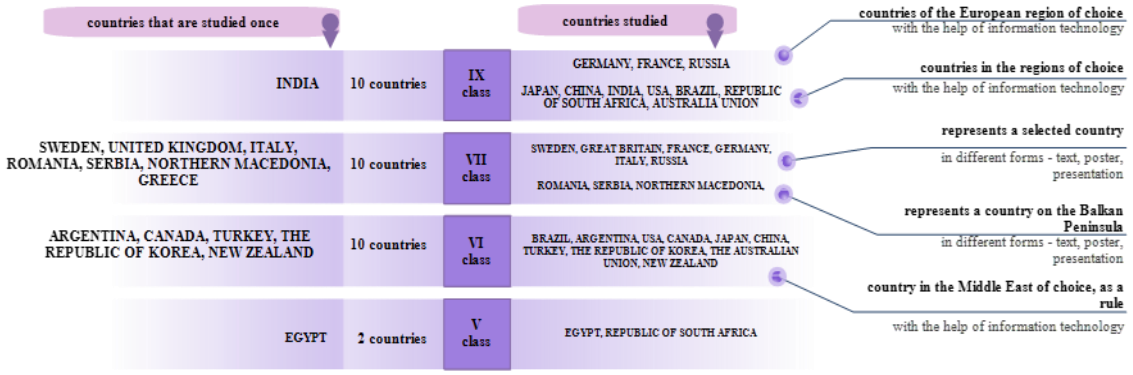

Figure 7. Normatively determined countries for studying by classes of the curricula

The specificity of country training and a new didactic foreshortening is the fixed study of a total of 14 countries once, mainly in the Junior high school stage of basic degree of education (13 countries). Only one of these 14 is a one-time studied in the first high school stage of medium degree of education - India (Fig. 7). The peculiarity of the new educational changes is the fact that out of the 14 single-time-studied countries, all neighbour countries of Bulgaria are present - 5 in total (Fig. 8). The study of the border neighbours countries of Bulgaria is determined only in the basic degree of junior high school stage of education (Fig. 8).

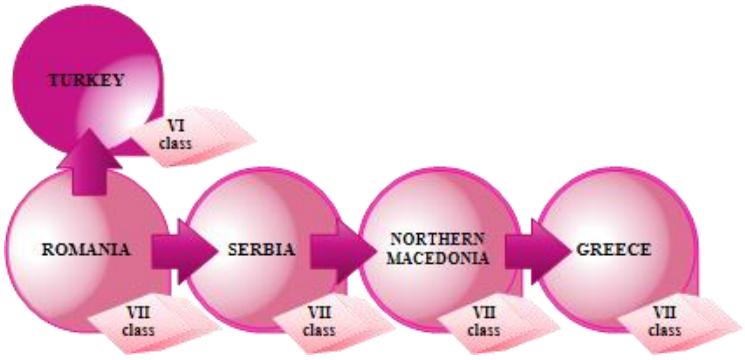

Figure 8. Normatively reglamented boundary countries for study by classes and curricula.

A specific didactic perspective in studying the geography of countries is their study in grades V, VI and VII of the basic degree and with a meaningful deployment from far to near, from Africa to Europe (Africa, South America, North America, Asia , Australia and Oceania, Antarctica, Europe), or from the unknown to the known. [13] The most procedurally fixed countries for study are the continents Europe - 10 countries and Asia - 4 countries (Fig. 9). The number of deterministic countries to study is higher in the junior high school stage - a total of 22 countries and less in the first high school stage - 10 countries. The geography training of the countries in the first high school stage is chorologically developed in the opposite direction from the near to the distant, from the familiar to the unknown - Europe, Asia, North America, South America, Africa, Australia (Fig. 10). [10]

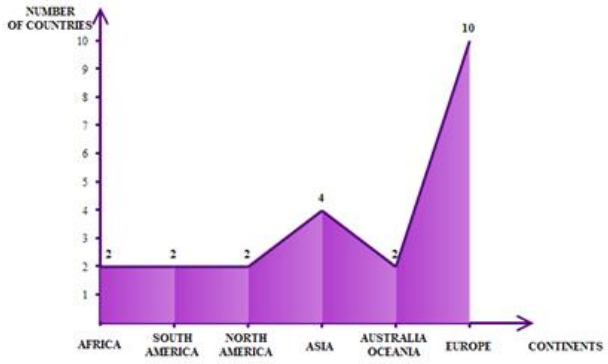

Figure 9. Number of countries to study in junior high school stage and regional vector of study Africa – Europe.

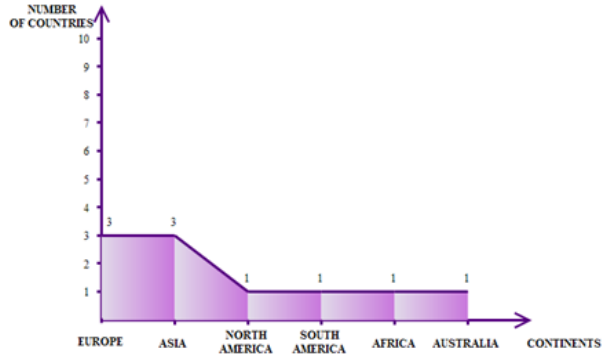

Figure 10. Number of countries to study in the first high school stage and regional vector of study Europe – Australia.

Didactic tradition in the school geography is to characterize a country in a certain sequence - rule or algorithm. [14] The geographical characteristic of a country is preserved in the new educational realities, combined with the normative competences as the expected results of training for knowledges, skills and attitudes, as well as a rule for characteristic of a country (Fig. 11). The sequence is identical for the two stages and levels of education: geographical location, natural environment, population, economy, cities. The rule for characterization of a country is an educational and didactic technology, and as a scientifically based solution for studying a country it is characterized by variability, standardization, hierarchy, complexity, consistency and dialectical unity of the steps in the rule. [10, 12, 15]

The geography training of the countries in the Bulgarian school is studied in the complex application of the following principles: regional-territorial, typological and deductive-inductive.

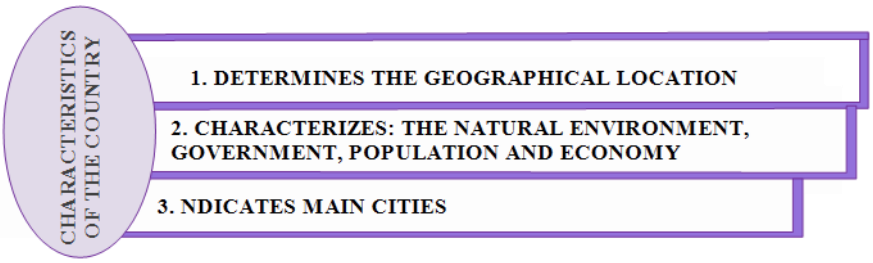

Figure 11. Rules for characterization of the country in the new curricula in geography and economics for 5th and 6th grade.

In total, in the teaching of geography of the continents and countries, the curriculum content (V, VI, VII, IX grade) is composed of 5 active verbs, applied 17 times with different frequency: characterizes, explains, groups, presents, compares (Fig. 12). Active verbs are from four of the six levels of assimilation - from the 2nd to the 5th level: 2) for understanding - explains, compares; 3) for application - characterizes; 4) for analysis - presents; 5) for synthesis - grouped.

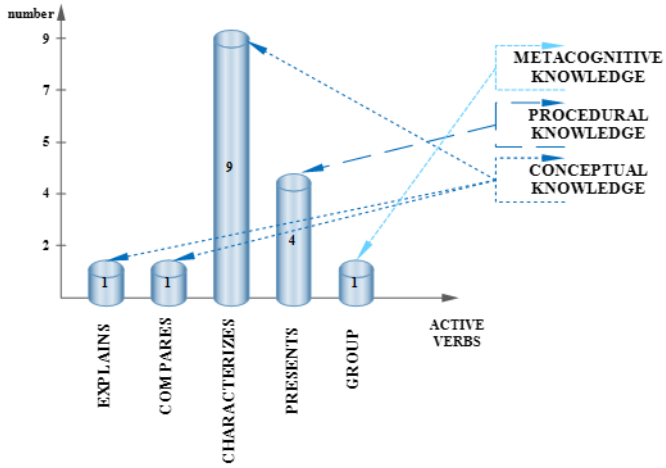

Figure 12. Model of active verbs for the formation of competencies as expected outcomes for studying countries in curricula [10]

The curricula present the horizontal connections by key competences with different repeatability, content and behavioural frameworks, classified by activity through active taxonomic verbs.

Intra - disciplinary integration synthesis in geography training in the V th to IX th grade countries is based on a mixed model as part of the training concept of traditional school geographic education. [16] The blended model provides for systematic and expanded learning content as well as continuity at the level of linear, cyclic, methodological and holistic geographical synthesis.

For the formation of geographical culture and geographical literacy, a vertical synthesis of country training has been constructed, which provides training, upbringing and socialization in building a system of geographical knowledges. [17] The curricula have a new structure and content that realize the unity of the educational principles and goals, as well as consistency and interconnectedness between the different didactic segments of the curriculum content for countries.

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FORMATION OF GEOGRAPHICAL LITERACY THROUGH SYSTEMS OF CONCEPTS

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ABSTRACT

The article focuses on the development of social geography, its relationship with the school geographical education and the sciences of the humanities sector.
It is argued that the place of social geography in the system of social geographical sciences is in the scope of the social sphere, including both the economy and social, spiritual and cultural activities.
The statement is argumented that the socialization of geography is a multifaceted process, corresponding to global trends in social development and the logic of scientific development based on the differentiation and integration of the spheres of human knowledge.
Emphasis is placed on the structure and specifics of territorial communities.
The research uses general scientific (interpretation, summary, synthesis, analysis) and private scientific methods (chronological, social modeling, etc.).

Keywords: social geography, geographical education, territorial communities

INTRODUCTION

In the 1960s and 1970s the emphasis was on the unity of geography, on the search for direct influence of the approaches of the scientifical researches on the field of social and natural geography.
In the beginning of the 1980s the „curiosity" of geographers transferred to other topical questions, such as what is (or what is the structure of) the geographical science.
The indicative lifestyle of the individual provokes also other questions, topical during the following years: what is the structure of social geography and of its attendant social sciences, what is the pace of their transformation and etc.?
The first attempts for definition of social geography are refered to Elisee Reclus (1875) (Reclus, 1873-1893), Paul de Rousiers (1884), Albert Demangeon (1896). Within the range of their limited (at that time) abilities, was the inclusion of the suggested programme for socio-cultural studies of certain territories. It has a multi-dimensional character, because it covers issues of social nature such as life satisfaction, pressurized interethnic relationships, problems of sacredness, as well as elements concerning the psycho-social consolidation and framing (geographically substantiated) of the contradictory peculiarities of man. Issues which have been discussed in the studies of Paul Vidal de la Blache (Vidal de la Blache, 1926). The last years are beneficial for social geography, because of the natural opening of the „geographical windows" and because of the „approach" attitude of the science to it.

In the sense of its scientifical survival we highlight the following features of manifestation: The first one is connected with the clarification of the etymology of the term „social geography".

The numerous publications on this issue are not unanimous. We can mention some authors with not so traditional ideas: E. Jones and J. Eyles (Jones and Eyles, 1977) [3], F. Ratzel (Ratzel, 2008) [4], L. Mazurkiewicz (Mazurkiewicz, 1992) [5], D. Harvey (Harvey, 1996) [6], G. Benko and U. Strohmayer (Benko and Strohmayer, 2004) [7], P. Gould and U. Strohmayer (Gould and Strohmayer, 2004) [8], P. Claval and N. J. Entrikin (Claval and Entrikin, 2004) [9], G. Benko and A. J. Scott (Benko and Scott, 2004) [10], M. Bassin and V. Berdoulay (Bassin and Berdoulay, 2004) [11], P. J. Taylor and H. Van der Wusten (Taylor and Van der Wusten, 2004) [12], C. Philo and O. Soderstrom (Philo and Soderstrom, 2004) [13], D. Ley and M. Samuels (Ley and Samuels, 1978) [14], M. Samuels (Samuels, 1978) [15], A. Buttimer (Buttimer, 1978) [16], I. Wallace (Wallace, 1978) [17], C. Harris (Harris, 1978) [18], Yi-Fi Tuan (Tuan, 1978) [19] and others.

The studies of E. Jones and J. Eyles are aimed at determining the nature of social geography, at the concepts, models and approaches in its development, at defining the group framework and decoding of the space-model-process relation.

F. Ratzel discusses issues about the interaction between the social base and culture, and L. Mazurkiewicz – about the factors, that have led to the accelerated development of social geography and especially to its entry into the Eastern European science. He relates this „boom" to the processes of economization and regionalization.

Much profound and detailed are the studies of D. Harvey. In the context of development of social geography, he studies and analyzes the correlation between time and space, the cultural-political responses to their variable dimension, the factors and the dynamics for development of social geography, … the geographic imagination.

Our opinion differs from that of the doyen of Russian economic geography. N. N. Baransky (Баранский, 1980) about the sameness of social and societal geography. [20] We consider the first one to be leading, but still a composite segment of societal geography.

The second feature rejects the existence of social geography as a self-dependent science. The studies in this sphere are considered to be fragmented manifestations of the socio-geographical attitude.

If we turn again to Russian geography, we have to note the different approach in recognizing the „private" geographical sciences, influencing the visualization of social geography.

E. Alaev (Алаев, 1983) [21] and V. Gohman (Гохман, 1984) [22] consider it a part of the triune methodological approach, studying economy, society and ecology.

Too indicative is the statement of U. G. Saushkin (Саушкин, 1973): „Soial geography is not a new „branch" of science like geography of industry, of population, of services, but socio-geographical aspects should be present in all branches and fields of our science." [23]

In some of the studies social geography is considered a self-dependent science, but it has a different role in the hierarchy of socio-geographical directions. Probably because of this, many authors note its tight relation with the geography of population and with the interdisciplinary character of socio-geographic studies. Even some of them consider social geography part of the geography of population, studying the social development of territorial social communities (A. Dolinin and others) (Долинин, Бугаев, Шипунова, 1984). [24]

Others classify it as being equal to economic geography, giving it the status of a leading geographic field (S. Y. Nimmick (Ныммик, 1984) [25]; T. B. Ratviyr (Ратвийр, 1984) [26]; A. I. Alekseev, S. A. Kovalev, A. A. Tkachenko (Алексеев, Ковалев, Ткаченко, 1983) [27], N. S. Mironenko (Мироненко, 1990) [28] and others).
It is often suggested that social geography is a branch of socio-economic geography, studying the norms and factors for development of traditional social structures, the rates of their manifestation and the objective social proportions of „coexistence".
Actually, the object of research of this science is society (Figure 1), while its subject we refer to the territorial organization of social sphere.

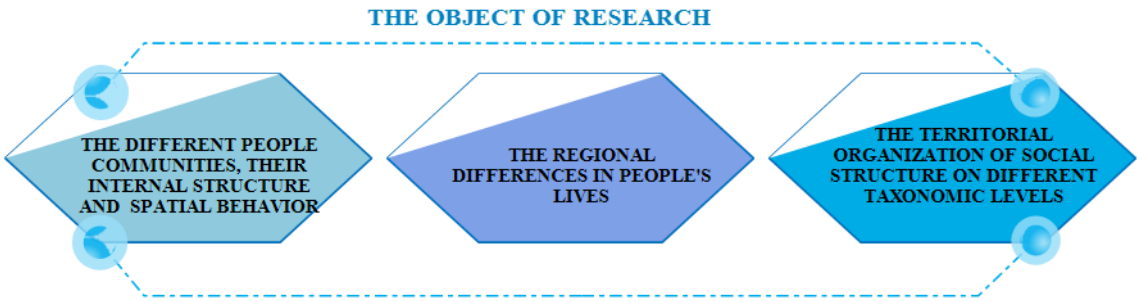

Figure 1. The object of Research of Social Geography

By definition the place of social geography in the system of social geographical sciences is within the scope of public sphere, including economy, as well as social, spiritual and cultural activity (Figure 2).

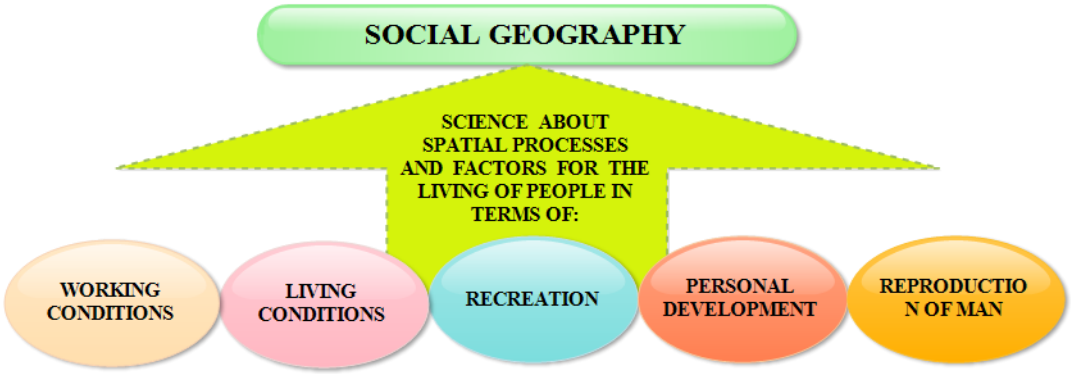

Figure 2. Nature of Social Geography.

Each one of them has responsible functions. For instance, the economic sphere aims to provide the necessary living conditions through the production and providing of resources for living.
Social sphere is directed to qualitative demographic elements of society, the spiritual – to the formation of moral values, revealed in the process of making of geographic decisions defending the personal, as well as the „regional" collective priority, and the political – to the creation, cultivation and reproduction of the political ideas.
The many attempts for separation of social geography from the geography of population and social culture have always led to the initial question concerning its objective scientific content.
T. Ratviyr suggests an approach, consisting in the consideration of the issue how to reach the real collaboration between geography and sociology through the prism of the „synthesis-integration" relation. He claims that „in social geography are included not the

already established socio-geographic scientific directions, but only the socio-geographic segments of the geography of population, cultural geography, geography of education, as well as the socio-geographic body of economic geography" (Ратвийр, 1984). [26]
The sociologization of geography is a multidimensial process, corresponding to the global trends of social development and to the dialectical logic of development of the science based on the differentiation and integration of the spheres of human knowledge.
„The inspirer" of social geography in Russia – V. Maksakovsky, appeals for such a science, that should be facing man, his goodwill to the natural habitat, to his social comfort (Максаковский, 2007). [29]
The logic of territorial organization of society leads to the outlining of the main stages in its development (Table 1).

Table 1. Stages of development of social geography and the idea of territorial organization of labor.

№	NAME (CONTENT) OF SCIENCE	MAIN TYPES OF TERRITORIAL SYSTEMS	LEADING SUBSYSTEM	IDEA ABOUT THE PLACE OF MAN
1.	**ECONOMIC GEOGRAPHY**	Territorial-productional systems	Production	Man as means of development of production, basic productive force
2.	**SOCIO-ECONOMIC GEOGRAPHY**	Territorial socio-economic systems	Production system of distribution	The human factor as a base for economic development
3.	**SOCIAL GEOGRAPHY**	Territorial social systems	Socio-demographic (territorial community of people)	Human development is a social aim of social development
4.	**HUMAN GEOGRAPHY**	Geo-education in the age of the Noosphere	Socio-ecosystem	Sustainable environmental and social development, consensus in the system „nature-man-economy"

Note. Source of information: L. P. Bogdanova (Богданова, 2006) [30]

In socio-geographic studies territorial communities have a focusing social character. They are a resource group of social geography and the geography of population, provoking researches on urban inequality, social positioning, the way of perceiving social processes and etc (Fig. 3).
The territorial community is usually considered as one of the social groups, designated on the base of territorial feature, having the freedom of social communication.
The outlining of borders and the revelation of the nature of territorial communities is a socio-geographic problem. Undeniable contribution for its solution, according to us, have A. I. Alekseev and others (Алексеев, Ковалев, Ткаченко, 1983) [31], N. S. Mironenko (Мироненко, 1990) [32], A. I. Trofimov and others (Трофимов, Чистобаев, Шарыгин, 1993; 1993a) [33, 34]. At the same time they act as self-dependent socio-territorial systems or as a core of the functioning territorial systems (A. Tkachenko) (Ткаченко, 2001; 2002; 2002a) [35, 36, 37].

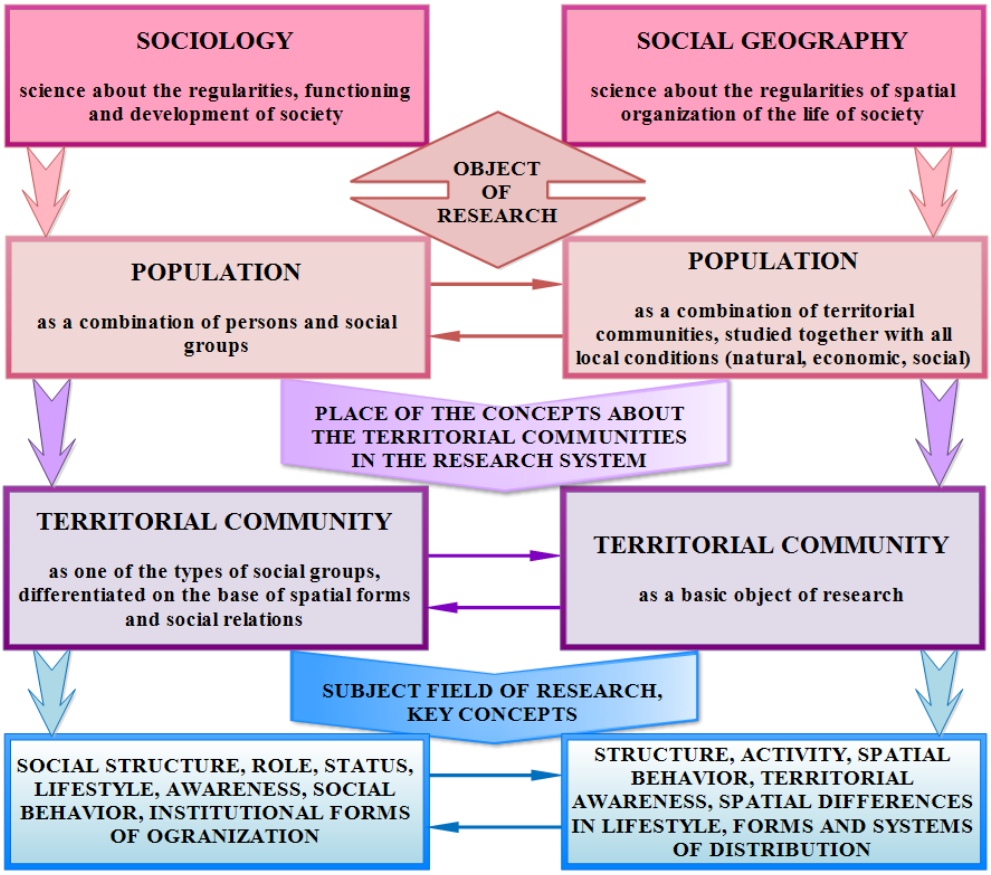

Figure 3. Territorial communities in the system of concepts and the sphere of research in sociology and social geography.

In social geography the taxonomy of the different territorial communities is analyzed through the prism and within the framework of social regions, which (although there are many contradictions in their ordering) have the following levels:

1. Territorial communities on national level. We consider them the largest, historically developed territorial community, which survived due to social relations, as well as to the nostalgic feeling for preserving of the national.
2. Territorial communities in the large socio-economic areas. Their heterogenic origin „boldly" contrasts with their homogeneous social behavior. It has been prompted by the sense for political, cultural and … personal survival and self-preservation.
3. Territorial communities on district, municipal and lower taxonomic level. Their differentiation is the most objective transitory image of the ethno-demographic diversity. But also the most inconstant and unstable. Because of the social psycho-geographical process, documenting the almost invisible social relationships.
4. The community, encoded in the cognition of each one of us, looking at social processes with some expectations. We consider it primary, initial, irreplaceable. This is the family, generic community. From which every one departs along the path of his ambitions. But to which he comes back in times, deeply hidden in his individual peace of mind.

This community fixes that psycho-geographical core of cognition and behavior, which ordinary man cannot go around, and which is possessed by him. It has a secondary root – either the memory of its creation and localization, or the romantic taste of what has been shared by the predecessors, concerning the possibility for the memories to "be present" at the moment of their sharing.

The interaction between geography and sociology led to the appearance of the theory of T. Parsons (Парсонс, 1996) [38], which outlined four structural categories – value, norm, community organization, manifestation (a public role, that physiognomizes territorial communities).

The studying of their psychology and the territorial aspects of geography lead not only to its sociologization, which is necessary for every „open" society, but also to the further shaping of its multidimensional scientific spectrum.

*** * ***

The territorial settling of population is a process, provoked both by the individual's being and by his way of thinking. He is participant in that type of activity, where his geographic being is part of the social process. Under the influence of the socio-reproductional approach, in unison with the understanding of R. Kabo, geography sets itself the task to "study the social person and his image (and behavior), his versatile characteristics and actions" (Кабо, 1947). [39]

With the researches by R. Kabo and the following publications by N. Baransky (Баранский, 1980; 1980a; 2001) [40, 41, 42], S. Kovalevsky (Ковалевски, 1979) [43] and V. Pokshishevsky (Покшишевски, 1978) [44], conditions were created for the „birth" of socio-economic geography, for its curious insight into the problems of the „non-productive" sphere.

The first scientific meeting, discussing these problems in Russa (1962) set the official scientific „directive" – the studying in „territorial aspect of the population and the production forces as producer of material and spiritual goods, as well as their replicator."

On the border between the 1960s and 1970s „started" such geographic directions of socio-economic geography as geography of services, geography of recreation, cultural geography, geography of religions and others. Subsequently these aspects found their place in regional studies, aimed at the formation of the socio-economic image of certain territories (S. Lavrov, A. Anohin, N. Agafonov) (Лавров, Анохин, Агафонов, 1984). [45]

From this point of view, we consider social policy as „helper" of social geography, and the last one – as a registrator of the materialized social successes.

During the stage of humanitarian geography in the development of social geography and the idea of the territorial organization of labor, the main type of territorial system is geoeducation in the era of the noosphere. The leading subsystem is localized in a socio-ecosystem in which the idea of human place is in the context of sustainable development of nature and society, for evolutionary balance, consensus and interaction in the system „nature - man – economy".

In the school geographical education in the field of competence „Geography of society and economy" of the state educational standard (DOS) several content areas are studied, which are based on the expected results for junior high school students: population, demographic indicators, forms of settlement, problems of the population and settlements, political map and international organizations, nature of the economy and grouping the economic activities. [46] The expected results are linked to only 4 of the 9 groups of key competences, which are aimed at acquiring mathematical competences, learning skills, social and civic competences, as well as skills to support sustainable development and a healthy lifestyle and sports.

DOS for the first high school stage is deployed at the level of expected results for each of the content lines - population, settlements, political map, world economy. Additional structural and content accents are the problems of demographic and social development,

nature and forms of urbanization, as well as its consequences, forms of political organization of society. The most numerous are the spirally upgraded and expanded requirements at the level of expected results related to the economy: factors for economic development and territorial location, features and mechanisms of the market economy and indicators of economic development, structure and territorial organization of the economy. [46]

In DOS the connections of the expected results with the groups of key competencies have been increased - a total of 6 groups. The same 4 interactions and integrative connections have been preserved since the junior high school stage, as they have been further developed with the improvement of the competencies in the field of the Bulgarian language, initiative and entrepreneurship.

The content and the situational analysis of expected results in the field of competence for geography of society and economy and their interrelation and interaction with the groups of key competencies reveal several problematic lines for social geography: discrepancy in terminology for the two educational stages ; the simultaneous presence in the DOS of economy; knowledge of the political map of the world and its changes to explain the changes and reveal the reasons in the modern political map; from grouping economic activities to the characteristics and mechanisms of the market economy by analyzing indicators of economic development.

Another problematic point in the state requirements is the unfinished and strategically ill-considered vision of the connections of the expected results with the 9 groups of key competencies and the absence of significant and causal groups to public geography, which in conditions of digital transformations in education and science and in people's lives they are a necessity.

The specific difference in the school's geographical education compared to the scientific foundations of the social geography in the conceptual model of the system „nature - society – economy" against that of the humanitarian geography „nature - man – economy".

A specific problematic issue is the lack of explicit and clearly defined relationships of the expected results with the concept of sustainable development and the 17 goals as an integrative symbiosis between natural and social geography.

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STEPS TOWARDS MODERN GEOGRAPHY IN HUNGARY: RESULTS OF DEVELOPMENT OF PROBLEM-ORIENTED EDUCATIONAL INSTRUMENTS

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ABSTRACT

According to domestic and international surveys, one of the biggest problems in geography education in Hungary is the growing gap between students' thorough theoretical knowledge and practical applicability. However, Hungarian teaching practice has been slow to respond to a process that has been going on for decades, during which the concept of valuable knowledge has changed significantly. While quality, well-applied and practical knowledge has gained high social and economic value (as opposed to directly applicable, passive knowledge), primary and secondary education and teacher training continue to struggle to bring about the necessary change.

The present study discusses the effectiveness of a learner-centered, activity-based worksheet compilation developed by our research team for primary and secondary geography education to facilitate problem-based geography education. The results show that the short-term use of worksheets has already helped the experimental groups to solve their tasks more successfully than the control groups.

The results of the pretest showed that there was only a small difference between the two groups attitudes toward geography, and the difference in mean performance was not significant in the evaluation test. However, the results of the follow-up showed that the short-term use of activity-based worksheets had already helped the experimental groups to complete the questionnaire tasks more successfully than the control groups. In the geographic post-test, the students in the experimental group significantly outperformed their peers in the control group (Mexp = 21.92 (SD = 5.83), Mctrl = 18.99 (SD = 6.31), t = 3.31, p = 0.001). The experimental effect size was found to be medium (eta-square = 5.6%).

Keywords: activity-based learning, problem-based learning, inquiry-based learning, Geography education, effectiveness of activity-based exercises

INTRODUCTION

Our teaching practice is often based on the usual content and methodological schemes. This is true for both geography teachers who have been teaching for decades and geographers with a recent degree in public education. At the same time, it has been felt for years that changes in content, curriculum, the proliferation of digital teaching tools, and changing societal demands for knowledge (to name but a few of the external constraints) pose new challenges for colleagues in public education and geography teachers of the future. Nowadays, instead of the predominance of lexical knowledge, the acquisition of geographical knowledge that can be applied in practical life has become more important, and at the same time there is a growing need to renew the methodological culture of geography teachers [17], [18].

According to national and international surveys, one of the biggest problems in Geography education in Hungary is the growing gap between the students' thorough theoretical knowledge and its practical applicability. However, Hungarian teaching practice is slow to respond to the process that has been taking place over several decades, during which the concept of valuable knowledge has changed significantly [6], [7]. Unfortunately, curriculum reforms in Hungary (National Core Curricula were published in 1995, 2003, 2007, 2019) have not or only slowly been followed by a change in the methodological practice of Hungarian teachers, and the social promotion of the necessary changes has been insignificant. While qualitative, well-applicable and practical knowledge has gained high social and economic value (as opposed to knowledge that cannot be applied directly and contains passive knowledge), primary and secondary education as well as teacher training are still struggling to implement the necessary changes in their basic methodological practice [3].

The contemporary world of work requires certain new skills and abilities which people need to thrive in everyday life. These skills and abilities are like those that students need to employ when solving the exercises of a PISA survey. The new expectations arising on behalf of present-day society and economy imply that instead of employing traditional teaching methods to transfer lexical knowledge, there is a growing need for new methods that facilitate greater student activity, skills enabling, for example, the development of communication, problem-solving methods, group collaboration, and the development of the critical use of Geographical information in addition to solid Geographical literacy [14], [31].

The need for methodological change has been encouraged for years in Hungary, but the implementation process is slow. A possible solution of the present situation is to empower teachers with diverse teaching methods and teaching aids [15], [28], [14]. The complete science education, including Geography, should be reconsidered in terms of curriculum content, amount and quality of information, teacher training, and methodological renewal is only one step in this process [5], [16].

In 2016, the Geography Methodology Research Group of the Hungarian Academy of Sciences was established with the support of the Hungarian Academy of Sciences from the researchers of the Universities of Szeged, Pécs and Debrecen and teachers working in public education. Our main goal was to establish a tool development that offers problem-oriented educational opportunities and digital technological innovations for the methodological renewal of geography education. Our aim is to prepare student aids for 13 - 17-year-old, processing the geography of Hungary, which allow teachers to process the problem centrally in certain areas of Hungary, and serve as a model for a similar methodological approach to other parts of the curriculum [25].

THEORETICAL BACKGROUND

One of the main tasks of today's geography teachers is to prepare their students to receive, select and organize information from traditional and digital media and other sources, to evaluate and monitor changes in the world. Problem-based teaching and learning (PBL) is a very good opportunity to develop all these knowledge elements, the main feature of which is a learning environment in which the driving force of learning is embodied by the problem itself [1], [20]. Students become familiar with the problem before learning the information needed to solve the problem, and do not have to solve various lifelike problems to practice the acquired knowledge. An important benefit of problem-based learning is that it also develops students 'critical, analytical, and creative thinking. Students can work in groups to solve a problem, but it is also possible in the form of individual research tasks [2]. In other words, cooperative learning, project work, ICT (Information Communication Technology) and research-based learning can also be linked during PBL.

The new challenges Geography education must face justify the needs for employing new methods instead of traditional ones. Methods that transfer lexical knowledge should be replaced by those that increase student activity. If children are active participants in the learning process, their work can become more effective. When the learning and instruction process becomes more efficient, the competencies set up by the new challenges of our world can develop, so there is a real need for a reinterpretation of the the Hungarian methods of learning and instruction [10], [11].

Both national and international studies aim at elaborating, testing, and developing new methods, which can be used from the lower grades of primary schools to higher education. Such methods include active learning, problem-based, project-based, inquiry-based methods, as well as a greater involvement of ICT tools [8], [23]. By employing these methods, students' skills and abilities can and do develop. Their problem-solving ability improves, because they actively must engage in finding the answers and optimal solutions to questions, tasks, and projects. Due to students' active role, causal relationships are also easier to notice and understand, while their critical thinking is also evolving [19]. Working in groups entails the development of communication and reasoning skills, and they can learn to adapt to each other much better. The coordinating and final evaluating role belongs to the teacher, but the students also self-check and self-assess their own progress, which have a positive effect on their self-knowledge. The development of these skills helps the process of knowledge consolidation, which also has a positive effect in the practical application of their knowledge in the future [4], [9], [21], [22], [24], [26], [27], [30].

These skills are also essential in the world of work. During an interview, would-be employers are interested in how well the applicants can communicate, whether they can work in a team or not, how creative, independent they are, how good their problem-solving method is, and whether they are able to self-reflect. The previously mentioned learning methods positively affect skills that are important today, that is, they meet the new challenges of the world. [5], [29].

To raise the prestige of Geography, it is mainly the teachers who can contribute to it the most by employing new, student-centered and inquiry-based methods. Though educators can motivate and arouse interest, due to the constant shortage of time, a toolkit can also help them. A toolkit should be designed by including the latest methodological innovations, employing ICT tools, etc. The focus is on diverse methodological applicability which helps students use their knowledge in everyday life. If they experience

the usefulness of what they do, if they are active participants in the process, if they feel that they are improving, and they receive continuous external and internal confirmation, their motivation, interest, and enthusiasm are likely to increase. As a result, these changes can increase the prestige of the geography too [12], [13].

RESEARCH QUESTIONS AND HYPOTHESES

The main purpose of our present investigation was to reveal the effects of using a methodological toolkit our research group has been developing. This methodological toolkit includes separate worksheets that focus on selected parts of Hungary, either a town or a region, and provides a diverse compilation of geographical problems. The problems are connected to physical geographical, environmental, social, and economic issues, and provide opportunities to engage students in active and inquiry-based learning. In addition, we sought to increase the geographical literacy and the reading comprehension of students by certain tasks that involved active reading. Therefore, a classroom-based Geography teaching experiment was designed to test the effectiveness of our worksheets. There was our major research question: Will the experimental group students outperform their control group peers with respect to standard geographical performance?
Our hypotheses were as follows: (1) Students from the experimental group will significantly outperform their control group peers with respect to geographical tasks that require active and constructively responsive thinking. (2) At the same time, their performance will not be significantly weaker on more traditional geographical tasks

METHODS

To determine the benefits of the developed toolkit over traditional education as accurately as possible, we conducted an experimental and control group study with six elementary schools in spring, 2019, when, according to the curriculum, the main topic of the geography lessons is the geography of Hungary (Grade 8). A quasi-experimental research design was used, i.e., Geography classes volunteering to be involved in the training program were selected first, and then control classes from both the same schools and from other settlements with similar SES-background students were recruited. 115 people took part in the experimental instruction (during which the participating teachers used the worksheets developed by us during their teaching), while 151 students in the control groups, who learned the geography of Hungary in the usual way (266 people in total). The experimental group worked with the worksheets we developed for about 3 months. Following data cleansing, 94 responses from the experimental group and 95 responses from the control group were included in the analysis (Table 1).

Table 1 Participants of the pre- and post-tests.

Data	Pre-test	Post-test
Total	189	189
Experimental group	94	94
Control group	95	95
Participating schools (Hungary)	Esztár, Hajdúhadház, Kaposvár, Kiskunhalas, Pécs, Szeged	

We employed a pre- and post-test design to measure differences in learning outcomes between experimental and control groups. The pre-test consisted of two parts: an attitude test based on the questions of the PRIMAS Project [8], and a geographical assessment test. The post-test consisted of only one part, the geographical assessment test of the pre-

test. The effectiveness of the application of the experimental, inquiry- and problem-based tasks was measured by the pre- and post-test design of the geographical assessment. The assessment test consisted of four exercises, two of which (Exercises 2 and 3) were specifically aimed at traditional topographic knowledge (which is a focus of traditional Geography teaching in Hungary). Two exercises (Exercises 1 and 4) were novel, inquiry- and problem-based exercises that put traditional geographical information into a new textual framework, thus testing the efficiency of enhancing geographical literacy and reading comprehension.

Participating teachers of the experimental training program were asked to use the worksheets developed by our research group. They were also the ones to administer the pre- and post-tests to the students. After testing, the data were collected and processed, and only those entries were used for further quantitative and qualitative analyses that were included in both the pre- and the post tests.

The toolkit, developed by the research group, is a collection of inquiry-based and problem-oriented tasks related to the teaching of Hungary's geography, which can facilitate the methodological renewal of Hungarian Geography education. The main principles of the interactive worksheets are as follows:

- 1. Teaching how to learn: the purpose is to teach students how to collect information independently, thus establishing the ability to learn, and the tasks are age specific.
- 2. Providing a creative learning environment that facilitates the joy of discovery and develops communication among other social skills.
- 3. Offering textbook renewal: the tasks of the individual worksheets belong to the geography of Hungary, and they represent a truly complex approach.
- 4. Applying information and communication technologies (ICT), providing access to up-to-date information using QR codes that lead students to different online educational software.
- 5. Creating a constructivist learning environment in which the acquisition of knowledge is not passive but active and creative.
- 6. Applying innovative, cooperative learning organization techniques which diversify the learning process and encourage action, individual research, knowledge acquisition and discussion.
- 7. Acquiring real, applicable knowledge through problem- and practice-oriented training that focuses on everyday life situations.

In the data analysis process, statistical analyses usually applied for revealing experimental effects have been used. We used the IBM SPSS Statistics 25 software, and the statistical analyses were selected according to the measures we used. While the geography test items were of dichotomous nature, the questionnaire items used four-point ranking scales, and Likert-scale items can be handled as interval-scale variables. Our analyses therefore involve descriptive statistics (absolute and relative frequencies), comparing distributions (two-sample Kolmogorov-Smirnov tests), and comparing group means (t-test, Levene-test and ANOVA).

RESULTS

To analyze the effectiveness of our intervention program, we (1) compared the control and experimental groups with respect to the pre-test score (both cognitive and affective variables), and (3) compared their performance at the post-test. While the latter enables for measuring the effect size of the experimental treatment, the pre-test comparison may ensure that the two groups have comparable baselines.

Changes in the attitude towards geography

As for the attitude towards Geography as a school subject, the experimental and control groups have similar mean values. Mexp = 3.63, Mctrl = 3.59. The difference is not significant (t = .27, p = .79).

On the questionnaire items concerning agreement or disagreement with different statements about the students' personal relations with geography, there were some items on which the experimental and control groups significantly differed from each other (p > .05). The three exceptions are items 2, 8 and 13. As we can see from the results presented in Table 2, the mean values obtained from the two groups are close to each other, and the direction of the difference varies with items. Nevertheless, all three items on which significant differences were revealed indicate in general a more favorable affective prerequisite inclination towards learning geography.

Table 2 Mean (SD) values for the statements on personal relationship with learning geography (items adapted from the attitude test of the Primas Project, [8]).

Item	N	Mean	Std. Deviation
I enjoy Geography at school.	186	3.55	0.953
I'm talented in Geography.*	186	3.05	1,109
I talk to my family about what I experienced in Geography class.	184	2.48	1.109
I talk to my friends about what I experienced in Geography class.	186	2.57	1.133
I'm waiting for the Geography lessons.	186	3.17	1.007
I think Geography helps us understand the world around us.	186	3.82	0.880
I enjoy studying Geography.	185	3.11	1.039
I agree that we have to study Geography at school.*	186	4.09	0.899
As an adult, I want to deal with things related to Geography.	185	2.09	1.055
I like to occupy myself with Geography-related things in my spare time.	185	2.49	1.089
Geography is very important to me.	186	2.78	1.008
I like Geography.	186	3.46	1.019
I learn Geography quickly.*	182	3.23	1.020
As an adult, I will benefit from Geography in my daily life.	186	3.22	1.138
I wish we had more lessons in Geography at school.	186	2.54	1.111
I would like to spend my life using Geography at a higher level in my work.	183	2.13	1.045
I think it's helpful to have Geography at school.	185	3.82	0.955
Even at an advanced level, Geography would be easy for me.	185	2.38	1.087
After graduating from school, I will have many opportunities to use Geography.	185	3.1	1.074
I want to work in a profession where Geography is important.	186	2.11	1.107
I can easily understand the new geographical materials.	185	3.36	1.060

Note. The between-group average of the experimental and control groups was significant on items marked with *.

Students' results on the geography tests

Having analyzed the affective characteristics of students' Geography learning, now we turn our attention to the Geography pre-test results. 32 items were examined in the assessment test. Their reliability is adequate: 0.89 (Cronbach-a), i.e., based on item-omitting reliability, the test measures reliably. The average solution level is 20.10 (standard deviation: 6.52).

There was no significant difference between the experimental and control group's average performance (Mexp = 12.27 (SD = 4.95), Mctrl = 11.18 (SD = 4.65), t = 1.56, p = 0.12).

On the Geography post-test, students from the experimental group significantly outperformed their control group peers (Mexp = 21.92 (SD = 5.83), Mctrl = 18.99 (SD = 6.31), t = 3.31, p = 0.001). The experimental effect size proved to be of medium level (eta-squared = 5.6%). Table 3 presents the task-level analysis of the results of the post-test as revealed by general linear model (ANOVA).

Table 3. Task-level analysis of the results of the post-test.

Task	*Experimental group*		*Control Group*		*F*	*p*	η^2*(%)*
	M	SD	M	SD			
1*	6.23	2.81	4.80	2.86	11.88	0.001	6.0
2	4.76	2.14	5.15	1.87	1.72	0.19	0.9
3	6.29	1.83	5.77	2.00	3.48	0.06	1.8
4*	4.68	1.54	3.27	1.61	37.35	<0.001	16.7

* Inquiry-based task

The results in Table 3 suggest that students in the experimental group proved to be significantly more successful on two tasks: Task 1 and Task 4. The difference between the experimental and the control group on Task 3 was marginally significant. Eta-squared effect size indices show that there was a large experimental effect on Task 4, a middle-sized effect on Task 1, and there were small effects on Task 2 and Task 3. The success of the research group's experimental training program is likely to be due to the fact that the inquiry-based tasks, which the students got used to during the three-month trial period, aroused their interest and are more closely connected to the world around them, which are known to increase learning outcomes. The use of the worksheets developed by our research group helped the experimental groups to solve these tasks more successfully (Table 3) compared to the control groups.

Discussion of pedagogical experiences

An important phase of any methodological development is testing the "product", based on the experience of which it can be further developed. Geography teachers volunteered to test the toolkit we developed, and they also agreed to share their comments and experiences not only in the form of a questionnaire, but also during personal discussions, which took place in forums and school meetings.

Overall, students were happy to solve the new worksheets. They enjoyed the fact that in many cases they could use the Internet for finding the solution, collecting information independently, creating a flyer, a presentation, a plan a trip for a specific topic, etc. Working in groups or pairs helped them to communicate with each other. Their feedback was usually that the tasks in the worksheets were interesting and not too difficult in the first place.

The products of independent work and the opinion of teachers show a more nuanced picture. Questions that require short answers and are easy to solve were considered easy and interesting. However, there are also more complex questions, during which connections must be seen, or the answer must be collected from several places, prior knowledge must be used, and conclusions must be drawn. These tasks were already more difficult to cope with, which is mainly the result of the frequent use of traditional, mainly frontal teaching methods. In the course of frontal instruction, students are given ready-made knowledge that only needs to be recognized, but they do not need to apply this knowledge to their everyday life, so activity-based tasks like the ones in the worksheets may scare the students.

However, due to the active student role in the solution of the tasks, the knowledge and connections could be found by the students, and as the work required more practical, deeper thinking, it seemed to be more efficient in consolidating knowledge.

CONCLUSION

High-quality and practical knowledge has become greatly valued in our post-modern society, values which are not well-represented in contemporary Hungarian Geography education. Most of the Hungarian teachers still employ traditional instructional methods which do not empower students with skills and competences required in present-day labor market. As a change to activity- and inquiry-based learning and instruction involves curriculum reforms, the continuous development of teaching tools and the renewal of in-service teachers' methodological practice, the necessary methodological transformation seems to be taking place rather slowly. Hungarian teachers of Geography are limited to a narrow choice of teaching tools, so the MTA-SZTE Research Group on Geography Teaching and Learning set out to develop an activity-based toolkit consisting of interactive worksheets. These worksheets are based on inquiry-based approach and focus on the teaching and learning of Hungary's Geography.

The effectiveness of this student-centered, activity-based worksheet compilation for Geography teaching was tested in 2019. Volunteering teachers of Geography (with Grade 8 students) were asked to use the new developed worksheets in their Geography lessons for a period of three months. These Grade 8 students formed the experimental group, while control groups were also recruited, but this groups did not learn from these new developed worksheets. Students of both groups were administered a pre- and a post-test, the first of which also contained an attitude test. The results of the pre-test indicated that there was only a slight difference between the two groups' attitude toward Geography, and the difference between the average performance was not significant concerning the assessment test. However, the results of the post-test revealed that even a short-term use of the worksheets has already helped the experimental groups to solve the inquiry-based tasks more successfully than the control groups.

Our results imply that by employing activity- and inquiry-based worksheets and making them widely available, hopefully geography teaching will start to change, moving towards active learning more and more increasingly, with the help of more modern teaching aids and more practical knowledge.

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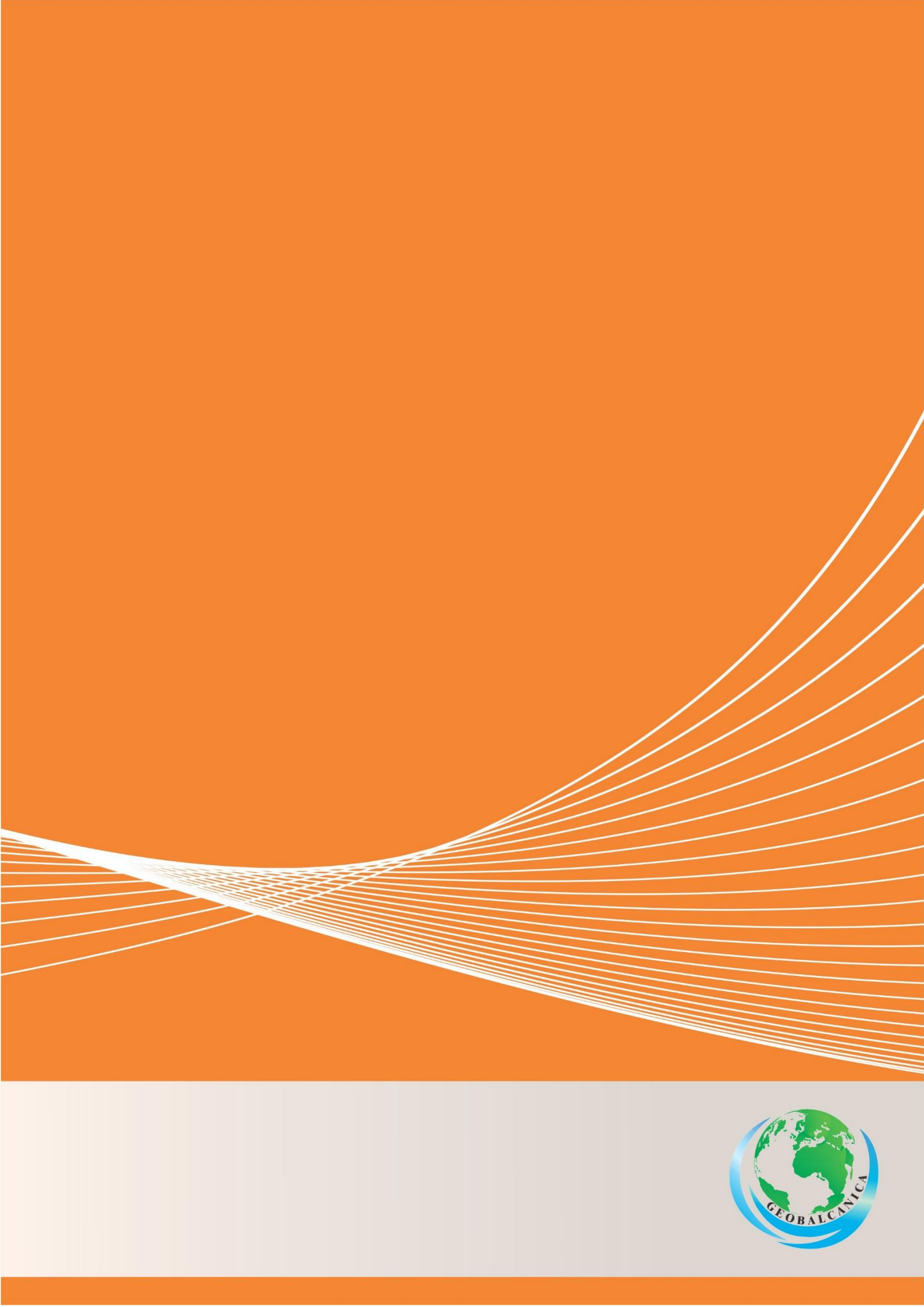
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