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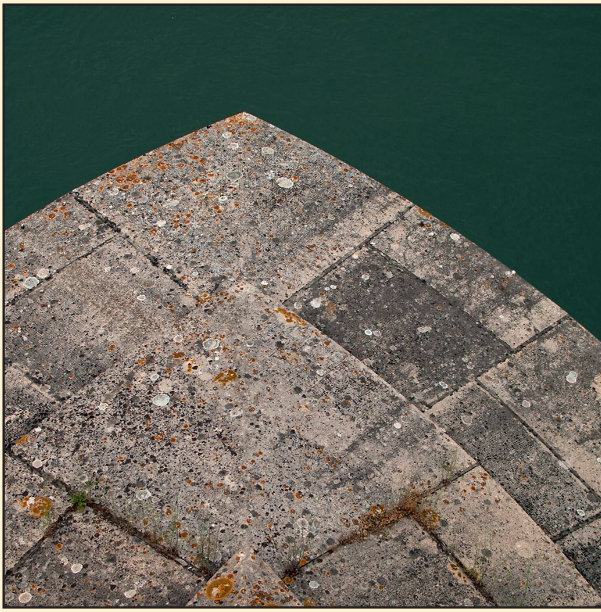

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Fotografija na naslovnici: Vztrajnost – nosilec mostu Daladier (Avignon) v reki Roni (fotografija: Anej Visković).

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LATEGLACIAL STUDIES IN THE WESTERN VALLEYS OF THE ITALIAN JULIAN ALPS AND IN THE KORITNICA VALLEY

Wolfgang Tintor, Maja Andrič


WOLFGANG TINTOR

Dogna valley with Montasio, Jof di Miez and Monte Zabus. Positon Chiout di Gus.

Lateglacial studies in the western valleys of the Italian Julian Alps and in the Koritnica valley

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ABSTRACT: Different from the northern valleys of the Italian Julian Alps the bottoms of the western valleys do not contain any late-pleistocene moraines. However, common to all valleys is the large glaciation most probably in the Gschnitz-stage, in which the glaciers reached particularly low locations due to special favourable aspects such as north-exposure, steep and narrow gorges, high shading and considerable snow accumulation. This is also valid for the sidebranches of the Slovenian Koritnica valley which are again directed west-east. Still younger glacier stages could be found in the upper sections of the Dogna, Raccolana and Bala valley. For the moraines of very low altitudes in the Resia valley, at the entrance to Možnica and the upper Raccolana valley pollen analyses are available. All considerations in the paper are estimations based on geomorphological and climatological experience.

KEY WORDS: geomorphology, glacial, Gschnitz stadial, gorge-like valleys, high precipitation, moraines, kame terraces, pollen analysis

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1 Introduction

1.1 General facts concerning the Lateglacial

After the rapid decay of the high-glacial ice stream-net and the piedmont lobes about 21,000–19,000 years ago a transitional era followed with several halts and readvances which were named the »Alpine Lateglacial« by Penck and Brückner (1901/1909). Large parts of the Central Alps were deglaciated, even if still big systems of dendritic glaciers existed which filled especially the longitudinal valleys of the Inn or Drau (van Husen 2000). The oldest stadials were named after the classical type localities »Bühl« and »Steinach« (Heuberger 1968); in the latter stage the main valleys were already free of ice and the glaciers had retreated into the tributary valleys (van Husen 2000). After a marked cooling phase the »Gschnitz« readvance occurred with large blocky ridges (Ivy-Ochs et al. 2005). With well-defined, often sediment-rich moraines from cirque and smaller valley glaciers the »Senders« stadial followed with its type locality being situated in the rear part of the Stubai valley (Kerschner 1986). Likewise in the Stubai valley both of the youngest readvance phases, »Daun« and »Egesen« were discovered with little accentuated moraines showing solifluction overprint for the older phase.

However, the Egesen stage contains sharp-crested, often blocky ridges mostly at the foot of cirques (Ivy-Ochs et al. 2005). With the exception of the Egesen readvance which was dated in the Younger Dryas (11,000–10,000 BP) the absolute ages of the individual stadials are still unclear; according to a recent paper the Gschnitz stadial can be classified to 15,400 ± 1400 BP (Ivy-Ochs et al. 2005).

Regarding the temperature conditions in the Bühl and Steinach stage little more is known than estimated values; for the Gschnitz stadial, however a lowering of the summer temperatures was calculated with 8.5–10.0°, whereas for the Younger Dryas they were only 3.5–4.0 °C lower than modern values (Ivy-Ochs et al. 2005).

Considering the more maritime external areas of the Alps, to which the Julian Alps are counted, the lowering of the mean annual air temperature in the Tyrolean Alps was calculated with 4.1° for the Senders stadial, with 3.5° for the Daun stadial and with 2.9° for the Egesen stadial (Kerschner 1985). Different from the still drier Central Alps in the Lateglacial the more oceanic Southern Alps received about the same amounts of precipitation as today (Kerschner 1985).

The impact of two of the coldest stadials – Gschnitz and Egesen – also affected the vegetation composition: with climatic warming after the Gschnitz stadial afforestation progressed and the treeline in northern Italy shifted to 800–1000 m (Vescovi 2007). This trend even increased at ca. 14,800–14,400 and 13,800 cal. BP with a change in forest composition and density having more broadleaved trees. The results of the vegetation: the landscape in the Alps was open with predominantly herbaceous plants (Vescovi 2007, Andrič 2009). These palaeoenvironmental conditions also had a significant impact on the formation of the lateglacial glaciers in the Julian Alps.

1.2 Research area

This paper presents the continuation of an essay on the Lateglacial in the northern valleys of the Italian Julian Alps (Tintor 2005) and is based on a very detailed glacial-morphological treatise on the catchment of the Fella (Desio 1927).

The research area is framed by the western Val Canale from Ugovizza to Pontebba where it turns south, runs through the Canal del Ferro, bends westward close to Chiusaforte

and reaches the Resia valley at Resiutta. East of Passo di Predil (1156 m) the article also dealt with the 15 km long Koritnica valley which belongs to Slovenia and runs into the Soča valley in the Bovec basin (figure 1). The research area comprises about 360 km^2.

The Val Canale lies at an altitude of 770 m in Ugovizza, however at only 568 m in Pontebba and just 315 m in Resiutta. The Dolina Koritnica reaches only 430 m near Bovec; this expresses how low the local base of erosion is in the western and and southern valleys of the Julian Alps. The altitude difference is often higher than 2000 m at a horizontal distance of only 5 km: Montasio is 2200 m above the Dogna and Raccolana valleys, Canìn is 2090 m higher than the Resia valley and Mangart is 2040 m higher than the Koritniška valley (Tintor 1993). This precipitous relief together with the enormous precipitation cause extraordinarily high morphodynamics with landslides, mudstreams, debris amount and a strong notching and ramification into tributaries, especially in the western valleys. These facts show clearly that large parts of the valleys do not or cannot contain lateglacial moraines any longer as they were eroded.

The recent conditions of precipitation – they may have been very similar in the Lateglacial – should be dealt with in greater detail: in the Resia valley on average 2700–3000 mm are recorded annually and in Bovec 2840 mm (1951–1980). This precipitation situation may be compared to an extra-alpine and Mediterranean region, the Durmitor area in Montenegro where the calculated precipitation on the highest parts amounts to about 2600 mm (Djurović, 2009; 2012). Very favourable for glaciation is the annual course of precipitation influenced by the Mediterranean Sea with the main peak in autumn and the secondary one in spring; it can be assumed that in the Lateglacial most of the precipitation fell in the form of snow. On Sella Nevea two metres of snow are not unusual in wet winters. Finally it must be emphasized that particularly in the lee of W–E directed ridges and crests most of the snow was deposited; this can be considered the reason that today two small glaciers still exist in a low position at the foot of the north faces of Canìn and Montasio.

2 The Lateglacial in the individual valleys

2.1 Dogna valley

Because of the deeply notched and narrow valley bottom terminal moraines are missing entirely in the Dogna valley; they must have been eroded rapidly, while many lateral moraines were found. In the lower section

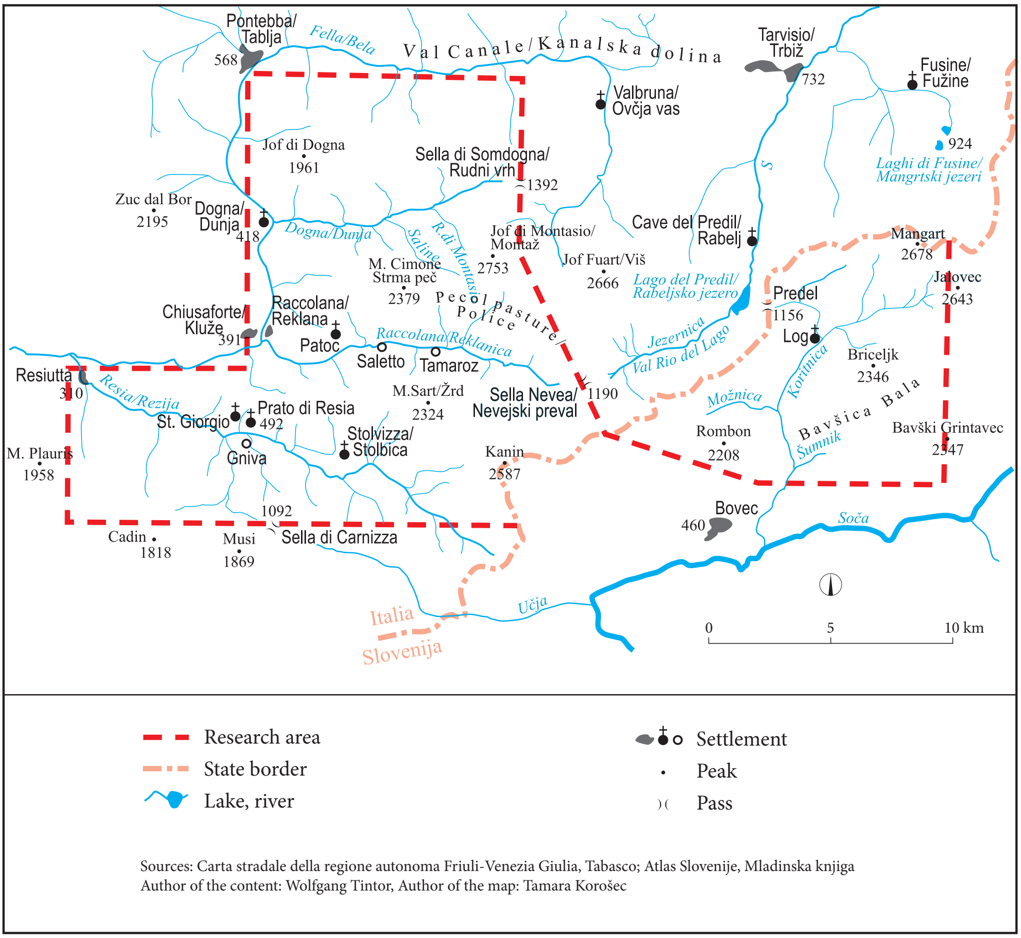

Figure 1: Research area, its surroundings and sites of lateglacial moraines.

on the still more easily accessible north side four smaller ridges were found of which two at a time correlate in their altitude (770 m below Chiout Zucuin and 730 m a bit W of Chiout di Gus; 950 m on the slope Culas above Chiout Zucuin and 920 m at the pasture Tassót). The ice thickness can thus be determined to 410 m at the utmost for the upper moraines and to 220 m for the lower ones (probably Bühl stage).

Regrettably no certain indications could be found for the Steinach stadial in the entire valley, whereas the Gschnitz stage has left very clear marks, particularly on the southern valley flank.

If you follow the marked path no. 640 well-rounded triassic boulders can be found close to house ruins on the former pasture Costa di Goliz (650 m); a near-terminus lateral moraine can be seen up to 720 m, above which erratics are found up to 800 m.

Beyond the hard passable Sfonderat gorge after another brook notch you get to the rock ledge reforested pasture Granvalt where at 660 m there are situated two well-formed lateral moraines (Desio 1927). Here the valley bottom consists of yellow marl limestones of the Raibl strata; so the numerous triassic boulders on the opposite valley side stand out against those particularly well. At 630 m just below the road there is the largest erratic block consisting of light Dachstein limestone showing that presumably a very steep Gschnitz glacier fed primarily by avalanches flowed a short distance out of the Sfonderat gorge into the Dogna valley. Very similar conditions will have prevailed in the adjacent Rondolon gorge where however no moraines could be found, just some erratics here and there. The snowline calculated just overviewingly

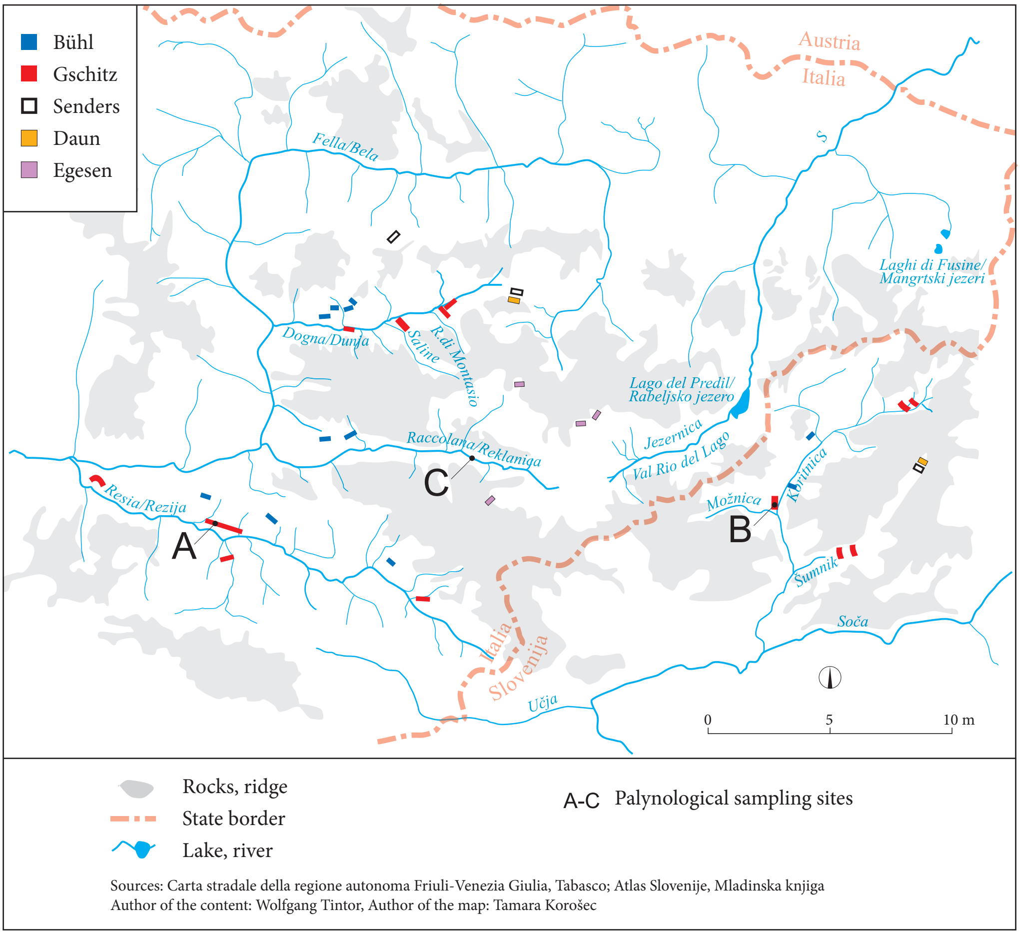

Figure 2: Presumable stadials of the moraines and palynological sampling sites

Figure 3: Gschnitz moraine cut by the Dogna stream toward Clapadorie gorge; position Dogna Road.

for both of the gorge glaciers would result in 1300–1400 m (method Höfer) which is low for the Gschnitz stadial and can only be explained with the particular topographical position.

The side gully of Rio Saline following in the east is the widest of all north facing gullies in the Dogna valley. Its Gschnitz glacier reached a length of 4.5 km and its near-terminus lateral moraines west of Colle Fratte are impressive accumulations up to a height of 20 m (Desio 1927). The snowline determined with 1480 m corresponds fairly exactly to that for the somewhat longer Gschnitz glacier in the Val di Rio Freddo (Tintor 2005).

The uppermost and very last side gorge in the Dogna valley is the already mentioned Clapadorie. Its glacier pushed up two marked near-terminus lateral moraines at its right side. The snowline of this glacier fed exclusively by drifted snow and avalanches was calculated for 1520 m (figure 4).

On the Somdogna pass there is a wide and 500 m long ridge on its southernn side showing a small pond at its inner side (Il Laghetto, 1442 m). Most probably in the Senders stage a largely debris-covered glacier must have come down there into the soft marl limestones of the Raibl layers at the pass. The snowline of the 900 m long cirque glacier was at 1630 m, which is strikingly low, but that should be caused by the north–east exposure and the steep relief of the lower glacier half.

At the lower end of the small cirque of Jof di Somdogna you find a terminal moraine (1620 m) whose 500 m long glacier was very shallow in its snout area and may be assigned to the Daun stadial.

2.2 Raccolana valley

In this narrow mountain valley with frequently vertical rock walls there are only few lateglacial moraines; near its lower end in a flat area of Stavolo Bilizzis (558 m) many light, rounded triassic boulders can be

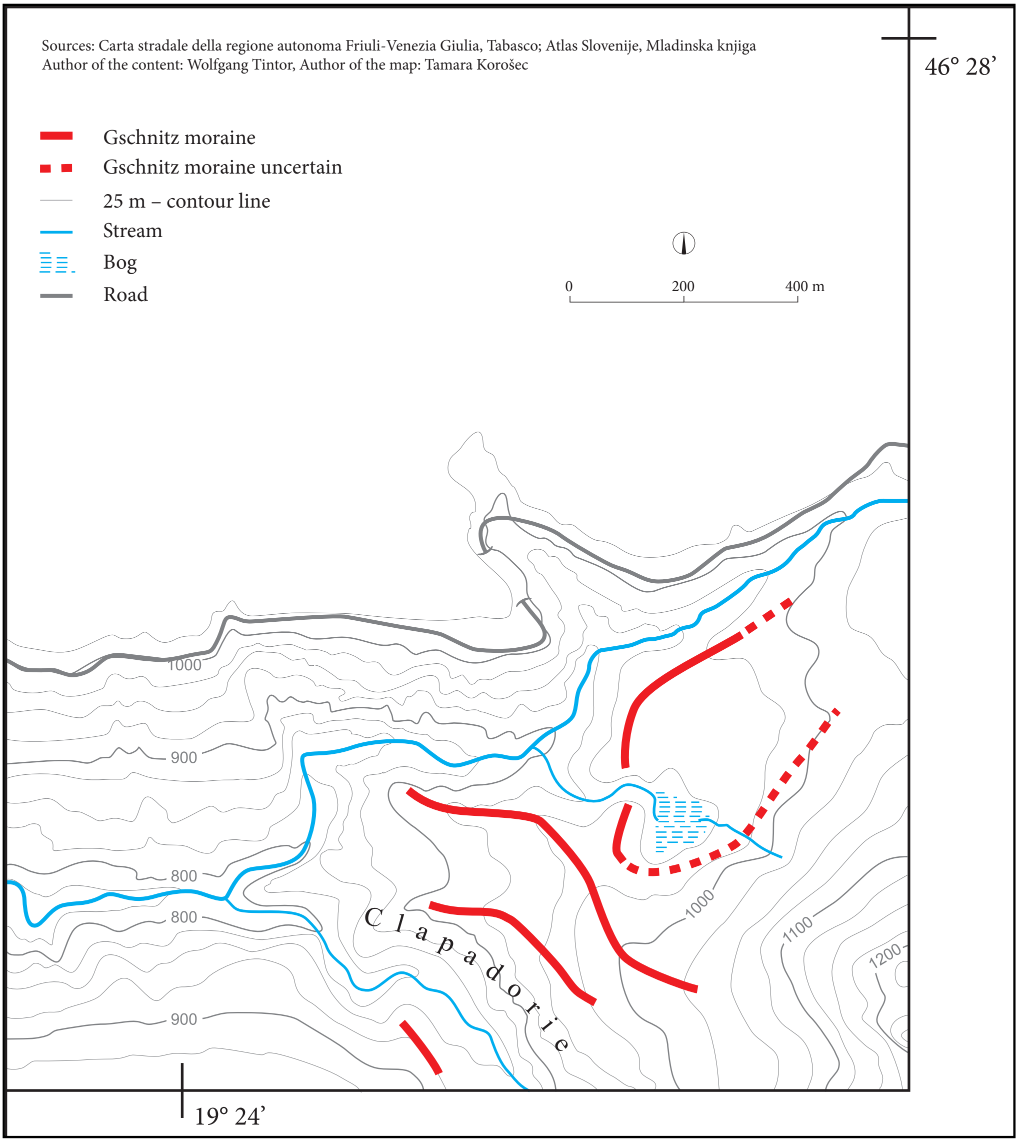

Figure 4: Gschnitz moraines in the upper Dogna valley.

found; most probably they have to be assigned to the Bühl stadial as they belong to a small lateral ridge high above the valley bottom. In this phase the Raccolana glacier must have been 140 m thick.

The impressive Patòc moraines (785 m) on the sunny side above Chiout Michel are Bühl-lateral moraines indicating a glacier with a thickness of 300 m. From here a small and shallow branch (20–25 m thick) flowed down the Patòc valley.

Like in the Dogna valley Steinach moraines are missing completely here as well; it can be concluded that in this stadial most of the Raccolana valley was filled with ice. This also implies that the massive kame terraces in the valley must be of younger age.

80 m above the valley floor (Plan Moras) a 2.5 km long gorge glacier flowing down the Sbrici ravine pushed up a near-terminus lateral moraine; due to its location at the confluence of a side gorge it must

have been a Gschnitz glacier. The snowline calculated roughly resulted in 1250 m which is a very low value. The very steep and narrow gorge glaciers in this valley had all in common that they lay far below the climatic snowline even at that time.

The two kame terraces following up the valley, at Tamaroz and W of it with flat areas in 600–620 m will have been dammed by a north-facing hanging glacier from Cresta Indrinizza and by a small S facing ice stream from Monte Cimone. From the very steep Vallone Blasic another glacier must have run down in the Gschnitz stadial. Today only some ice-abraded rock zones in the steep tributary give evidence of it and also the fine sediments dammed at its lowest margin when the glacier blocked the valley bottom temporarily. The snowline of the 3 km long glacier will have been at an altitude of 1400 m.

Up the valley on a hill similar to a ridge a sediment sample for a pollen analysis was collected and the results (table 1) showed that pollen grains are present in very low concentration, whereas the percentage of degraded pollen is high (20%) suggesting a selective degradation of pollen grains. Of the preserved tree pollen birches, pines and spruces predominated; as in the vicinity of the digging zone there are many beeches and many roots in the uppermost layer of the soil there could have been a contamination with recent beech pollen in the sample (table 1). Even so doubts remain if this formation really is a moraine of the Gschnitz stadial. It could also be an atypical postglacial debris flow and is therefore not contained in figure 2, but the sites of the samples are marked with A–C. In any case the glacier belonging to it would have been 4 km long down from Sella Nevea whereas the main glacier flowing NE into Valle Rio del Lago still reached a length of 8.5 km in that stadial.

During a hiking tour on the N declivity of Canìn a small lateral moraine was found in Foran dal Muss at 1850 m; due to its high altitude it may be assigned to the Egesen stadial. Another one was found at the turn-off of the track to Sella Blasic (1950 m). On the sunny Montasio side a terminal moraine could be detected at the lower end of the small Palone cirque; in its W part (2090 m) it is already covered by

Figure 5: Fine sediments of a kame terrace east of Vallone Blasic; position Raccolana road.

Table 1: The results of pollen analyses are presented as the number of pollen grains counted in each sample. In brackets the percentage of each pollen type was calculated on the basis of pollen sum of all taxa (without degraded pollen); see figure 2 for the position of the study sites.

	Val Resia San Giorgio 460 m-A	Dolina Koritnica Možnica 530 m-B	Val Raccolana 655 m-C
Pinus (pine)	145 **(35.9%)**	40 **(20.3%)**	6 **(8.6%)**
Picea (spruce)	24 **(5.9%)**	36 **(18.2%)**	5 **(7.2%)**
Betula (birch)	5 **(1.2%)**	26 **(13.1%)**	14 **(20.2%)**
Fagus (beech)	–	4 (2.0%)	6 (8.6%)
Alnus (alder)	2 (0.4%)	1 (0.5%)	3 (4.3%)
Corylus (hazel)	10 (2.4%)	2 (1.0%)	6 (8.6%)
Carpinus b. (hornbeam)	–	1 (0.5%)	3 (4.3%)
Salix (willow)	1 (0.2%)	–	–
Fraxinus o. (ash)	–	–	1 (1.4%)
Poaceae (grass)	8 (1.9%)	11 (5.5%)	9 (13.0%)
Cyperaceae (sedge)	11 (2.7%)	2 (2.0%)	–
Chenopodiaceae (goosefoot)	–	1 (0.5%)	–
Compositae lig. (dandelion family)	22 (5.4%)	23 (11.6%)	7 (10.1%)
Filicales (monolete fern spores)	171 (42.4%)	22 (11.1%)	9 (13.0%)
Trilete spores (trilete fern spores)	3 (0.7%)	23 (11.6%)	–
Selaginella (clubmoss)	1 (0.2%)	2 (1.0%)	–
Thelypteris pal. (marsh fern)	–	2 (1.0%)	–
Indet. degraded (indetermined, degraded pollen)	16 (3.9%)	16 (8.1%)	14 (20.2%)
Pollen sum	403	197	69
pollen concentration no. of grains/1 cm³	6378	1109	406

a recent debris slope, however towards E it is well marked and climbs up to 2125 m there. The little glacier will have occupied an area of 0.95 km²; together with the glaciated flanks at the foot of Modeon del Montasio it amounted to 1.5 km².

In the spacious Cregnedul cirque a distinct terminal moraine of the Egesen stadial (2030 m) could be discovered; the glacier belonging to it had an area of 1.2 km².

Following to E at the foot of Forcella Lavinal dell' Orso there is a striking terminal moraine at an altitude of 1990–2030 m; its Egesen glacier facing E amounted to 0.94 km² and has also to be attributed to the catchment of Valle Rio del Lago.

Interestingly the terminal moraines of the same stadial in the region of Mt. Durmitor (Montenegro) are also situated at an altitude of ca. 2000 m, some in the west even at 1800 m (Djurović 2009).

2.3 Resia valley

The southernmost of the three valleys is at the same time the lowest one; even so the valley was considerably glaciated in the Lateglacial because of the excessively high precipitation.

At Stavoli Ruschis 10–20 m high lateral moraines were discovered (crest height 697 m) which can be assigned to the Bühl stadial with a high degree of certainty; at that phase the Resia glacier was still 330 m thick there. Another Bühl moraine was found E of Prato di Resia at the ruins of the pasture Bükvica (705 m); here, too the glacier was about 300 m thick. Two km east of Stolvizza some small moraines were discovered of which the corresponding ice thickness must also have amounted to 300 m and possibly 390 m for an older Bühl phase.

The moraine complex immediately E of the Calvary of Resiutta is bent convexly, about 400 m long, reaches 402 m in its highest point and must have been pushed up by a 4.5 km long glacier from the tributaries of Rio Resartico and Rio Serai. There a snowline of only 1070 m can be assumed. Apart from the very high quantities of snow again the great inclination, the north exposure, the narrow gullies and the slopes towering highly and steeply to east which counteract the intensive solar radiation, can be seen as supportive to glaciation. Besides the ridge from Monte Plauris to the Cime del Monte Musi as well as the valleys south and north of it still receive the highest annual precipitation of the Alps (Musi/Muzci 3313 mm, Coritis 2939 mm).This can also be assumed for the lateglacial climate in this region (Tintor 1993).

Only 4.5 km upstream and 50–80 m higher the largest moraines of this study area can be found: the 3.5 km long, mighty and blocky terminal moraines (440–465 m) of San Giorgio were attributed partly to fluvioglacial processes (Desio 1927). They correlate with the near-terminus lateral moraines on the other side of the stream at Gniva which can be followed up to 570 m. They were accumulated by a 5 km long tributary glacier from the Barmán valley in which you come across the next terminal ridges already after 2 km. Most probably they represent the second phase typical for the Gschnitz stadial and are again blocky. The snowline of this impressive ice stream was situated at 1130 m which again was only possible due to the special factors mentioned above. From the San Giorgio moraine a sediment sample was taken for a pollen analysis: 35.9% were pine pollen, only 5.9% spruce, 1.2% birch, ca. 2.7% sedge, but also 42.4% monolete fern spores (Filicales, table 1). Although these results are well comparable with the pollen record of the Gschnitz moraine at the lower Fusine lake (Tintor 2005), they do not permit the authors a very detailed datation of the moraine. But together with the morphological diagnosis it should be sufficient to classify both situations to the Gschnitz stadial.

In the upper valley section notching in side gullies and small ravines increases sharply, frequently you come across kame terraces, of which one of the largest is that of Huda Raven, southeast of the confluence of Rio Ronch; at its southeastern side (564 m) it is incised by Rio Secco and exposed in several decametres, in which you can observe an alternating deposition of coarse material and fine sediments (figure 6): The kame terrace is 50–60 m thick and was formed supposedly in the Gschnitz stadial at the margin of a glacier which flowed 4.5–5 km long from the S and W facing flanks of Picco di Grubia, Picco di Carnizza and Canìn. Its snowline must have been in 1430–1450 m which in view of the high precipitation at the Kanin/Canìn ridge is not so low.

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Figure 6: Up to 60 m high and 400 m long opening with sand and gravel of the kame terrace Huda Raven in the upper Resia valley; position Rio Secco.

2.4 Koritnica valley and tributaries

The Koritnica valley shows a well-formed lateral moraine (720 m) on its western side immediately above the main village Gorenji Log pod Mangartom; it can be assigned to the Bühl stadial due to its altitude above the valley bottom. The glacier will have had a thickness of ca. 80 m in this part of the valley.

Šifrer and Kunaver (1978) mentioned six different end moraines only for Loška Koritnica which could not be verified. In the upper part of Koritnica two unambiguous and blocky glacial deposits were found: the lower one is situated in an altitude of 860–865 m close to the abandoned farm Ganza and the upper, more marked one in 940–950 m. These should be the two phases of the Gschnitz stadial, but interestingly the glacier was hardly more than 3 km long here and ended fairly high. Accordingly high also the snowline of 1580 m – at an assumed mean altitude of the ridges framing the glacier with 2300 m. The uppermost valley is exposed to the sun and furthermore the precipitation in the Lateglacial must have decreased rapidly from the outward ranges in the south toward north similar to the present time which was also decisive here (Tintor 1993).

The 5 km long, deeply notched side valley of Možnica is terminated at its southern side by the ridge from the Confin peak to Rombon; at the lower end of the valley there is a mighty, wide and 60–70 m high terminal moraine (max. 590 m) which the stream cuts through meanderingly in a narrow gorge. On both sides two near-terminus lateral moraines run down steeply implying that the glacier in between was still 550 m wide and could have dammed the Koritnica river at least in the first Gschnitz phase (figure 7). A lateral moraine was found at 800 m by geologists who also reconstructed the glaciers of the Koritnica and Soča valley for a stadial not mentioned by modelling (Bavec 2004); so their climatic snowline calculated for the whole area bears no relation to the orographical snowline of our local glaciers.

A sample taken from the lower part of the moraine (530 m) produced a meaningful result with a high percentage of tree pollen (table 1); the pollen record itself allowed only a wider (presumably Lateglacial)

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Figure 7: Moraine complex (centre and lower half of the picture) at the confluence of Možnica into the Koritnica valley.

temporal determination but the following additional factors also speak in favour of the Gschnitz stage in spite of the low location: the strong shading of the lateglacial glacier by the Rombon ridge in the south, the maximum zone of precipitation on this very ridge and connected with that the high snow accumulation in the immediate leeward side to the N of it, the special height of the moraine itself as well as the lack of other moraines in the more spacious area between 800 and 900 m in which for example in the northern valleys of the Julian Alps Gschnitz moraines are situated in large numbers. The snowline for the Možnica glacier amounted to a rather low value of 1250 m.

The morphological map of Šifrer and Kunaver (1978) and a later paper (Kunaver 1990) describe six different end moraines for Bavšica and the Bala valley which could not be verified. The lowest, blocky terminal ridge is at 700 m; 500 m up the valley you discover the next end moraine (figure 2). The glacier flowing down the Bala valley to Bavšica was 6.5 km long, a second southern tributary ice stream from Bavški Grintavec had a length of 3.5 km (table 2). The mean altitude of the peaks and ridges framing the lateglacial ice streams can be assumed with 2200 m here which means a snowline of 1450 m. Kunaver (1990) assumes a Bühl stadial for these frontal moraines; however, they are too well preserved, arranged in two phases immediately behind each other and moreover, located in a tributary, not in the main valley.

In the area of Planina Bala alp just a valley step with debris slopes could be found but by no means an accumulation of glacial deposits. Only at an altitude of 1400 m you come across a small ridge which is a debris-rich accumulation, possibly belonging to the Senders stage; the glacier of this stadial was just 2 km long and its snowline was thus situated at 1800 m. In a horizontal distance of about 700 m and at an altitude of 1560–1600 m you find another glacial proof which was pushed up by a small cirque glacier with a length of about 1.3 km and presumably it can be assigned to the Daun stadial.

Table 2: Front altitude (in m) and length (in km) of glaciers of the presumable Gschnitz stadial in the individual valleys.

	Dogna	*Raccolana*	*Resia*	*Koritnica*
Sfonderat	(600/3,0)			
Saline	(750/4,5)			
Clapadorie	(830/3,5)			
Somdogna	950/2,5			
Sbrici		(500/2,5)		
Blasic		(560/3,5)		
Monte Plauris			400/4,5	
Barmán			440/5,0	
Ronch			(560/4,5)	
Koritnica				860/3,0
Možnica				520/5,0
Bavšica/Bala				680/6,5

( ) – values = estimated, without terminal moraines

3 Conclusions

All glaciers of the presumable Gschnitz stadial mentioned in this paper belonged without exception to the avalanche basin type without an actual accumulation area. All glaciers were strongly subordinate to the relief and were covered highly with debris, particularly the one streaming down from the Barmán valley, a north-facing tributary of the Resia valley and the Možnica glacier whose terminal moraines are exceedingly mighty.

Of the twelve lateglacial glaciers listed up in table 2 seven were north- or north-west-facing, three directed to southwest and one each was east- and south-southeast-facing. The lowest one was that ice stream flowing down from Monte Plauris to the lowest part of the Resia valley (400 m altitude of the front moraine), the highest one the small Somdogna glacier (figure 4), where it is no coincidence that the first was situated leeward of the ridge with the highest precipitation at the southern verge of the Alps and the latter one in the northernmost and therefore drier valley. The southern periphery of the Julian Alps is still considered to be the wettest part of the Alps. As described in the preceding chapters most glaciers owed their low position also favourable topographical aspects like the present Montasio glacier, a narrow gorge glacier with its snout at 1880 m; therefore their local orographical snowline was far below the climatic snowline.

The precipitation increasing to the S margin of the mountains corresponds with the snowline decreasing from north to south; it amounted to an approximate altitude of 1500 m on average of three glaciers for the N valleys (Tintor 2005); in the Dogna valley the mean value was just 50 m lower followed by the only insignificantly more southern Koritnica valley with 1430 m on average. The snowline in the Raccolana valley may have been 1325 m on average of only two very steep gorge glaciers which means another lowering of more than 100 m. Likewise in the Resia valley it must have been located another 110 m lower, that is at 1210 m on average. The straight line from the lateglacial front moraines of the N valley glaciers to those of the Resia valley amounts to just 15–19 km; the precipitation averaged from four stations each increases, however by 1000 mm at this distance according to present conditions (Tintor 1993). Thus also in this mountain range the importance of the precipitation can be expressed as the crucial parameter for glaciation along with the temperature and the relief.

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DETECTION OF FORMER LANDFILLS IN GRAVEL PLAIN USING GEOMORPHOMETRIC ANALYSIS AND HIGH-RESOLUTION LIDAR DTM

ODKRIVANJE PRIKRITIH ODLAGALIŠČ ODPADKOV V PRODNI RAVNINI Z GEOMORFOMETRIČNO ANALIZO IN LIDAR DMR

Mateja Breg Valjavec


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Bumpy and wavy micro-terrain of former landfill in Ljubljana gravel plain.
Grbinast in valovit mikro-relief nekdanjega odlagališča odpadkov na Ljubljanskem polju

Detection of former landfills in gravel plain using geomorphometric analysis and High-Resolution LiDAR DTM

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ABSTRACT: The article represents the application of geomorphologic approach to discover the potential areas of buried waste in agricultural landscape of Ljubljana gravel plain. Some former waste disposal sites or landfills are underground sites characterized by heterogeneous old waste buried in formerly concave landforms: old inactive gravel pits or paleo-riverbeds. They form different types of anthropogenic landforms. They were primary recognized and located with the terrain visualization (analytical shading, hypsometry) of LiDAR data and in continuation with geomorphometric analysis and classification of fluvial terrain. Due to subsidence of heterogeneous waste, terrain of former landfill sites is bumpy and uncharacteristic of fluvial surface morfology or terrain. The geomorphometric analysis was applied to differentiate the anthropogenic landforms (gravel pits, filled gravel pits …) from natural alluvial landforms with combination of two geomorphometrics: *multiresolution index of valley bottom flatness (MrVBF)* and *convergence index* and high density LiDAR data. Result is the automatically derived classification of terrain in to three classes: (1) bumpy terrain, typical for areas with high terrain potential for landfill, (2) flat terrain, typical for dry paleo riverbeds and (3) »agricultural« terrain, typical for intensive fields and meadows. By comparing the results of geomorphometric analysis with the results of visual analysis the 26 of 46 visually detected anthropogenic landforms are overlapping the areas of high terrain potential for landfill and among these 8 objects were proved with geohistorical analysis of archive aerial photographs.

KEY WORDS: applied geography, landfill, gravel pit, paleo riverbed, visualisation technics, geomorphometry, LiDAR, DTM, Ljubljana gravel plain.

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1 Introduction

The main research objects are former landfills on Ljubljana gravel plain. These are underground objects characterized with heterogenous old waste being buried in once concave landforms. The results of previous Slovene studies (Bricelj 1988; Šebenik 1994; Kušar 2001; Breg and Urbanc 2005; Breg et al 2007; Smrekar 2007 etc.) and some international studies (Silvestri in Omri 2008) showed that in the past the waste was often illegally disposed in natural (paleo river beds, sinkholes) or anthropogenic basins (gravel pits or other open mining pits). Regarding these the research is oriented in study of landfills in gravel pits and paleo riverbeds being among the most frequent concave landforms in the terrain of Ljubljana gravel plain.

The main objective of this research is to show that landfills can be determined also by using geomorphic methods and LiDAR terrain data. Despite the remarkable accuracy and usefulness of LiDAR data can be theoretically determined only landfills, the consequences of which are visible in the LiDAR DTM, which applies to landfills that were not adequately covered with a thick layer of fertile soil, which would allow intensive farming. At these landfills intensive agricultural land use and production is not present, but meadows and reforestation, which is reflected in the micro-terrain and in texture of shaded terrain.

Many researchers attempted to identify buried waste by using various techniques of remote sensing and multispectral satellite data. They were focusing on degraded vegetation and soil pollution. Detailed review of past remote sensing researches is available in Silvestri and Omri (2008), Slonecker et al (2010) and others. Almost none research has been done in terms of studying the effects on geomorphology resulting from the landfilling of waste. Using Landsat TM and ETM satellite data or very higher spatial resolution remote sensing data (Quickbird, Ikonos, GeoEye1) also geomorphic changes in various geomorphic features, such as riverbed and shoreline migration, meanders and old riverbeds can be identified (Ghanavati et al. 2008). Podobnikar et al. (2008) showed that analysing DTMs with 25 m pixel resolution enables highlighting changes to the geomorphology and makes human impacts visible as they clearly noticed many anthropogenic landforms (road embankments, traffic infrastructure, filled sinkholes, active gravel pits) on a karstic surface also with marking the differences between DTMs from different periods. By photogrammetric processing of the archive aerial photographs DTM of former landscape can be processed. By further comparison with DTM of recent landscape elevation differences may be calculated. Using this approach the number and extent of filled dolines was quantitatively analysed in Slovene Logatec karst polje (Breg Valjavec 2010). For the Bílina coal mine (Slovak Republic) the elevation data was obtained for different periods and volumetric analysis was used to calculate the temporal terrain differences (volume of excavated minerals) completed during the selected years (Pacina and Weiss 2011).

The research is focusing in smaller landfills that are able to be visualized on the LiDAR terrain and recognized as the anthropogenic landforms through discovering the terrain texture of »scars« that were created in landscape due to underground waste dumping. The idea to recognize landfills with geomorphometric analysis of recent terrain became more realistic with the availability of high-density LiDAR data, development of digital geomorphometric methods and specific software. DTM, which is obtained from a laser cloud of points, reflecting even the smallest variation in the topography (from few centimeter to some ten's centimeters), being a consequence of geomorphological and anthropogenous processes (Mlekuž 2010), like the land use impacts in terrain. LiDAR allows observation traces, scars and finger prints of natural and anthropogenic processes on the Earth's surface (Komac 2009; Mlekuž 2010).

2 Case study area

Ljubljana plain in general represents a tectonic depression filled mainly with gravel and sand sediments. In fluvial terrain of the gravel plain several terraces (highest Pleistocene and the lower Holocene terraces) accompany the main River Sava (Radinja 1951; Šifrer 1969). By moving river current from old into new riverbed paleo riverbeds have formed. In the recent landscape these are longitudinal slightly concave landforms that can be identified as lowering's in terrain, especially in the lower Holocene terraces. Regarding this the study area was narrowed down to Holocene terrace. Study area (Figure 4) represents suburban belt (villages) on the northern part of Ljubljana that is interconnected with agricultural countryside (meadows and fields) and young forest vegetation along the River Sava. The areas in the immediate vicinity of cities were and are still impacted by illegal waste dumping (Breg and Urbanc 2005). Due to the gravel sediments, the wider area of Ljubljana plain has always been interesting for gravel extraction especially near Sava River. Many medium-size gravel pits (from 1,000 to 5,000 m^2) were partially or completely filled with waste and turned into »*waste pits*« (Breg and Urbanc 2009).

3 Methodology and LiDAR data

The methodology is based on geomorphologic approach that determines landfill areas on the basis of fluvial terrain characteristics and determination of anthropogenic landforms. It consists of two recognition methods based on DTM data: (1) visualization technics (analytical shading and hypsometry) and (2) geomorphometric analysis. It is possible to determine the landform types with greater certainty with several different methods compared to each other (Ciglič and Gostinčar 2011). Numerical (geomorphometric) as well as visual analysis of DTM enables the recognition of landforms, such as ridges, picks, valleys (Podobnikar and Možina 2008) and also anthropogenic landforms. The anthropogenic landforms were primary recognized and located with the terrain visualization of LiDAR data and in continuation with geomorphometric analysis and classification of fluvial terrain.

The applied and analysed terrain data is LiDAR DTM (Lidar 2008, © GEOIN), based on data from laser scanning of 8 and 14 February 2008. Aerial survey was conducted by Optech Gemini LiDAR sensor. Primary data processing was done with Dashmap 5.3 and PosPac 4.4 software. For the final classification and treatment of the software package Terra Solid and MicroStation (Geoin 2011) was used. The cloud of points was divided into four classes of which we used class of points of the terrain.The terrain was smoothed by filling up the smaller »sinks« and analysed with visual and automated technics. Regarding land use types, only built up areas were excluded from geomorphometric analysis.

4 Visual analysis and characteristics of anthropogenic terrain of landfills

The Lidar DTM was visualized so the terrain anomalies of an anthropogenic origin were located in the terrain of recent landscape. Regardless of the wide spectre of its uses, it is important to demonstrate (visualize) the DTM effectively, as it is the only assurance to guarantee the appropriate result interpretation. Despite several descriptions of advanced terrain demonstration, analytical shading remains one of the most common methods (Zakšek et al. 2010). Analytical shading (Figure 2 and 3) simply means a computer-assisted assembly of a shaded terrain from the DTM. The method, developed by Yoëli (1965), where the value of the grey is in correlation to the cosine of the ray's incidence angle of the direct terrain lighting, has become the standard. This is the angle between the direction towards the light source and the perpendicular line to the terrain surface. In this way, the areas perpendicular to the ray from the imaginary light source are white, and the areas with an incidence angle of 90° or more are in a complete shade or completely black, while the areas between an incidence angle between 0° and 90° are displayed with the appropriate grey or other color shade (Zakšek et al. 2010). The hypsometry (Figure 1) is a visualisation technic that allows us to adapt the image histogram to our needs and expose the smaller landforms and micro-terrain characteristics (landfills). Both visualisation technics, analytical shading and hypsometry, were applied separated on the same LiDAR data sections (measuring 750 m × 500 m). By selecting smaller sections of DTM also the interval among minimum and maximum elevation values has narrowed. Smaller sections of gravel plain enable better color contrast in visualising flat terrain at local scale and to detect micro-terrain variability and texture. With presented visualization methodology, we displayed DMR very precisely and reconstructed the old riverbeds in the agrarian landscape. We studied the natural terrain characteristics of fluvial terrain (paleo riverbeds) and anthropogenic landforms in order to determine geomorphic characteristics of landfills in filled basins.

The essential geomorphic characteristic of paleo riverbeds are very low slopes at the bottom of the riverbed (under 0.5°) that quickly increase (for a few degrees) on the fold to the slope. The terrain anomalies were identified in the riverbeds that are a consequence of human activity and are shown as a convex landform (embankment), which interrupts the riverbed flow on a certain section of the river and can then continue on once more (Figure 1). The quality of visual recognition of convex anthropogenic land-

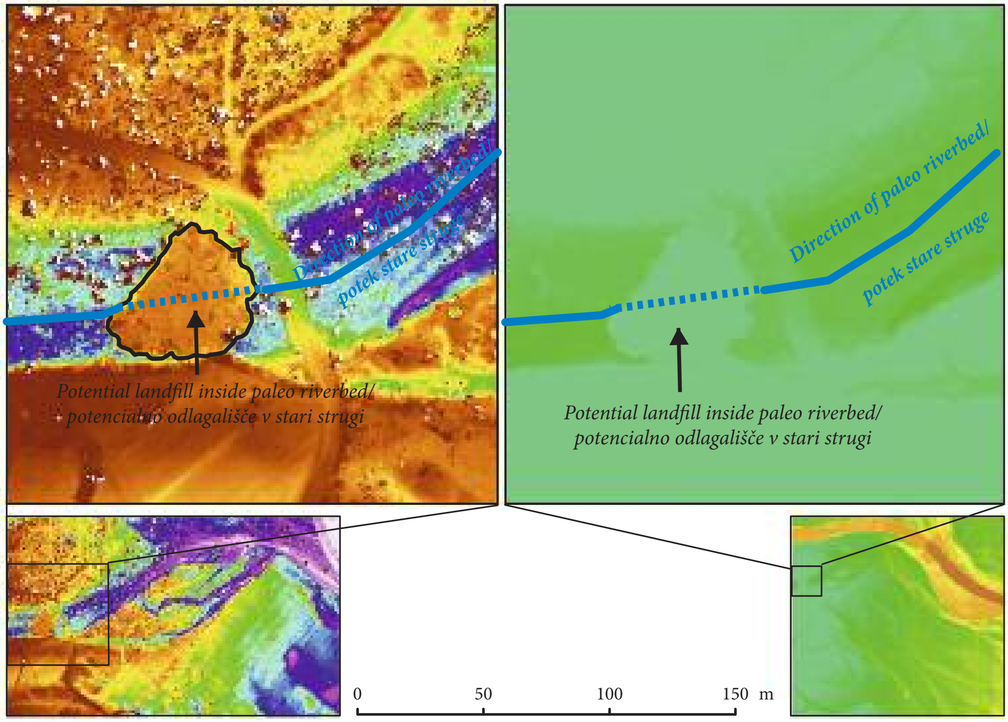


Figure 1: Reconstruction of paleo riverbeds with visual analysis of DTM in different scales and detection of geomorphic anomalies.

forms inside paleo riverbeds on LiDAR DTM depends on the size of study area. On the left image is taken zoomed view from visualization of 750 × 750 m study area and on the right image is taken zoomed view from entire area.

Completely filled gravel pits do not particularly stand out in the terrain, as they were levelled with the surrounding terrain when they were filled. Since the waste may be very heterogeneous, it decays with different intensity. In accordance, a bumpy terrain is formed (Figure 2), which is untypical in the fluvial terrain of the alluvial plain. As the Latin name (Lat. *Fluvio* means river) designates, fluvial landforms are shaped by the movement of river water or in general when the laminar flow runs into a linear one due to its tendency to concentrate. For this reason, natural landforms in fluvial terrain are linear (valley, ravine, gorge, erosion channel and ridge).

Bumpy landforms, typical for filled gravel pits, can be successfully studied on shaded terrain as wavy texture (Figure 2). Natural fluvial terrain of studied agrarian landscape is changed also due to the traditional and intensive agricultural land use.

By analyzing high resolution LiDAR DTM the effects of different land-uses can be recognized. This enables the classification of different types of land use from the geomorphological point of view. In the case of filled gravel pits dumped waste represents anthropogenic bedrock.

In the formation of micro-terrain landforms in a completely flat terrain (gravel plain) play leading role landscape elements such as bedrock and in some cases also soil (soil depth), vegetation (tree roots), fauna (mole) and human. They can take the lead in geomorphological reshaping of flat terrain. Considering this, very similar bumpy micro-terrain was detected also in some other land use types:

- forest that is growing on the shallow soils (rendzina) on paleo-gravelbeds near Sava River;
- abandoned agricultural land inside extensive agrarian land, usually overgrown with bushes and trees, limited to the smaller strips or lots;
- traditional meadow or pasture that include trees (Figure 3, green ring).

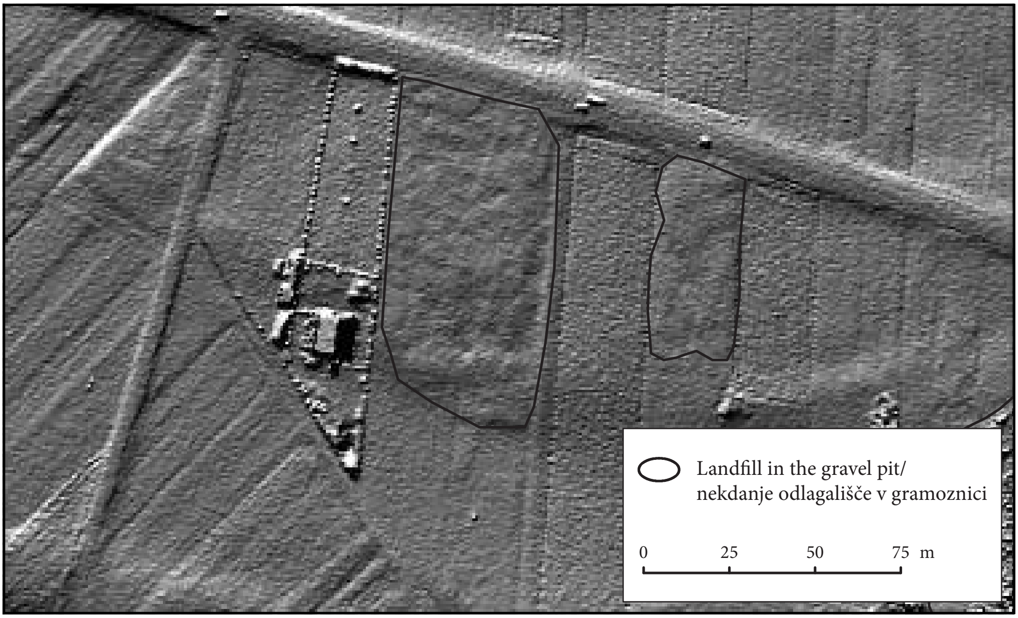


Figure 2: Terrain of filled gravel pit is usually slightly convex and bumpy (black ring area). The terrain of surrounding fields is agriculturally altered due to the plowing and tillage of soil.

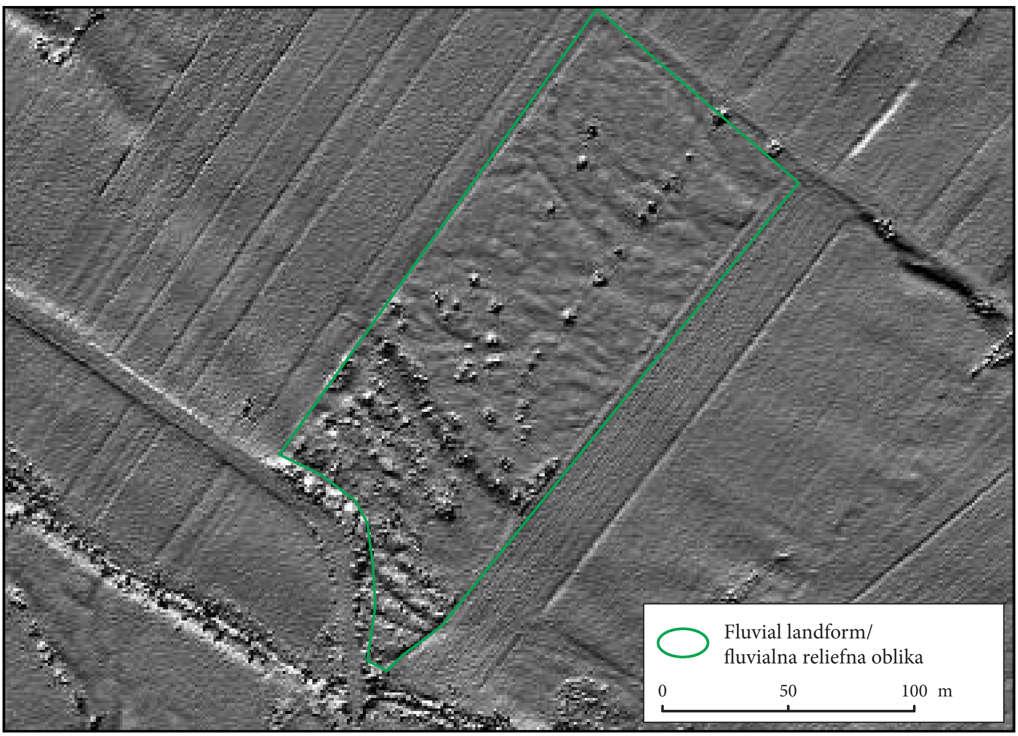


Figure 3: Micro-terrain that is shaped in traditional meadow (green ring) has very similar texture (micro-terrain) like the terrain of waste pit, used as a meadow (see Figure 2).

Final dilema in separation between natural bumpy landforms and anthropogenic bumpy landforms (related to landfills) can be solved with geohistorical analysis of gravel pits, reconstruction of paleo riverbeds and field studies.

With the visual analysis of DTM the 67 potential anthropogenic landforms related to excavation of gravel and waste dumping (Figure 4) were defined on a 5 km^2 of case study surface. Landforms were divided into four groups according to concavity / convexity, and potential for presence of buried waste (Figure 4):

1. Convex landforms are potential landfills if they are »overfilled« gravel pit or just a larger pile of dumped waste, expressly elevated above the surroundings.
2. Bumpy landforms (potential landfills):

2A. bumpy (slightly) convex micro-terrain,

2B. bumpy (slightly) concave micro-terrain,

3. Concave landforms are allegedly unfilled gravel pits or paleo riverbeds;

Considering further geomorphomorphic analysis only convex (5), bumpy convex (24) and bumpy concave landforms (17) are potential landfills. Regarding this we can conclude that 46 objects have potential to be landfill.

5 Geomorphometric analysis and results

Geomorphometry is the science of topographic quantification; its operational focus is the extraction of land-surface parameters (terrain) and objects from digital elevation models (Hengl and Reuter 2009, Hrvatin and Perko 2009) or digital terrain models. The modern geomorphometry differs from classical quantitative geomorphology while it's specialized on computer characterisation and analysis of continuous topography (Hengl and Reuter 2009). The geomorphometric analysis is a second phase of our research and encompasses determination of the potential areas that have the terrain characteristics typical for filled basins (landfills).

The DTM can be automatically divided into classes with the use of geomorphometric parameters (the slope, curvature, level of incline curves, topographic openness, the accumulation of the water current) in order to determine landforms connected to fluvial processes (Anders et al. 2009). The Convergence index was used to exclude the converging areas, as they are not typical for the area of filled gravel pits with bumpy terrain and may also represent natural concave landforms (paleo riverbeds) and unfilled gravel pits. The module (in SAGA software) calculates an **index of convergence/divergence** regarding to the overland flow. By its meaning, it is similar to a plan or horizontal curvature, but gives much smoother results. The calculation uses the aspects of surrounding cells, i.e. it looks to which degree the surrounding cells point to the center cell. The result is given as percentages; negative values correspond to convergent, positive to divergent flow conditions. Furthermore, the areas of the flattened terrain were separated from the not

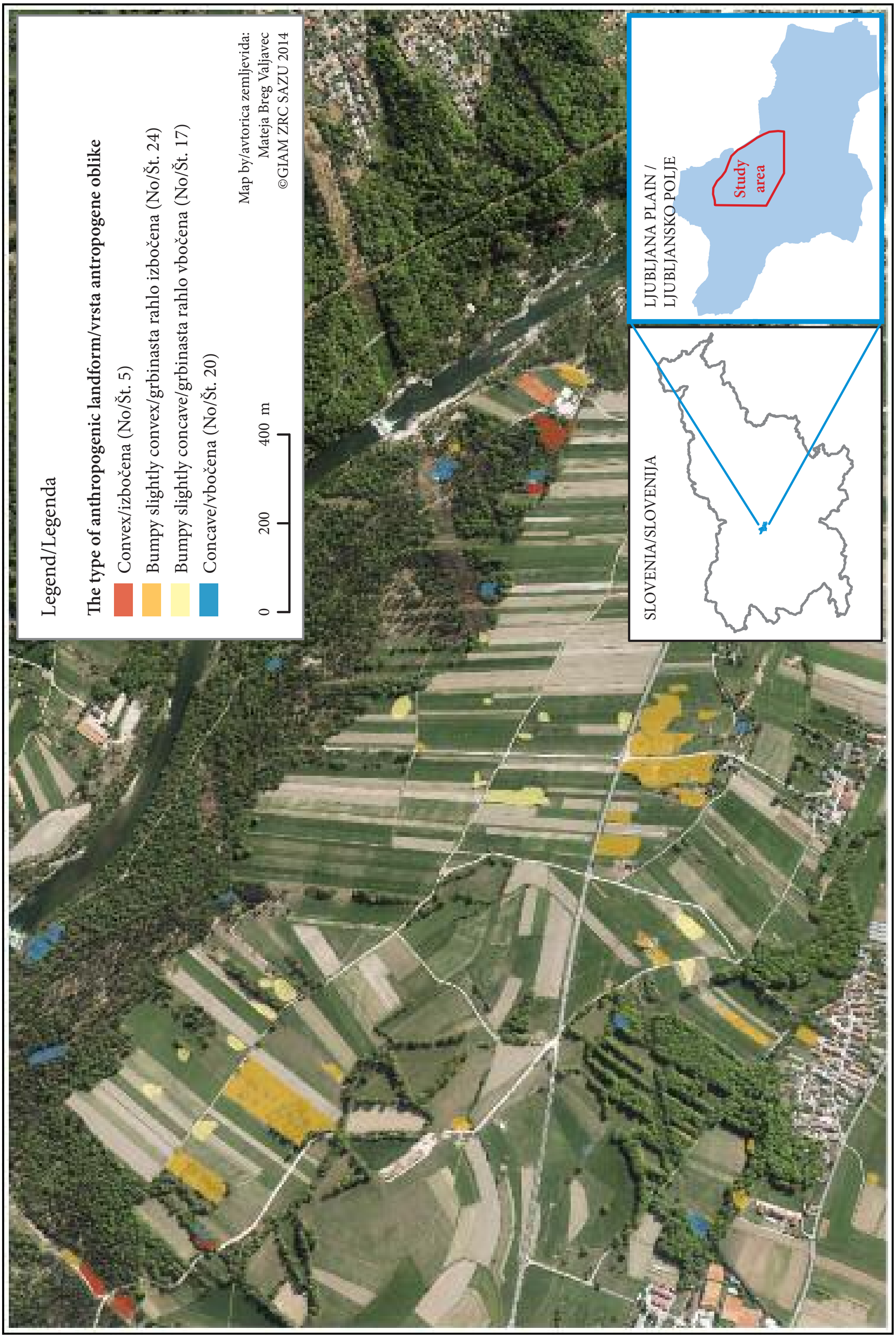
Table 1: Joining the results of both geomorphometric indexes.

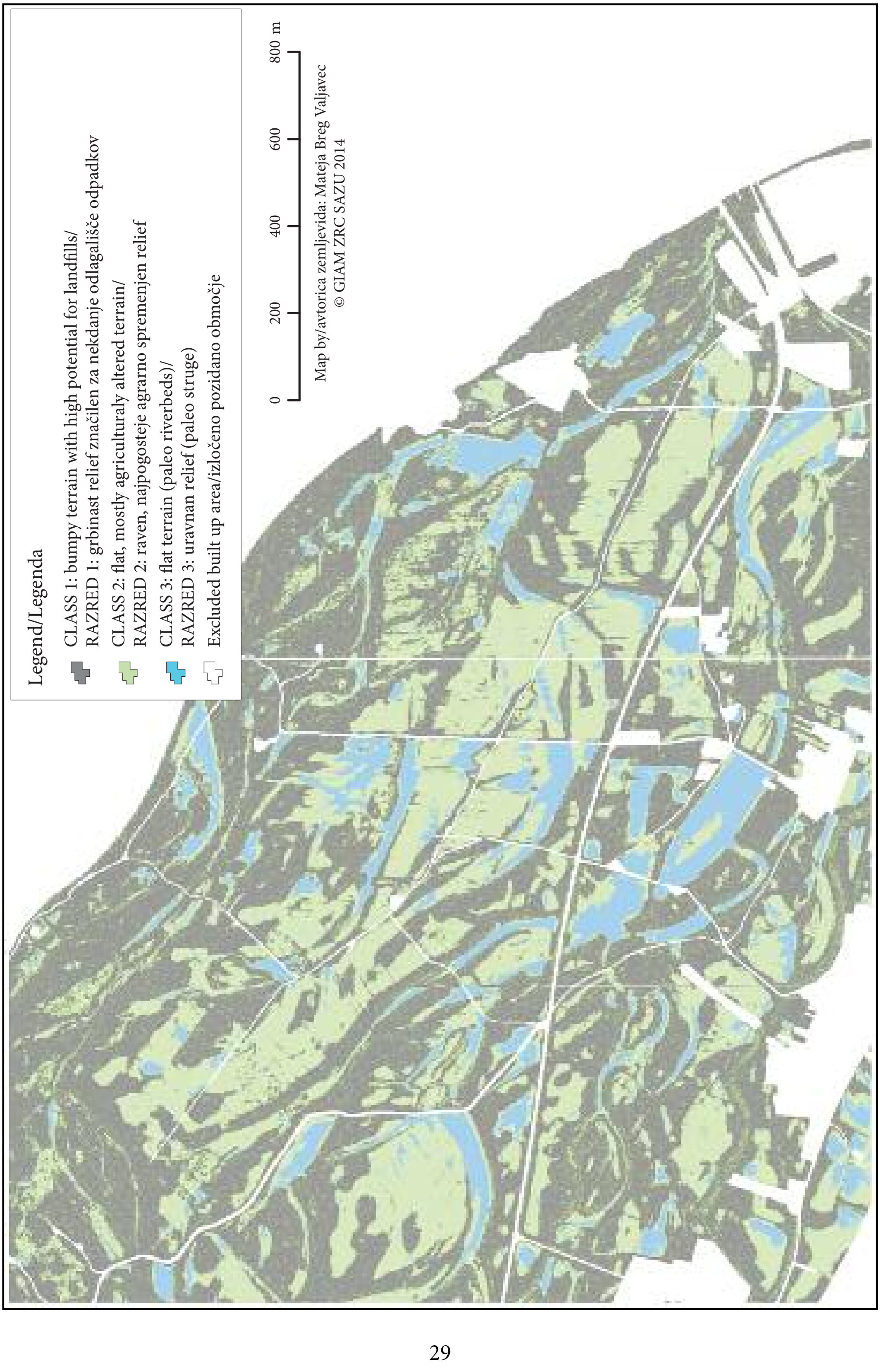
<table>
<tr><th>Layer number</th><th>Layer name</th><th>Cell value</th><th>Cell value</th><th>Layer 1+2</th></tr>
<tr><td>Layer 1</td><td>Index of convergence / divergence</td><td>0 (areas of converging, draining)</td><td>1 (areas of divergence)</td><td rowspan="3">CLASS 2
1 (flat but anthropogenously altered terrain)</td></tr>
<tr><td>Layer 2</td><td>multiresolution index of valley bottom flatness</td><td>0 (flat areas)</td><td>1 (bumpy, wavy terrain)</td></tr>
<tr><td colspan="2">Layer 1+2</td><td>CLASS 3
0 (paleo riverbed)</td><td>CLASS 1
2 (bumpy terrain)</td></tr>
</table>

Figure 4: Spatial distribution of anthropogenic landforms which were recognized and classified by visual analysis of LiDAR terrain on study area Ljubljana plain. ➤ p. 28

Figure 5: Geomorphometric classification of alluvial terrain. ➤ p. 29

Figure 6: Comparison of two terrain methods (visualisation and geomorphometric analysis) and further improvements of results with geo-historical analysis (Breg Valjavec, Gostinčar and Smrekar 2011). ➤ p. 30


Legend/Legenda
The type of anthropogenic landform/vrsta antropogene oblike
Convex/izbočena (No/Št. 5)
Bumpy slightly convex/grbinasta rahlo izbočena (No/Št. 24)
Bumpy slightly concave/grbinasta rahlo vbočena (No/Št. 17)
Concave/vbočena (No/Št. 20)
0
200
400 m
Map by/avtorica zemljevida:
Mateja Breg Valjavec
©GIAM ZRC SAZU 2014
LJUBLJANA PLAIN /
LJUBLJANSKO POLJE
Study
area
SLOVENIA/SLOVENIJA


Legend/Legenda
CLASS 1: bumpy terrain with high potential for landfills/
RAZRED 1: grbinast relief značilen za nekdanje odlagališče odpadkov
CLASS 2: flat, mostly agriculturaly altered terrain/
RAZRED 2: raven, najpogosteje agrarno spremenjen relief
CLASS 3: flat terrain (paleo riverbeds)/
RAZRED 3: uravnan relief (paleo struge)
Excluded built up area/izločeno pozidano območje
0
200
400
600
800 m
Map by/avtorica zemljevida: Mateja Breg Valjavec
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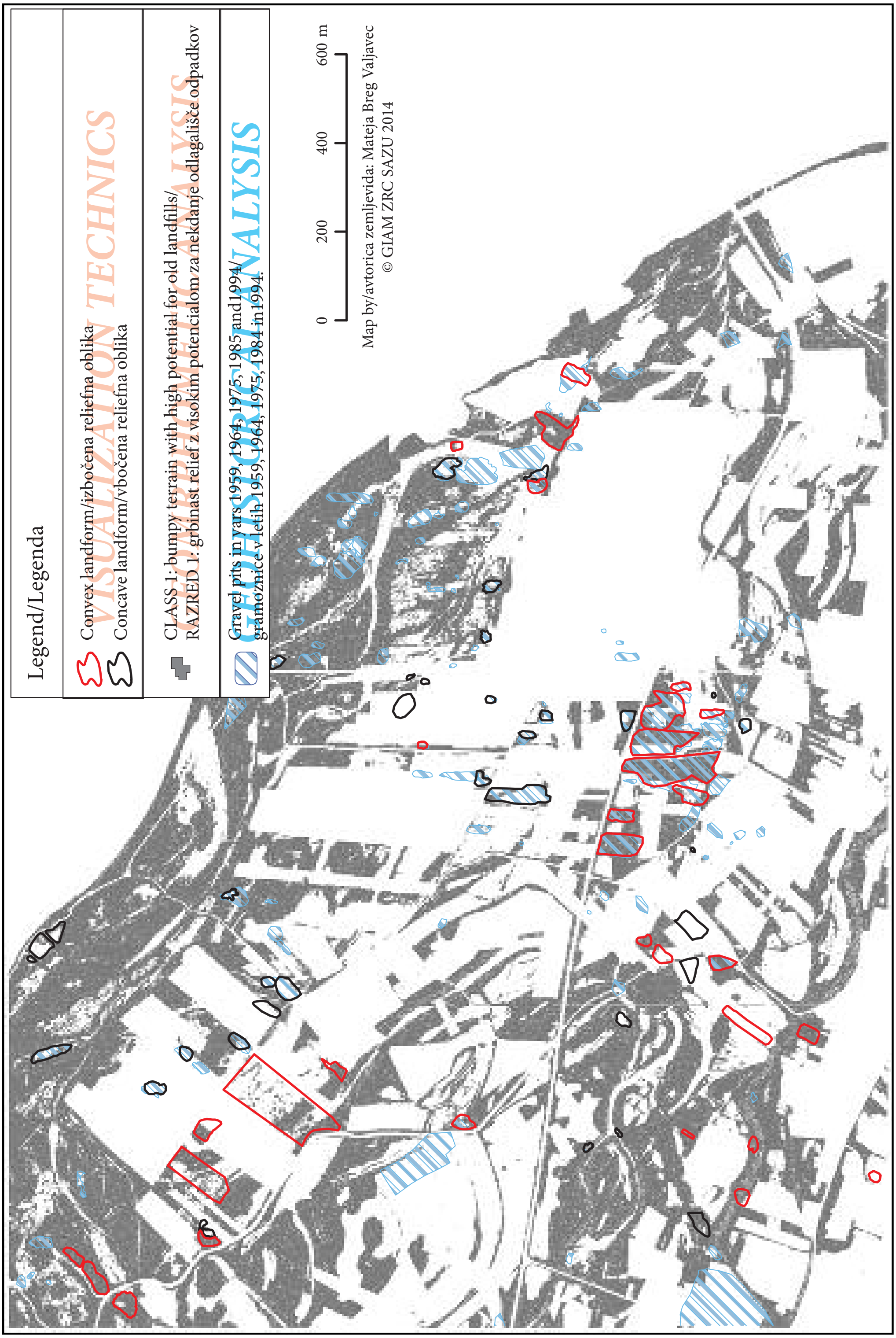
Legend/Legenda
Convex landform/izbočena reliefna oblika
Concave landform/vbočena reliefna oblika
CLASS 1: bumpy terrain with high potential for old landfills/
RAZRED 1: grbinast relief z visokim potencialom za nekdanje odlagališče odpadkov
Gravel pits in yars 1959, 1964, 1975, 1985 and 1994/
gramoznice v letih 1959, 1964, 1975, 1984 in 1994.
VISUALIZATION TECHNICS
0
200
400
600 m
Map by/avtorica zemljevida: Mateja Breg Valjavec
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flattened one (wavy, bumpy) with a **multiresolution index of valley bottom flatness** (MrVBF module in SAGA software) intended for charting the sedimentation areas (in this case paleo riverbeds). The MrVBF algorithm (Gallant and Dowling 2003) works on raster DTMs. The Valley Flatness (VF) at a single scale is calculated as a function of (1) the local topographic position of a cell within a moving window and (2) the slope of a 3 × 3 cell window. A cell is part of a flat valley when it is locally low and has a low slope. Fuzzy VF values for multiple resolutions are calculated by resampling the DEM to increasingly coarse solutions and then repeating the procedure (Gallant in Dowling, 2003). Using the two described geomorphometric indexes (Layer 1, Layer 2) the alluvial terrain of study area was classified in to three classes (Table 1 and Figure 5). Class 3 is representing paleo riverbeds (completely flat areas) the areas inside Class 2 correspond to agriculturally altered areas that express flat terrain, similar to natural characteristics while Class 1 corresponds to areas of bumpy wavy terrain or terrain of landfills. The areas in Class 1 were named **areas with a high terrain potential for landfills**.

6 Disscusion and conclusions

By overlapping results from visual analysis (from Figure 4) with results of geomorphometric analysis (from Figure 5) 26 of 46 visually detected potential landfills are matching with the CLASS 1(the areas of high terrain potential for landfill, grey polylines in Figure 6). These 26 objects can be relatively surely characterized as landfills (red polygons). To improve the reliability of results, obtained from LiDAR analysis, we compared them (Figure 6) with geo-historical data on known locations of old gravel pits (Breg Valjavec, Gostinčar and Smrekar 2011). On the study area 30 gravel pits in different stage of excavation / degradation were registered from archive aerial photographs from years 1959, 1964, 1975, 1985 and 1994. Finally, only 8 locations were recognized with all three methods as the landfills.

Huge quantity and density data, which is obtained by LiDAR, is still the best managed and presented by visualization technics (Kalawsky 2009 in: Mlekuž 2010). Visualization technics are useful also at the local scale by studying smaller areas of flat landscapes. There are undoubtedly many options for determining landfills with the geomorphometric analysis of very precise LiDAR data in the future. The success in detection of landfills with geomorphometric analysis depends very much on the type of landfills, their micro-terrain characteristics and land use type above buried waste. The applied geomorphometric analysis is the suitable way for detection of convex and slightly convex bumpy objects that are potential landfills. On Figure 6 are represented as red polylines overlapping grey and grey-blue dashed areas. Concave and slightly concave landforms (on Figure 6 are represented as black polylines overlapping white areas) are converging areas representing either concave anthropogenic landforms (partially filled gravel pits, preserved gravel pits) or concave natural landforms and must be additionally studied with field survey in order to detect buried waste.

The method enables the best results on areas of agrarian land use (fields, intensive meadows) as well on open surfaces with no significant higher vegetation cover (no tress). In contrary, the methodology is almost not applicable for overgrowing areas inside agrarian land use and in forest as they express similar micro-terrain characteristics as waste pits. In order to improve results and to distinguish between natural and anthropogenic terrain in those land use types it is needed to study the vegetation cover (tree density and height). In addition some analysis of the ortho-photo images (i.e., infrared band) in combination with LiDAR vegetation layer can be performed. Regarding the field work on known landfills (Breg Valjavec 2012) we can assume that if the trees are tall and dense, it means they flourish on a stable natural rock foundation and natural soils that enable a stable growth to higher plants. Lower trees of bush growth inside forest may flourish on the areas of filled gravel pits, as the anthropogenic soils (deposols) and the inhomogeneous original foundation (waste) does not guarantee a static stability to the tall trees (e.g. English oak).

With future research the applied methodology should be improved in the framework of existing geomorphometric methods using GIS terrain modeling and additional data layers (land use data and near-infrared aerial photographs) as well as with more object oriented geomorphometric analysis. The presented geomorphometric analysis individually enables only detection of broader areas having terrain characteristics similar to landfills but not exactly the individual landfills object. Regarding the geomorphological backgrounds, on which the object oriented concept is based, the methodology could be applied in studying landfills in similar alluvial plains along rivers and can be put into the context of paleo riverbeds on floodplains.

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Odkrivanje prikritih odlagališč odpadkov v prodni ravnini z geomorfometrično analizo in LiDAR DMR

DOI: http://dx.doi.org/10.3986/AGS54106
UDK: 911.2:551.43(497.451Lj. polje)
551.43:628.472.3(497.451Lj. polje)
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COBISS: 1.01

IZVLEČEK: V članku predstavljamo geomorfološki pristop za odkrivanje nekdanjih odlagališč odpadkov v prodni ravnini na primeru Ljubljanskega polja. Večina nekdanjih odlagališč odpadkov je skritih v vbočenih reliefnih oblikah: starih neaktivnih gramoznicah ali starih rečnih strugah (paleo struge). Z vizualno interpretacijo reliefa smo najprej določili antropogene reliefne oblike, ki so nastale zaradi izkopavanja proda in reliefne oblike, ki se izoblikujejo z odlaganjem odpadkov v kotanje. Uporabili smo LiDAR DMR, ki smo ga prikazali s pomočjo analitičnega senčenja in hipsometrične barvne lestvice. Ugotovili smo, da je zaradi posedanja heterogenih odpadkov, relief nekdanjih odlagališč v kotanjah, ki niso bila strokovno sanirana, grbinast in zato neznačilen za linijsko oblikovan fluvialni relief prodne ravnine. Na podlagi teh ugotovitev vizualne analize, smo s pomočjo dveh geomorfometričnih indeksov (konvergenčni indeks in indeks ploskosti) fluvialni relief prodne ravnine ločili v tri razrede: (1) grbinasti relief, značilen za potencialna prikrita odlagališča, (2) ravni relief značilen za dna starih strug ter (3) »agrarni« relief, značilen za intenzivno obdelana kmetijska zemljišča. S primerjavo rezultatov obeh metod smo 26 od 46 antropogenih reliefnih oblik, ki smo jih določili z vizualno analizo, potrdili tudi z geomorfometrično analizo. Le 8 od teh 26 objektov pa se ujema tudi z nekdanjimi gramoznicami, določenimi na arhivskih aeroposnetkih.

KLJUČNE BESEDE: uporabna geografija, odlagališče odpadkov, gramoznica, stara struga, vizualna interpretacija, tekstura, geomorfometrija, LiDAR, DMR, Ljubljansko polje.

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1 Uvod

Glavna raziskovalna tema so **nekdanja odlagališča odpadkov v kotanjah** Ljubljanskega polja. To so podzemni objekti, za katere je značilna nepoznana in heterogena struktura starih odpadkov, s katerimi so zapolnjene vbočene reliefne oblike. Rezultati predhodnih domačih študij (Bricelj 1988; Šebenik 1994; Kušar 2001; Breg in Urbanc 2005, Breg s sodelavci 2007; Smrekar 2007 itd.) in primerljivih mednarodnih študij (Silvestri in Omri 2008) dokazujejo, da je bilo odlaganje odpadkov v preteklosti vezano večinoma na naravne (stare struge, vrtače) in antropogene kotanje (gramoznice). Skladno s tem bomo v raziskavi predstavili reliefne značilnosti z odpadki zapolnjenih kotanj (gramoznice in stare struge) ter možnosti za določanje le-teh na podlagi geomorfoloških značilnosti.

Glavni cilj raziskave je daljinsko zaznavanje nekdanjih odlagališč odpadkov, skritih pod površjem, s pomočjo analize LiDAR podatkov, ki temelji na geomorfoloških metodah in poznavanju geomorfologije obrečne prodne pokrajine. Kljub izjemni natančnosti in uporabnosti LiDAR podatkov pa lahko na LiDAR DMR določamo samo podzemna odlagališča, katerih posledice so vidne na zemeljskem površju in zato na DMR. To velja za odlagališča, ki niso bila prekrita (sanirana) z ustrezno debelo plastjo rodovitne zemljine, ki bi omogočala intenzivno kmetijsko obdelavo. Na tovrstnih odlagališčih zato ni prisotna intenzivna kmetijska raba tal ampak trajni travniki in zaraščanje, kar se odraža v **mikro-reliefu** oziroma teksturi prikazanega reliefa.

V preteklih študijah so poskušali zaznavati podzemna odlagališča z uporabo različnih tehnik daljinskega zaznavanja predvsem z uporabo več-spektralnih satelitskih posnetkov. Poudarek je bil na zaznavanju degradiranih tal, s poudarkom na degradiranem rastlinstvu in prsti. Podrobnejši pregled daljinskega zaznavanja različnih tipov odlagališč odpadkov je na voljo v člankih Silvestrija in Omrija (2008) ter Sloneckerja s sodelavci (2010). Bistveno manj raziskav je bilo narejenih z vidika preučevanja reliefnih posledic, ki nastanejo zaradi odlaganja odpadkov. V ta namen so bili uporabljeni satelitski posnetki različnih prostorskih in spektralnih ločljivosti (Landsat TM, Landsat ETM, Quickbird, Ikonos, GeoEye1), kjer so z vizualno analizo določali geomorfološke spremembe, kot je dinamika prestavljanja rečnih strug, spreminjanje morske obale, meandrov in rekonstrukcija starih rečnih strug (Ghanavati s sodelavci 2008). Podobnikar s sodelavci (2008) ugotavlja, da analiza DMR s 25 m ločljivostjo celice omogoča tudi preučevanje večjih geomorfoloških sprememb, ki jih je povzročil človek: cestni nasipi, prometna, infrastruktura, zasute vrtače, aktivne gramoznice. Poseben pristop določanja antropogenih reliefnih sprememb je tudi določanje volumetričnih sprememb reliefa, ki jih kvantitativno določamo z iskanjem razlik med DMR-ji istega območja iz različnih obdobij. S fotogrametrično metodo stereo-izvrednotenja arhivskih aeroposnetkov lahko prikažemo relief v nekdanji pokrajini. Relief nekdanje pokrajine primerjamo z reliefom današnje pokrajine in na tak način določimo višinske razlike in na primer zasute kotanje. Tovrsten način je bil uporabljen za določanje zasutih vrtač na Logaškem polju (Breg Valjavec 2010) ter v primeru površinskega kopa rudnika Bilina (Slovaška), kjer so na podoben način z volumetrično analizo določili količino izkopane rudnine v določenem obdobju (Pacina in Weiss 2011).

Ker so odlagališča, ki zapolnjujejo gramoznice, številna in po aluvialni pokrajini zelo razpršena, je geomorfometrična analiza reliefa prikritih odlagališč usmerjena v reliefne značilnosti manjših lokalnih območij. Z dostopnostjo visoko ločljivih LiDAR podatkov, razvojem digitalnih geomorfometričnih metod in posebne programske opreme je postalo možno tudi odkrivanje prikritih odlagališč z razpoznavanjem (mikro) reliefnih posledic. DMR, ki je izdelan iz laserskega oblaka točk, omogoča določanje najmanjših razlik v topografiji (od nekaj centimetrov do nekaj deset centimetrov), ki so posledica geomorfoloških ali antropogenih procesov. LiDAR omogoča opazovanje sledov človeškega delovanja iz različnih časovnih obdobij (plasti pokrajine), z njim razpoznavamo brazgotine in prstne odtise naravnih in antropogenih procesov na površini Zemlje (Komac 2009; Mlekuž 2010) ter odkrivamo teksturo »brazgotin«, ki so bile ustvarjene v naravnem reliefu zaradi podzemnega odlaganja odpadkov.

2 Preučevano območje

Ljubljansko polje je tektonska udorina zapolnjena predvsem s prodnimi in peščenimi sedimenti. V fluvialnem reliefu ob reki Savi so izoblikovane številne terase, višja pleistocenska in nižje holocenske (Radinja 1951; Šifrer 1969). S prestavljanjem rečnega toka iz starih v novo nastajajoče struge so predvsem na holocenskih terasah ohranjene stare opuščene struge. V pokrajini jih lahko opazujemo kot podolgovate rahlo vbočene reliefne oblike, še posebej v nižjih holocenskih terasah.

Študijsko območje (slika 4) predstavlja obmestno območje na severnem robu mesta Ljubljane s prevladujočo kmetijsko rabo tal (travniki in njive), ki prehaja v mlado gozdno vegetacijo na prodiščih ob reki Savi. Območje je v neposredni bližini mesta, zato je zanj značilno, da je pod vplivom nezakonitega odlaganja odpadkov (Breg in Urbanc 2005). Zaradi prodnatih sedimentov, je Ljubljansko polje že od nekdaj zanimivo za pridobivanje gramoza, zlasti v bližini reke Save. Mnoge srednje velike gramoznice (od 1000 do 5000 m^2), so bile v preteklosti delno ali v celoti zapolnjene z odpadki in so se spremenile v »odpadkovnice« (Breg in Urbanc 2009).

3 Metodologija in LiDAR podatki

S preučevanjem osnovnih geomorfoloških značilnosti naravnega reliefa prodne ravnine in določanjem značilnosti antropogenih reliefnih oblik smo postavili geomorfološki pristop za odkrivanje podzemno odloženih odpadkov in s tem nekdanjih odlagališč odpadkov. Uporabljen geomorfološki pristop, vključuje dva načina iskanja in preučevanja podzemnih odlagališč na DMR: (1) **vizualna interpretacija reliefa** in (2) **geomorfometrična analiza**. Pri tem smo upoštevali dejstvo, da z uporabo in primerjavo več metod dosežemo večjo stopnjo natančnosti določitve reliefne oblike (Ciglič in Gostinčar 2011). Numerična, v tem primeru geomorfometrična analiza, kot tudi vizualna analiza DMR omogočata določanje naravnih reliefnih oblik in tudi antropogenih reliefnih oblik (Podobnikar in Možina 2008). Lokacije in reliefne značilnosti z odpadki zapolnjenih kotanj smo najprej določili z metodami vizualne interpretacije reliefa v nadaljevanju pa z geomorfometrično analizo in klasifikacijo fluvialnega reliefa. Uporabili smo LiDAR DMR (Lidar 2008 © GEOIN) izdelan na podlagi laserskega skeniranja površja z dne 8. in 14. februarja 2008. Snemanje je potekalo z Optech Gemini LiDAR senzorjem. Primarna obdelava podatkov je bila opravljena z Dashmap 5.3 in programsko opremo PosPac 4.4. Za klasifikacijo in obdelavo podatkov je bil uporabljen programski paket Terra Solid in Microstation (Geoin 2011). Izmed štirih razredov klasificiranega oblaka točk, smo uporabili sloj relief, ki smo ga s predhodnimi obdelavami zgladili. Iz analize so bila izključena pozidana območja, ker na njih ni možno določati nekdanjih odlagališč.

4 Vizualna interpretacija in značilnosti antropogenega reliefa odlagališč

Reliefne anomalije, ki so predvidoma antropogenega nastanka, smo določali na LiDAR DMR, ki smo ga prikazali z različnimi tehnikami vizualizacije. Ne glede na širok spekter uporabe DMR, je prva stopnja njegove uporabe nazoren prikaz oziroma vizualizacija numeričnih podatkov o nadmorskih višinah. Kljub mnogim opisom naprednih prikazov reliefa, ostaja analitično senčenje ena najpogostejših metod (Zakšek s sodelavci 2010). Analitično senčenje (Slika 2 in 3) pomeni le računalniško podprto izdelavo senčenega reliefa iz DMR. Kot standard se je uveljavila metoda, ki jo je razvil Yoëli (1965) in pri kateri je vrednost sivine sorazmerna kosinusu vpadnega kota žarka neposredne osvetlitve reliefa. Gre za kot med smerjo proti viru svetlobe in pravokotnico na ploskev reliefa. Tako so območja pravokotna glede na žarek iz navideznega svetlobnega vira bela, območja z vpadnim kotom osvetlitve 90° ali več, pa so v popolni senci in so črna, medtem ko so območja z vpadnim kotom med 0° in 90° prikazana z ustreznim sivim ali drugim barvnim tonom (Zakšek s sodelavci 2010). Hipsometrija (Slika 1) je vizualizacijska tehnika, kjer prikažemo vrednosti DMR s hipsometrično barvno lestvico. Z raztezanjem ali krčenjem histograma slike prilagodimo prikaz potrebam analize. V našem primeru je to izpostavljanje manjših reliefnih oblik oziroma značilnosti mikro-reliefa. Obe vizualizacijski tehniki, analitično senčenje in hipsometrija, smo uporabili na manjših izsekih podatkov LiDAR (velikost 750 m × 500 m) s čimer smo zmanjšali interval med najnižjo in najvišjo vrednostjo slike (nadmorsko višino) ter dosegli boljši barvni kontrast v prikazu reliefa ravnine in izrazitejšo osenčenje mikro-oblik (Slika 1, levo). S takšno metodologijo prikaza DMR smo zelo natančno rekonstruirali potek starih strug v agrarni pokrajini. Določili smo značilnosti fluvialnega reliefa prodne ravnine (suhe struge) in geomorfološko izoblikovanost območij z odpadki zapolnjenih kotanj. Za nadaljnjo geomorfometrično analizo je bistvena značilnost starih strug. Imajo obsežno longitudinalno ravno dno (naklon pod 0,5°) in hiter porast naklona v brežinah, kar omogoča tudi natančno geomorfometrično opredelitev starih rečnih strug. Z vizualno interpretacijo smo odkrili izbočene anomalije v strugah, ki so posledica antropogenih aktivnosti in s tem potencialna odlagališča odpadkov. Prekinitve strug se pojavijo lokalno, kjer na določenem odseku strugo prekine izbočena oblika (kup odpadkov), struga pa se po prekinitvi nadaljuje (Slika 1). Kakovost vizualne interpretacije izbočenih antropogenih reliefnih oblik znotraj starih strug na LiDAR DMR je odvisna od velikosti vizualiziranega območja DMR. Na levi sliki je povečan pogled iz DMR velikosti 750 × 500 m in na desni sliki povečan pogled v DMR celotnega območja.

Slika 1: Rekonstruiranje starih strug z vizualno analizo na različno velikih izsekih DMR in reliefne anomalije v strugi.
Glej angleški del prispevka.

Z odpadki zasute gramoznice v fluvialnem reliefu ravnine ne izstopajo izrazito, saj so bile z zasutjem izravnane z okoliškim reliefom. Ker so odpadki zelo heterogeni, razpadajo z različno intenzivnostjo in se tudi različno posedajo. Grbinast relief, ki se v desetletjih oblikuje nad odpadki, se razlikuje od fluvialnega reliefa v prodnati okolici (slika 2). Že latinsko ime (lat. *Fluvio* pomeni reko) pove, da so fluvialne reliefne oblike nastale zaradi toka vode. Širše gledano oblikuje fluvialni relief celotna hidrografska mreža, kjer se laminarni tokovi združujejo v linearnega in na koncu v reko. Naravne fluvialne oblike so, zaradi takšnega delovanja vode, linearnih oblik (dolina, grapa, soteska, erozijski jarek, sleme), medtem ko so grbinaste reliefne oblike, značilne za z odpadki zapolnjene gramoznice, nelinearne. Najbolje jih zaznamo z vizualno interpretacijo senčenega reliefa (Slika 2). Naravni fluvialni relief preučevane pokrajine je močno preoblikovan predvsem zaradi tradicionalne in intenzivne kmetijske rabe tal. Na visoko-ločljivih LiDAR DMR-jih lahko učinke različne rabe tal zaznamo in omogočajo klasifikacijo različnih tipov rabe tal. V primeru z odpadki zapolnjenih kotanj imajo pomembno vlogo različno posedajoči se odpadki, ki predstavljajo antropogeno matično podlago.

Na podlagi vizualne analize reliefa ugotavljamo tudi, da pri izoblikovanju mikro-reliefnih oblik v povsem ravnem fluvialnem reliefu pogosto prevzamejo vodilno vlogo (pre)oblikovanja reliefa pokrajinske prvine kot je matična podlaga (tudi antropogena na primer odpadki), prst (globina prsti), rastlinstvo (drevesne korenine), živalstvo (delovanje krta) in navsezadnje človek (oranje). Skladno s tem smo odlagališčem podoben grbinast relief odkrili tudi v tipih rabe tal, kjer ni antropogenih vplivov:

- grbinast mikro-relief relief na pogozdenih prodiščih ob Savi, ki se izoblikuje zaradi delovanja korenin in zardi plitve rendzine;
- grbinast mikro-relief je značilen za opuščene kmetijske površine, znotraj intenzivnih kmetijskih zemljišč in je omejen na manjše pasove (na primer mejice) ali parcele;
- grbinast mikro-relief na pašniku ali trajnem travniku, kjer so prisotna drevesa (zeleni obroč na Sliki 3).

Dokončno razločevanje med opisanimi naravnimi grbinastimi mikro-reliefnimi oblikami ter antropogenimi grbinastimi oblikami, ki nastanejo na z odpadki zapolnjenih kotanjah, je možno z geo-historično analizo in določitvijo gramoznic v preteklosti (analiza arhivskih letalskih posnetkov), rekonstrukcijo starih strug in terenskim vzorčenjem (npr, prsti).

Slika 2: Relief z odpadki zapolnjene in samo zatravljene gramoznice je najpogosteje rahlo grbinast. Relief okoliških njiv pa je spremenjen zaradi oranja in rahljanja prsti.
Glej angleški del prispevka.

Slika 3: Izoblikovanost površja na trajnem travniku (območje omejeno z zeleno) je zelo podobno izoblikovanosti površja na z odpadki zapolnjeni zatravljeni gramoznici (glej sliko 2).
Glej angleški del prispevka.

Na vzorčnem območju (velikem 5 km^2) smo z vizualno analizo DMR določili 67 antropogenih reliefnih oblik, ki se navezujejo na izkopavanje gramoza (gramoznice) in odlaganje odpadkov (Slika 4). Antropogene reliefne oblike smo razdelili v štiri skupine glede na vbočenost / izbočenost ter razgibanost reliefa (grbinast relief) (Slika 4):

1. **Izbočene reliefne oblike**, so potencialna odlagališča odpadkov, ki so nastala v prenapolnjeni gramoznici oziroma predstavljajo kup odpadkov dvignjen nad raven okoliškega površja.
2. **Grbinaste reliefne oblike** (potencialna odlagališča):

2A. grbinast (rahlo) izbočen mikro-relief,
2B. grbinast (rahlo) vbočen mikro-relief,

3. **Vbočene reliefne oblike** so domnevno opuščene gramoznice ali naravne stare struge;

Pri izbočenih (5), grbinastih rahlo izbočenih (24) in grbinastih rahlo vbočenih (17) oblikah reliefa je sum, da so nastale zaradi odlaganja odpadkov v kotanje, največji, zato so njihove značilnosti pomembne kot osnova za nadaljnjo geomorfometrično analizo. Skladno s tem je rezultat vizualne analize 46 potencialnih odlagališč odpadkov v kotanjah.

Slika 4: Prostorska razporeditev antropogenih reliefnih oblik, ki smo jih določili z vizualno analizo LiDAR DMR na preučevanem območju Ljubljanskega polja.
Glej angleški del prispevka.

5 Geomorfometrična analiza in rezultati

Geomorfometrija je veda, ki se ukvarja s kvantitativnim preučevanjem reliefa; njen cilj je pridobivanje reliefnih parametrov in reliefnih oblik na podlagi digitalnih modelov reliefa (Hengl in Reuter 2009, Hrvatin in Perko 2009). Sodobna geomorfometrija se razlikuje od klasične kvantitativne geomorfologije po tem, da temelji povsem na računalniški analizi reliefa (Hengl in Reuter 2009). Geomorfometrična analiza je druga stopnja naše raziskave, s katero želimo avtomatsko določiti območja, ki imajo reliefne značilnosti z odpadki zasutih kotanj.

Digitalni model reliefa lahko razdelimo v razrede z uporabo geomorfometričnih parametrov kot je naklon in ukrivljenost reliefa. Za natančnejšo klasifikacijo geomorfoloških oblik uporabimo dodatne parametre, kot je na primer akumulacija vodnega toka za določanje reliefnih oblik povezanih s fluvialnimi procesi (Anders s sodelavci 2009). Z izračunom **konvergenčnega indeksa reliefa** (*Index of convergence*) smo izločili uravnana konvergentna območja, saj niso značilna za že predstavljeni relief z odpadki zasutih kotanj pač pa označujejo naravne vbočene reliefne oblike (stare struge) in nezasute gramoznice. Modul je vgrajen v program SAGA in izračunava indeks površinskega stekanja / raztekanja vode. Po pomenu je podoben planarni ali horizontalni ukrivljenosti reliefa (*curvature*), a daje veliko boljše rezultate. Izračun temelji na celicah v okolici, t. j. preuči, do katere stopinje celice v okolici so usmerjene na sredinsko celico. Rezultat je predstavljen v odstotkih, kjer negativne vrednosti ustrezajo stekanju, pozitivne vrednosti pa odtekanju vodnega toka. Območja ravnega reliefa smo od neravnega (valovitega, grbastega) ločili z **indeksom ploskosti reliefa** (ang. *multiresolution index of valley bottom flateness – MrVBF*). Slednji se izračuna s samostojnim modulom v programu SAGA, namenjen pa je kartiranju sedimentacijskih območij (v našem primeru stare struge). Algoritem za izračun indeksa ploskosti (Gallant in Dowling, 2003) deluje, kot konvergenčni indeks, na rastrskih DMR. Ploskost doline (ang. *valley bottom flateness, VF*) je izračunana kot funkcija lokalne topografske lege v celici znotraj premikajoče se sence in pobočja v 3 × 3 oknu celice. Celica je del ravne doline, ki je lokalno ploska in ima nizko pobočje. Približne vrednosti za več ločljivosti so izračunane tako, da ponovno vzorčimo DMR na vedno bolj slabe ločljivosti in pri tem ponavljamo postopek. Indeks ploskosti je tako izmerjena kombinacija posameznih vrednosti VF, kjer so vrednosti VF, ki so manjše od 0,5, določene kot grebeni in so zato izločene (Gallant in Dowling 2003).

Na podlagi rezultatov opisanih geomorfometričnih indeksov (sloj 1, sloj 2) smo relief aluvialne ravnine razdelili v tri razrede (preglednica 1, slika 5). Razred 3 predstavlja relief značilen za dna starih suhih strug (povsem raven relief). V razred 2 spada antropogeno spremenjen raven agrarni relief, ki je posledica kmetijskega obdelovanja in je značilen za njive in intenzivne travnike. Za razred 1 je značilen grbinast, rahlo valovit relief, ki se pojavlja na odlagališčih odpadkov a tudi na povsem naravnih območjih kot je

Preglednica 1: Postopek združevanja rezultatov obeh geomorfometričnih indeksov.

sloj	ime sloja	vrednost celice	vrednost celice	Sloj 1+2
sloj 1	konvergenčni indeks	0 (območje stekanja vode – vbočen relief)	1 (območje raztekanja vode – izbočen relief)	
sloj 2	indeks ploskosti	0 (raven relief)	1 (neraven, grbinast relief)	**RAZRED 2** 1 (uravnan antropogeno spremenjen relief)
sloj 1+2		**RAZRED 3** 0 (stara struga)	**RAZRED 1** 2 (grbinast relief)	

gozd, trajni travnik in podobnih neintenzivnih tipih rabe tal, kot je bilo navedeno že tudi pri rezultatih vizualne analize v prejšnjem poglavju. Območja znotraj razreda 1 smo poimenovali **območja z visokim reliefnim potencialom za nekdanje odlagališče odpadkov**.

Slika 5: Geomorfometrična klasifikacija ravninskega reliefa.
Glej angleški del prispevka.

6 Razprava in sklepi

Na podlagi rezultatov ugotavljamo, da sta za določanje z odpadki zapolnjenih kotanj uporabni obe predstavljeni metodi vizualne interpretacije reliefa. Vendarle pa je za uspešno določanje popolnoma zasutih gramoznic primernejši prikaz DMR z analitičnim senčenjem reliefa, pri čemer je, zaradi majhnih reliefnih razlik med zasuto kotanjo in okolico, pomemben pokazatelj tekstura senčenega reliefa. Na senčenem reliefu smo odkrili grbinast relief zasutih kotanj, ki ga na nesenčenem reliefu težje zaznamo ali sploh ne zaznamo. Za določanje odlagališč v starih strugah je primernejši prikaz reliefa s hipsometrično barvno lestvico, saj so pokazatelj reliefne razlike, ki jih lahko zaznamo z vizualno interpretacijo.

Z združevanjem in prekrivanjem rezultatov vizualne (Slika 4) in geomorfometrične analize (Slika 5), ki so predstavljeni na Sliki 6, ugotavljamo, da se 26 od skupno 46 vizualno razpoznanih antropogenih reliefnih oblik, ki so potencialna odlagališča odpadkov, pokriva z območji visokega reliefnega potenciala za nekdanja odlagališča odpadkov (Razred 1). Te antropogene reliefne oblike lahko z veliko gotovostjo opredelimo kot potencialna odlagališča odpadkov. Za dodatno potrditev rezultatov LiDAR analize smo uporabili geohistorične podatke o starih gramoznicah (Breg Valjavec, Gostinčar in Smrekar 2011), kjer je prostorsko lociranih 30 gramoznic v različni stopnji izkopavanja gramoza v presečnih letih 1959, 1964, 1975, 1985 in 1994.

Slika 6: Primerjava rezultatov obeh metod (vizualne in geomorfometrične analize) in delna potrditev rezultatov z geohistoričnimi podatki o gramoznicah (Breg Valjavec, Gostinčar in Smrekar 2011).
Glej angleški del prispevka.

LiDAR podatki, ki so za računalniško modeliranje še vedno zelo zahtevni (količinsko obsežni), so še vedno najlažje obvladljivi z uporabo najrazličnejših vizualizacijskih tehnik (Kalawsky 2009 v: Mlekuž 2010). Slednje so uporabne tudi kadar preučujemo manjša ravninska območja. Nedvomno pa je veliko možnosti za odkrivanje nekdanjih odlagališč odpadkov tudi v sodobnih in prihodnjih geomorfometričnih analizah LiDAR reliefa. Uspeh pri odkrivanju odlagališč odpadkov z geomorfometrijo pa je najbolj odvisen od vrste odlagališča, njegovih reliefnih in mikro-reliefnih značilnosti ter rabe tal nad odloženimi odpadki. Opisana geomorfometrična analiza je uporabna za določanje izbočenih reliefnih oblik ter grbinastih (rahlo izbočenih) mikro-reliefnih oblik, ki so hkrati potencialna odlagališča odpadkov. Na Sliki 6 so slednja označena z rdeče obrobljenimi prozornimi poligoni, ki prekrivajo sivo in sivo-modro črtkano območje. Vbočene in grbinaste (rahlo vbočene) reliefne oblike (na sliki 6 označene z črno obrobljenimi belimi poligoni), ki so potencialno tudi odlagališča odpadkov, z opisano geomorfometrično analizo niso določljive. Predstavljajo bodisi opuščene gramoznice, delno zapolnjene gramoznice ali stare struge. Če želimo iz teh oblik izločiti potencialna odlagališča odpadkov, je potrebna dodatna geohistorična analiza in terensko delo.

Predstavljena geomorfometrična analiza omogoča najboljše rezultate v kmetijski pokrajini s prevladujočo kmetijsko rabo tal (njive, travniki) kakor tudi na odprtih površinah brez vidnejšega rastlinskega pokrova (brez dreves). Nasprotno pa je metodologija skoraj neuporabna na z drevesih poraslih območjih znotraj kmetijskih zemljišč in v gozdu saj imajo podobne mikro-reliefne značilnosti kot z odpadki zapolnjene gramoznice. Če želimo na teh območjih ločiti območja antropogenih grbinastih oblik, torej potencialna odlagališča, od naravnega grbinastega reliefa, je potrebna dopolnilna analiza rastlinskega pokrova oziroma analiza gostote in višine dreves. Uporabimo lahko letalske ali satelitske posnetke (npr. infrardeč sloj) v kombinaciji z LiDAR slojem vegetacije. Na podlagi rezultatov terenskega preučevanja rastlinstva na nekdanjih odlagališčih odpadkov (Breg Valjavec 2012) predpostavljamo, da visoka in gosto zasajena drevesa uspevajo na stabilni naravni matični podlagi in prsti, ki omogočata oporo visokoraslim rastlinam. Na površini odlagališč (npr. odlagališče v zapolnjeni gramoznici), ki so znotraj gozda pa so drevesa redkejša, nižja in grmovne rasti saj antropogena matična podlaga (nesprijeti, heterogeni odpadki) in antropogena prst (deposol) ne omogočata stabilne in kakovostne rasti gostim in visokim drevesom (npr. hrast dob).

S prihodnjimi raziskavami je potrebno metodologijo izboljšati v okviru obstoječih geomorfometričnih metod, GIS modeliranja reliefa, z vpeljavo dodatnih visoko-ločljivih podatkov (raba tal, satelitski posnetki) ter z bolj objektno usmerjeno geomorfometrično analizo. Samo z opisano geomorfometrično analizo, brez vizualne analize, lahko določamo samo širša območja, ki imajo reliefne značilnosti, ki so podobne reliefu z odpadki zasutih kotanj, ne pa natančne lege in oblike posameznega odlagališča v kotanji oziroma kotanje. Upoštevajoč geomorfološka izhodišča, na katerih temelji predstavljeni koncept odkrivanja prikritih, podzemnih odlagališč, je metodologija uporabna v preučevanju odlagališč v podobnih aluvialnih obrečnih ravninah (npr. prodnih, ilovnatih), kjer jih je možno postaviti v kontekst starih suhih strug na poplavnih ravnicah.

7 Literatura

Glej angleški del prispevka.

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SPATIAL AND SOCIAL CHANGES CAUSED BY THE CONTINUOUS EXPLOITATION OF LIGNITE IN THE KOLUBARA LIGNITE BASIN, SERBIA

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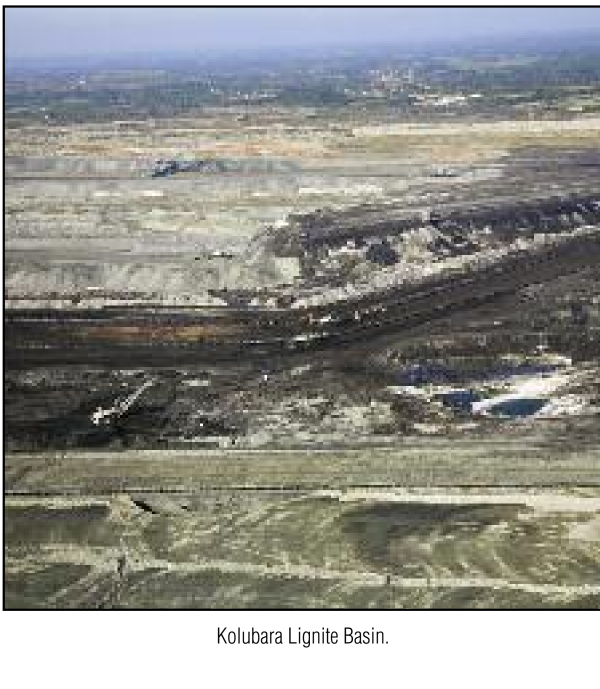

Kolubara Lignite Basin.

Spatial and social changes caused by the continuous exploitation of lignite in the Kolubara lignite basin, Serbia

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ABSTRACT: The Kolubara Lignite Basin in the Republic of Serbia is the most important source of this type of fossil energy. Available lignite reserves enable the production of electricity, so the priority, in this region, is its exploitation. This is the reason why all other characteristics of this region have undergone major changes. Since the lignite exploitation started, the land use and river courses have changed in the region, local communities have been moved out, the settlements, infrastructure and human activity have been altered. The whole landscape acquired a completely different image. The social aspect is a sensitive and delicate feature, but the regulation of the region is also significant. Local population in this region has faced a set of social, cultural and economic problems.

KEY WORDS: mining, space transformation, regional development, demographic changes, Serbia

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1 Introduction

The influence of mine basins on the environment can be observed through an identification and relativization of development conflicts and harmonization of different conflict interests in the organization and the utilization of the space. In general, almost all the changes which emerge as a result of the impact of mining on the environment are of spatial character. Spatial changes comprise of changes such as taking up huge areas of land for the development of pits, relocation of a watercourse and major traffic and other infrastructures and organization of new settlements for moving the population out of the mining area (Spasić et al. 2009). Spatial changes are also defined as degraded fields or land, woodland, geothermal water or other natural elements which have been modified by mining. Cultural potentials which can be modified by the mining include technological heritage, infrastructure, production facilities and housing (Marot and Harfst, 2012). During the process of claiming land for the purpose of surface exploitation, a conflict between of two important activities which are equally treated in most countries: the production of mineral raw materials and the production of food (Spasić et al. 2005).

Lignite represents, undoubtedly, the most significant energetic potential of the Republic of Serbia. In the Kolubara Basin, there are 20% of geological or exploitation reserves, and the degree of the activity of the deposits is 35%. The availability of the lignite reserves on a relatively small area such as the Kolubara Basin makes it possible to open big pits by keeping the right attitude towards the environment and respecting the principles of economic and rational production of energy. The Mining Basin »Kolubara« is the biggest producer of lignite in Serbia with 28–29 million tons a year, which represents 70% of all the coal produced in Serbia (The Spatial Plan … 2008). A significant factor of development on state, regional and town scope is industry, so a great attention should be paid to its location. Well developed areas with properly built infrastructure, abundance of work force and facilities for developers are preferable compared to less developed regions (Đukičin et al. 2011).

In Eastern Europe the move of post-communist countries to democracy and markets is unanimously described as »transition«. The theory of transition, therefore, is a natural starting point for understanding post-communist change (Nedović-Budić et el. 2011).

The process of industrialization and urbanization refers to the cities and their environments, and it is considered to be the most significant element in the transformation of the geographical environment. The changes in the geographical environment are reflected through the increase of population in the cities, workforce migrations in the direction village-city, transformations in the physiognomic features of cities and their surrounding settlements. The impact of the lignite exploitation on the geographical environment can be observed in the changes in functional structure in cities and their surroundings, as well as in demographic elements. Spatial changes also comprise a set of social changes (Smiljanić 2002).

This paper shows spatial and social changes in the Kolubara Lignite Basin which have been created as a result of lignite exploitation and accelerated development of the mentioned area. Due to these trends, the population of the area was exposed to numerous demographic, social and economic changes, which will be presented in the paper. A section of the paper presents the results of a questioning conducted among the population of the settlements situated in the Kolubara Basin.

The underlying conditions of lignite mining and utilisation are characterised in the main by the energy management and energy-policy situations and, in particular, the underlying conditions on site – ie in the vicinity of the lignite mines.

In Germany, lignite is the most important domestic and subsidy-free source of energy, which, with a share of about one quarter, constitutes a key cornerstone of the energy mix used for power generation (Kulik and Drijver 2012). If the German concept of joint resettlement, mine planning and mining engineering, water management, were applied in Kolubara Basin in any form, many social and demographic problems would be avoided. Romania also was faced with lignite exploitation and resettlement in Oltenia. So far, as a result of the lignite open cast opening and extension there were resettled 2200 households, 40 social and cultural constructions (Fodor 2010). Slovenia also has long experience about lignite exploitation in Velenje (Markič and Sachsenhofer 2010). Velenje region has interesting, preserved natural landscapes, which are suitable for a range of recreational activities and tourism development (Marot and Harfst 2012; Komac et al. 2011; Hose et al. 2011).

2 The research area

The area where exploitation of lignite is conducted in the Kolubara Basin lies 50 km to the south-west of Belgrade, which contributes to its favourable location. The most significant traffic route is the Kolubara River which vertically cuts across the area with the road of first degree and railway route Belgrade–Bar. Moreover, there are numerous smaller regional roads as well as a network of local roads (Todorović and Miletić 2007).

The main determinant factors in the success of a region are the fulfilment of the conditions for a good social and economic environment, while it is undoubtedly the case that a healthy environment favouring the growth and deployment of entrepreneurial skills develops more easily in settlements located nearer to larger centres (Ernits 2003). Environment in the Kolubara Basin is not healthy and there are many social and economic disparities. The industrial, mining and energy centres zones/belts and settlements in the proximity of traffic corridors and the major urban centres represent areas burdened by numerous environmental problems such as contaminated industrial land, degraded land in the zones of exploitation of mineral raw materials, polluted water and air, plus unsustainable waste management (Miljanović et al. 2010).

3 Spatial changes due to lignite exploitation

Major differences in well-being among territorial units at subnational level impede the progress of society and may cause economic, social, urban, environmental and political problems. Acknowledging of regional differences in well-being is of key importance for efficient planning and implementation of regional and spatial policy measures.The most significant conflict of mining industry with the environment in the Kolubara Basin refers to occupying agricultural and forest land in the process of surface exploitation. The occupation of land can be permanent or temporary during the exploitation, provided that recultivation brings it back to its original use (Spasić et al. 2005).

The exploitation area of the Kolubara Basin is a dynamic environment where land use changes because of the development of mining activity. According to certain dynamics, the front of mining activity moves, occupying new areas of settlements for the purpose of mining and organisation of traffic and infrastructural corridors, and parts of the pits, where exploitation is finished, are used as dump areas. Dump areas which are completely filled up are technically and biologically recultivated (Spasić et al. 2009).

Terrain inclination and the slope processes are the causes for the occurrence of the landslides and high-intensity soil erosion (Dragicevic et al. 2011; Dragićević et al. 2012).

During the opening of surface pits in the Kolubara Basin, the process of decreasing groundwater levels was conducted in close vicinity of pits, thus preventing the inflow of groundwater in the work area of the pit. The level of groundwater has decreased (Spasić et al. 2005).

Based on the Plan of General Regulation of the Settlement Vreoci, changes in land use in the central part of the Kolubara Basin up to 2020 will be most evident in the mining and agricultural sectors. In the eastern part of the Kolubara Basin, agricultural land will also expand but not as much as areas used for mining, since large-scale exploitations are planned. Spatial changes happening due to lignite exploitation in the Kolubara Basin, in addition to changes of land, land use and the groundwater levels, also cause changes in riverbeds.

In the Kolubara Basin, there have been major relocations of the Kolubara riverbed as well as regulations of its watercourse (Spasić et al. 2009). The first huge intervention in Kolubara river system happened in 1959, when the Kolubara's riverbed was diverted into its right tributary Pestan River. Those construction works were done for the purpose of lignite exploitation, which permanently influenced the entire process of fluvial erosion: stronger bank erosion resulted in larger amounts of sediment yield (Roksandic et al. 2011). The Kolubara river has been relocated further and regulated because of the opening of the pit »Tamnava – Istočno polje«. In the period 1975–1977, the relocation and regulation of the Kolubara was conducted within the opening of the surface pit »Tamnava – Istočno polje« and its protection from flooding. The performed protection activity of SP »Tamnava – Istočno polje« against floods from the Kolubara and its left tributaries, the river Vraničina and the brook Skobalj, consists of relocating the Kolubara riverbed in the area from the railway bridge Vreoci – Obrenovac (km 28 + 880) to the Vraničina estuary (km 37 + 380) and building protective embankments. Significant morphological changes on the Kolubara and Peštan

Figure 1: The position of the Kolubara Lignite Basin (Internet 1).

JASMINA ĐORĐEVIĆ

Figure 2: Kolubara D field.

happened in 1976. Moving the course of the Kolubara was aimed at widening the strip mining of lignite (Dragićević et al. 2007).

The River Peštan was regulated in its lower course, from the Kolubara estuary (km 0 + 000) to the railway bridge Belgrade – Bar (km 3 + 070) in 1981. In the regulated riverbed of the river Peštan, from the Kolubara estuary and the Ibar motorway, on the kilometre 1 + 065 a cascade was built to control vertical alignment and the completely regulated riverbed in the upstream direction (Dragićević et al. 2007).

4 Social changes in the Kolubara lignite basin

Relocating population from the exploitation area in the Kolubara Basin certainly represents the most significant and the most sensitive change occurring due to a radical development of the industry and economy. Based on numerous questioning (surveys were done by the authors) in this field of study, it has been concluded that the population experiences this relocation as an imposition and expresses deep dissatisfaction with it. Over half of the population had to change their profession after relocation, and a huge number of them were left jobless.

Changes in demography affect different aspects of both urban and rural areas. Sudden increases in the population may lead to a complete disorganisation of a city or even of a village (Pereira Dra et al. 2010). The exploitation of lignite in the Kolubara Basin started in 1896, and the first open pit mining started in 1952. The largest resettlements began in the last decade of the 20th century when 1614 households were relocated out of the zone of open pits development (Spasić et al. 2009). According to the Plan of General Regulation for the settlements of Vreoci, Zeoke, Medoševac and Burovo (2008) up to 2020, the most intensive relocations will be conducted in the settlements of Vreoci (1006 households), Zeoke (177 households), Medoševac (145 households) and Burovo (43 households) (Lukić and Matijević 2006).

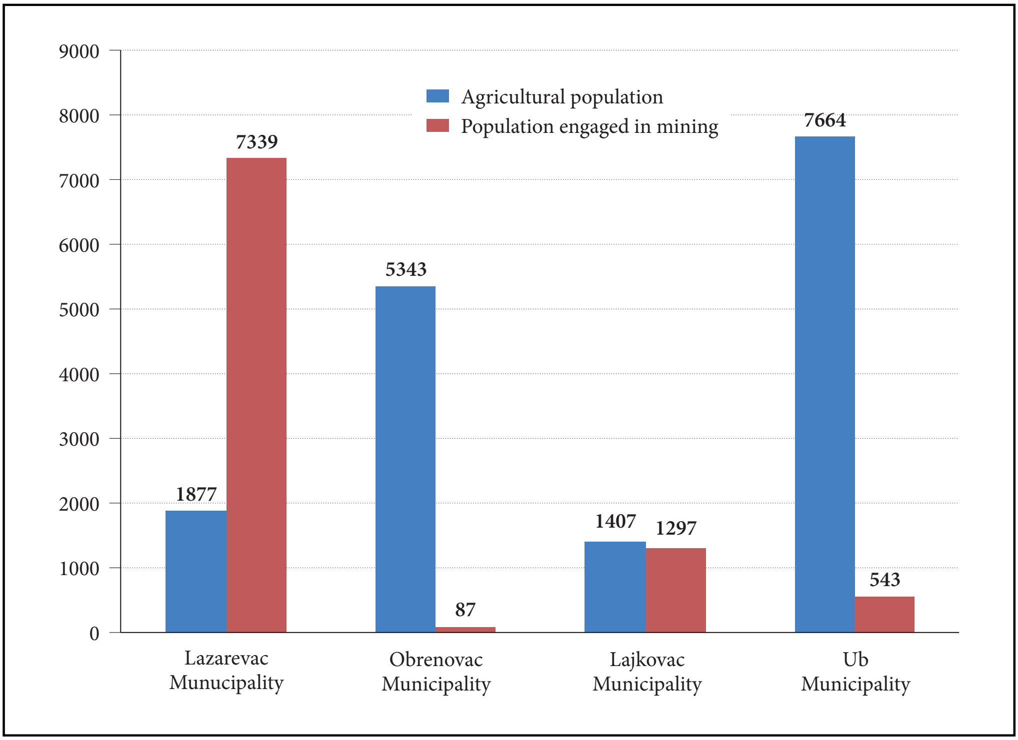

Figure 3: Agricultural population and population engaged in mining according to 2002 census (Republički zavod za statistiku … 2004).

Since the most intensive relocation of the population has been conducted and planned in the settlement of Vreoci in the municipality of Lazarevac, the phenomenon of relocation will be specially treated in the case study of this settlement which can be used as guidelines for all other settlements with similar plans.

The population of Vreoci has largely urban socio-economic features, with a relatively high level of activity for both genders, aging processes, etc. Most of the employees work in one of the facilities of the Mining Basin »Kolubara«. Relocations were conducted through the process of expropriation, most often through payments for the taken properties, and the households had to solve the problem of the new place of residence on their own. By 2015, 95% of population from Vreoci will be resettled, and 18% from settlement Šopić (The Plan of General … 2008).

Accelerated process of demographic aging of the population will cause further disappearance of single households, which will contribute to the fall in the total number of village households which are affected not only with this problem, but also with the problem of relocation (Lukić and Matijević 2006).

Twenty of respondents were interviewed at their homes. They were asked about their social and economic situation. Due to aging, relocation and negative population growth in the settlements of the Kolubara Basin, a series of demographic, social and economic problems are projected in the next periods. In the relocation of the population, the most affected are people without qualifications and those who are not ready enough to adjust to a new environment. During the research among the population for the purpose of this paper, they stated that they received large sums of money for the expropriated properties, but at the same time they lost the roof over their heads. In this manner, a great number of people without adequate qualifications are threatened to become social cases. In addition to demographic problems in the process of intensive exploitation, there are key changes in the network of settlements. Disturbing the functional organisation of settlements and traditionally formed village communities is a special problem which, in spite of material and other reimbursements, can be resolved only by the change in generations (Spasić et al. 2007).

Finding locations for new settlements represents a very complex process, regarding the fact that the relocation of settlements is accompanied by problems related to: redistribution of functions among settlements, resulting in the transformation of the network of settlements; limited possibilities of resettlement of the mining basin after the completed exploitation, resulting in an uninhabited area; the stability of the landfills after the completion of mining works; the fact that the population does not want to be relocated to remote locations, which represents a problem because in large lignite basins, the pits are usually developed continually along a huge territory; and the principles of rationality which impose relocation of the population within the existing settlements. This decreases investment in settlement organisation and the construction of buildings with public functions, but there is also a problem of accepting new population by the domestic population, i. e. the adaptation of the new population (Spasić et al. 2009).

5 Conclusion

Modern human activity often influences the change of the space. Most often these changes are stressful for the spatial and social elements. In addition to planned projects and activities, it is not rare to have some failures. Exploitation in the Kolubara Lignite Basin is on the list of priorities because of its significance. This attitude of responsible institutions in Serbia causes permanent and radical changes in the area. A question is often asked if it is good to transform an area so that its land use and river courses are drastically changed, population relocated? What are the effects of these endeavours and what is the future for such an area?

Due to lignite exploitation, settlements were relocated, and the population faced numerous social and economic problems. The Republic of Serbia is the country which has not overcome the transition yet and which still does not have economic and other instruments to help it handle conflict situations like the one in the Kolubara Basin in the right way. The need for energy products exploitation is understandable, but, at the same time, relocation of the population and settlements should not be dealt with so easily. Due to one activity in an area, other activities should not be neglected. All activities should be conducted according to a plan, with good calculations and with the least number of negative effects. The Kolubara Basin is not the best example of these activities. In these activities Serbia should follow the example of well organised lignite exploitation country like Germany (Kulik and Drijver 2012).

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POPULATION GROWTH IN THE BORDER VILLAGES OF SREM, SERBIA

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BOJAN ĐERČAN

Children in the village Bikić Do.

Population Growth in the Border Villages of Srem, Serbia

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ABSTRACT: Population growth in the border villages of Srem (Vojvodina, Serbia) has been analysed in this paper, with the goal of explaining how and why it differed from other areas in the region. Special attention has been paid to the 1990s, because these villages became part of a border region and a high level of migration on the territory of the former Yugoslavia occurred, much of it through this territory. The results of the research are derived from literary resources and applying mathematical and statistical procedures in the processing of data received from the Statistical Office of the Republic of Serbia. They were checked on the field via a questionnaire. This paper is significant because it enriches knowledge about villages of Srem, the municipality of Šid and population trends at the end of the 20th century.

KEY WORDS: Serbia, Srem, Municipality of Šid, population growth, immigration, border rural settlements, ethnic composition

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1 Introduction

With the collapse of Yugoslavia at the beginning of the 1990s, new borders were established, and consequently border villages. Literary sources (Penev 1994; Kovačević 2006; Kovačević et al. 2009; Ivkov-Džigurski et al. 2010) mention problems of the new border villages in Serbia. Among them in particular are demographic problems, such as depopulation, emigration, the ageing of the populace etc. (Vujadinović et al. 2010). These problems also appear in other parts of Europe, according to other sources (Machold et al. 2002; Ni Laoire 2000; Stockdale 2002, 2006).

This research on the population trends in the border villages of Srem had as its goal the determination of the parameters of the population movement and thereby illustrating to what extent drawing the border had in demographic sense positive or negative influence on these villages. For that reason, particular attention has been paid to the period between the last two censuses. Đurđev et al. (2004) stated that according to the 2002 census refugees and displaced persons from the region of the former Yugoslavia caused regional differences in the growth rate of the population of Vojvodina. The share of this category of people in the total population in the municipality of Šid, in 2002, had the highest value at 23.4%. Given that the wartime operations in Croatia and Bosnia and Herzegovina stopped in the mid 1990's, it must be assumed that there were even more of people present at that time but many of them lost their refugee status by obtaining citizenship.

Srem, one of three regional units of the Autonomous Province of Vojvodina, has fourteen border settlements (VGI 1982; 1982a; 1982b; 1983). From that number, two border villages (Neštin and Vizić) are

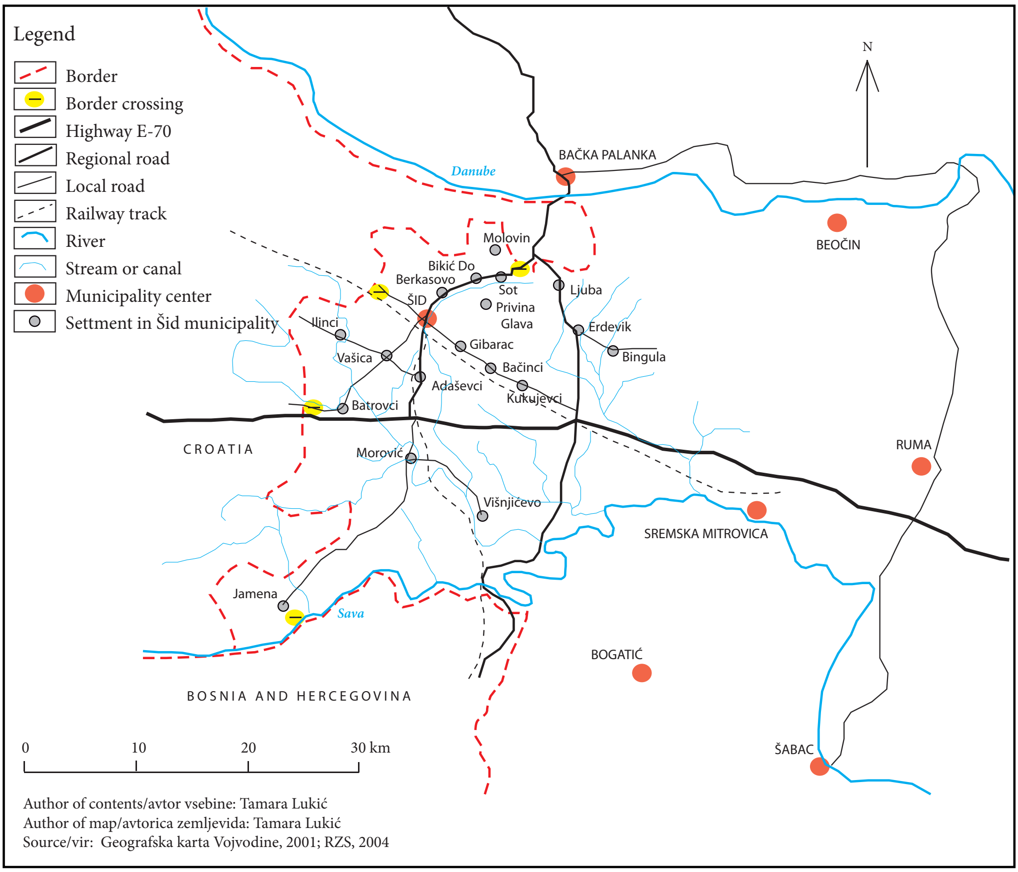


Figure 1: Geographic position of settlements in the municipality of Šid.

part of the municipality of Bačka Palanka (Bogdanović et al. 1997), one (Sremska Rača) is located in the municipality of Sremska Mitrovica (Ćurčić et al. 2002) and eleven settlements (Figure 1) are part the municipality of Šid (Ćurčić 2001). Considering the fact that most of the settlements are located in the municipality of Šid, because of the factors of standardisation of local self-management performance, this paper will be focused only on these villages. According to the categorisation of settlements by Statistical Office of the Republic of Serbia, only one of eleven settlements in the municipality of Šid has been deemed to be a 'town settlement' (Statistical Office of the Republic of Serbia, 2004a). The multi-functionality of this settlement, which is simultaneously the municipality centre, puts other villages into an unequal position. The administrative and management functions of the settlement imply the presence of other functions, e.g. educational, cultural, etc., and in that way positively modify the demographic situation. For that reason, Šid will be excluded from the analysis, and only village settlements will be compared.

2 Material and methods

This paper is the result of analyses of data received at the Statistical Office of the Republic of Serbia. Data were illustrated by drawing maps: relevant content was extracted from existing figures, in order to form the desired maps.

The results of the research were verified on the field by conducting a questionnaire for one hundred respondents, i.e. an interview was conducted with ten respondents in each village. Respondents were between the ages of 19 and 65, and both sexes were equally represented. The aim of the interview was to explain some occurrences observed in the analysis and processing of statistical data. For that reason, the questions were of an open character, and answers to them were not predictable.

3 Results and discussion

The analyses of the population trends should find and explain differences in the movements of people in the border villages of the municipality of Šid in the period from the census in 1991 to the census in 2002. In addition to the explanation will be a discussion of the ethnic structure of the population, and the results of the conducted interview.

3.1 Population figures

An international recommendation was accepted that the census be carried out every ten years, in the first year of the decade; this has been the practice since 1961 (Stanković 2006). Because the census that should have been carried out in 2001 was made in 2002, the comparability of census data was seriously damaged; nevertheless, certain tendencies in population trends could be observed (Đurđev et al. 2010).

According to the 1991 census, the population of the border villages in this area ranged from 299 inhabitants, registered in Bikić Do, to 2105 inhabitants in Morović. Differences in the population sizes of villages were preserved in the most recent census: in 2002, they ranged from 298 inhabitants in Molovin to 2164 inhabitants in Morović. Analyses of the geographical position and relief characteristics show that border villages with smaller populations are located in the northern half of the border, i.e. on the slopes of the Fruška Gora mountain and in river valleys of its streams. Only Batrovci differs from this trend; it is located on the Bosut River, somewhat north of the E-70 motorway. None of the villages has changed the category of size to which they belonged, but within the categories certain changes occurred (Table 1).

Table 1: Classification of border villages of the municipality of Šid according to the size and according to the 1991 and 2002 censuses.

Census	≤ 500	500–1000	1000–1500	1500–2000	2000 ≥
1991	3	3	2	1	1
2002	3	3	2	1	1

Source: Statistical Office of the Republic of Serbia, 2004a

In the period when the aforementioned border villages were not border villages, the population decreased in all villages from the 1981 census to the 1991 census. That decrease was –9.2% in average and was three times higher than the value calculated for the municipality Šid (–3.1%). The decrease in the population ranged from –0.7% in Bikić Do to –18.7% in Molovin (Figure 2). There was no decrease in the number of inhabitants in the town of Šid. Characteristic migrations, for the decade of 1981–1991, which were initiated in earlier decades by the processes of urbanisation, industrialisation and suburbanisation, continued to occur (Lukić 2010, 2). The development of secondary and tertiary businesses in the municipal and regional centres, such as Šid, increased the population from 1981 to 1991 by 5.8%.

However, in the period from 1991 to 2002, four of the ten observed villages showed increases in population (Figure 2). During the analysis of the geographic position of these border villages, the conclusion was drawn that population number increased in villages that are located on the highway M 18.1 (Bikić Do and Berkasovo), which connects Šid and Bačka Palanka, and in villages that are located on crossroads for other municipality villages (Vašica, Morović). Border villages that did not have an increase in population are not located on these transit lines. The population decreases in those villages ranged from –0.4% in Sot to –12.7% in Jamena. Consequently, it was concluded that, although a decrease was noticed, its intensity is smaller than in the decade that preceded (Table 2).

The increase in the number of inhabitants in the border villages (2.2%) is less than a fourth than that on the municipal level (9.8%). Given that the number of inhabitants in the town of Šid increased by 15.2%, it can be concluded that the municipal centre was more attractive for settlement than other municipal rural settlements that were not on the border.

3.2 Population trend

Changes of the values of population were explained in parameters of population trends, i.e. rates of natural population growth and migration balance were calculated.

3.2.1 Natural movement

According to the rate of natural population growth, among the border villages of the municipality of Šid there are three types of villages: villages that did not register positive natural population growth in the observed period, from 1991 to 2001 (Vašica, Ilinci, Jamena and Sot), villages that registered positive natural population growth in one year (Batrovci, Berkasovo and Morović) and villages that had positive natural population growth in four of ten years (Molovin, Ljuba and Bikić Do) (Table 3).

Table 2: Population number of border villages in the municipality of Šid.

Settlement	Year			Change in absolute number		Change in relative number (in %)	
	1981	1991	2002	1991/1981	2002/1991	1991/1981	2002/1991
Batrovci	464	399	361	–65	–38	–16.3	–10.5
Berkasovo	1217	1103	1258	–114	155	–10.3	12.3
Bikić Do	301	299	336	–2	37	–0.7	11.0
Vašica	1740	1636	1758	–104	122	–6.4	6.9
Ilinci	1011	883	843	–128	–40	–14.5	–4.7
Jamena	1577	1399	1241	–178	–158	–12.7	–12.7
Ljuba	639	585	563	–54	–22	–9.2	–3.9
Molovin	362	305	298	–57	–7	–18.7	–2.3
Morović	2196	2105	2272	–91	167	–4.3	7.4
Sot	900	819	816	–81	–3	–9.9	–0.4
Villages*	10407	9533	9746	–874	213	–9.2	2.2
Town (Šid)	13450	14275	16834	825	2559	5.8	15.2
Municipality**	37459	36317	40255	–1142	3938	–3.1	9.8

Note: Villages* – 10 border villages of the municipality of Šid; Municipality** – all (19) settlements of the municipality of Šid; Source: Statistical Office of the Republic of Serbia, 2004a; own calculations.

Figure 2: The change in the population (in %) in the border villages of the municipality of Šid, according the 1981–2002 censuses. ➤ p. 56

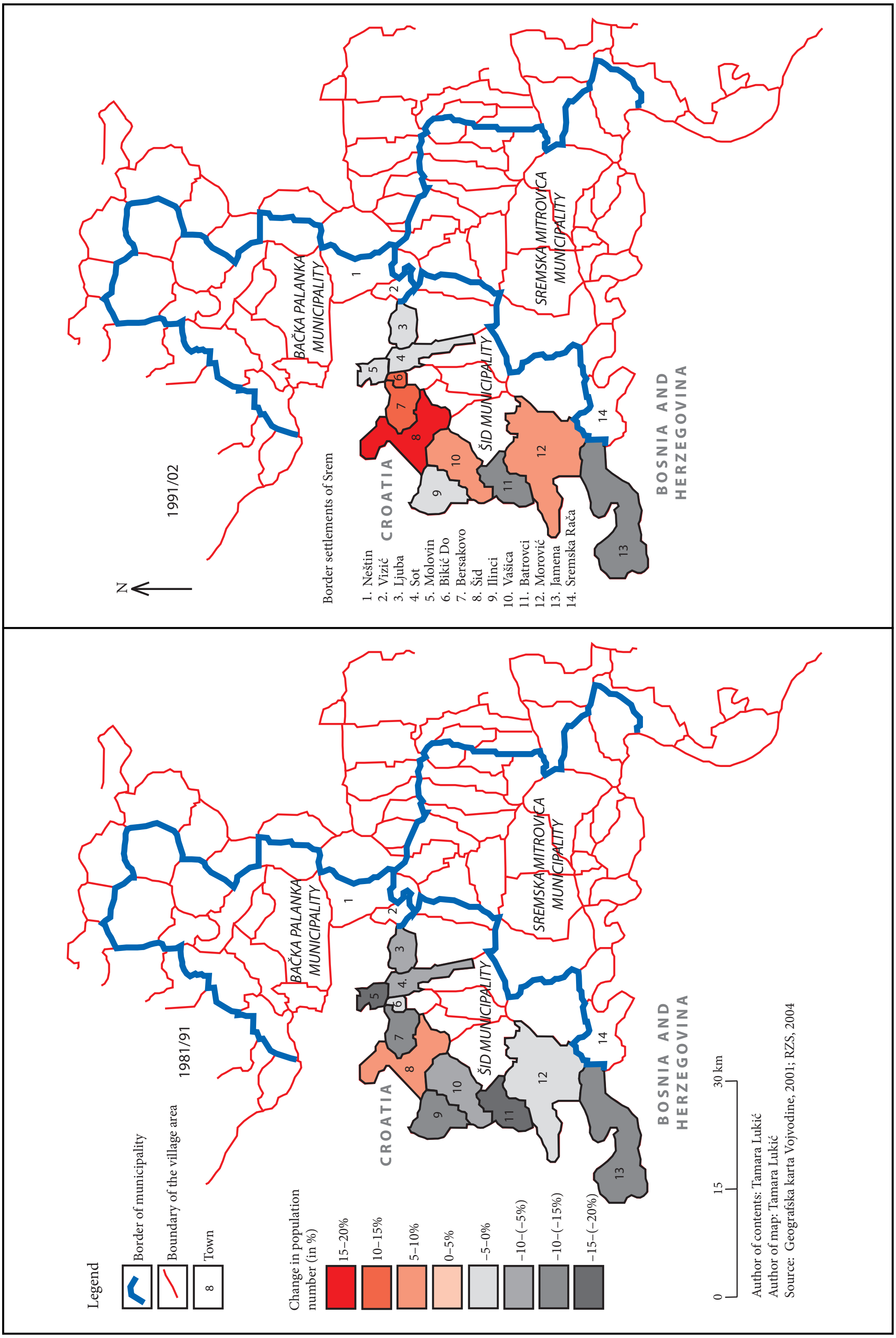

1991/02
N
BAČKA PALANKA MUNICIPALITY
SREMSKA MITROVICA MUNICIPALITY
ŠID MUNICIPALITY
CROATIA
BOSNIA AND HERZEGOVINA
Border settlements of Srem
1. Neštin
2. Vizić
3. Ljuba
4. Sot
5. Molovin
6. Bikić Do
7. Bersakovo
8. Šid
9. Ilinci
10. Vašica
11. Batrovci
12. Morović
13. Jamena
14. Sremska Rača
1981/91
BAČKA PALANKA MUNICIPALITY
SREMSKA MITROVICA MUNICIPALITY
ŠID MUNICIPALITY
CROATIA
BOSNIA AND HERZEGOVINA
Legend
Border of municipality
Boundary of the village area
Town
Change in population number (in %)
15–20%
10–15%
5–10%
0–5%
–5–0%
–10–(–5%)
–10–(–15%)
–15–(–20%)
0
15
30 km
Author of contents: Tamara Lukić
Author of map: Tamara Lukić
Source: Geografska karta Vojvodine, 2001; RZS, 2004

Table 3: Changes of the rate of natural population growth (in ‰) in border villages of the municipality of Šid in the period between 1991 and 2001.

Settlement	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Batrovci	–4.4	–6.7	–13.5	–18.3	–18.6	–7.1	4.8	–12.2	–24.7	–20.1	–20.2
Berkasovo	–5.0	–8.4	–5.1	–5.1	–3.5	–11.3	–17.6	5.3	–20.6	–13.6	–13.4
Bikić Do	–19.9	–13.3	0.0	–10.0	–3.3	–3.3	–3.3	10.0	10.0	10.0	6.6
Vašica	–1.7	–6.4	–7.0	–4.7	–9.5	–7.8	–12.0	–9.7	–7.9	–14.1	–14.6
Ilinci	–17.0	–12.2	–2.1	–11.5	–18.0	–18.2	–6.5	–8.8	–20.1	–6.8	–17.1
Jamena	–7.1	–12.3	0.0	–10.6	–8.8	–11.6	–9.7	–11.2	–14.8	–5.7	–14.5
Ljuba	6.3	–11.1	–9.6	–9.7	–13.1	–16.5	0.0	1.7	–1.7	3.4	3.4
Molovin	2.8	–8.6	–8.7	0.0	–15.0	3.1	0.0	–12.7	–6.4	3.3	6.6
Morović	–3.7	–7.8	–5.1	–6.0	0.0	3.7	–11.7	–5.7	–6.1	–6.2	0.0
Sot	–13.5	–12.5	–14.9	–11.5	–2.3	–10.6	–14.2	–3.6	–13.3	–19.5	–22.0
Villages*	–6.3	–9.9	–6.6	–8.7	–9.2	–8.0	–7.0	–4.7	–10.6	–6.9	–8.5
Town (Šid)	2.1	0.2	2.4	–1.5	1.2	1.4	–1.1	–2.1	–1.4	–1.7	–1.0
Municipality**	–2.0	–4.9	–3.0	–4.8	–4.1	–3.3	–5.1	–3.1	–6.1	–5.2	–5.4

Note: Villages* – 10 border villages of the municipality of Šid; Municipality** – all (19) settlements of the municipality of Šid; Source: Statistical Office of the Republic of Serbia, 2004a; Statistical Office of the Republic of Serbia, 2010; own calculations

From the border villages of Srem that were singled out as those in which the population increased, only Bikić Do distinguished itself also as one in which positive natural population growth was registered and has occurred continuously during previous four years (Figure 3). In other border villages, the changes of population were mainly influenced by mechanical population movement.

The townžs population growth rate in the first half of the observed decade, except for 1994, had a positive value, followed by a negative one. Positive population growth could not compensate for the volumes of negative rates in municipal settlements, so the population growth rate at the municipal level, had permanent negative values in the observed period, showing a negative growth tendency. Thus, population growth could be the result of a solely mechanical movement of population, i.e. immigration.

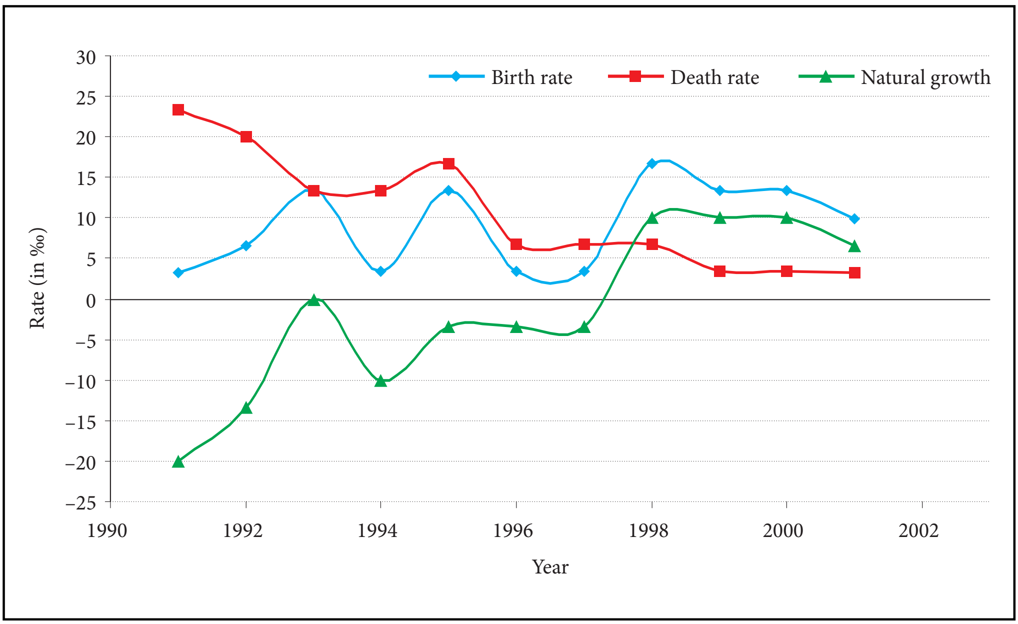


Figure 3: Changes of the rate of natural population growth of Bikić Do in the period between 1991 and 2001 (Statistical Office of the Republic of Serbia, 2010; own calculations).

3.2.2 Migrations

Migration into Europe has been on the rise in recent decades (Hooghe et al. 2008; Meuleman et al. 2009). Regions of the former Yugoslavia, to which the border villages of the municipality of Šid also belong, have followed this trend in their own way. This is the best illustrated by analysing the proportions of immigrant populations. According to the 2002 census, the immigrant population constitutes the majority in the municipality of Šid (56.3%), as well as in the town (57.1%) and in the border villages (52.9%). Specifically, the portion of the population that has lived in the border villages of the municipality of Šid from their birth, the so-called natives, differs greatly, ranging from 36.7% in Morović to 63.7% in Ljuba (Table 4). Border villages in the municipality of Šid in which less than 50% of the people are natives are those villages that have increased their populations. From other border villages, only Sot is part of this group.

In all the border villages of the municipality of Šid, the majority of the immigrant population is comprised of people who have migrated from the territories of former Yugoslav republics, other than Serbia (Lukić and Matijević 2006). Except the village Ljuba, their portion in the total immigrant population exceeds 50% (Table 5). The share of the immigrant population on the municipal level (63.3%) and on at the town level (52.1%), is lower than the share in the border villages of the municipality of Šid (69.7%). Refugees are those people who do not plan to migrate, but they are suddenly forced to do so, and consequently they make little preparation and generally do not know their destination (O'Docherty Madrayo 1988). In the interviews, it was concluded that for most of the immigrant population, and almost 100% of the female respondents, the main reason for migration was the fear of potential violence, i.e. war trauma. This fact is concurrent with the research results Lim et al (2007; 1542) and Vrecer (2010, 499).

In the questionnaire, one of the questions referred to the factors that crucially affected the immigrants' choice to migrate to a certain village. The answers were different, but among them the most frequent were the following: in some villages they already had relatives, rarely friends; in some villages, the prices of real estate were more favourable; some villages, for example on the slopes of the Fruška Gora mountain, had similar landscape characteristics to the area they came from, i.e. for those from hilly terrain, it is more difficult to adjust to life on the plains and vice versa; personal reasons, for example forming the family, etc. Some of these answers coincide with the results of Pilkington (1998) and Lukić and Nikitović (2004).

In some of the border villages, significant portions of migrants who did not come from the territories of former Yugoslavia stand out. For example, 43.3% of migrants in Bikić Do and 35.3% in Berkasovo are settled populations of intra-municipal migrations. In the interviews, it was stated that the reason many migrated from other municipal villages to Bikić Do or to Berkasovo was that these places are populated by Rusyn minority, and some of the respondents think that Rusyns settle in these villages for the reason of marriage.

In Ljuba, it has been recorded that more than one third of the settled population (33.5%) are migrants who settled from the territories of other municipalities in the Republic of Serbia. In interviews it was found

Table 4: Share of natives in total population, according the census 2002 in the border villages of the municipality of Šid.

Settlement	Sum	Natives		Immigrants	
		Number	%	Number	%
Batrovci	320	193	60.3	127	39.7
Berkasovo	1228	475	38.7	753	61.3
Bikić Do	336	158	47.0	178	53.0
Vašica	1717	842	49.0	875	51.0
Ilinci	827	478	57.8	349	42.2
Jamena	1130	586	51.9	544	48.1
Ljuba	559	356	63.7	203	36.3
Molovin	298	170	57.0	128	43.0
Morović	2164	794	36.7	1370	63.3
Sot	791	360	45.5	431	54.5
Villages*	9370	4412	47.1	4958	52.9
Town (Šid)	16311	7004	42.9	9307	57.1
Municipality**	38973	17019	47.3	21954	56.3

Note: Villages* – 10 border villages of the municipality of Šid; Municipality** – all (19) settlements of the municipality of Šid; Source: Statistical Office of the Republic of Serbia, 2004b; own calculations out that Ljuba is settled by the Slovak minority, and that these migrants have origins in the municipality Kovačica (Padina and Kovačica settlements), Bački Petrovac (Bački Petrovac, Gložan and Silbaš setllements), Beočin (the village of Lug), Stara Pazova (Stara Pazova settlement) and Bač (the village of Selenča) and others, i.e. from municipalities settled by Slovaks. Moreover, while talking with the local population, it was determined that Slovaks cherish their relations with their mother-land and that part of the marriage migrations happen between Ljuba and villages in Slovakia. This directly explains the fact that this village has the highest percent of people from the territories of other countries compared to other border villages of the municipality Šid (Table 5).

In the second place according to the level of migrant origin are those that have settled in the area as a result of intra-municipal migration. Such people represent nearly one in three immigrants (30.3%) in the town of Šid and one in five in the municipality (21.0%). According to Lukić and Tošić (2011, 322), the current economic reforms, the process of deindustrialisation and the privatisation of larger enterprises have been significant for changes in the commuting flows (directions and structure). The increase in the number of commuters in Serbia is one of the ways in which the population is adapting and overcoming the problems of unemployment and the lack of adequate jobs in the local milieu, while simultaneously maintaining of commuting as the form of mobility that prevents further concentration of people in urban centres. The features of a municipality attract residents, but they change their place of residence towards other municipal settlements 'in search of bread'. Based on the interviews, it was found that the jobs in the food-processing industry (Molovin and Berkasovo Wineries, 'Agropapuk' in Kukujevci, 'Big Bull' in Bačinci, etc.) appeared in rural settlements and thus they became the gravitational point for the working age population of the municipality.

Table 5: Share of migrants according to their origin, in total migrants (in %), according to the 2002 census in the border villages of the municipality of Šid.

Settlement	Sum	Same municipality	Other municipality	Other countries***	Former YU republics	Other countries	Unknown
Batrovci	127	13.4	7.9	5.5	72.4	0.0	0.8
Berkasovo	753	35.3	8.2	2.4	52.7	0.5	0.9
Bikić Do	178	43.3	5.6	0.0	50.6	0.0	0.5
Vašica	875	18.3	4.0	2.1	75.1	0.3	0.2
Ilinci	349	19.5	7.2	2.9	69.9	0.0	0.5
Jamena	544	6.6	3.7	4.2	83.8	0.7	1.0
Ljuba	203	18.2	33.5	0.5	45.8	1.0	1.0
Molovin	128	21.1	11.7	4.7	61.7	0.8	0.0
Morović	1370	14.2	6.0	4.5	74.2	0.7	0.4
Sot	431	13.0	6.5	1.6	77.0	0.5	1.4
Villages*	4958	18.9	7.2	3.0	69.7	0.6	0.6
Town (Šid)	9307	30.3	10.0	6.1	52.1	0.8	0.8
Municipality**	21954	21.0	9.6	4.5	63.3	0.8	0.8

Note: Villages* – 10 border villages of the municipality of Šid; Municipality** – all (19) settlements of the municipality of Šid; other republics*** – Montenegro (During the 2002 census, Serbia and Montenegro constituted Federal Republic of Yugoslavia (1992–2003)); Source: Statistical Office of the Republic of Serbia, 2004b, own calculations.

Shares of migrants in border villages of the municipality of Šid show that the majority of this part of the population of every village was settled during the 1990s, ranging from 27.8% in Jamena to 77.0% in Sot (Table 6). The period between 1946 and 1960 relates to the time of colonisation, which was conducted according to the Law on Agrarian Reform and Colonisation from 1945, by which population from hilly terrain of the former Yugoslavia (Gaćeša 1984, 113; Ćupurdija 1998, 225), i.e. from the same territory as from the observed decade (1990s), settled the territory of Vojvodina. The highest shares of population settled in that period were found in the southern border villages Jamena (25.6%) and Batrovci (23.6%).

In the migrant population, two groups have de facto been singled out: migrants who settled the border villages of the municipality of Šid for economical or political reasons, and migrants who came for personal reasons, i.e. marriage. In interviews, the following information was received: most people have no plans to return to the place from which they came; all of the interviewed people agreed that the border is characterised by great permeability, but they remember when there was no border. Most of the respondents, 73%, who found themselves in the border villages of the municipality of Šid for economic or political

Table 6: Share of migrants according to the time of immigration, in total migrants (in %), according to the census 2002 in the border villages of the municipality of Šid.

Settlement	Before 1940	1941–1945	1946–1960	1961–1970	1971–1980	1981–1990	1991–2002	Unknown
Batrovci	0.0	0.0	23.6	13.4	7.1	7.1	47.2	1.6
Berkasovo	0.9	1.1	7.4	11.8	9.3	11.2	54.8	3.5
Bikić Do	1.1	2.2	11.8	5.1	12.4	14.0	51.1	2.2
Vašica	1.3	0.3	8.3	4.9	3.9	7.9	71.9	1.5
Ilinci	1.1	1.4	18.3	12.0	12.9	8.3	44.1	1.7
Jamena	1.5	0.6	25.6	20.6	11.0	8.1	27.8	5.0
Ljuba	3.0	2.0	16.3	7.4	10.8	13.3	45.3	2.0
Molovin	1.6	1.6	6.3	17.2	17.2	12.5	43.0	0.8
Morović	0.7	0.5	12.9	11.2	8.8	9.1	55.5	1.2
Sot	0.5	0.2	5.1	3.2	4.9	6.7	77.0	2.3
Villages*	1.0	0.8	12.6	10.4	8.6	9.2	55.2	2.2
Town (Šid)	0.9	0.9	11.8	16.6	14.4	11.5	38.5	5.4
Municipality**	1.0	0.9	11.4	12.6	10.3	9.8	50.2	3.9

Note: Villages* – 10 border villages of the municipality of Šid; Municipality** – all (19) settlements of the municipality of Šid; Source: Statistical Office of the Republic of Serbia, 2004b; own calculations.

reasons said that they had adapted themselves to the environment in which they live and that while going back could be personally satisfying, it was not economically justifiable. They said if there were appropriate economic conditions, they would support (about 84%) the immigration of their children in directions further from the border. A small amount of respondents, about 12%, sees the border as a zone of connecting, and not dividing of people. Most, 92%, admit that there are the benefits to life next to the border. Most frequently they mention the prices of some products, which are lower on the other side of the border, and the profit they can make from selling different products to people from the Republic of Croatia. Similar phenomena have been determined in the other parts of the world (Fitzgerald et al. 1988; Timothy and Butler 1995; Sullivan and Kang 1997; Bygvra 1998; Wang 2004; Roper 2007).

A positive migration balance for the period between 1991 and 2002 has been determined in half of the border villages of the municipality of Šid, i.e. in all villages in which there was an increase of population and in the village of Sot (Table 7). The example of Sot confirms that settled population will not have the crucial importance for the development of the population in the future; this is confirmed by data received from research by Nikitović and Lukić (2010). The rate of migratory balance in border areas of Srem (15.1 ‰) is quite similar to the value in the entire municipality (14.1 ‰). At present, the settled population has only covered depopulation.

Table 7: Migration balance of border villages of the municipality of Šid in the period between 1991 and 2002.

Settlement	Population growth	Average annual growth rate (in ‰)	Migration balance	Average annual rate of migration balance (in ‰)	Natural population growth	Average annual population growth rate (in ‰)
Batrovci	–38	–9.1	–24	24.5	–14	–33.6
Berkasovo	155	12.0	165	19.6	–10	–7.6
Bikić Do	37	10.7	39	15.5	–2	–4.8
Vašica	122	6.6	132	11.7	–10	–5.1
Ilinci	–40	–4.2	–26	10.3	–14	–14.5
Jamena	–158	–10.8	–147	–3.5	–11	–7.3
Ljuba	–22	–3.5	–17	3.9	–5	–7.4
Molovin	–7	–2.1	–3	8.7	–4	–10.8
Morović	167	7.0	172	9.0	–5	–2.0
Sot	–3	–0.3	11	15.0	–14	–15.3
Villages*	2559	15.1	2561	15.1	–2	0.0
Town (Šid)	213	2.0	293	2.8	–80	–0.8
Municipality**	3938	9.4	4115	14.1	–177	–4.7

Note: Villages* – 10 border villages of the municipality of Šid; Municipality** – all (19) settlements of the municipality of Šid; Source: Statistical Office of the Republic of Serbia, 2004a; 2004b; 2010; own calculations

3.3 Ethnic structure

Ethnic minorities have been present in the municipality of Šid for centuries. In Berkasovo, Bačinci, a rural village in the municipality of Šid that is not a border village and in the town of Šid itself, the arrival of Rusyns was recorded in 1746 (Đurđev 1998; Ivkov 2006, 45; Drljača 2006). At the end of the 18th century, the Diocese of Križevci (Croatia) moved the Rusyns from the Bačka settlements of Ruski Krstur and Kucura (Gavrilović 1956, 70; 1958; 1977, 153–215; Đerčan et al. 2010, 66). However, according to Beserminï (1937), Laboš (1979, 299) and Ramač (2009, 235), the Rusyns migrated from Krstur and Kucura, first to other settlements in Bačka and from the beginning of the 19th century to Srem and Slavonia, due to the troubles of the rural populace, which were caused by natural disasters, floods, drought and different field pests as well as due to the lack of arable land.

According to Sirácky (2002), Slovaks resettled in Slavonia and Srem in 1770. Stupavský (2010) reported the presence of Slovaks in Šid since 1810 and its existence within the military boundary with particular emphasis on the benefits of the town. According to Jankulov (1961), Slovaks inhabited the area in the middle of the 19th century. As he writes, the first families immigrated from Slovakia and Hungary, and in the second half of the 19th century they immigrated from Bačka on a larger scale. At that time, the area was also settled by Jews. The colonisation of the Hungarians is miniscule compared to other parts of Vojvodina.

A series of political developments, including changes in states' borders and the formation of new states, rendered Vojvodina a territory of migrations throughout the 20th century. These migrations have exerted a considerable impact upon Vojvodina's ethnic structure (Bjeljac and Lukić, 2008).

Table 8: Ethnic structure of population in the border villages of the municipality of Šid (in %), according to the 1991 and 2002 censuses.

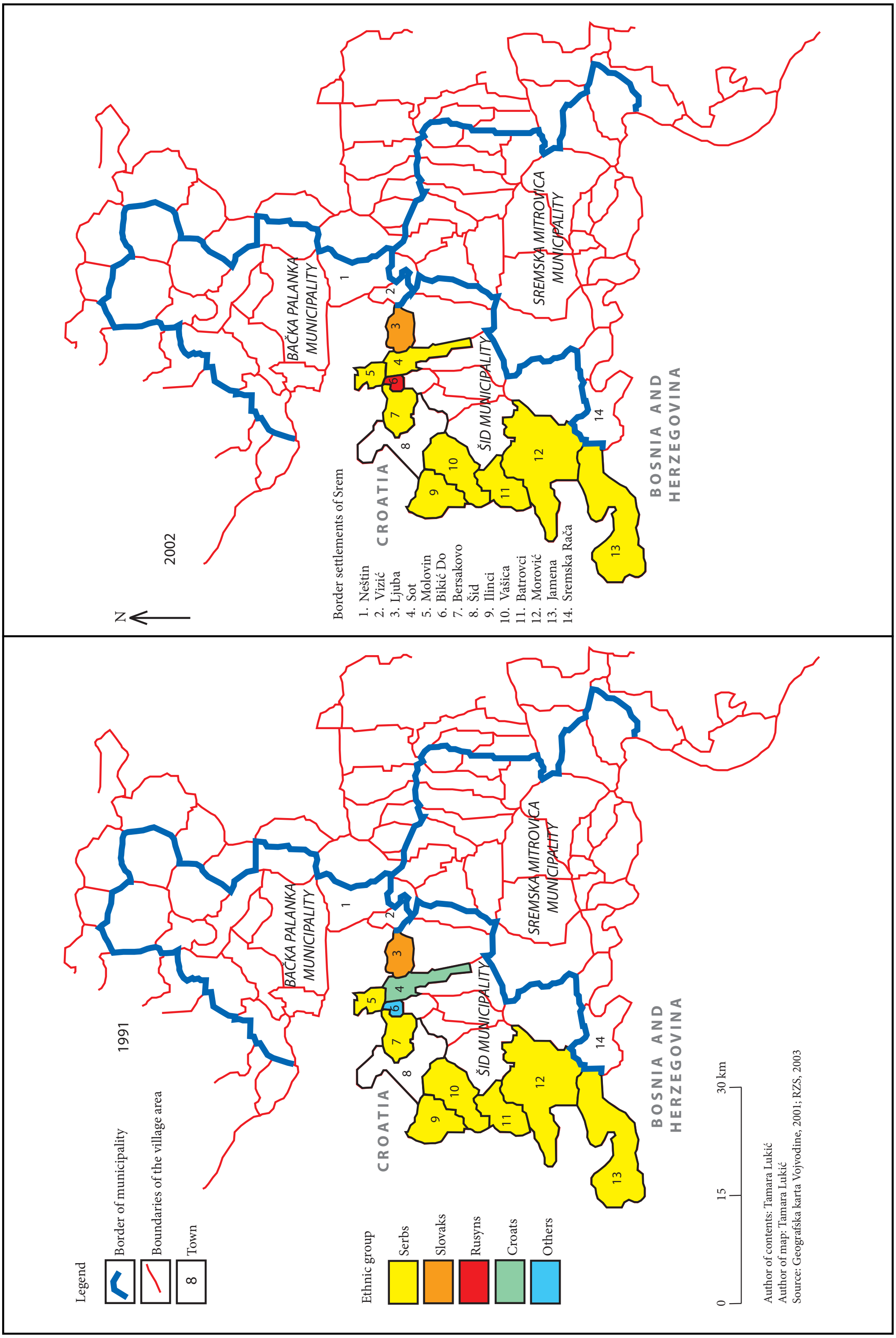
Ethnic group	Serbs		Slovaks		Rusyns		Croats		Others	
Census	1991	2002	1991	2002	1991	2002	1991	2002	1991	2002
Batrovci	54.6	67.8	0.3	0.3	No data	1.3	38.3	28.4	6.8	2.2
Berkasovo	54.7	68.5	2.3	1.7		15.0	8.3	3.8	34.7	11.0
Bikić Do	14.4	32.7	1.3	2.1		47.6	13.0	11.6	71.2	6.0
Vašica	63.9	86.2	2.4	1.4		0.8	25.7	7.2	7.9	4.4
Ilinci	93.3	96.3	0.2	0.4		0.0	2.3	1.0	4.2	2.4
Jamena	88.8	93.4	0.0	0.0		0.3	4.6	2.8	6.6	3.5
Ljuba	9.9	16.5	55.9	53.8		0.4	28.2	22.7	6.0	6.6
Molovin	84.3	87.6	0.0	0.3		0.3	8.5	4.7	7.2	7.0
Morović	61.9	87.3	0.5	0.4		0.3	28.4	8.0	9.3	4.1
Sot	4.4	43.0	4.2	3.5		0.9	57.6	40.1	33.8	12.5
Villages*	59.0	75.6	4.6	4.2		4.1	21.5	10.4	14.8	5.8
Town (Šid)	63.5	76.2	6.9	5.5		4.2	8.8	4.4	20.8	9.7
Municipality**	59.7	77.6	7.8	6.5		3.4	16.7	5.4	15.8	7.2

Note: Villages* – 10 border villages of the municipality of Šid; Municipality** – all (19) settlements of the municipality of Šid; Source: Statistical Office of the Republic of Serbia, 2003; own calculations.

In calculating the shares of certain ethnic groups in the total number of inhabitants of border villages of the municipality of Šid, some of the information that was obtained by interviewing the population has been confirmed. According to the census from 2002, Serbs were the majority in eight out of ten observed villages. Rusyns were the majority in Bikić Do, but significant presence of them (15%) has also been determined in Berkasovo. Slovaks were the majority only in Ljuba (Figure 4). In order to determine whether and to what extent population trends affected the ethnic structure, data from the last two censuses have been compared, according to which the share of Serbs has been increased in all villages. This contingent of refugees has directly increased the ethnic homogeneity of population (Matijević et al. 2005, 119). This supports the assertion of Cordeiro (1996) and Samers (1998, 124) that immigrants do not have to also be ethnic minorities.

Data on Rusyns from 1991 were not published. The share of the Croats has decreased in all villages, in Morović and Vašice by more than two thirds. According to their share in the entire population, in 1991

Figure 4: Dominant ethnicity in the border villages of the municipality of Šid, according to the 1991 and 2002 censuses. ➤ p. 62


1991
2002
N
Legend
Border of municipality
Boundaries of the village area
Town
Ethnic group
Serbs
Slovaks
Rusyns
Croats
Others
BAČKA PALANKA MUNICIPALITY
SREMSKA MITROVICA MUNICIPALITY
ŠID MUNICIPALITY
CROATIA
BOSNIA AND HERZEGOVINA
Border settlements of Srem
1. Neštin
2. Vizić
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6. Bikić Do
7. Bersakovo
8. Šid
9. Ilinci
10. Vašica
11. Batrovci
12. Morović
13. Jamena
14. Sremska Rača
0
15
30 km
Author of contents: Tamara Lukić
Author of map: Tamara Lukić
Source: Geografska karta Vojvodine, 2001; RZS, 2003

the Croats were the majority in Sot (Table 8). In interviews, it was explained that in 1990s, during the wars on the territory of Former Yugoslav Republics, Croats from villages in the municipality of Šid agreed to exchange their houses with Serbs from the territories of Croatia and Bosnia and Herzegovina. There is some mention of this by Kovačević et al (2010, 72).

Moreover, it was reported that in some villages certain political parties acted repressively, thereby motivating the Croatian population to migrate. The proximity of the border, i.e. Croatian territory, was a powerful and attractive motive for the Croatian population to move to nearby villages on the other side of the border; some of them already owned and cultivated land there.

4 Conclusion

Different tendencies in population trends were observed in ten border villages of the municipality of Šid in the period from the census in 1991 to the census in 2002. In four villages, there has been a determined increase in population. Analysing the local geography, it has been determined that those villages, unlike the others, are located either on busy roads or at crossroads. The more favourable position attracted people to settle those villages. Analysing natural population movement, it has appeared that from the four villages, only Bikić Do has positive population growth during half of the observed period. Accordingly, it has been concluded that the other villages had increased populations only as a result of a mechanical flow of population, which is confirmed by the fact that during the observed decade mass immigrations of people from the territories of former Yugoslavia to the region were taking place in the Federal Republic of Yugoslavia as a whole, and in the municipality of Šid specifically. Interviewing the refugee population for the purpose of obtaining information on their intentions about further movement, the most common answer received was that it depended on the economic situation. However, while visiting the field, the presence of different ethnic minorities was observed, which initiated analyses of data on ethnicity and the making of ethnic maps. The map confirmed that Bikić Do is the only village dominated by the Rusyn minority, which could also be one of the reasons only this border village has positive natural population growth. Drawing borders has positively affected the population numbers of border villages of the municipality of Šid, but the migration balance shows that a one-time 'population dosage' cannot obtain population growth in the conditions of negative trends observed at natural population movement.

5 Acknowledgments

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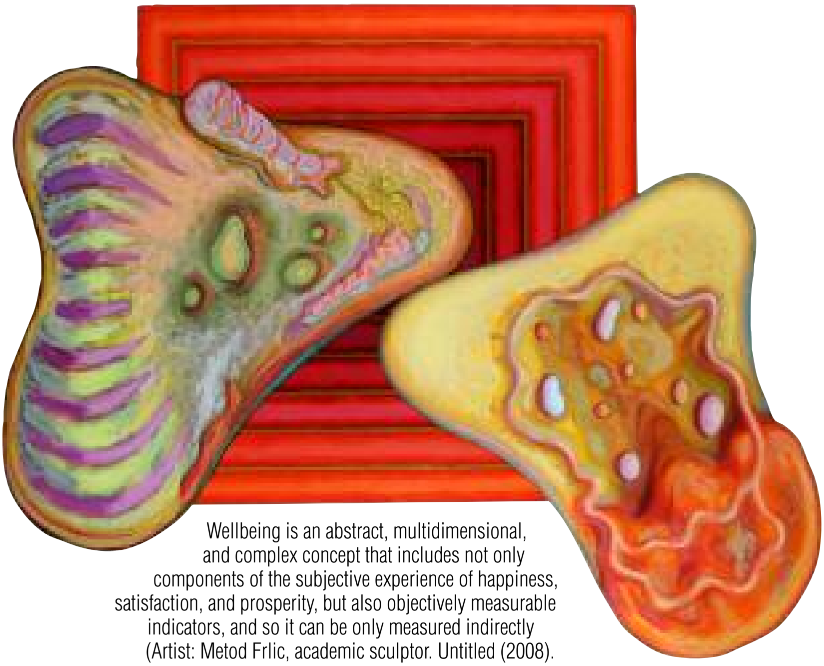
THE WELLBEING OF SLOVENIA'S POPULATION BY REGION: COMPARISON OF INDICATORS WITH AN EMPHASIS ON HEALTH

BLAGINJA PREBIVALCEV SLOVENIJE PO REGIJAH: PRIMERJAVA KAZALNIKOV S POUDARKOM NA ZDRAVJU

Lilijana Šprah, Tatjana Novak, Jerneja Fridl



Wellbeing is an abstract, multidimensional, and complex concept that includes not only components of the subjective experience of happiness, satisfaction, and prosperity, but also objectively measurable indicators, and so it can be only measured indirectly (Artist: Metod Frlic, academic sculptor. Untitled (2008). Painting on plywood, acrylic, 158 cm × 202 cm).

Blaginja je abstrakten, večrazsežen in kompleksen pojem, ki vključuje tako komponente subjektivnega doživljanja sreče, zadovoljstva in prosperitete, kakor tudi objektivno merljive kazalnike, zato jo lahko merimo le posredno (Avtor: Metod Frlic, akademski kipar. Brez naslova (2008). Slika na vezani plošči, akril, 158 cm × 202 cm).

The wellbeing of Slovenia's population by region: comparison of indicators with an emphasis on health

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ABSTRACT: In broader definitions, wellbeing is commonly described as a multidimensional concept, defined by the state of happiness, health, and prosperity. However, due to various understandings of conceptual issues regarding wellbeing, professionals encounter a number of methodological problems connected with measuring it. Composite indicators are thus being increasingly used to measure population's wellbeing. Health is an important area of wellbeing and is connected with indicators similar to those used for measuring general wellbeing. This article uses composite indicators to compare various areas of wellbeing, and especially health-related wellbeing, among the twelve Slovenian statistical regions. The findings show great differences between Slovenian regions. In western Slovenia (the Central Slovenia, Soča, Coastal-Karst, and Upper Carniola regions), the level of wellbeing is generally high, and in eastern Slovenia (the Carinthia, Lower Sava, Mura, and Central Sava regions) it is lower. Except for minor deviations, the level of general wellbeing in the regions matches the level of health-related wellbeing.

KEYWORDS: geography, medicine, population's wellbeing, composite wellbeing indicator, health, region, mental disorder

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1 Introduction

An overview of the literature on conceptual issues of wellbeing and its measurements reveals many methodological problems (Matthews 2006; Costanza et al. 2009). Wellbeing is a complex concept, defined as a state of happiness, health, and prosperity (Cowie and Lewis 1989, 1450). Due to its abstract and multidimensional nature, it can only be measured indirectly using a series of selected indicators, which must also be appropriately contextualized within a specific economic, social, and cultural environment, and primarily include those social values that reflect the perception of wellbeing in a specific environment. Recently, there has been increased interest among the professional and research community in studying wellbeing as well as many discussions on suitable methodological approaches to measuring it (Matthews 2006). In this regard, the main question is whether wealth and economic development are crucial to defining wellbeing. Ever since the establishment of the Organization for Economic Cooperation and Development (OECD) in 1961, the gross domestic product (GDP) has been the main indicator of measuring and understanding economic and social progress, which has also been connected with wellbeing. However, current studies point to a multilayered nature of the concept of wellbeing, which also includes subjective and nonmaterial components such as happiness, satisfaction, freedom, health, and education (Diener and Seligman 2004; Costanza et al. 2009).

The OECD has also responded to some methodological and content-related problems connected with measuring wellbeing. On its fiftieth anniversary, as part of the project »OECD Wellbeing Indicators« (OECD 2011), it presented a new method of monitoring general wellbeing as a response to demands for comparative information on the living conditions of people in countries with varying levels of development. The OECD wellbeing indicators include indicators of material conditions (income and wealth, jobs and housing), and quality of life (health, work-life balance, education, community, civil engagement and government, quality of the environment, safety, and life satisfaction; OECD 2011, 18, 19). The majority of indicators are based on statistical data, but some are also developed based on opinion polls.

The current financial and economic crisis opens numerous new aspects of understanding wellbeing, also in connection with the current global and social challenges related to climate changes, demographic trends, and public health (Stuckler et al. 2009). Evidence suggests that economic development is not necessarily connected with better wellbeing (Boarini, Johansson and D'Ercole 2006; Mikulić, Sándor and Leoncikas 2012). Especially topical is the question of how the crisis will be reflected in people's health. The findings show that during crises specific diseases and death rates increase due to distinctive reasons (e.g., suicide rate), mental health deteriorates (more depression and anxiety disorders), and the rates of domestic violence and other violence increase, as does drug and alcohol abuse (Levy & Sidel 2009; Avčin et al. 2011; Stuckler et al. 2011). Alarming is also the prediction that the crisis will increase inequalities in health, which will result in a lower level of wellbeing in a number of population groups (Buzeti et al. 2011; Gabrijelčič Blenkuš et al. 2012).

Improving population's wellbeing is one of the main development goals of any country, and therefore Slovenia also included this in Slovenia's Development Strategy (2005). Even when an individual country as a whole shows a fairly high level of wellbeing at an international scale, there can be considerable differences between individual areas or regions within the country. Regional differences in wellbeing can result from social, economic, and environmental problems that hinder balanced social and regional development. Therefore it is vital to continually monitor the geographically dependent levels of wellbeing, especially as they relate to effectively planning and implementing measures as part of spatial, economic, and healthcare policies, and ensuring access to public services, work, and high-quality living conditions (Rovan, Malešič and Bregar 2009, 71; Kerbler 2012, 175–176).

2 Purpose of the study and description of methodology

The aim of the present study is to explore the general wellbeing in individual statistical regions of Slovenia, and analyze the differences between them in terms of various aspects of wellbeing and selected health-related indicators.

Even though in recent years methodologies using composite indicators have become increasingly established in measuring wellbeing (OECD 2008), no »super« indicator is currently available that could be regarded as an official wellbeing measure. Therefore, based on the available statistical data and taking into account the methodology recommended by the OECD (2008, 2011), composite wellbeing indicators (CWBI) were developed for the purposes of this study. There are several regionalizations or divisions of Slovenia in place (Perko 1998), but for this study the division into statistical regions proved to be the most appropriate.

2.1 Selection criteria for basic indicators of wellbeing

In selecting the basic sociodemographic, economic, healthcare, and environmental indicators for the CWBI, the conceptual adequacy of indicators, their availability in statistical regions, accessibility during the reference period (2006–2010), quality, and capacity to sum up several features of the phenomenon (expressed in the form of indexes, ratios, and coefficients) were taken into account.

The following secondary sources of statistical data were used:

1. SI-STAT online information portal of the Statistical Office of the Republic of Slovenia /SURS/ (Internet 1);
2. Electronic publications of the *Slovenske regije v številkah* (Slovenian Regions in Numbers) from 2006 to 2010 (SURS 2006–2010);
3. *Zdravstveni statistični letopis* (Health Statistics Yearbook), 2006–2008 (IVZ 2006–2008);
4. Statistical appendices to the publication of the Institute of Macroeconomic Analysis and Development /UMAR/ (Apohal Vučkovič et al. 2010, 127).

3 Identification of regional wellbeing on the basis of composite wellbeing indicators

3.1 Structure of a composite indicator of wellbeing

The CWBI areas and dimensions were identified based on the areas of the OECD indicators of wellbeing (OECD 2011). The CWBI of every region includes seventy basic indicators that were divided into sixteen areas (dimensions) of wellbeing: income, education, housing, jobs, environment, general health, safety, parental benefits, social transfers, availability of health and social services, risk behaviors, occupational health, neonatal health, stability of partnerships, developmental prospects, and demographic profile. The number of basic indicators included differs across dimensions, as indicated by the values provided in parentheses in Figure 1.

Before the development of the composite indicator, the statistical data of basic indicators that were not expressed as ratios (percentages, coefficients, and indexes) were recalculated into comparable units (per population and area of region) and standardized. A multivariate principal component analysis, which aims to reduce the scope of data or, in our case, indicators, while losing as little information as possible, was then used to develop a composite wellbeing indicator from a selection of basic indicators. Basic indicators were retained in an individual dimension only if they had relevant content for a particular area of wellbeing and if, based on the results of the principal component analysis, they explained the highest possible variance of data behind the basic indicators making up this component. The numerical value of an individual dimension was calculated by multiplying basic indicators by component weights and then the results obtained were averaged across the time period studied. A linear transformation of a STEN score, a standard scale running from 1 to 10, was used to classify regions according to their wellbeing levels in particular areas. A value of 1 represented the lowest calculated value pertaining to a particular dimension of wellbeing (the lowest level of wellbeing in a particular area), whereas a value of 10 was assigned to the highest calculated value of dimension of wellbeing (the highest level of wellbeing in a particular area). The CWBI value was calculated as a mean value of all sixteen dimensions of wellbeing within a particular statistical region. Regions were classified according to their CWBI values into four categories: regions of high wellbeing, regions of moderately high wellbeing, regions of moderately low wellbeing, and regions of low wellbeing.

Table 1 shows basic indicators included in the dimensions of wellbeing and their influence on wellbeing. The plus sign was assigned to indicators when their high values (e.g., working population) contributed

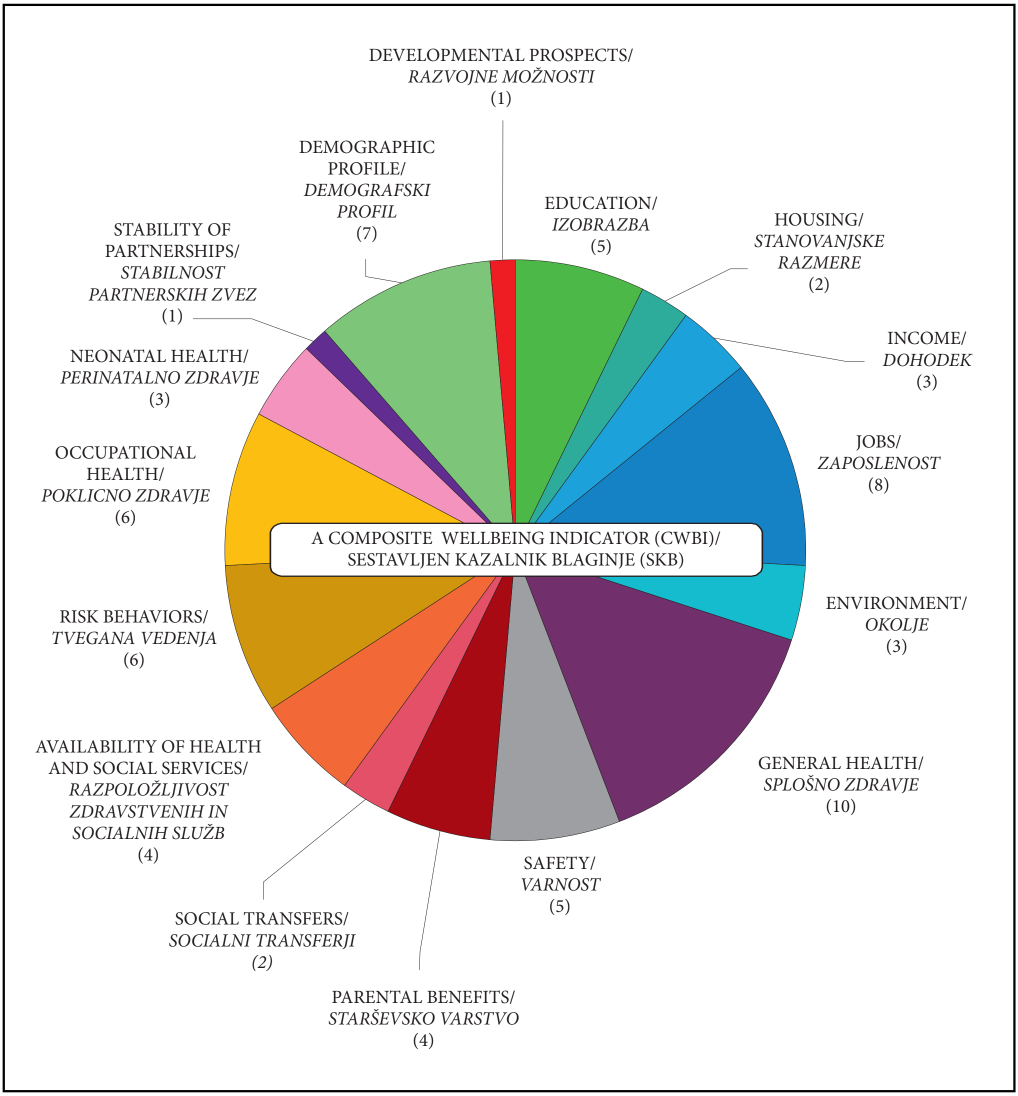


Figure 1: Structure of a regional composite wellbeing indicator in terms of wellbeing dimensions and the number of basic indicators included in them.

to a higher level of wellbeing within a region. The minus sign stands before indicators whose higher values (e.g., unemployment rate) signal lower levels of wellbeing in the region. A shorter time period (three or four years) was taken into account regarding those indicators that were not available for the full reference time period (2006–2010).

3.2 Inter-regional comparison with respect to different levels and areas of wellbeing

Figure 2 compares social, demographic, health, economic, and environmental dimensions of wellbeing between statistical regions of Slovenia. The regions were divided into four groups in terms of their CWBI

Table1: Overview of basic wellbeing indicators comprising the composite indicator of wellbeing and their influence on wellbeing.

DERIVED INDICATOR	BASIC INDICATOR	INFLUENCE ON WELL-BEING	DATA SOURCE AND REFERENCE PERIOD
Income	GDP per capita[a] index	+	*SURS, 2006–2008*
	GDP per capita in purchasing power standard units index	+	*SURS, 2006–2008*
	Net monthly salary of an employed person	+	*SURS, 2006–2010*
Education	Share of population 22–64 years of age with no education, with an incomplete education, or primary education	–	*SURS, 2006–2009*
	Share of population 22–64 years of age with secondary education	+	*SURS, 2006–2009*
	Share of population 22–64 years of age with tertiary education	+	*SURS, 2006–2009*
	Proportion of student population within the actively working population	+	*SURS, 2006–2009*
	Share of adult population 22–64 years of age engaged in lifelong learning	+	*SURS, 2006–2009*
Housing	Average household floor space (m^2) per person	+	*SURS, 2006–2010*
	Number of completed dwellings (new constructions, additions, changes in intended use)	+	*SURS, 2006–2010*
Jobs	Share of actively working population	+	*SURS, 2006–2010*
	Employment-population ratio	+	*SURS, 2006–2009*
	Registered unemployment rate	–	*SURS, 2006–2010*
	Share of unemployed with primary education	–	*SURS, 2006–2010*
	Share of unemployed with secondary or tertiary education	–	*SURS, 2006–2010*
	Job vacancies	+	*SURS, 2006–2010*
	Share of employed persons 55–64 years of age	+	*SURS, 2007–2009*
	Number of active enterprises	+	*SURS, 2006–2009*
Environment	Annual volume of water supplied to households from public water supply	+	*SURS, 2006–2010*
	Discharge of unpurified wastewater from public sewage system	–	*SURS, 2007–2009*
	Estimated damage caused by natural disasters as percentages of regional GDP	–	*SURS, 2006–2008*
General health	Number of drug prescriptions per person	–	*IVZ, 2007–2009*
	Rate of hospital treatment of diseases	–	*IVZ, 2006–2009*
	Number of cases with circulatory diseases as the most frequent causes of death	–	*IVZ, 2006–2009*
	Number of cases with digestive diseases as the most frequent causes of death	–	*IVZ, 2006–2009*
	Number of visits in general practice for endocrine, metabolic, and eating disorders	–	*IVZ, 2006–2008*
	Number of visits in general practice for mental and behavioral disorders	–	*IVZ, 2006–2009*
	Number of visits in general practice for circulatory disorders	–	*IVZ, 2006–2008*
	Number of visits in general practice for metabolic and eating disorders	–	*IVZ, 2006–2008*
	Number of visits in general practice for musculo-skeletal disorders	–	*IVZ, 2006–2008*
Safety	Total number of convicted adults	–	*SURS, 2006–2010*
	Number of convicted adults by criminal offense against spouses, family, and children	–	*SURS, 2006–2010*
	Total number of convicted minors (under the age of 18)	–	*SURS, 2006–2010*
	Number of cases of self-harm	–	*SURS, 2006–2009*
	Number of cases of assault on other persons	–	*SURS, 2006–2009*
Parental benefits	Number of children 1–5 years of age in preschools	+	*SURS, 2006–2009*
	Number of beneficiaries with the right to part-time work because of parenting duties	+	*SURS, 2006–2009*
	Number of beneficiaries with the right to paternity leave compensation	+	*SURS, 2006–2009*
	Number of marriages	+	*SURS, 2006–2010*
Social transfers	Number of recipients of financial social assistance	–	*SURS, 2006–2009*
	Number of recipients of scholarships among upper secondary and tertiary students	+	*SURS, 2008–2010*
Availability of health and social services	Number of physicians	+	*SURS,2007–2009*
	Number of nurses	+	*SURS,2007–2009*
	Number of hospital beds	+	*SURS, 2007–2009*
	Number of beds available in retirement homes	+	*SURS, 2006–2009*
Risk behaviors	Number of persons seriously injured in traffic accidents	–	*SURS,2006–2009*
	Number of persons killed in traffic accidents	–	*SURS, 2007–2009*
	Hospitalization rates due to suicide	–	*IVZ, 2006–2009*
	Number of suicides	–	*IVZ, 2006–2009*
	Number of visits due to alcohol consumption	–	*IVZ, 2006–2009*
	Number of drug abuse cases in primary care	–	*IVZ, 2006–2009*

Occupational health	Number of reported injuries at work	–	*IVZ, 2006–2009*
	Share of work days lost due to sick leave per person	–	*IVZ, 2006–2010*
	Frequency index (IF) [b]	–	*IVZ,2006–2010*
	Seriousness of sick leave [c]	–	*IVZ, 2006–2010*
	Rate of hospital treatment of diseases	–	*IVZ, 2006–2009*
	Average duration of hospitalization due to illness	–	*IVZ, 2006–2009*
Neonatal health	Stillbirths	–	*IVZ, 2007–2009*
	Number of women giving birth via caesarian section	–	*IVZ, 2006–2009*
	Share of newborns with low birth weight (under 2500 g)	–	*IVZ, 2007–2009*
Stability of partnerships	Number of divorces	–	*SURS, 2006–2010*
Developmental prospects	Development hazard index [d]	–	*UMAR, 2007–2013*
Demographic profile	Population density	–	*SURS, 2006–2009*
	Number of live births	+	*SURS, 2006–2010*
	Number of deaths	–	*SURS, 2006–2010*
	Total increase in population (natural and migration increase)	+	*SURS, 2006–2010*
	Coefficient of age dependency [e]	–	*SURS, 2006–2010*
	Aging index [f]	–	*SURS, 2006–2010*
	Number of farmers within actively working population	–	*SURS, 2006–2010*

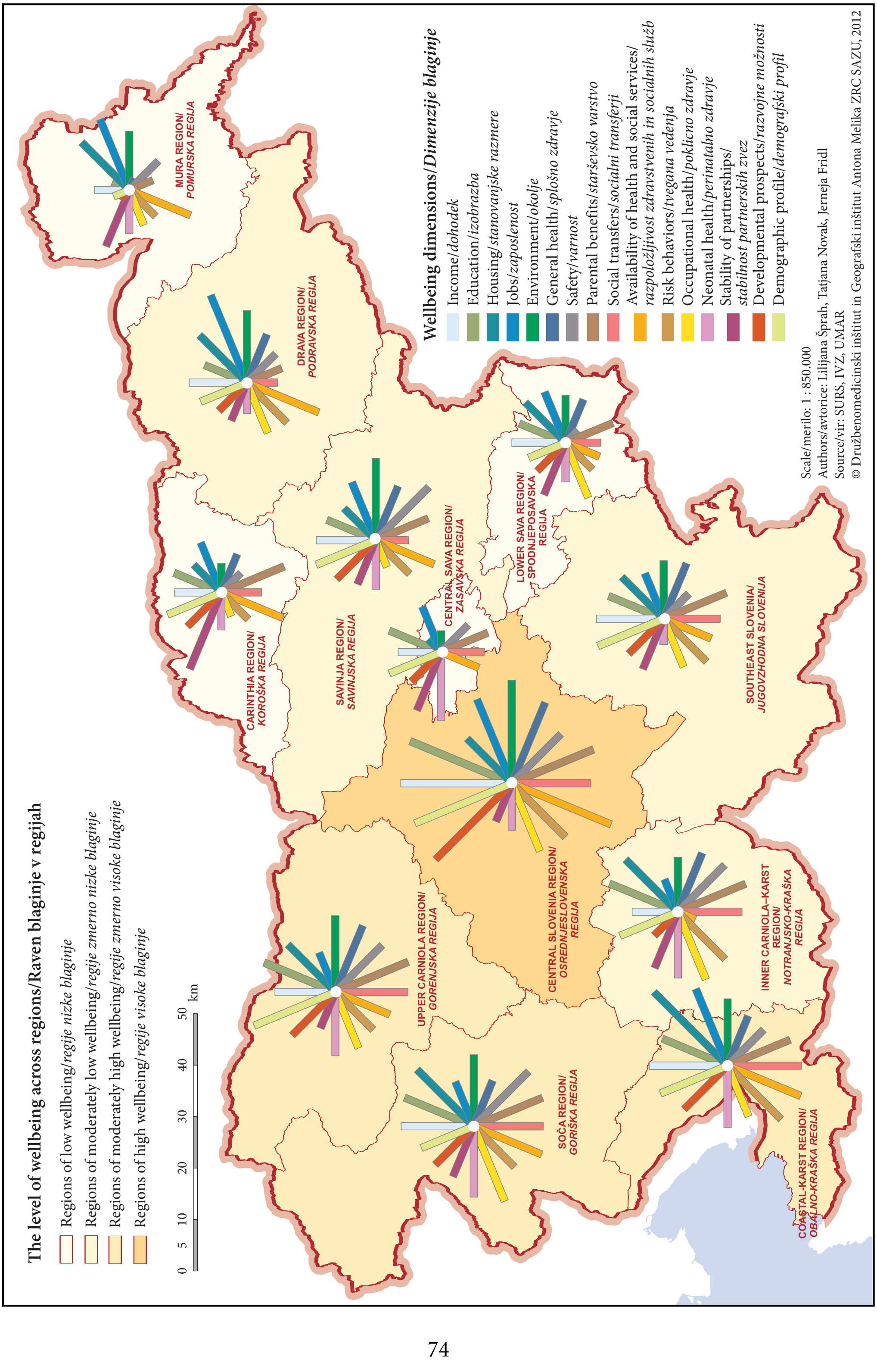
Notes:
[a] The *GDP per inhabitant index* compares the GDP per inhabitant with the national GDP within the same year.
[b] The *Frequency index* describes the number of sick leaves per 100 employees in one year.
[c] *Seriousness of sick leave* signals the average duration of one sick leave due to illness, injury, or other medical reason.
[d] The *Development hazard index* comprises eleven indicators (development, regional burden, and developmental prospects; Pečar & Kavaš 2006).
[e] The *Coefficient of age dependency* is the ratio between the young (0–14 years), old (over 65 years), and work-capable (over 15 years) population.
[f] The *Aging index* shows the ratio between the old (over 65 years) and young population (0–14 years), multiplied by 100.
Definitions *a* and *d–f* are taken from data sources (Internet 1), whereas definitions *b–c* are taken from the Health Statistics Yearbook (IVZ 2006d).

value (the values ranged from 7.6 to 3.3; interval: 1.07) and are represented in various shades of orange in the figure:

- Group 1: Regions of high wellbeing (CWBI = 7.6 to 6.52): Central Slovenia region /*Osrednjeslovenska regija*/ (CWBI = 7.58).
- Group 2: Regions of moderately high wellbeing (CWBI = 6.53 to 5.45): Soča region /*Goriška regija*/ (CWBI = 5.94), Coastal-Karst region /*Obalno-kraška regija*/ (CWBI = 5.90), Upper Carniola region /*Gorenjska regija*/ (CWBI = 5.78), and Inner Carniola–Karst region /*Notranjsko-kraška regija*/ (CWBI = 5.20).
- Group 3: Regions of moderately low wellbeing (CWBI = 5.46 to 4.38): Savinja region /*Savinjska regija*/ (CWBI = 4.91), Southeast Slovenia /*Jugovzhodna Slovenija*/ (CWBI = 4.88), and Drava region /*Podravska regija*/ (CWBI = 4.75).
- Group 4: Regions of low wellbeing (CWBI = 4.39 to 3.32): Carinthia region /*Koroška regija*/ (CWBI = 4.21), Lower Sava region /*Spodnjeposavska regija*/ (CWBI = 4.04), Mura region /*Pomurska regija*/ (CWBI = 3.45), and Central Sava region /*Zasavska regija*/ (CWBI = 3.37).

There were considerable differences in wellbeing among the regions, with Central Slovenia standing out as the region with the highest level of wellbeing, and the Mura and Central Sava regions as having the lowest levels of general wellbeing (Figure 2). In western Slovenia there is a group of regions with relatively high levels of general wellbeing (the Central Slovenia, Soča, Coastal-Karst, and Upper Carniola regions), and in eastern Slovenia there is a group of regions with the lowest levels of general wellbeing (the Drava, Carinthia, Lower Sava, Central Sava, and Mura regions). Regions with higher levels of general wellbeing also exhibit high levels of wellbeing in all other areas. The residents of these regions have higher education profiles and higher incomes, experience better housing and environmental conditions, and also have more employment opportunities and better parental benefit opportunities. At the same time, these regions have better development opportunities and a more favorable demographic profile.

Figure 2: Inter-regional comparison with respect to different levels and areas of wellbeing. ➤ p. 74


The level of wellbeing across regions/Raven blaginje v regijah
Regions of low wellbeing/*regije nizke blaginje*
Regions of moderately low wellbeing/*regije zmerno nizke blaginje*
Regions of moderately high wellbeing/*regije zmerno visoke blaginje*
Regions of high wellbeing/*regije visoke blaginje*
0 5 10 20 30 40 50 km
MURA REGION/
POMURSKA REGIJA
DRAVA REGION/
PODRAVSKA REGIJA
CARINTHIA REGION/
KOROŠKA REGIJA
SAVINJA REGION/
SAVINJSKA REGIJA
CENTRAL SAVA REGION/
ZASAVSKA REGIJA
LOWER SAVA REGION/
SPODNJEPOSAVSKA
REGIJA
SOUTHEAST SLOVENIA/
JUGOVZHODNA SLOVENIJA
CENTRAL SLOVENIA REGION/
OSREDNJESLOVENSKA
REGIJA
UPPER CARNIOLA REGION/
GORENJSKA REGIJA
SOČA REGION/
GORIŠKA REGIJA
INNER CARNIOLA–KARST
REGION/
NOTRANJSKO-KRAŠKA
REGIJA
COASTAL–KARST REGION/
OBALNO-KRAŠKA REGIJA
Wellbeing dimensions/*Dimenzije blaginje*
Income/*dohodek*
Education/*izobrazba*
Housing/*stanovanjske razmere*
Jobs/*zaposlenost*
Environment/*okolje*
General health/*splošno zdravje*
Safety/*varnost*
Parental benefits/*starševsko varstvo*
Social transfers/*socialni transferji*
Availability of health and social services/
razpoložljivost zdravstvenih in socialnih služb
Risk behaviors/*tvegana vedenja*
Occupational health/*poklicno zdravje*
Neonatal health/*perinatalno zdravje*
Stability of partnerships/
stabilnost partnerskih zvez
Developmental prospects/*razvojne možnosti*
Demographic profile/*demografski profil*
Scale/merilo: 1 : 850.000
Authors/avtorice: Lilijana Šprah, Tatjana Novak, Jerneja Fridl
Source/vir: SURS, IVZ, UMAR
© Družbenomedicinski inštitut in Geografski inštitut Antona Melika ZRC SAZU, 2012

3.3 Inter-regional comparison with respect to basic indicators of health-related wellbeing

A comparison of regions in terms of the level of wellbeing in health-related areas showed that regions of high and moderately high wellbeing also display a generally higher level in general, occupational, and neonatal health and the availability of health and social care services (comparing columns in Figure 2; higher CWBI values in Table 2). This was followed by an analysis of how certain selected indicators of health-related wellbeing are distributed across regions. Because health-related wellbeing can also be linked with drug and alcohol consumption, suicidal behavior, and injuries in car accidents, indicators making up the dimension of »risk behaviors« were also included (Table 2).

Table 2 shows that the general level of wellbeing does not necessarily reflect the wellbeing in individual areas within a specific region. Thus the Central Slovenia region (a region of high wellbeing in terms of its CWBI value) ranks high on the majority of basic indicators of wellbeing, but compared to other regions it exhibits some deviations in health-related areas such as the highest level of hospitalization due to disease, a fairly high share of newborns with a low birth weight, a large number of treatments for drug abuse, and a large number of persons injured in car accidents. Such deviations can also be observed in other regions. In the Central Sava region (which has the lowest level of general wellbeing), a low level of health-related wellbeing predominates, but the region stands out with relatively good status in some other areas, such as the largest number of primary healthcare appointments due to musculo-skeletal disorders and a small number of injured in car accidents, fewer stillborn babies, and a relatively good availability of beds in retirement homes.

4 Discussion

Until recently, wellbeing was predominantly measured with approaches that used either macroeconomic statistics such as the GDP or people's subjective opinions about their satisfaction with the quality of life as an approximation for the wellbeing assessment. It turned out that subjective opinions of wellbeing as part of international and interregional comparisons are not reliable because they depend strongly on the cultural context and various psychological factors (Diener 2000). Therefore, the use of composite indicators is becoming increasingly established in measuring wellbeing (Matthews 2006; OECD 2011); this method was also used in the study presented here.

Slovenia is treated as a homogenous regional unit in international comparisons, but many Slovenian economic, sociological, anthropological, and healthcare studies show great differences and special features at the level of its territorial units (municipalities and statistical regions), which are consequently reflected in access to services, commodities, and infrastructure, in economic and employment opportunities, in the accessibility and availability of healthcare and social services, and elsewhere (Nared 2002; Bole 2004; Ravbar, Bole and Nared 2005; Nared 2007; Bole 2008a, Bole 2008b; Dernovšek and Šprah 2008; Bole 2011; Ravbar 2011; Knežević Hočevar 2012; Korenič and Mavec 2012). In various international studies, these differences and special features in Slovenia remain unnoticed because the data are aggregated at the national level. This can also be seen from the findings of an OECD study (2011), in which interactive tools for measuring wellbeing were used to compare wellbeing across the OECD member states. Among the thirty-four members, Slovenia was ranked twenty-first overall. In some dimensions of wellbeing, it came close to the OECD average (health, social inclusion), or even higher (employment, personal safety); it fell below the OECD average with regard to housing and life satisfaction (Internet 2).

This study focused on the level of wellbeing in Slovenian statistical regions as measured by the adapted methodology of the OECD indicators. The results showed that, in terms of general wellbeing defined with a mean CWBI value, regions differ greatly from one another because the range of the CWBI was considerable: from 7.58 to 3.37. The situation in health-related wellbeing is especially interesting because in some regions it deviates from the general wellbeing status. That the estimated general wellbeing and health-related wellbeing match is also confirmed by the fact that a high level of wellbeing coincides with economically and socially better developed urban centers; however, a mismatch of these estimates in some regions also draws attention to the fact that favorable living and environmental conditions in municipalities do not necessarily reflect high economic and social development (Malešič, Bregar, and Rovan 2009, 47, 51).

Table 2: Selected basic indicators of various health-related areas of wellbeing.

AREA OF WELLBEING	VALUE OF CWBI DIMENSION / BASIC INDICATOR	CE	SO	CO	UP	IN	SA	SE	DR	CA	LO	MU	CN
		High wellbeing		*Moderately high wellbeing*				Moderately low wellbeing				Low wellbeing	
General health	*Value of CWBI dimension*	*7.8*	*4.4*	*4.8*	*6.4*	*5.7*	*5.2*	*5.3*	*4.7*	*3.7*	*4.2*	*1.1*	*0.9*
	Number of drug prescriptions per person	7.1	7.0	7.1	7.0	7.9	8.1	7.7	8.6	7.9	8.6	9.1	8.7
	Rate of hospital treatment of diseases	110.3	151.0	159.2	128.6	114.2	146.6	128.4	130.7	151.7	145.0	165.7	149.6
	Number of visits in general practice for mental and behavioral disorders	38	48	44	44	52	39	41	45	45	37	56	57
	Number of visits in general practice for musculo-skeletal disorders	181	211	234	217	214	223	196	215	247	198	233	181
Occupational health	*Value of CWBI dimension*	*6.5*	*7.2*	*4.9*	*5.4*	*6.5*	*2.6*	*4.6*	*4.9*	*2.3*	*5.3*	*3.4*	*0.3*
	Number of reported injuries at work	23.4	29.3	20.2	29.0	29.6	36.2	31.8	29.9	35.8	26.6	22.8	30.7
	Share of work days lost due to sick leave per person	3.82	3.83	4.75	3.84	4.93	4.74	4.54	4.33	4.69	4.14	4.60	5.30
	Frequency index (IF) [a]	82.2	117.6	102.4	81.2	118.6	76.9	84.9	82.0	76.1	88.6	74.8	62.0
	Seriousness of sick leave [b]	17.1	11.9	17.0	17.3	15.2	22.5	19.5	19.3	22.6	17.0	22.7	31.3
	Rate of hospital treatment of diseases	110.3	151.0	159.2	128.6	114.2	146.6	128.3	130.7	151.7	145.0	165.7	149.6
	Average duration of hospitalization due to illness	8.94	7.85	6.98	7.96	8.80	7.25	8.63	8.36	6.91	7.69	7.51	8.70
Neonatal health	*Value of CWBI dimension*	*4.2*	*6.3*	*5.5*	*5.7*	*5.9*	*4.4*	*2.3*	*2.8*	*3.3*	*3.5*	*3.9*	*6.1*
	Stillbirths	4.8	3.0	4.7	4.0	3.6	5.5	8.0	6.2	5.2	6.9	6.2	3.7
	Number of women giving birth via caesarian section	5.0	6.4	5.3	4.7	5.9	4.2	4.5	5.6	4.6	5.2	5.6	5.8
	Share of newborns with low birth weight (under 2,500 g)	6.6	5.7	5.8	5.8	6.3	5.7	6.9	7.5	6.9	6.7	6.3	6.2
Risk behaviors	*Value of CWBI dimension*	*6.8*	*5.1*	*6.7*	*4.8*	*6.0*	*4.3*	*5.4*	*5.0*	*3.4*	*3.4*	*3.3*	*0.1*
	Number of persons seriously injured in road traffic accidents	6.0	5.2	7.3	6.0	6.2	6.0	5.8	5.3	4.9	4.7	5.4	2.4
	Number of persons killed in road traffic accidents	0.9	1.1	1.0	0.9	1.6	1.3	1.4	1.2	1.0	0.9	1.4	1.0
	Hospitalization rates due to suicide	0.08	0.20	0.22	0.25	0.09	0.35	0.22	0.21	0.42	0.11	0.23	0.57
	Number of suicides	1.8	2.0	1.8	1.4	1.6	2.7	2.3	2.7	2.7	2.9	2.7	2.7
	Number of visits due to alcohol consumption	19.5	28.9	18.0	30.6	27.8	26.4	24.0	23.2	27.4	33.9	31.1	36.2
	Number of drug abuse cases in primary care	7.1	7.2	7.7	7.0	6.6	6.8	6.3	4.3	4.7	6.5	28.6	9.1
Availability of health and social services	*Value of CWBI dimension*	*9.6*	*6.6*	*7.0*	*5.2*	*1.7*	*5.6*	*4.6*	*6.9*	*5.9*	*3.3*	*5.9*	*3.7*
	Number of physicians	41.6	17.3	22.7	20.2	10.2	18.6	18.8	22.8	19.4	13.6	16.5	14.9
	Number of nurses	98.0	61.8	80.8	85.4	39.3	72.8	67.5	81.4	83.5	54.4	84.8	60.5
	Number of hospital beds	72.9	57.2	57.7	33.6	10.6	45.0	26.1	55.3	48.1	18.1	37.1	27.4
	Number of beds available in retirement homes	46.3	30.0	37.8	51.0	66.8	46.5	50.3	40.3	54.0	54.3	37.0	64.0

Abbreviations: *CWBI – composite wellbeing indicator; CE – Central Slovenia region; SO – Soča region; CO – Coastal-Karst region; UP – Upper Carniola region; IN – Inner Carniola–Karst region; SA – Savinja region; SE – Southeast Slovenia; DR – Drava region; CA – Carinthia region; LO – Lower Sava region; MU – Mura region; CN – Central Sava region.

Notes: [a] The *Frequency index* describes the number of sick leaves per 100 employees in one year.

[b] *Seriousness of sick leave* signals the average duration of one sick leave due to illness, injury, or other medical reason.

Special attention was directed to health as an important component of social wellbeing and its impact on the people's quality of life. This is also proved by various measures of economic development (Suhrcke et al. 2006; Buzeti et al. 2011, 17–28), in which an increasingly larger set of health indicators are used. Especially in light of the current economic crisis, in public health one can observe that the issue of mental disorders will become especially topical for the duration of the crisis (WHO 2011). More recent international and Slovenian studies are already reporting an increase in suicidal and violent behavior, increased drug and alcohol abuse, and increased incidence of depression and anxiety disorders, which are also connected with the general social insecurity, loss of jobs, and increased social and economic differences between various population groups (Levy & Sidel 2009; Avčin et al. 2011; Mikulić, Sándor and Leoncikas 2012). Therefore, in future planning and implementing social and healthcare policies, regional differences and the related cultural differences will also have to be taken into account; these have a great impact on regional development (Urbanc, Boesch and Jelen 2007; Razpotnik, Urbanc and Nared 2009). Only in this way can the objectives of various strategies for ensuring wellbeing and health to all Slovenians be followed.

5 Conclusion

This article presents a study of wellbeing in Slovenian regions using composite indicators. The study was based on the OECD methodological recommendations, but only objectively measureable indicators of wellbeing were included. Special attention was dedicated to health-related wellbeing, in which regional differences in general, occupational, and neonatal health, risk behaviors, and the availability of health and social care services were analyzed. The findings reveal a fairly heterogeneous pattern of wellbeing in Slovenian regions because there are significant differences in the development, living standards, and population health among certain regions. In this respect, Central Slovenia stands out as the region with the highest level of wellbeing. Western Slovenia is dominated by regions of moderately high wellbeing (the Soča, Coastal-Karst, and Upper Carniola regions), whereas eastern Slovenia is characterized by regions with the lowest levels of wellbeing (the Carinthia, Lower Sava, Mura, and Central Sava regions). These differences are likely to become even larger in the upcoming period of global crisis.

The levels of health-related wellbeing differ considerably across Slovenian regions. Because the good health of the population is vital for reducing poverty, the long-term development of the society, and raising the level of general wellbeing in the society, it is especially important for the government to work towards reducing differences between regions. Therefore, in the future more attention should be directed towards geographically specific data. Only a good knowledge of special regional features makes it possible to effectively plan and implement economic, social, environmental, and healthcare policy measures.

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Blaginja prebivalcev Slovenije po regijah: primerjava kazalnikov s poudarkom na zdravju

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IZVLEČEK: Blaginja se v širših definicijah najbolj pogosto opisuje kot večrazsežen pojem, opredeljen s stanjem sreče, zdravja in prosperitete. Vendar se zaradi različnih razumevanj konceptualnih vprašanj blaginje, strokovnjaki srečujejo s številnimi metodološkimi težavami na področju njenega merjenja. Metodologija sestavljenih kazalnikov se vse bolj uveljavlja tudi na področju merjenja blaginje prebivalcev. Zdravje predstavlja pomembno področje blaginje, z njim pa se povezujejo podobni kazalniki kot pri merjenju splošne blaginje. V prispevku smo z metodo sestavljenih kazalnikov blaginje primerjali različna področja blaginje in še posebej blaginjo, povezano z zdravjem, med dvanajstimi statističnimi regijami Slovenije. Ugotavljamo, da obstajajo med slovenskimi regijami velike razlike v blaginji. V regijah zahodne Slovenije (Osrednjeslovenska, Goriška, Obalno-kraška, Gorenjska) je raven blaginje v glavnem višja, v regijah vzhodne Slovenije (Koroška, Spodnjeposavska, Pomurska, Zasavska) nižja. Z izjemo manjših odstopanj raven splošne blaginje v regijah sovpada z ravnijo blaginje na področju zdravja.

KLJUČNE BESEDE: geografija, medicina, blaginja prebivalcev, sestavljeni kazalnik blaginje, zdravje, regija, duševna motnja

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1 Uvod

Pregled literature o konceptualnih vprašanjih blaginje in njenem merjenju razgrne številne metodološke težave (Matthews 2006; Costanza in ostali 2009). Blaginja je kompleksen pojem, opredeljen kot stanje sreče, zdravja in prosperitete (Cowie in Lewis 1989, 1450). Zaradi njene abstraktnosti in večdimenzionalnosti jo je mogoče meriti le posredno z naborom izbranih kazalnikov, ki pa se morajo tudi ustrezno umeščati v določeno ekonomsko, socialno in kulturno okolje ter vključevati predvsem tiste družbene vrednote, ki odražajo pojmovanje blaginje v konkretnem okolju. Zadnje čase smo priča povečanemu zanimanju strokovne in raziskovalne javnosti za preučevanje blaginje ter številnim razpravam o ustreznih metodoloških pristopih njenega merjenja (Matthews 2006). Pri tem se zastavlja osrednje vprašanje, ali sta bogastvo in ekonomski razvoj ključna za opredeljevanje blaginje. Vse od ustanovitve Organizacije za ekonomsko sodelovanje in razvoj (OECD) leta 1961 je namreč bruto domači proizvod (BDP) predstavljal osrednji kazalnik merjenja in razumevanja ekonomskega ter družbenega napredka, ki se ga je povezovalo tudi z blaginjo. Vendar aktualne študije kažejo na večplastnost pojma blaginje, ki vključuje tudi subjektivne in nematerialne sestavine, kot so npr. sreča, zadovoljstvo, svoboda, zdravje, izobrazba (Diener in Seligman 2004; Costanza in ostali 2009).

Na nekatere metodološke in vsebinske dileme, povezane z merjenjem blaginje, se je odzvala tudi OECD. Ob svoji petdesetletnici je v okviru projekta »OECD kazalniki blaginje« (OECD 2011) predstavila nov način spremljanja širše pojmovane blaginje kot odgovor na zahteve po primerjalnih informacijah o življenjskih razmerah ljudi v različno razvitih državah. OECD kazalniki blaginje vsebujejo kazalnike materialnih razmer življenja (dohodek in bogastvo, zaposlitev in stanovanjske razmere) in kakovosti življenja (zdravstveno stanje, usklajenost dela in zasebnega življenja, izobraževanje, družbena povezanost, civilna gibanja in vlada, kakovost okolja, osebna varnost in subjektivna blaginja) (OECD 2011, 18 in 19). Večina kazalnikov temelji na statističnih podatkih, nekateri pa so oblikovani tudi na podlagi javnomnenjskih anket.

Aktualna finančna in gospodarska kriza odpira številne nove vidike razumevanja blaginje, tudi v povezavi s sedanjimi svetovnimi in družbenimi izzivi na področjih podnebnih sprememb, demografskih trendov in javnega zdravja (Stuckler in ostali 2009). Dokazi govorijo, da gospodarska razvitost ni nujno povezana z večjo blaginjo (Boarini, Johansson in D'Ercole 2006; Mikulić, Sándor in Leoncikas 2012). Še posebej postaja aktualno vprašanje, kako se bo kriza odrazila na zdravju prebivalcev. Izsledki raziskav namreč kažejo, da v obdobju kriz naraščajo specifične bolezni in umrljivost zaradi svojevrstnih vzrokov (npr. stopnja samomorilnosti), poslabšuje se duševno zdravje (več depresivnih in anksioznih motenj razpoloženja) in stopnja nasilja v družinah ter v širšem okolju, povečuje pa se tudi zloraba drog in alkohola (Levy in Sidel 2009; Avčin in ostali 2011; Stuckler in ostali 2011). Skrb vzbuja tudi napoved, da bo kriza poglobila neenakosti v zdravju, kar se bo posledično odrazilo v nižji ravni blaginje številnih prebivalstvenih skupin (Buzeti in ostali 2011; Gabrijelčič Blenkuš in ostali 2012).

Izboljševanje blaginje prebivalcev je eden od poglavitnih razvojnih ciljev vsake države, zato jo je tudi Slovenija vključila v Strategijo razvoja Slovenije (2005). Četudi posamezna država kot celota v mednarodnem merilu izkazuje dokaj visoko raven blaginje, so znotraj nje lahko precejšnje razlike med posameznimi območji oziroma regijami. Regionalne razlike v blaginji so lahko izvor socialnih, ekonomskih in okoljskih težav, ki zavirajo uravnotežen družbeni in regionalni razvoj. Zato je pomembno sprotno spremljanje geografsko pogojene ravni blaginje, še posebej v luči učinkovitega načrtovanja in izvajanja ukrepov prostorskih, ekonomskih in zdravstvenih politik ter zagotavljanja dostopnosti do javnih storitev, dela in kakovostnih bivalnih razmer (Rovan, Malešič in Bregar 2009; Kerbler 2012).

2 Namen raziskave in metodološka pojasnila

Namen predstavljene raziskave je preučiti splošno blaginjo posameznih statističnih regij Slovenije in preveriti razlike med njimi z vidika različnih področij blaginje ter izbranih kazalnikov, povezanih z zdravjem.

Čeprav se v zadnjih letih na področju merjenja blaginje vse bolj uveljavljajo metodologije s sestavljenimi kazalniki (OECD 2008), pa trenutno še ne razpolagamo s »super« kazalnikom, ki bi obsegal vse njene dimenzije, niti s posebej definiranim, ki bi bil sprejet kot uradna mera blaginje. Zato smo na osnovi razpoložljivih statističnih podatkov in ob upoštevanju metodoloških priporočil OECD (2008; 2011) za potrebe te raziskave oblikovali sestavljene kazalnike blaginje (SKB). V Sloveniji poznamo več različnih regionalizacij oziroma delitev Slovenije (Perko 1998), za našo raziskavo pa je zaradi dostopnosti podatkov najprimernejša delitev na statistične regije.

2.1 Kriteriji za izbor temeljnih kazalnikov blaginje

Pri vključevanju temeljnih sociodemografskih, ekonomskih, zdravstvenih in okoljskih kazalnikov v SKB smo upoštevali vsebinsko primernost kazalnikov, njihovo razpoložljivost na ravni statističnih regij in dostopnost v referenčnem obdobju (2006–2010) ter njihovo kakovost in zmožnost povzemanja več značilnosti pojava (izraženost v obliki indeksov, stopenj ali koeficientov).

Uporabili smo sledeče sekundarne vire statističnih podatkov:

1. SI-STAT spletni podatkovni portal Statističnega urada RS (Internet 1);
2. elektronske publikacije Slovenske regije v številkah, od 2006 do 2010 (SURS 2006–2010);
3. Zdravstveni statistični letopisi, od 2006 do 2008 (IVZ 2006–2008);
4. statistične priloge publikacije Urada RS za makroekonomske analize in razvoj (Apohal Vučkovič in ostali 2010, 127).

3 Določanje ravni blaginje regij s pomočjo sestavljenih kazalnikov blaginje

3.1 Struktura sestavljenega kazalnika blaginje regije

Področja oziroma dimenzije SKB smo opredelili na podlagi področij OECD kazalnikov blaginje (OECD 2011). SKB vsake regije vključuje 70 temeljnih kazalnikov, ki smo jih po vsebinski sorodnosti razvrstili v 16 področij (dimenzij) blaginje: dohodek, izobrazba, stanovanjske razmere, zaposlenost, okolje, splošno zdravje, varnost, starševsko varstvo, socialni transferji, razpoložljivost zdravstvenih in socialnih služb, tvegana vedenja, poklicno zdravje, perinatalno zdravje, stabilnost partnerskih zvez, razvojne možnosti in demografski profil. Število vključenih temeljnih kazalnikov se med dimenzijami razlikuje, kot je razvidno iz vrednosti v oklepaju na sliki 1.

Slika 1: Struktura sestavljenega kazalnika blaginje regije z vidika dimenzij blaginje in števila vanje vključenih temeljnih kazalnikov.
Glej angleški del prispevka.

Statistične podatke temeljnih kazalnikov, ki niso bili izraženi v relativnih ocenah (odstotki, koeficienti, indeksi), smo pred zasnovo sestavljenega kazalnika preračunali v primerljive enote (glede na število prebivalcev oziroma površino regije) in jih standardizirali. Iz nabora temeljnih kazalnikov smo nato z multivariantno statistično metodo glavnih komponent, katere namen je zmanjšati razsežnost podatkov oziroma v našem primeru kazalnikov ob čim manjši izgubi informacij, oblikovali sestavljeni kazalnik blaginje. V posamezni dimenziji blaginje smo zadržali zgolj tiste temeljne kazalnike, ki so bili vsebinsko smiselno povezani s področjem in so glede na rezultate metode glavnih komponent pojasnili kar največ razpršenosti podatkov iz temeljnih kazalnikov, ki sestavljajo to komponento. Številsko vrednost posamezne dimenzije blaginje smo izračunali z obtežitvijo temeljnih kazalnikov z dobljenimi komponentnimi utežmi in dobljeno vrednost povprečili za preučevano obdobje. Za razvrščanje regij glede na raven blaginje po posameznih področjih smo uporabili linearno »STEN« transformacijo z razponom vrednosti od 1 do 10. Vrednost 1 je predstavljala najmanjšo izračunano vrednost dimenzije blaginje (najnižja raven blaginje na določenem področju), vrednost 10 pa največjo izračunano vrednost dimenzije blaginje (najvišja raven blaginje na določenem področju). Vrednost SKB je bila izračunana kot povprečna vrednost vseh 16 dimenzij blaginje v posamezni statistični regiji. Regije smo nato glede na njihove vrednosti SKB razvrstili v štiri kategorije: regije visoke blaginje, regije zmerno visoke blaginje, regije zmerno nizke blaginje in regije nizke blaginje.

Preglednica 1 kaže temeljne kazalnike, vključene v dimenzije blaginje, in njihov vpliv na blaginjo. Z znakom (+) so označeni kazalniki, kjer njihove višje vrednosti (npr. obseg delavno aktivnega prebivalstva) prispevajo k višji ravni blaginje v regiji. Znak (–) je pred kazalniki, kjer njihove višje vrednosti (npr. stopnja brezposelnosti) znižujejo raven blaginje v regiji. Pri tistih kazalnikih, za katere statistični podatki na regionalni ravni niso bili dostopni za referenčno obdobje (2006–2010), smo upoštevali krajše referenčno obdobje (tri oziroma štiri leta).

Preglednica 1: Pregled vključenih temeljnih kazalnikov v sestavljen kazalnik blaginje regije in njihov vpliv na blaginjo.

PODROČJE BLAGINJE	TEMELJNI KAZALNIK	VPLIV NA BLAGINJO	PODATKOVNI VIR IN REFERENČNO OBDOBJE
Dohodek	Indeks BDP (bruto domačega proizvoda) na prebivalca [a]	+	*SURS, 2006–2008*
	BDP na prebivalca, izražen v standardih kupne moči	+	*SURS, 2006–2008*
	Povprečna mesečna neto plača na zaposleno osebo	+	*SURS, 2006–2010*
Izobrazba	Delež prebivalcev, starih 22–64 let, brez izobrazbe, z nedokončano ali dokončano osnovnošolsko izobrazbo	–	*SURS, 2006–2009*
	Delež prebivalcev, starih 22–64 let, s srednješolsko izobrazbo	+	*SURS, 2006–2009*
	Delež prebivalcev, starih 22–64 let, z višje ali visokošolsko izobrazbo	+	*SURS, 2006–2009*
	Število študentov glede na delovno aktivno prebivalstvo	+	*SURS, 2006–2009*
	Delež odraslih oseb, starih 25–64 let, vključenih v vseživljenjsko izobraževanje	+	*SURS, 2006–2009*
Stanovanjske razmere	Povprečna površina stanovanja na osebo	+	*SURS, 2006–2010*
	Število dokončanih stanovanj (novogradnje, povečave, spremembe namembnosti)	+	*SURS, 2006–2010*
Zaposlenost	Delež delovno aktivnega prebivalstva	+	*SURS, 2006–2010*
	Stopnja delovne aktivnosti	+	*SURS, 2006–2009*
	Stopnja registrirane brezposelnosti	–	*SURS, 2006–2010*
	Delež brezposelnih z osnovnošolsko izobrazbo	–	*SURS, 2006–2010*
	Delež brezposelnih z višje- oz. visokošolsko izobrazbo	–	*SURS, 2006–2010*
	Število prostih delovnih mest glede na delovno aktivno prebivalstvo	+	*SURS, 2006–2010*
	Delež delovno aktivnega prebivalstva, starega 55–64 let	+	*SURS, 2007–2009*
	Število aktivnih podjetij glede na delovno aktivno prebivalstvo	+	*SURS, 2006–2009*
Okolje	Količina vode, dobavljene gospodinjstvom iz javnega vodovoda	+	*SURS, 2006–2010*
	Delež neprečiščene odpadne vode, izpuščene iz kanalizacije	–	*SURS, 2007–2009*
	Ocenjena škoda zaradi elementarnih nesreč, izražena v deležu regionalnega BDP	–	*SURS, 2006–2008*
Splošno zdravje	Število zdravniških receptov	–	*IVZ, 2007–2009*
	Stopnja hospitalizacije zaradi bolezni	–	*IVZ, 2006–2009*
	Število primerov bolezni obtočil kot najpogostejših vzrokov smrti	–	*IVZ, 2006–2009*
	Število primerov bolezni prebavil kot najpogostejših vzrokov smrti	–	*IVZ, 2006–2009*
	Število obiskov v primarnem zdravstvu zaradi endokrinih, prehranskih in presnovnih motenj	–	*IVZ, 2006–2008*
	Število obiskov v primarnem zdravstvu zaradi duševnih in vedenjskih motenj	–	*IVZ, 2006–2009*
	Število obiskov v primarnem zdravstvu zaradi bolezni obtočil	–	*IVZ, 2006–2008*
	Število obiskov v primarnem zdravstvu zaradi bolezni prebavil	–	*IVZ, 2006–2008*
	Število obiskov v primarnem zdravstvu zaradi bolezni mišično-skeletnega sistema in veziva	–	*IVZ, 2006–2008*
Varnost	Število obsojenih polnoletnih oseb ne glede na vrsto kaznivega dejanja	–	*SURS, 2006–2010*
	Število obsojenih polnoletnih oseb glede na kazniva dejanja zoper zakonsko zvezo, družino in otroke	–	*SURS, 2006–2010*
	Število obsojenih mladoletnih oseb ne glede na vrsto kaznivega dejanja	–	*SURS, 2006–2010*
	Število primerov samopoškodbenega vedenja	–	*SURS, 2006–2009*
	Število primerov napada na drugo osebo	–	*SURS, 2006–2009*
Starševsko varstvo	Delež otrok v vrtcih med vsemi otroki, starimi 1–5 let	+	*SURS, 2006–2009*
	Število upravičencev do dela s skrajšanim delovnim časom zaradi starševstva	+	*SURS, 2006–2009*
	Število upravičencev do očetovskega nadomestila zaradi starševstva	+	*SURS, 2006–2009*
	Število sklenjenih zakonskih zvez	+	*SURS, 2006–2010*
Socialni transferji	Število prejemnikov denarnih socialnih pomoči	–	*SURS, 2006–2009*
	Delež štipendistov med dijaki in študenti	+	*SURS, 2008–2010*
Razpoložljivost zdravstvenih in socialnih služb	Število zdravnikov	+	*SURS, 2007–2009*
	Število medicinskih sester	+	*SURS, 2007–2009*
	Število bolnišničnih postelj	+	*SURS, 2007–2009*
	Število ležišč v domovih za ostarele	+	*SURS, 2006–2009*

Tvegana vedenja	Število hudo poškodovanih v cestnoprometnih nesrečah	–	*SURS, 2006–2009*
	Število umrlih v cestnoprometnih nesrečah	–	*SURS, 2007–2009*
	Stopnja hospitalizacije zaradi samomora	–	*IVZ, 2006–2009*
	Število samomorov	–	*IVZ, 2006–2009*
	Število obravnav zaradi uživanja alkohola	–	*IVZ, 2006–2009*
	Število obravnav zaradi zlorabe drog	–	*IVZ, 2006–2009*
Poklicno zdravje	Število prijavljenih poškodb pri delu glede na delovno aktivno prebivalstvo	–	*IVZ, 2006–2009*
	Delež izgubljenih koledarskih dni na zaposlenega zaradi bolniškega staleža	–	*IVZ, 2006–2010*
	Indeks frekvence (IF) [b]	–	*IVZ, 2006–2010*
	Resnost (R) bolniškega staleža [c]	–	*IVZ, 2006–2010*
	Stopnja bolnišničnih obravnav zaradi bolezni	–	*IVZ, 2006–2009*
	Povprečno trajanje hospitalizacije zaradi bolezni	–	*IVZ, 2006–2009*
Perinatalno zdravje	Mrtvorojenost	–	*IVZ, 2007–2009*
	Delež porodnic s carskim rezom v anamnezi	–	*IVZ, 2006–2009*
	Delež novorojenčkov z nizko porodno težo (pod 2500 g) med živorojenimi	–	*IVZ, 2007–2009*
Stabilnost partnerskih zvez	Število razvez glede na število prebivalcev v posamezni regiji	–	*SURS, 2006–2010*
Razvojne možnosti	Indeks razvojne ogroženosti [f]	–	*UMAR, 2007–2010*
Demografski profil	Gostota naseljenosti	–	*SURS, 2006–2009*
	Delež živorojenih	+	*SURS, 2006–2010*
	Delež umrlih	–	*SURS, 2006–2010*
	Skupni prirast prebivalstva (naravni in selitveni prirast)	+	*SURS, 2006–2010*
	Koeficient starostne odvisnosti [d]	–	*SURS, 2006–2010*
	Indeks staranja [e]	–	*SURS, 2006–2010*
	Delež kmečkega prebivalstva	–	*SURS, 2006–2010*

Opombe:
[a] *Indeks BDP* na prebivalca primerja bruto družbeni proizvod na prebivalca regije v primerjavi s podatkom za Slovenijo v istem letu.
[b] *Indeks frekvence* odraža število primerov odsotnosti z dela zaradi bolniške odsotnosti na 100 zaposlenih v enem letu.
[c] *Resnost bolniškega staleža* je povprečno trajanje ene odsotnosti z dela zaradi bolezni, poškodbe ali drugega zdravstvenega vzroka.
[d] *Koeficient starostne odvisnosti* je razmerje med mladim (stari od 0 do 14 let) in starim (nad 65 let) ter delovno sposobnim (nad 15 let) prebivalstvom.
[e] *Indeks staranja* je razmerje med starim (stari 65 let ali več) in mladim prebivalstvom (stari od 0 do 14 let), pomnoženo s 100.
[f] *Indeks razvojne ogroženosti* je izračunan iz 11 kazalnikov (kazalniki razvitosti, razvojne ogroženosti in razvojnih možnosti) (Pečar in Kavaš 2006).
Opredelitve izrazov *a, d–f* so povzete iz podatkovnih zbirk (Internet 1), definiciji *b–c* pa iz Zdravstvenega statističnega letopisa (IVZ 2006).

3.2 Primerjava regij glede na različne ravni in področja blaginje

Slika 2 prikazuje primerjavo socialnih, demografskih, zdravstvenih, ekonomskih in okoljskih dimenzij blaginje med slovenskimi statističnimi regijami. Regije smo glede na vrednost SKB razvrstili v štiri skupine (razpon vrednosti SKB: od 7,6 do 3,3; interval 1,07) in so na sliki obarvane v različnih odtenkih oranžne barve:

- 1. skupina: Regije visoke blaginje (SKB = 7,6 do 6,52): Osrednjeslovenska regija (SKB = 7,58).
- 2. skupina: Regije zmerno visoke blaginje (SKB = 6,53 do 5,45): Goriška regija (SKB = 5,94), Obalno-kraška regija (SKB = 5,90), Gorenjska regija (SKB = 5,78) in Notranjsko-kraška regija (SKB = 5,20).
- 3. skupina: Regije zmerno nizke blaginje (SKB = 5,46 do 4,38): Savinjska regija (SKB = 4,91), Jugovzhodna Slovenija (SKB = 4,88) in Podravska regija (SKB = 4,75).
- 4. skupina: Regije nizke blaginje (SKB = 4,39 do 3,32): Koroška regija (SKB = 4,21), Spodnjeposavska regija (SKB = 4,04), Pomurska regija (SKB = 3,45) in Zasavska regija (SKB = 3,37).

Med regijami so se pokazale precejšnje razlike v blaginji, pri čemer izrazito izstopa Osrednjeslovenska regija, kot regija z najvišjo, ter Pomurska in Zasavska kot regiji z najnižjo ravnijo splošne blaginje (slika 2). V zahodnem delu Slovenije se je oblikovala skupina regij z višjimi ravnmi splošne blaginje (Osrednjeslovenska, Goriška, Obalno-kraška in Gorenjska regija) in v vzhodnem delu skupina regij z najnižjimi ravnmi splošne blaginje (Podravska, Koroška, Spodnjeposavska, Zasavska in Pomurska regija). V regijah z višjo ravnijo splošne blaginje se pojavlja tudi višja raven blaginje na skoraj vseh drugih področjih. Prebivalci v teh regijah imajo višjo izobrazbo, več dohodka, prebivajo v boljših stanovanjskih in okoljskih razmerah, imajo tudi več zaposlitvenih možnosti in boljše razmere glede starševskega varstva. Hkrati so to regije z večjimi možnostmi za razvoj in iz ugodnejšim demografskim profilom.

Slika 2: Primerjava slovenskih regij glede na različne ravni in področja blaginje.
Glej angleški del prispevka.

3.3 Primerjava regij glede na temeljne kazalnike blaginje, povezane z zdravjem

Primerjava regij glede na raven blaginje področij, povezanih z zdravjem, je pokazala, da se v regijah visoke in zmerno visoke blaginje odraža tudi na splošno višja raven blaginje na področju splošnega, poklicnega in perinatalnega zdravja ter razpoložljivosti zdravstvenih in socialnih služb (primerjava stolpcev na sliki 2; višje vrednosti dimenzij v sklopu SKB v preglednici 2). Preverili smo tudi, kako se po regijah razvrščajo nekateri izbrani temeljni kazalniki blaginje, povezani z zdravjem. Ker se blaginja na področju zdravja lahko povezuje tudi z uživanjem drog in alkohola, samomorilnim vedenjem in poškodbami v cestnoprometni nesrečah, smo vključili tudi kazalnike, ki sestavljajo dimenzijo blaginje *tvegana vedenja* (preglednica 2).

V preglednici 2 lahko vidimo, da splošna raven blaginje ne odraža vedno blaginje na posameznih področjih v določeni regiji. Tako se Osrednjeslovenska regija (regija visoke blaginje glede na vrednost SKB) pri večini temeljnih kazalnikov uvršča na mesta, ki jih lahko povezujemo z večjo blaginjo, vendar pa se v primerjavi z ostalimi regijami na področju zdravja pojavljajo tudi nekatera odstopanja, npr. najvišja stopnja hospitalizacije zaradi bolezni, dokaj visok delež novorojenčkov z nizko porodno težo, večje število obravnav zaradi zlorabe drog in več huje poškodovanih v cestnoprometnih nesrečah. Takšna odstopanja lahko opazimo tudi v drugih regijah. V Zasavski regiji (z najnižjo ravnijo splošne blaginje) prevladuje nizka raven blaginje na področju zdravja, vendar pa izstopa v primerjavi z ostalimi regijami z relativno dobrim stanjem na nekaterih področjih, kot so npr. najmanj obiskov v primarnem zdravstvu zaradi bolezni mišično-skeletnega sistema in veziva in manj hudo poškodovanimi v cestnoprometnih nesrečah, manj mrtvorojenimi otroci in z relativno dobro razpoložljivostjo ležišč v domovih za ostarele.

4 Razprava

Za merjenje blaginje so še do nedavnega prevladovali pristopi, ki so kot približek ocene blaginje uporabljali bodisi makroekonomske statistike, kot je npr. BDP, bodisi subjektivne presoje ljudi o njihovem zadovoljstvu s kakovostjo življenja. Izkazalo se je, da subjektivne presoje blaginje v okviru mednarodnih in medregijskih primerjav niso zanesljive, saj jih močno pogojuje na eni strani kulturni kontekst in na drugi različni psihološki dejavniki (Diener 2000). Zato se na področju merjenja blaginje vse bolj uveljavlja metoda sestavljenih kazalnikov (Matthews 2006; OECD 2011), ki smo jo uporabili tudi v predstavljeni raziskavi.

Kljub temu, da je v okviru mednarodnih primerjav Slovenija obravnavana kot homogena regionalna enota, pa številne domače ekonomske, geografske, sociološke, antropološke in zdravstvene študije kažejo, da se na ravni njenih teritorialnih enot (občin, statističnih regij) pojavljajo velike razlike in posebnosti, ki se posledično izkazujejo tudi v dostopu do storitev in blaga ter infrastrukture, v ekonomskih in zaposlitvenih možnostih, v dostopnosti in razpoložljivosti zdravstvenih ter socialnih storitev in drugje (Nared 2002; Bole 2004; Ravbar, Bole in Nared 2005; Nared 2007; Bole 2008a, Bole 2008b; Dernovšek in Šprah 2008; Bole 2011; Ravbar 2011; Knežević Hočevar 2012; Korenič in Mavec 2012). V različnih mednarodnih študijah ostajajo te razlike in posebnosti Slovenije neopažene, saj so podatki agregirani na državni ravni. To lahko razberemo tudi iz izsledkov študije OECD (2011), v kateri so s pomočjo interaktivnega orodja merjenja blaginje opravili mednarodno primerjavo blaginje v državah članicah OECD. Slovenija je med 34 članicami OECD zasedla skupno 21. mesto. Pri nekaterih dimenzijah blaginje se je uvrstila blizu povprečja držav OECD (zdravje, vključenost v družbo), ali celo višje (zaposlenost, osebna varnost), pod povprečje držav OECD pa je zdrsnila pri dimenzijah stanovanje in zadovoljstvo z življenjem (Internet 2).

V prispevku nas je zanimala raven blaginje v statističnih regijah Slovenije, kot jo omogoča prilagojena metodologija OECD kazalnikov. Rezultati so pokazali, da se regije glede na splošno raven blaginje, opredeljeno s srednjo vrednostjo SKB, med seboj zelo razlikujejo, saj je bil razpon vrednosti SKB med regijami precejšen, od 7,58 do 3,37. Posebej je zanimivo stanje blaginje na področju zdravja, ki v nekaterih regijah odstopa od stanja splošne blaginje. Ujemanje ocen splošne blaginje in blaginje na področju zdravja potrjuje spoznanje, da visoka raven blaginje sovpada z gospodarsko in socialno bolje razvitimi urbanimi središči, vendar pa neujemanje teh ocen v nekaterih regijah tudi opozarja na to, da se ugodne

Preglednica 2: Izbrani temeljni kazalniki za različna področja blaginje, povezana z zdravjem.

PODROČJE BLAGINJE	VREDNOST DIMENZIJE V SKB*/ TEMELJNI KAZALNIK	OS	GR	OB	GO	NO	SA	JV	PD	KO	SP	PO	ZA
		regija visoke blaginje	*regije zmerno visoke blaginje*				regije zmerno nizke blaginje			regije nizke blaginje			
Splošno zdravje	*Vrednost dimenzije v SKB*	*7,8*	*4,4*	*4,8*	*6,4*	*5,7*	*5,2*	*5,3*	*4,7*	*3,7*	*4,2*	*1,1*	*0,9*
	Število zdravniških receptov na prebivalca	7,1	7,0	7,1	7,0	7,9	8,1	7,7	8,6	7,9	8,6	9,1	8,7
	Stopnja hospitalizacije zaradi bolezni	110,3	151,0	159,2	128,6	114,2	146,6	128,4	130,7	151,7	145,0	165,7	149,6
	Število obiskov v primarnem zdravstvu zaradi duševnih in vedenjskih motenj	38	48	44	44	52	39	41	45	45	37	56	57
	Število obiskov v primarnem zdravstvu zaradi bolezni mišično-skeletnega sistema in veziva	181	211	234	217	214	223	196	215	247	198	233	181
Poklicno zdravje	*Vrednost dimenzije v SKB*	*6,5*	*7,2*	*4,9*	*5,4*	*6,5*	*2,6*	*4,6*	*4,9*	*2,3*	*5,3*	*3,4*	*0,3*
	Število prijavljenih poškodb pri delu	23,4	29,3	20,2	29,0	29,6	36,2	31,8	29,9	35,8	26,6	22,8	30,7
	Delež izgubljenih koledarskih dni na zaposlenega zaradi bolniškega staleža	3,82	3,83	4,75	3,84	4,93	4,74	4,54	4,33	4,69	4,14	4,60	5,30
	Indeks frekvence (IF)[a]	82,2	117,6	102,4	81,2	118,6	76,9	84,9	82,0	76,1	88,6	74,8	62,0
	Resnost (R) bolniškega staleža[b]	17,1	11,9	17,0	17,3	15,2	22,5	19,5	19,3	22,6	17,0	22,7	31,3
	Stopnja bolnišničnih obravnav zaradi bolezni	110,3	151,0	159,2	128,6	114,2	146,6	128,3	130,7	151,7	145,0	165,7	149,6
	Povprečno trajanje hospitalizacije zaradi bolezni	8,94	7,85	6,98	7,96	8,80	7,25	8,63	8,36	6,91	7,69	7,51	8,70
Perinatalno zdravje	*Vrednost dimenzije v SKB*	*4,2*	*6,3*	*5,5*	*5,7*	*5,9*	*4,4*	*2,3*	*2,8*	*3,3*	*3,5*	*3,9*	*6,1*
	Mrtvorojenost	4,8	3,0	4,7	4,0	3,6	5,5	8,0	6,2	5,2	6,9	6,2	3,7
	Delež porodnic s carskim rezom v anamnezi	5,0	6,4	5,3	4,7	5,9	4,2	4,5	5,6	4,6	5,2	5,6	5,8
	Delež novorojenčkov z nizko porodno težo (pod 2500 g) med živorojenimi	6,6	5,7	5,8	5,8	6,3	5,7	6,9	7,5	6,9	6,7	6,3	6,2
Tvegana vedenja	*Vrednost dimenzije v SKB*	*6,8*	*5,1*	*6,7*	*4,8*	*6,0*	*4,3*	*5,4*	*5,0*	*3,4*	*3,4*	*3,3*	*0,1*
	Število hudo poškodovanih v cestnoprometnih nesrečah	6,0	5,2	7,3	6,0	6,2	6,0	5,8	5,3	4,9	4,7	5,4	2,4
	Število umrlih v cestnoprometnih nesrečah	0,9	1,1	1,0	0,9	1,6	1,3	1,4	1,2	1,0	0,9	1,4	1,0
	Stopnja hospitalizacije zaradi samomora	0,08	0,20	0,22	0,25	0,09	0,35	0,22	0,21	0,42	0,11	0,23	0,57
	Število samomorov	1,8	2,0	1,8	1,4	1,6	2,7	2,3	2,7	2,7	2,9	2,7	2,7
	Število obravnav zaradi uživanja alkohola	19,5	28,9	18,0	30,6	27,8	26,4	24,0	23,2	27,4	33,9	31,1	36,2
	Število obravnav zaradi zlorabe drog	7,1	7,2	7,7	7,0	6,6	6,8	6,3	4,3	4,7	6,5	28,6	9,1
Razpoložljivost zdravstvenih in socialnih služb	*Vrednost dimenzije v SKB*	*9,6*	*6,6*	*7,0*	*5,2*	*1,7*	*5,6*	*4,6*	*6,9*	*5,9*	*3,3*	*5,9*	*3,7*
	Število zdravnikov	41,6	17,3	22,7	20,2	10,2	18,6	18,8	22,8	19,4	13,6	16,5	14,9
	Število medicinskih sester	98,0	61,8	80,8	85,4	39,3	72,8	67,5	81,4	83,5	54,4	84,8	60,5
	Število bolnišničnih postelj	72,9	57,2	57,7	33,6	10,6	45,0	26,1	55,3	48,1	18,1	37,1	27,4
	Število ležišč v domovih za ostarele	46,3	30,0	37,8	51,0	66,8	46,5	50,3	40,3	54,0	54,3	37,0	64,0

Okrajšave: *SKB – sestavljeni kazalnik blaginje; OS – Osrednjeslovenska regija; GR – Goriška regija; OB – Obalno-kraška regija; GO – Gorenjska regija, NO – Notranjsko-kraška regija; SA – Savinjska regija JV – Jugovzhodna Slovenija; PD — Podravska regija; KO – Koroška regija; SP – Spodnjeposavska regija; PO – Pomurska regija; ZA – Zasavska regija.

Opombe: [a] *Indeks frekvence* odraža število primerov odsotnosti z dela zaradi bolniške odsotnosti na 100 zaposlenih v enem letu.

[b] *Resnost bolniškega staleža* je povprečno trajanje ene odsotnosti z dela zaradi bolezni, poškodbe ali drugega zdravstvenega vzroka.

življenjske in okoljske razmere občin ne odslikavajo vedno tudi v njihovi gospodarski in družbeni razvitosti (Malešič, Bregar in Rovan 2009, 47 in 51).

Posebno pozornost smo namenili zdravju kot pomembni komponenti družbene blaginje in vpliva na kakovost življenja prebivalcev. To dokazujejo tudi različne mere gospodarskega razvoja (Suhrcke in ostali 2006; Buzeti in ostali 2011, 17–28), v katerih se pojavlja vedno širši nabor kazalnikov zdravja. Še zlasti v luči trenutne gospodarske krize lahko na področju javnega zdravja zasledimo, da bo problematika duševnih motenj v času trajanja krize še posebej aktualna (WHO 2011). Novejše mednarodne in domače raziskave namreč že poročajo o porastu samomorilnega in nasilnega vedenja, povečani zlorabi drog in alkohola ter višji incidenci depresivnih in anksioznih motenj razpoloženja, ki jih med drugim povezujejo tudi s splošno družbeno negotovostjo, izgubami zaposlitev ter poglabljanjem socialnih in ekonomskih razlik med različnimi prebivalstvenimi skupinami (Levy in Sidel 2009; Avčin in ostali 2011; Mikulić, Sándor in Leoncikas 2012). Zato bo pri bodočem načrtovanju in izvajanju socialnih in zdravstvenih politik potrebno poznati tudi regionalne razlike in z njimi povezane kulturne razlike, slednje imajo velik vpliv na regionalni razvoj (Urbanc, Boesch in Jelen 2007; Razpotnik, Urbanc in Nared 2009). Le tako bomo sledili ciljem različnih strateških usmeritev za zagotavljanje blaginje in zdravja vsem prebivalcem Slovenije.

5 Sklep

V prispevku smo predstavili raziskavo blaginje v slovenskih regijah s pomočjo metodologije sestavljenih kazalnikov. Pri tem smo izhajali iz metodoloških priporočil OECD, a vključili le objektivno merljive kazalnike blaginje. Posebno pozornost smo namenili področju blaginje, povezane z zdravjem, kjer smo preučili regionalne razlike na področju splošnega, poklicnega in perinatalnega zdravja, tveganih vedenj ter razpoložljivosti zdravstveno socialnih storitev. Izsledki raziskave razkrivajo dokaj heterogeno sliko blaginje v slovenskih regijah, saj se med nekaterimi regijami kažejo precejšnje razlike v razvitosti, v življenjskem standardu kot tudi na področju zdravja prebivalcev. Izstopa Osrednjeslovenska regija kot regija z najvišjo ravnijo blaginje. V zahodni Sloveniji prevladujejo regije zmerno visoke blaginje (Goriška, Obalno-kraška in Gorenjska regija), medtem ko vzhodni del Slovenije geografsko zaokrožajo regije z najnižjimi ravnmi blaginje (Koroška, Spodnjeposavska, Pomurska in Zasavska regija).V prihajajočem obdobju svetovne krize se bodo verjetno razlike še dodatno poglobile.

Blaginja, povezana z zdravjem, je v slovenskih regijah precej različna. Ker je dobro zdravje populacije pomembno tako za zmanjševanje revščine kot za dolgoročni razvoj družbe in dviganje splošne blaginje v družbi, je še posebej pomembno, da država deluje v smeri zmanjševanja razlik med regijami. Zato bo treba v bodoče posvetiti več pozornosti geografsko razčlenjenim podatkom. Le poznavanje regionalnih posebnosti bo omogočilo učinkovito načrtovanje in izvajanje ukrepov na področju ekonomskih, socialnih, okoljskih in zdravstvenih politik.

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7 Literatura

Glej angleški del prispevka.

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SOME OLDER SOURCES FOR CROATIAN EXONYM ANALYSIS

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Part of the map of Australia from the Geographical Atlas (1955) showing that many geographical names were domesticated then.

Some older sources for Croatian exonym analysis

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ABSTRACT: The article introduces the review of some older sources in the Croatian language that might be useful for the Croatian exonym analysis, and may also refer to the exonym status it the context of the Croatian language development and geographers' indifference concerning that issue. Because of frequent changes in orthography, geographical names (as well as exonyms) have experienced different modifications, which can be followed through eight analyzed editions published during the period from 1880 to 1974. It was indicated that geography as a profession has greatly failed in serious research of exonyms.

KEY WORDS: geographical names, exonyms, Croatian language, orthography, geography, Croatia

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1 Introduction

Avoiding the current discussions and dilemmas of the definition and division of endonym and exonym terms, by the term exonym in this article we refer to *»the name that is used in a language for the geographical object that is situated outside the area in which the language is widely spoken (and most frequently has the official status), and the name itself is significantly different from its original, endonymic form used in the area where the object is situated (and/or in the area where this language has no official status)«* (modified according to: Kadmon 2002, 2006; Woodman 2003; Kladnik 2007a, 2007b, 2007c, 2007d, 2009; Jordan 2007). Exonyms, which are also known by other terms such as domesticated or Croatized geographical names, together with the original geographical names of objects situated outside the Croatian speaking area belong to a wider group of geographical names that we can tentatively put under the common denominator of »foreign« geographical names (Kladnik 2007c, 23; in Croatian *strana* or *tuđa geografska imena*). The aim of this article is to make a review of some older sources for the Croatian exonym analysis, and also to provide the insight into a broader context of the Croatian language development, especially its orthographic rules, as well as to trace the geographers' indifference concerning systematic exonymic research. The purpose of this article is to make the analyzed sources the basic groundwork for drafting the list of standardized Croatian exonyms.

2 The methodology

The chronological approach and text analysis of the names mostly situated on the maps have been used in this research. Eight representative geographical sources, atlases and lexicons have been singled out. Similarly, Drago Kladnik has reviewed and examined Slovenian exonyms and the results have been published in his book *Podomačena tuja zemljepisna imena v slovenskih atlasih sveta* (»Adapted exonyms in Slovenian world atlases«, 2007b). Not only have the principal bibliographical data of every publication been introduced in the research process, but also the way of writing geographical names has been emphasized, i.e. exonyms, emphasizing the representative examples and theirs singularities. Since the analyzed editions were published between the 1880s, when the first such books appeared in the Croatian language, and 1970s, when the mass production of atlases and similar books mostly based on the translation of foreign books began to appear, this almost one century long period has been divided into four periods, depending on the temporarily dominant language politics. Apart from that, we follow the development of geography in Croatia, so we could attain the answer to the question why during this long period of time there were only few prominent Croatian geographers who very rarely addressed the issue of writing and using the exonyms in their abundant professional work.

3 Crossing the centuries: 19th to 20th century

The status of the Croatian language from the second half of the 19th century till World War I was characterized by the struggle of four philological schools (Pranjković, 2009: 4). Contemporary orthographies mostly followed the tradition of the Zagreb philological school, which advocated the position that geographical names should be written according to the etymological, i.e. morphological principle. The pivotal characteristic of that principle is that one should not write the phonemes that are actually spoken, but should keep the root (etymon) of the word. For example, *Francuz – Francuzka* (French – France), *Norvežanin – Norvežka* (Norwegian – Norway), *Englez – Englezka* (Englishman – England) (Barić et al. 2003, 28). The followers of the other school, named Vuk's school, issued *Hrvatski pravopis* (»Croatian Orthography«) written by Ivan Broz, which was an important one because it was advocating the idea of *»Piši kako govoriš!«* (»Write as you speak!«: Internet 1). It was the first orthography in Croatia that became obligatory for all schools. It was based on the phonological principle, but in its usage there were no extremes. Due to the lack of orthographical unity it is no wonder that we can find the reflection of mixed orthographical rules in many sources produced in that period.

The first analyzed source named ***Slike iz obćega zemljopisa*** (»The Images from General Geography«) was published in six volumes from 1888 to 1900. Nineteen European countries were described in great

Figure 1: Map of Switzerland from The Images from General Geography showing exonymic forms of geographical names for lakes.

detail there. The books were written by Ivan Hoić who addressed mostly geographical and historical themes in his professional career. Methodologically, Hoić followed the contemporary German geographical school – »the classical school«, as we call it today (Hrvatska enciklopedija, vol. 4, 606; Hrvatski biografski leksikon, vol. 5, 603–604). The mentioned volumes were issued during the period that is considered very important for the development of Croatian geography, i.e. not long after its institutionalization on the Faculty of Philosophy in Zagreb in 1883. From that moment on the first voluminous books and geographical studies about the Croatian land written by Croatian authors were being published (Feletar 1993, 6–11; Pepeonik 1996, 12–13; Magaš 2006). Producing these six volumes with dominantly geographical themes in the Croatian language was therefore a very serious and important event in the first years after the foundation of geography as an institutionalized science.

Concerning the topic of writing geographical names, Hoić has very often used Croatized names, e.g. *Francuzka* (France), *Spljet* (Split), *Marselj* (Marseille), *Portugalska* (Portugal), *Mletci* (Venice), *Iztočna Rumelija* (East Rumelia), *Genovezki zaliv* (the Genoa Bay), *Bielo more* (the White Sea), *Osiek* (Osijek), *Bukarešt* (Bucharest), *Budapešta* (Budapest), *Bruselj* (Brussels), *Jermenija* (Armenia), *Bristolski kanao* (the Bristol Channel). On the other hand, some geographical names for which we nowadays usually use Croatized, domesticated forms, were then written in the forms more similar to the original ones, e.g. *Athena* (originally Athína, English Athens), the state of *Algir* (originally al-Jazā'ir, English Algeria), *Oporto* (originally and in English Porto), *Firenza* (originally Firenze, English Florence). That is the outcome of a started but not yet finished process of geographical names domestication. However, concerning the fact that Hoić applied a very courageous approach of domesticating many still unaccepted geographical names, we can consider his books one of the earliest comprehensive sources for the Croatian exonym analysis.

4 Between the two world wars

During the period between 1918 and 1941 many Croatian writers were impressed by the new Yugoslav enthusiasm and therefore started writing in ekavian pronunciation, but most of them returned to ijekavian pronunciation at the beginning of the 1920s. As part of strong endeavors in unifying the Croatian and Serbian standard languages, *Pravopis srpskohrvatskog jezika* (»Serbo-Croatian Orthography«) by

Aleksandar Belić was officially introduced (Barić et al. 2003, 34–35). In wider usage there was also *Pravopisno uputstvo za sve osnovne, srednje i stručne škole Kraljevine SHS* (»Orthographical Instructions for all Primary, Secondary and Professional Schools in the Kingdom of Serbs, Croats and Slovenens«) issued in 1929, according to which the names should be written phonetically or originally, the latter in the cases where the pronunciation of names was very distinct from the original versions. However, the frequency of usage of the mentioned rules in practice is evident from the following sources.

Leksikon Minerva – praktični priručnik za modernog čovjeka (»Minerva Lexicon – a Practical Handbook for a Modern Man«) was the second source we analyzed. In its preface the *Lexicon* is introduced as »*… not only the first ours, but also generally the first lexicon in the Slavic South …*« It was published in 1936. In 1583 pages the *Lexicon* contains 54 000 terms and 8 maps, 2297 illustrations and 38 tables.

Due to a rather vague explanation of rules for writing geographical names, in the *Lexicon* we can find many variants of geographical names. For example, we can find country names such as: *Nicaragua, Costarica, Colombija* (Columbia), *Chile, Bolivia, Uruguay, New Zealand, Romania, Španija* (Spain), *Abesinija* (the Ethiopian Empire, Abyssinia) or *Canada*, from which we can conclude that some country names had already gained their Croatian form, while others had not. We can also notice different hybrids in the names of seas, oceans, channels, mountains or regions: *Koralno more* (the Coral Sea), *Arafura more (the Arafura Sea), Tasman-more* (the Tasman Sea), *Banda-more (the Banda Sea)*, *Bassov put* (the Bass Strait), *Cookov put* (the Cook Strait), *Hudson Bay, Tripolitanija* (Tripolitania), *Grønland* (Greenland), or *Alaska,* so it seems that many geographical names had not been totally Croatized yet. The result was the appearance of a sort of semi-Croatized mixed names that consisted of a translated appellative, and not translated proper names, i.e. left in their original form, such as: *Barents-more* (the Barents Sea), *Timor-more* (the Timor Sea), *Ural-gorje* (the Ural Mountains).

The first comprehensive world atlas in the Croatian language, ***Minervin svjetski atlas*** (»Minerva's World Atlas«) was published in 1938. The editors were the geographers Filip Lukas and Nikola Peršić. Filip Lukas was a geographer, but also historian and theologian. He was especially interested in geopolitics, and was

Figure 2: On the map of Australia and Oceania from the Minerva's World Atlas we can notice semi-Croatized forms of some sea names.

Figure 3: In Minevra's World Atlas the process of exonymization partly overtook country names, which is seen on the example of South America.

addressing the topics within economic, regional and political geography, as well as lexicography (Hrvatska enciklopedija, vol. 6, 680–681; Magaš 2007, 157). Nikola Peršić was practising both economic geography and demography (Magaš 2007, 157). Both of them were professionally engaged in the period between the two world wars, when the number of published books dealing with geographical issues significantly increased. However, these books were mostly foreign ones. Only in the later years of that period some Croatian geographers distinguished themselves from the others (Feletar 1993, 11–12; Pepeonik 1996, 13; Magaš 2006).

Minervin svjetski atlas includes 169 textual pages and 50 colored maps (i.e. 110 main and »auxiliary« maps); it offers an overview of the world on the eve of World War II. In the last pages of the book there is a very detailed and systematic geographical names index, which makes this atlas an extremely alluring source for the exonym analysis.

Concerning writing exonyms, in the preface we can read: »*A small number of names of large towns and rivers for which we have traditional domesticated names (such as:* Beč *(Vienna, author's comment),* Rim *(Roma, author's comment),* Mleci *(Venice, author's comment),* Rajna *(the Rhine, author's comment),* Laba *(the Elbe, author's comment) and so on), are being left as they are, together with the original names in the parentheses, for example* Beč (Wien).« Lukas and Peršić pointed out that »*… despite our best will, somewhere … we had to recede from some principles for many reasons, because the absolute consistency would often be unsuitable.*«

5 Period of the ISC (1941–1945)

As an opposition to the Yugoslav linguistic trends, whose main tendency was homogenization of the languages during the period between the two world wars, in the period of the Independent State of Croatia (ISC) the old Croatian linguistic tradition and reimplementation of the orthography based on keeping the root of the word came into life again. This time the morphological principle was applied literally (Barić et al. 2003, 35). Namely, the new government of the »ustaša« wanted to remove »*… all Serbized words* *imposed between 1918 and 1941 …«* (Samardžija 2008, 43). The most important document of the linguistic politics was *Zakonska odredba o hrvatskom jeziku, o njegovoj čistoći i o pravopisu* (»Legal Regulation of the Croatian Language, Its Purity and Orthography«; Samardžija 2008, 45). New *Hrvatski pravopis* (»Croatian Orthography«) by the authors Franjo Cipra and Adolf Bratoljub Klaić was also written in 1944.

The reference source for this period was ***Poviestni zemljopis Evrope*** (»A Historical Geography of Europe«). It is a translation of the original *An Historical Geography of Europe* by the author Gordon East published in 1944, with the index of geographical names in the end of the book. It is one of the oldest translated books of historical and political geography. Since there is a considerable lack of maps in the book, geographical names mainly appear in the textual part. It was noticed that the exonymic forms of the names were used in large extent, such as: *Kampanja* (Campania), *Tiber* (the Tiber), *Eufrat* (the Euphrates), *Andaluzija* (Andalusia), *Galipolje* (Gallipoli), *Mađarska* (Hungary), *Bavarija* (Bavaria), *Ženevsko jezero* (Lake Geneva), *Daleki Iztok* (the Far East), *Englezka* (England), *Flandrija* (Flanders), *Katalonija* (Catalonia), *Solun* (Thessaloniki), *Šlezija* (Silesia), but we can also find semi-Croatized names such as *Macedonija* (Macedonia) or *Toscana* (and *Toskana*; Tuscany). Since the root based orthography was being literally applied, many geographical names from this source look very archaic from today's viewpoint, e.g. *Englezka* (modern Engleska; England), *Francuzka* (modern Francuska; France), *Norvežka* (modern Norveška; Norway).

6 After World War II

After reaching the so called »Novi Sad Agreement« in 1954, the Croatian language became equal and united with the Serbian and Montenegrin languages (Barić et al. 2003, 35). A mutual orthography was issued in 1960, based on the phonological principle according to *Pravopis hrvatskosrpskoga književnog jezika* (»Orthography of the Serbo-Croatian Standard Language«) from 1958.

Conceived in this way, the unity of language, together with the »Novi Sad Agreement« and new orthography, were rejected by the »Declaration on Language« (full name »The Declaration on the Status and Name of the Croatian Standard Language«) from 1967, the outcome of which was the appearance of *Hrvatski pravopis* (»Croatian Orthography«) by the authors Stjepan Babić, Božidar Finka and Milan Moguš in 1971. Besides some others, we have used this orthography handbook till today. Although it especially accentuates the problems of writing exonyms, its main disadvantage is that while explaining the ways of writing exonyms, there are just a few examples for it, and those are generally the uncontested ones. For instance, on page 69 of the 1994 edition as the examples of region names and country names there are: *Albanija* (Albania), *Austrija* (Austria), *Bavarska* (Bavaria), *Bugarska* (Bulgaria), *Češka* (the Czech Republic), *Danska* (Denmark), *Engleska* (England), *Etiopija* (Ethiopia), *Grčka* (Greece), *Indija* (India), *Irska* (Ireland) … while disputable names such as *Kapverdski Otoci* (Cape Verde), *Maldivi* (the Maldives), *Mijanmar* (Myanmar) are not even mentioned, which leaves room for arbitrary interpretations of writing geographical names that are not given in the book (Crljenko, Klemenčić 2011, 108).

In the analysis, this period is primarily represented by ***Geografski atlas i statističko-geografski pregled svijeta*** (»Geographical Atlas and Statistical-Geographical Overview of the World«). We have analyzed its fourth edition from 1955; the first edition was issued in 1951. The editors were Petar Mardešić and Zvonimir Dugački, while the technical editor of the maps was Josip Zoričić. Petar Mardešić was a sailor, lexicographer, cartographer and publisher. He was a contributor to the *Pomorska enciklopedija* (»Naval Encyclopaedia«), and also the editor-in-chef of many atlases published by the Lexicographical Institute (Hrvatska enciklopedija, vol. 7., 58; Magaš 2007, 158). Prior to all his interests, Zvonimir Dugački was a geographer and cartographer. He was addressing the themes within the anthropogeography and regional geography and was also an author of many geographical and historical school maps (Hrvatska enciklopedija, vol. 3, 292; Hrvatski biografski leksikon, vol. 3, 659–660; Magaš 2007, 157). The productive scientific and professional work of both editors was accomplished in the period of a serious consolidation in the organization of Croatian geography, i.e. its actual shifting to the Faculty of Science. By doing so, new, more favorable conditions for its literature enrichment appeared (Feletar 1993, 12–16; Pepeonik 1996, 13–17; Magaš 2006). Apart from that, the Lexicographical Institute of the Federal People's Republic of Yugoslavia was established in 1950, which made a stable foundation for a serious scientific and professional lexicographical work based on the merits. Besides Mardešić and Dugački, some other prominent geographers were also permanent contributors with the Institute, such as: Oto Oppitz, Josip Roglić, Ivan Rubić, Veljko Rogić.

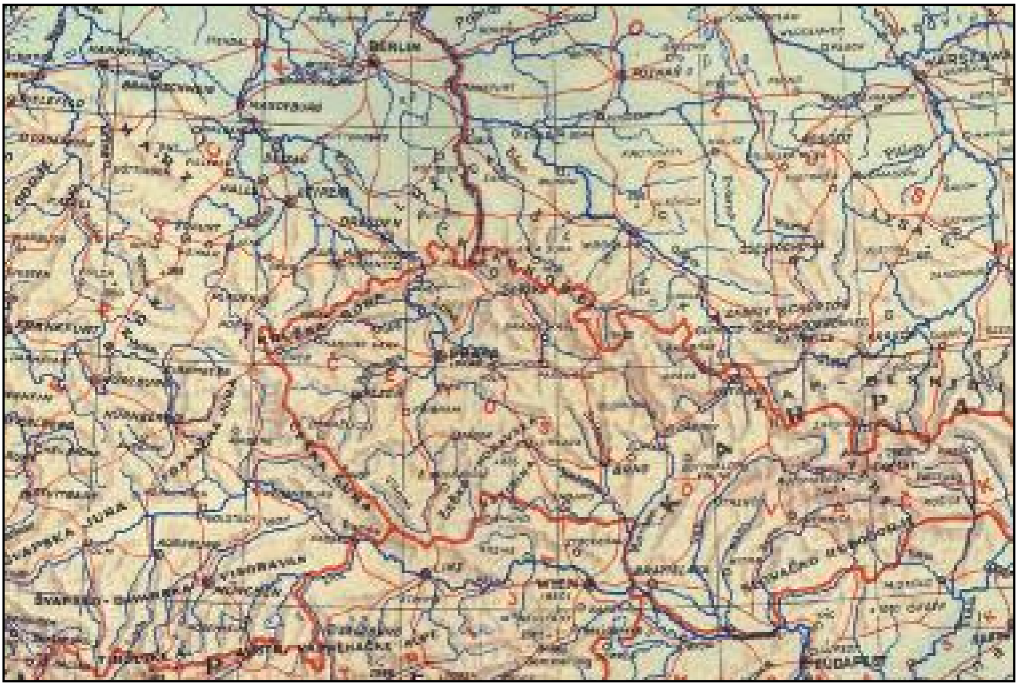

Figure 4: Map of Central Europe in the Geographical Atlas and Statistical-Geographical Overview of the World showing the unequal status of domesticated town names in respect to the original names.

In their lexicographical work they all surely had to address the problems of writing exonyms. Therefore since then geographers started to think of exonyms as a serious topic, at least of the issues concerning their usage on maps and in texts.

Geografski atlas i statističko-geografski pregled svijeta includes 50 colored general geographical maps and an alphabetical index of geographical names in the end of the book. By comparing the maps, it was observed that in some cases geographical names were written exclusively in their exonymic forms, such as *Prag* (Prague), *Beč* (Vienna), *Budimpešta* (Budapest), while in some other cases both forms were used, e.g. *Atene (Athinai*; Athens), *Rim (Roma;* Rome), *Praha (Prag;* Prague), *Warszawa (Varšava;* Warsaw). Such a situation gives us the right to imply that the makers of the maps had many difficulties in the implementation of rules for writing geographical names in practice. Nevertheless, exonyms began to be used in larger extent than before. For example, *Kalifornija* (California) was written in its exonymic form back then, so that it could later be written as *California*, and again *Kalifornija.* On the map of the United States of America, on the other hand, we could find rendered names for *Južna* (South) and *Sjeverna Karolina* (North Carolina), but also *Texas* and *New Mexico*, and a mixed name between an endonym and a full exonym *Virginija* (Virginia). As opposed to the still disputable names of regions, federal states and towns, the names of seas and bays gained their full adjectival forms.

The next examined source was ***Enciklopedija Leksikografskog zavoda*** (»Encyclopaedia of the Lexicographical Institute«). For the purpose of this analysis we have reviewed its first edition, which was published in seven volumes between 1955 and 1964. Two longtime Institute associates were involved in the process of making this *Encyclopaedia,* Oto Oppitz and Veljko Rogić, as the chief geographical editors. Oto Oppitz was a geographer and lexicographer, a physical geographer by vocation. He was also a permanent contributor and editor in many geographical and cartographical editions published by the Institute, such as *Pomorska enciklopedija* (Hrvatska enciklopedija, vol. 8, 112).Veljko Rogić is a geographer whose interests are mostly connected with regional, historical and political geography (Hrvatska enciklopedija, vol. 9, 396; Magaš 2007, 185).

The analysis of exonyms showed that most hydronyms and some (but not all!) names of regions were Croatized, for example Australian federal states *Novi Južni Wales* (New South Wales) and *Zapadna Australija* (Western Australia). A portion of the Croatized geographical names in *Enciklopedija*, similarly as in the other Institute's editions issued in the 1950s and 1960s, can be considered very remarkable compared to the publications that followed. Whether intuitively, whether because of the general internationalization and therefore increased necessity for the endonym use, and probably under the influence of a better familiarity of map makers with the global trends in the development of the exonym idea (especially concerning the 29th resolution of the Second UN Conference on the Standardization of Geographical Names held in 1972; Internet 2), a portion of exonyms in the following editions considerably decreased.

Oto Oppitz and Petar Mardešić were the chief editors of the first edition of ***Atlas svijeta*** (»World Atlas«) published by the Lexicographical Institute of the Federal People's Republic of Yugoslavia in 1961. There are 200 pages of geographical maps and an index that includes about 51 000 geographical names in the end of the book.

The exonym analysis in *Atlas svijeta* implicated that exonyms were used in a large extent. When being the oikonyms, exonyms had an advantage over the endonyms, so they were written on the place with larger fonts and then the endonyms followed, written in the parentheses in smaller fonts, e.g. *Beč (Wien*; Vienna*)*, *Budimpešta (Budapest), Prag (Praha;* Prague). This kind of practice was abandoned later, so in the latest edition (7th edition) the practice is reversed.

The last reviewed source was ***Veliki atlas svijeta*** (»Great World Atlas«), which was issued in 1974 as both Slovene and Croatian (Serbian) volume. The editor-in-chief for the Croatian edition was a geographer, author and editor of the school literature and atlases Alfonso Cvitanović (Hrvatski biografski leksikon, vol. 2, 773–774). *Veliki atlas svijeta* offers the abundance of general geographical maps and thematic maps, as well as a textual and tabular appendix for the entire world, continents, parts of the world and countries. The book ends with an index of geographical names.

A whole chapter in the *Atlas*, the one between pages 392 and 399, is devoted to geographical names, which was not the case before. In that chapter the editor explains the major problems of writing and reading geographical names in great detail. That is the reason why this text might be considered as one of the most

Figure 5: Domesticated names of seas, bays, islands and mountains on the map of North America in the World Atlas.

influential texts about the aforementioned topic. Not only does he argue the key dilemma of the map and atlas makers (whether to adopt the original name, and if so which one, or to accept the name that is domesticated), but he also refers to the international practice of treatment of geographical names, and emphasizes the problems of inconsistent writing of geographical names, the problems that are discussed even today (see more in: Crljenko 2008). The latter is the result of an absence of scientifically embedded body that would be engaged in the issues of geographical nomenclature (Cvitanović's criticism was initiated in 1974!) (see more in: Faričić 2003; Crljenko 2008). In the exonym-endonym relation he gives priority to endonyms (on maps the exonyms are written in the parentheses, e.g. *Roma (Rim*; Rome), *Napoli (Napulj;* Naples), *Trieste (Trst)*).

Cvitanović also accentuates the problem of inconsistency of our orthography (he was using *Pravopis hrvatskog književnog jezika* (»Orthography of the Croatian Standard Language« from 1960), the problem that is being alerted to even today (Crljenko 2012). The insight into the mentioned orthography handbook makes him wonder: »*… why should we exclude 'only domesticated names such as* Prag *(Prague, author's comment),* Varšava, *(Warsaw, author's comment),* Poznanj *(Poznan, author's comment),* Laba *(the Elbe, author's comment),* Odra *(the Oder, author's comment) and so on'?… Why should we render the name* Teutoburška šuma *(the Teutoburg Forest, author's comment), and use an untranslated name Schwarzwald?… In such cases the explanation that 'these names were adapted to our language ages ago', which we can find in the orthography book, does not help.*«

7 Key observations on the exonyms in the analyzed editions

According to the analysis of the chosen sources and by comparing the status of exonyms, its characteristics and the manners of writing and its usage, we have reached the following observations:

- The way of writing and the usage of exonyms are usually prescribed by the orthography rules, so as these rules changed, the characteristics of the foreign geographical names changed, too. The Croatian language and its orthography, as well as its exonyms, have been influenced by the political situation too often.
- The examples introduced in the orthography are very seldom and they are almost always the uncontested ones, so it often seems that there is no point in bringing up the rules for writing the geographical names at all. There are too many geographical names the writing of which stays unclear even after consulting the orthography.
- The earlier orthographies, prefaces or introductory chapters in the analyzed editions paid little attention to the explanations regarding writing foreign geographical names. When the practice improved, the writing became somewhat more uniformed.
- Between the two world wars sorts of mixed names between exonyms and endonyms appeared, i.e. semi-Croatized hybrid forms, especially hydronyms, which later adopted the full exonymic forms by translation or adjectival adaptation.
- Inconsistency noticed on the maps and in the texts inside the same publication is the result not only of abundance of geographical names, but also of both unclear treatment and the manners of writing geographical names. This was usually the case in the periods of transition from the original to the exonymic form of the names (e.g. in the oldest analyzed sources), especially after passing a resolution about reducing the number of exonyms, after which geographical names started to adopt their original forms again.
- Depending on the form the priority is given to (earlier to exonyms, later to endonyms), in some sources exonyms are written as the heading entries in the text or in the first place on the maps, while endonyms are written in the parentheses. In other sources, usually the newer ones, it is vice versa.
- The exonyms that have existed in the Croatian language for a long time and have therefore become part of our everyday communication, such as *Beč* (Vienna), *Budimpešta* (Budapest) or *Trst* (Trieste), appear in their exonymic form in all analyzed sources, no matter where they stand. Troubles arise with the exonyms that were not totally domesticated by the time of the publication of the mentioned sources, such as *Teksas* (Texas), *Sjeverna Dakota* (North Dakota), *Južna Australija* (South Australia), *Šangaj* (Shanghai) and so on. Therefore we can find them written in both ways.
- The review of geographical names in all examined editions indicated that the stage of exonymization depends on the type of geographical feature, so country names have become totally domesticated with time, while the names of towns and territorial units have been Croatized to a much lower extent. The names of seas, bays, rivers and so on have also been partially domesticated, often by translation or by using adjectival forms. However, there are many exceptions that we cannot understand.

8 Conclusion

When and if the problem of writing exonyms is discussed in Croatia, it is usually not about when to use an exonym and/or an endonym, but how to write one and why we cannot find it written in the same way in all of literature. The problems that arise from inconsistent and non-standardized writing of exonyms are indeed widespread in Croatia (Crljenko 2008), although many other languages have to deal with similar issues as well (Kladnik 2005; Kladnik an Bole). Such a chaotic situation in which one cannot be sure how to write a specific Croatized geographical name (and whether to domesticate an original name in the first place), seems to be a direct outcome of the deficiency of the orthographical rules, as well as the absence of a unique standardized list of exonyms. The latter one is the result of the absence of a commission that would seriously and frequently be engaged in the subject matter of geographical names, not just the problems with exonyms.

Analyzing the treatment, form and use of geographical names (and exonyms) in the chosen sources, we can say that geographical names have been significantly influenced by the development of the Croatian language. Though geographical names, as well as exonyms, should undoubtedly be examined and analyzed from the interdisciplinary point of view of several sciences, »… *in Croatia those are (exonyms, author's comment) almost exclusively treated as an orthographical problem* …« (Brozović Rončević 2011). Considering the obvious and indisputably strong relationship between language, orthography and geographical name, it is no wonder that Croatian linguists have gone furthest in the studies of geographical names. From 2005 to 2012 they were assembled in *Vijeće za normu hrvatskoga standardnog jezika* (»Council for the Standard Croatian Language Norm«), with the aim of standardizing language, geographical names, too (Brozović Rončević 2011). The process of exonym standardization has gone furthest in exonymization of country names and dependent territories, so on the official level *Abecedni popis država i zemalja i njihovih oznaka* (»Alphabetical list of countries and territories and their markings«; Internet 3) is being used.

To a much lesser extent, if at all, the use and treatment of geographical names have been influenced by the development of Croatian geography, which should certainly have a more important role regarding toponymy. Unfortunately, geographers have not been systematically analyzing and systematizing geographical names so far. All geographers mentioned in this article mainly brought to consciousness the problems of writing geographical names at the time they were involved in the lexicographical work. Apart from rare exceptions, the enthusiasm of other geographers concerning this topic has been even lesser. Certainly, that does not mean that geographers are unaware of the problems that arise in writing and pronunciation of exonyms. Nevertheless, it seems that the topic is not very challenging for them, or they think they have too little to say about it (which cannot be more wrong!), or they are simply oriented to other, »more geographical« themes. We will see if this kind of disinterest in the problems of geographical names among the Croatian geographers will soon be changed.

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A GEOGRAPHICAL METHODOLOGY FOR ASSESSING NODALITY OF A ROAD NETWORK. CASE STUDY ON THE WESTERN MOLDAVIA

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Road network is an important landscape element.

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ABSTRACT: The study tests the concept of nodality in a three-dimensional space, both as a projection of the physical-geographical support and an expression of topological centrality, which is insufficiently employed in papers attempting to evaluate the geographical or potential accessibility. The junctions of the reticular systems will be positioned differently within the network depending on the acquired nodality values, which may influence through their importance the potential for development of the polarized territory. By focusing on a methodology specific to nomothetic epistemology, aimed at highlighting the vulnerabilities induced by the dysfunctions within the road network and obtaining nodal hierarchies, the study allows for the extraction of legitimate relationships, which can be extrapolated beyond the particular space matrix selected for demonstration purposes only.

KEY WORDS: geography, transport geography, impeded-distance, accessibility, centrality, reticularity, roughness, Moldavia

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1 Introduction

The concept of nodality, as it is used in the field of Transport Geography, refers to a set of properties that a place (defined geometrically as a point) fulfils a geographical network. Furthermore, from the perspective of graph theory, any point benefits from its own nodality, with the implicit condition that the graph is connected. From these perspectives, the concept was constantly approached by geographers (see for example Ducruet 2008 for the field of transportion geography; Matthiessen et al. 2006 and 2002 for urban geography), but in the case of synthetic works in the field, it is either avoided, either given a secondary importance. Thus, from six reference works in geography of transportation, published over the last two decades (Rodrigue et al. 2009; Knowles et al. 2008; Black 2003; Banister 2002; Taaffe et al. 1996; Mérenne 1995), none is explicitly presenting the importance of indicators of nodality for geographical studies. Furthermore, the term of *nodality* is rarely used, no more than twice per piece of work.

The study of nodalities in the field of transportation geography is even more important since in the actual context of globalisation and dilution of national borders, permanent repositioning and redefinition of nodal points occur. As Knowles simply puts it, »*nodal situations change and the spatial qualities of centrality and intermediacy enhance the importance of strategically located hubs*« (Knowles 2006). Furthermore, the nodality is subject to trans-scalarity, its values being significantly different depending on the scale of analysis (see Debrie et al. 2005 for an example on the port nodalities).

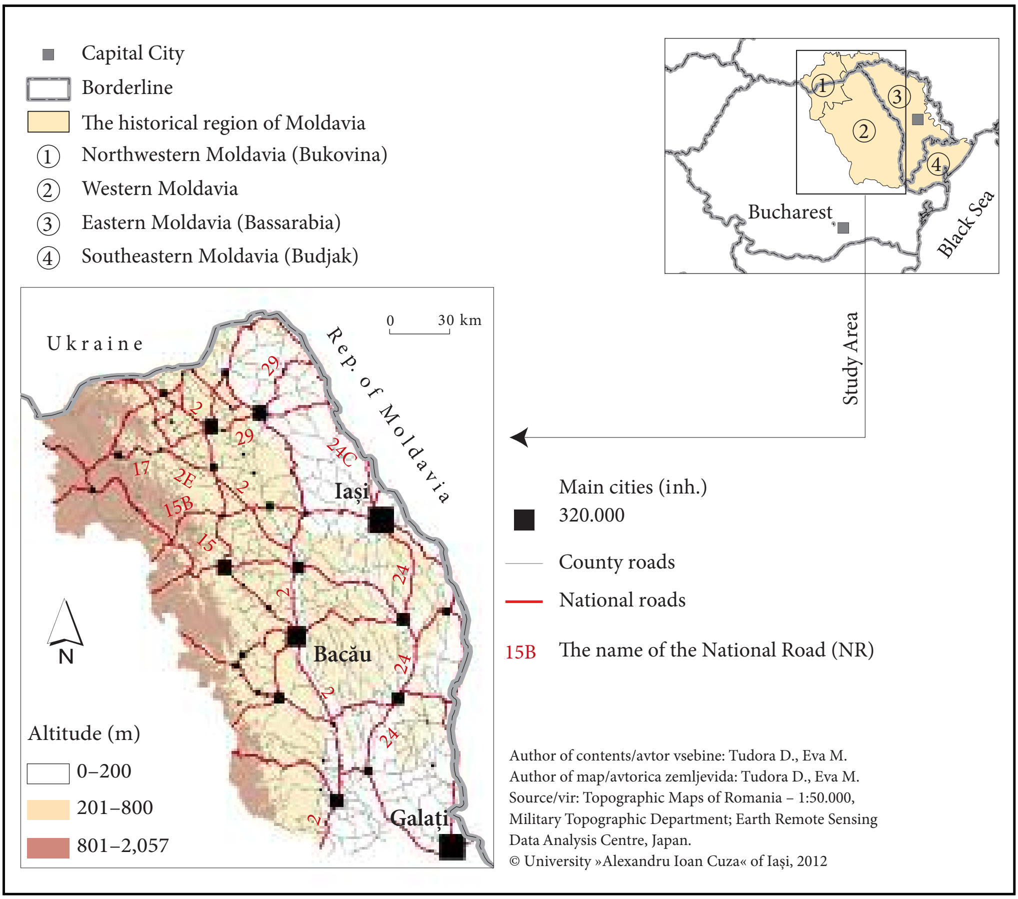

Figure 1: The study area as part of the historical region of Moldavia.

In this regard, the present article proposes a trans-scalar methodology for assessing nodality with the purpose of determining incoherences and vulnerabilities of a given reticular space. Nodality is seen as an internal feature of the reticular system, not to be confused with centrality and intermediacy as defined by Fleming and Hayuth (1994). The present article takes nodality as a property assigned initially only to the junctions of the network, but then transfers it through proximity and spatial interaction rules to neighbouring areas, taking into consideration the morphological aspects of the network (including the influence of topography) and the demographical aspects of settlements.

In the three-dimensional reticular environments, the space allows the interpreter to identify the friction that topography imprints on the network communication paths. The new topological context has the advantage of extracting, beyond the rigidity of a flat/predictable surface, the *roughness* with which the physical-geographical parameters lead to the occurrence rhythm rupture inside the network. Therefore, spaces select and are differentially selected, depending on certain features of cost and efficiency, the ability to reach them and from them being disturbed by the difficulty with which they manage to put in place fast routes, regardless of topography imperfections. The intensity and the frequency through which the *support-environment* creates and transfers geographical determinism produce disabilities within the routes communication systems, generating *vulnerability* to it. A vulnerable system of communication routes always involves additional costs in terms of time, waiting, or other costs resulting from delays or deviations (see Berdica 2002 for an overview). From a geographical point of view, the evolution of the vulnerability of a network, combined with the low resilience of socio-spatial systems including them, produces various forms of risk: isolation / claustration, disconnection / decoupling, divergence / territorial fragmentation.

The support-testing region for the hypothesis was chosen for having a common evolution of the network of communication routes. The eight Romanian counties included in the study area, with a surface of 46,000 km^2 and a total population of 4.7 million at the last census, represent nowadays a part of the historical region of Moldavia integrated into the Romanian territory since the formation of the modern Romanian state in the mid-nineteenth century (see Muntele et al. 2009 for an overview). The only exception is represented by the South Bukovina, a 5,000 km^2 area annexed to Romania after the First World War (figure 1).

2 Methodology

Peculiarities of the road network in Moldavia will be highlighted through the synthesis of methods specific to the analysis of reticular, planiform, and punctiform space structures. Since the ultimate goal of the study is to obtain models of functionality in the network, final products of the research will have several utilities. They are as follows: assessing / quantifying the role of physical-geographical factor in the deterioration of connectivity indices, extraction of the points with high nodality and identifying the dysfunctional ones, and posting a graphic synopsis underpinning the optimization models of connectivity.

To obtain the final models the three steps will be followed (figure 2):

a) Road network in Moldavia will be transformed into a graph in which vertexes will be represented by the junction of county and national roads. This yields to 1,240 road segments (arcs) and 881 junctions (nodes). The length of segments will be weighted by two parameters: sinuosity and slope. In this way, the obtained graph becomes a weighted graph, measured by an *impeded-distance* that expands or contracts space depending on the specific roughness.

b) Network centrality to the settlement systems of the region will be evaluated based on the potential interaction between area of influence of the graph nodes and the demographic barycentres of each reference system (natural, micro-regional, and regional). Distance parameters will use the distance-impedance determined in the previous step. Through this process, three types of adjusted nodality will be obtained: at the over-local, micro-regional, and regional level.

c) Total nodality for each junction will be calculated by means of progressive/ trans-scaling aggregation between the three types of adjusted nodality, where the natural nodality has the highest share. The nodal hierarchy of road segments within the network will be calculated as the arithmetic mean between the nodal values that load each junction and the determination of vulnerabilities of the reticular space of Moldavia will be extracted through a multivariate analysis.

For the calculations and the spatial analysis we made use of ArcGIS 9.3.

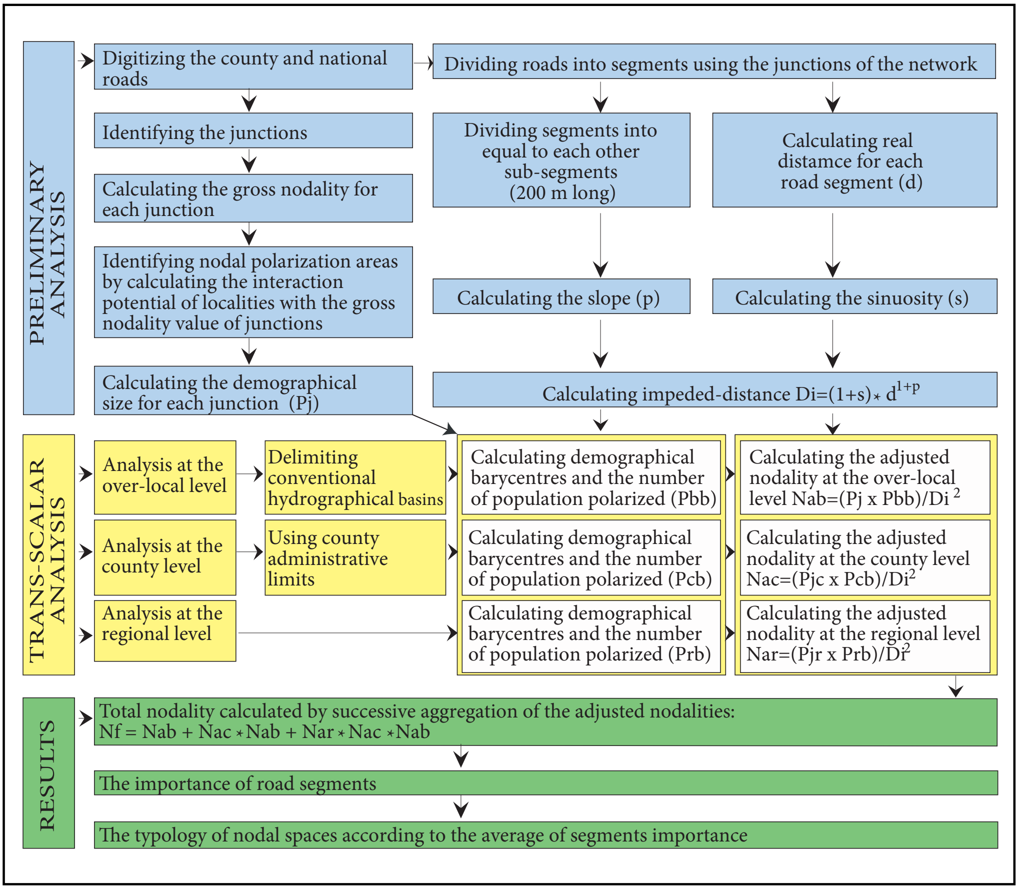

Figure 2: Guideline on the methodology for identifying the spatial structures generated by nodality.

3 Preliminary analysis

Connecting lines within a graph created by road network should be seen in their value dimension, actually representing distances/expressions of the spatial cost. Distances can be expressed in metric, temporal or cost dimensions, each with its own advantages and disadvantages (see Curl et. al. 2011 for an overview). Using metric distances seems obsolete since the new GIS technologies makes possible to calculate, with a relatively high precision, the temporal distances (Berke and Shi 2009; Salonen et al.; Shaw 2006) or the economic ones (cf. Combes and Lafourcade 2005). The latter are however dependent on the technological or economic conditions of the moment, reason for being susceptible to contextual changes. What appears to remain a permanent constraint for a more efficient functioning of the road network are its physical characteristics (sinuosity, slope), dependent on both the level of engineering techniques, but especially on the indirect influence of topography (especially for developing countries).

3.1 Assessing the influence of the topographic support

Although often positively correlated, roughness and altitude are different characteristics of land surface, the first with a spatial distribution that does not require uniformity, regularity and hard to comply with the inferential laws.

In reality, the roughness is a problem of topography, being an indicator strongly correlated with the terrain slope and its aspect (Sappington et al. 2007). In order to evaluate this two dimensions of roughness and the influence it has on the road network, we made use of two indictors: a first one calculating the slope (altitude variation between two points in relation with the distance separating them), and a second one estimating the degree of route collinearity, i.e. the sinuosity.

Both indicators were estimated using topographic maps 1 : 50,000 (for digitizing the road network) and a Digital Elevation Model with a 30 meters resolution provided by Earth Remote Sensing Data Analysis Centre (for extracting the altitudinal values), which were considered satisfactory for calculating the sinuosity (using the Linear Proprieties ArcScript provided by Rathert 2003), but insufficient for the slope parameter. To correct deficiencies in the slope case (common in mountains due to the presence of numerous road segments that traverse areas with slopes with packed walls or with reinforced embankment), one should use a raster with a very fine resolution, close to the actual width of the road (6 m for the carriageway and about 8 m for all parts of the platform).

Through the synthesis of the two variables of roughness, the space transmits to the network a certain friction, felt in each segment as a resistance force of the natural support, called impedance, and the associated distance will be named impeded-distance (D_i):

$$D_i = (1 + s) \cdot d^{1+p} \tag{1}$$

$$p = \frac{\sum_{i=1}^{n} \Delta H}{d} \tag{2}$$

$$s = 1 - \frac{e}{d} \tag{3}$$

where D_i is the impeded-distance, s – the sinuosity, d – the metric length of the road segment, p – the slope, ΔH – the maximum difference in altitude of each road sub-segment 200 m long, and e – the Euclidean distance between the ends of the road segment. From the formula (1), one can notice that each variable has a different impact factor: sinuosity is related to the distance by a multiplicative function, while the slope by an exponential one (friction imposed by a unit increase in the slope is greater than for a unit increase of sinuosity).

The roughness becomes an indicator able to quantify the heterogeneity of physical support and simultaneously to capture the impedance imposed on communication routes by altitude, landform energy, and topographic fragmentation.

Joining an impedance ratio leads to obtaining an impeded-distance always greater or equal to the distance actually measured, so it can be used later to calculate other types of geographical distance: time-distance, cost-distance, or economic-distance. Calculating the percentage ratio between impeded-distance and Euclidian distance, one can estimate the share of landform factor affecting distances between points, axes, and areas (figure 3).

The network of major roads of communication in Moldavia remains faithful to the conditions imposed by the topography roughness; thereby the network connectivity is vitiated by undue preference for S–N or NW–SE coupling direction. Deficiencies on the east–west connectivity are not mitigated by technical engineering innovations designed to reduce the roughness of the landform.

3.2 Assessing the gross nodality

Irrespective of the scale of analysis, the roads network creates junctions, which, depending on the proximity between them, will provide the associated spaces with the probability of interacting on various directions and configurations. As this probability is ensured easier, the administered reticular sub-systems will have a higher connectivity, will become more accessible, will stimulate emissions and attractiveness, will generate centres; hence, they will dispose of nodality. The nodality is the potential the network provides to the territory, in order to blend the real accessibility, to correct the centrality, and to generate anisotropic spaces.

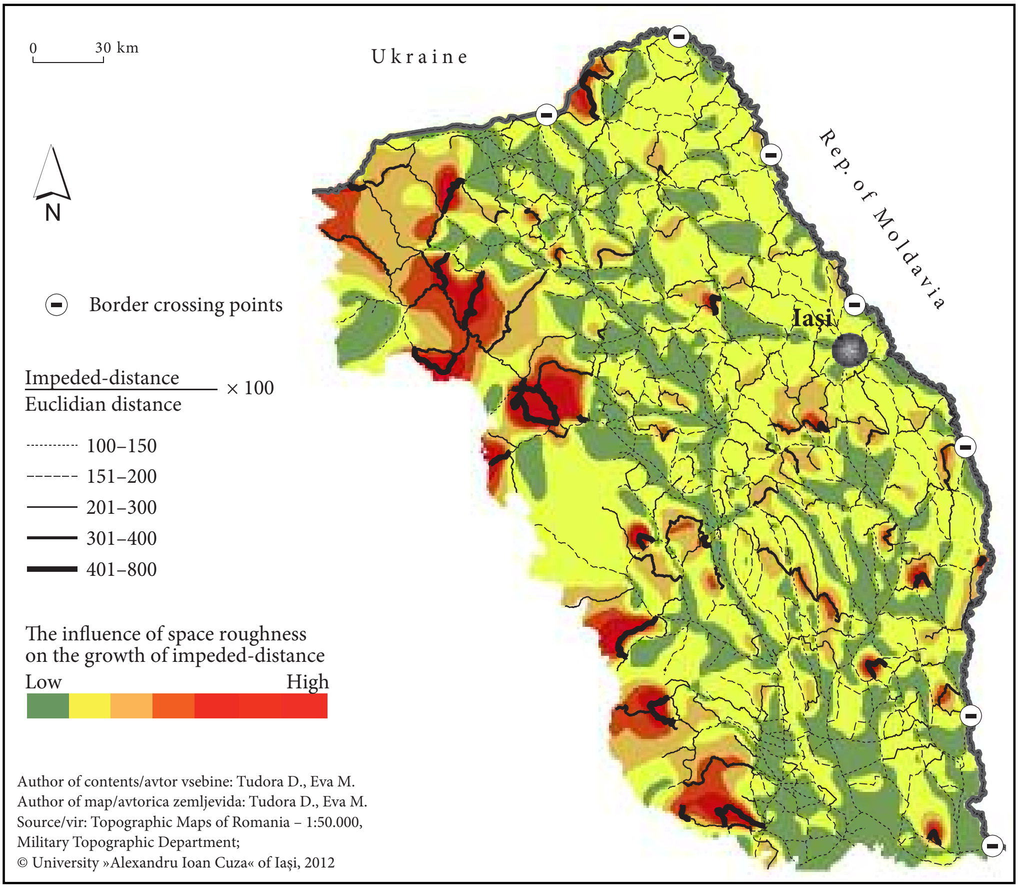

Figure 3: Space roughness influence on the growth of impeded-distance.

In the first stage of analysis, the nodality is calculated according to the concept of 'degree centrality', as an expression of local centrality (Freeman 1979). The degree of centrality involves calculating the number of edges connected to a given node. Given that the importance of road junctions within a region may depend on much more edges that are not necessarily related to the junction in question, the present article proposes calculating nodality by extracting the total number of junctions together in a buffer of 11,008 km, i.e. the average radius of the circles circumscribing Thiessen polygons for the 881 junctions within the region. Junctions located in areas well served by the means of communication, where many intersections occur, will be loaded with a high value of nodality, unlike peripheral junctions. Resulting values vary between 1 and 26 and will be called gross nodalities (figure 4).

4 Transscalar analysis

In the second stage, junctions attach a nodal space, defined by the potential of interaction between them and the population points within the region. Nodal gravity increases directly proportional to the value of gross nodality and inversely proportional to the square of the distance separating the junctions from the population points.

The area of nodal influence and the potential of interaction attached to it will be used in the formula for calculating the adjusted nodality. This will be estimated depending on the demographic mass attracted

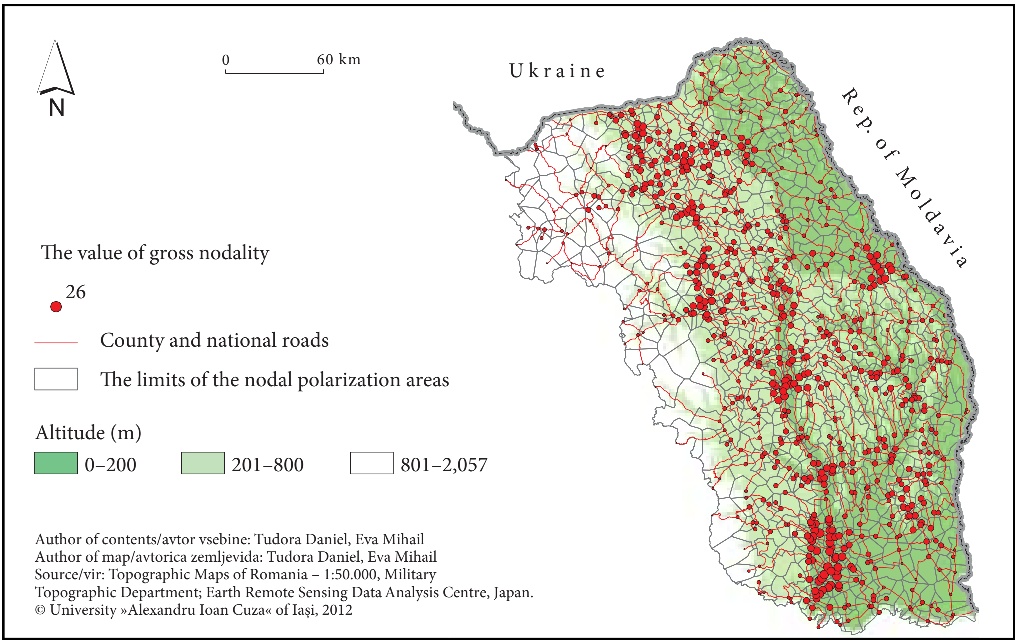

Figure 4: The gross nodality and the nodal polarisation areas.

by each nodal influence area and inversely proportional to the impeded-distance from the junction to the closest barycentre.

Because there are three categories of barycentres, each junction disposes of three types of adjusted nodality: the natural adjusted nodality, the county adjusted nodality, and the regional adjusted nodality.

4.1 The natural adjusted nodality

The natural adjusted nodality identifies the rapport the network maintains with the over-local spatial systems, focusing on the ability of graph nodes and segments to generate infra-territorial centrality. In addition, it notices the manner in which the ideological/driven projection of the communication routes systems neglected or overlooked the importance of discrete relations, eliminating inter-nodal competition.

In the condition of an *ad litteram* adaptation of social structures to the natural ones, artificial networks choose the easiest routes, dictated by the particularities of substrate: roads follow river configurations, intersections overlap with natural convergence areas, such as confluences, depressions, gathering water markets, or areas of narrowing beds.

Because modern society has persisted to ignore as far as possible the nature determinisms, but also from the necessity to produce reliable, fast, customized, and available connections, the initial network was supplemented by new segments as well as with re-accessibilizations of the pre-existing ones. The last were able to evolve to the stage in which nature had to readjust to the new nature: redrawing of river segments, including confluences, embankments, debit changes, or regularizations, cutting of slopes, intakes, undergrounding the courses of rivers, etc.

Based on gravity laws and interaction scenarios, the adjusted nodality model at the level of natural reference systems intends to notice the force through which the space (as a physical environment) was able to imprint the social systems its own trajectories, defining inertias, regularities with permanentization trends, hard to surmount by other logics, whether more efficient. In the same manner, it may be a sign stipulating deviations, repositioning and reconfigurations of socio-spatial structures, focusing on what is atypical, residual.

The classification of hydrographical basins respected the classical methodology (Gravelius 1914), the identification of watersheds being realized on the cartographic support provided by the 1 : 50,000 topographic maps. Furthermore, second order basins according to Gravelius system and the largest of the third and fourth orders were divided into sub-basins, thereby achieving a relatively balanced 27 areas for which the ratio maximum area / minimum area does not exceed 1.86.

Adjusted nodality was calculated for each node separately according to the following formula:

$$N_a = P_j \cdot \frac{P_b}{D_i^2} \tag{4}$$

where N_a is the adjusted nodality, P_j – the total population polarized by the respective junction, P_b – the population of the polarizing barycentre, and D_i – the impede-distance between junction and barycentre.

It should be noted that the calculation method allows each node to select its own barycentre, independently of the affiliation to a particular hydrographical basin, advantaging the junctions positioned on axis that transcend the hydrographical basins.

4.2 The adjusted nodality at the county level

The second nodality index personalizes the same processes reported in the case of reference system centred on conventional hydrographical basins, indicating that the establishment of clear landmarks, of administrative nature, requires for the reconfiguration mechanisms to become particular situations of the accretion and decoupling.

As in the previous case, the discourse focuses on the problem of nodal spaces that lose the centrality of their own administrative structures, being attracted through structural or serial fragmentation processes to higher nodality structures, created by differential accessibility and interaction.

The method of calculating the relations of interaction between the nodal spaces and the county barycentres allows junctions to select their own barycentre of attractiveness. The emissivity of nodal spaces is composed of two vectors: a demographical one directly proportional to the localities size which require a specific network node and a metric one inversely proportional to the distance that separates the respective junction from the barycentres likely to come into interaction with the concerned nodal space.

The highlighting of the nodal spaces not adapted to their own administrative structure on the one hand stresses the incomplete functionality of some infra-county interactions and, on the other hand, it indicates the underestimation of some distances to which big cities can impose themselves.

4.3 The adjusted nodality at the regional level

We underline the increased importance of the nodality centred on the city of Roman and the reticular drainage produced by the natural convergences from the median area of the Siret axis, identifying the subjective role induced by the potential factor of the place in the context of selecting such a level of connectivity analysis.

The demographical size acts secondarily in the final value of regional nodal index, while the imperceptibility originates from how each junction selects, depending on impedance and network complexity, certain preferential trajectories through which to access the centre.

Such contingencies explore historical deficiencies, warning on a north-south imbalance regarding the drainage efficiency. The latest population, the resizing of the settlements network and systems of communication routes depending on peripheral or extra-regional urban landmarks, betrays the reticular immaturity of the counties in southern Moldavia, compared to the north. Here, the filter of Christallerian balance achieved the transition from archipelago type of territorial structures to the ones related to rapid intermediary spaces.

4.4 The total nodality and the reticular importance of road segments

In order to obtain the total nodality, we made use of cumulative integration of adjusted nodalities for the three levels of analysis, these being found successively in the terms of amount, and being the more influential as they are hierarchical closer to the over-local system of reference:

$$N_t = N_{ab} + N_{ac} \cdot N_{ab} + N_{ar} \cdot N_{ac} \cdot N_{ab} \quad (5)$$

where N_t is the total nodality; N_{ab} – the adjusted nodality at the level of conventional hydrographical basins; N_{ac} – the adjusted nodality at the county level; N_{ar} – the adjusted nodality at the regional level.

The importance of road segments was calculated using the arithmetic mean of total nodalities related to the junctions that frame the respective segment, the roads linking important or very important cross-roads being favoured.

$$I_s = \frac{N_{j_1} + N_{j_2}}{2} \quad (6)$$

where I_s is the importance of road segments, N_{j1} – the total nodality for the starting junction, and N_{j2} – the total nodality for the ending junction (related to the opposite end of the segment).

Segment level analysis appreciates with greater accuracy the dysfunctions, convergences / divergences and reticular fragilities the road network in Moldavia hides (figure 5). Firstly, the segments cumulating continuous nodality are distinguishable, thus obtaining nodal linearity and becoming segments with a trans-regional character. It is true that such linearities are rare and incomplete, the only continuous section being created by NR2, opportunities for cross coupling on the east-westward direction being interrupted or disrupted for reasons of impedance or the appearance of a network capilarization process. The East Carpathians orographic barrier blocks the coherence of reticularity marked by the high values of nodality

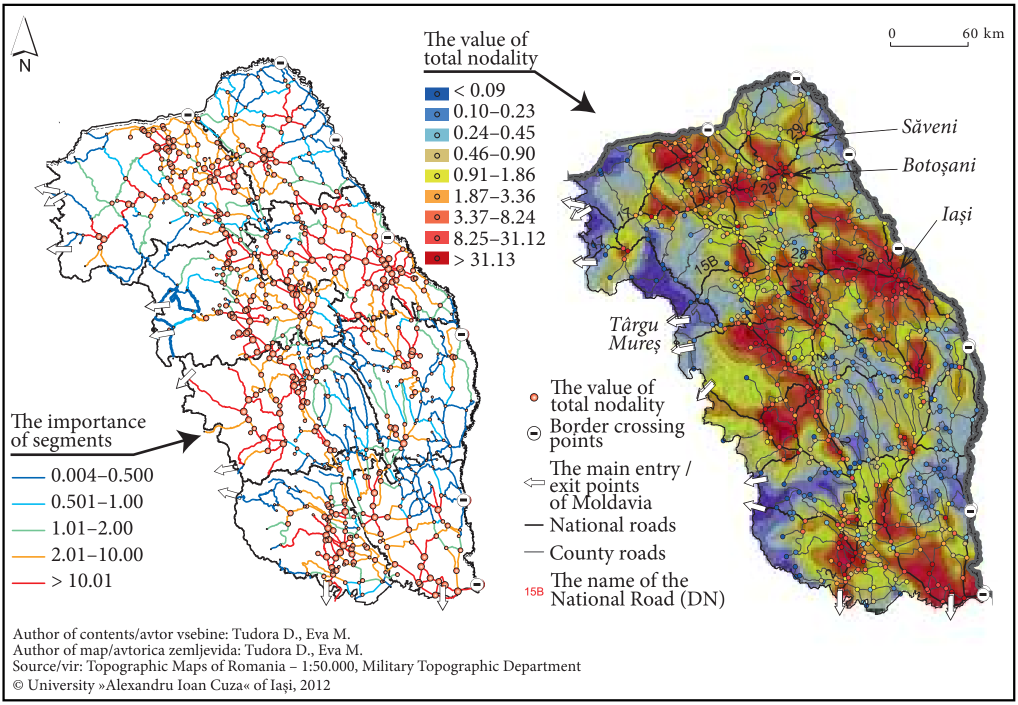

Figure 5: The importance of road segments and the total nodality.

specific for the segments overlapping NR28 and NR15B. This barrier brings extra impedance, but further validating the choice correctness of the highway section Iaşi – Târgu-Mureş along this route. In the counties of Suceava and Botoşani, a similar case is represented by the consecutive nodalities created by NR17 and NR29, which, except for short segments nodally vitiated by impedance (due to the existence of mountain passes), maintain their reticularity up to the east of Botoşani City. Supporting a highway project along this section could solve the deficiency of regional transversality in the northern half of Moldavia.

Reticular divergences identify areas in which the segments nodality decreases from a centre with high nodal value (over-local intersections) to neighbouring areas, disadvantaged by the peripheral position within the region and by the local network inconsistency. The example given by the segments nodality centred on the Săveni town is the most convincing at the regional level. The presence of segments with such a high nodality is influenced by the ability of the intersections from Săveni town to transfer upon some short sections (10 to 20 km) the nodal value made by an initial vertex. This sort of ribs with a rudimentary degree of centrality explain an inadequate maturity of the local networks and will have a negative effect on the subsequent data processing, with the capacity of corrupting the multivariate analysis at the nodal spaces level, because from the statistic point of view the convergence and the divergence will present confuse signs. The reticular hiatus are represented by spaces with very low nodality, which interfere with areas that present high nodality, having the deficiency of blocking the fluidity within the network. Their insertion within space reflects the vulnerability of reticular systems in front of the natural support roughness and compels the network to reconfiguration, which by permanentization creates inertia and behaviours specific for the anisotropic environments.

5 Applicability and relevance of the methodology

The analysis results can be used further to determine vulnerabilities and inconsistencies existing in a given reticular system. For this purpose, it is necessary to calculate the average importance of road segments crossing each of the 695 nodal polarisation areas. The difference between the initial number of junctions (881) and the number of polarization nodal areas (only 695 instead of 881) is due to the fact that the junctions located at distances of less than 500 m from each other were merged (they were considered acting as one single junction with a higher gross nodality). Furthermore, other junctions were eliminated from the analysis in the case they do not polarize any locality.

The use of the arithmetical average was preferred in the detriment of the representation of the gross values of the total nodality because of the fact that in this way one can obtain a more suggestive spatial image of the nodality at the level of polarization area by indirectly including in the formula the values of the neighbouring junctions:

$$N_{ap} = \frac{\sum_{i=1}^{n} I_{si}}{n} \tag{7}$$

where N_{ap} is the average nodality at the level of the nodal polarization area, I_{si} – the importance of the road segment calculated using the formula (6), and n – the number of road segments which cross the nodal polarization area. The usage of nodal polarization areas has the advantage of surprising the central spaces at regional level, dictated often by the existence of several powerful urban centres nearby, generators of convergence points between county and national roads, but it has the disadvantage of insufficient identification of the importance of lanes created by the main road communication ways.

Despite all of these deficiencies, the mapping of the nodality at the level of nodal spaces outlines several incoherencies of the reticular space of Moldavia, configured by ideological principles or by administrative attachment, being ignored the collinearities of the network at the trans-county scale or those customized within the areas of convergence generated by secondary nodalities:

- The reticular fragmentations of the sub-mountainous area situated southwest of the convergence area centred on the Onești City could be attenuated by coupling the axes situated along the rivers flowing in the area, there being many possibilities for welding some routes.
- The very low reticularity of northern part of Galați County claims a reconfiguration of the network depending on the presence of the most important road hub of the area, Bârlad City. It also depends on the border points, trans-national transfer niches of several local nodalities, significantly important for decongesting rural spaces and for stimulating commercial relations specific for areas such as dead-angle, bottom of bag, or abandoned peripheries.

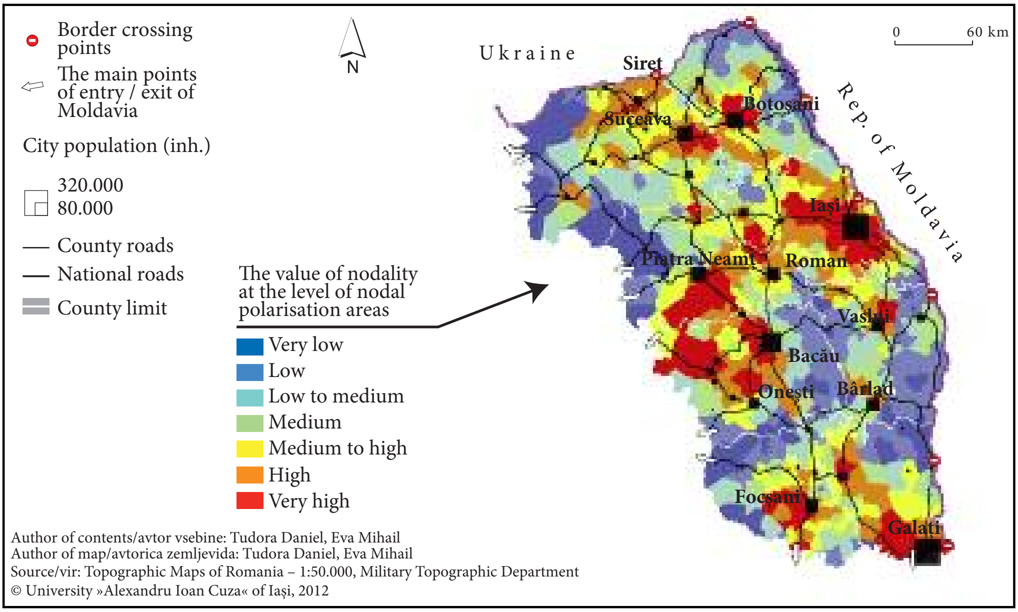

Figure 6: The value of nodality at the communal and nodal polarisation areas level.

- Consecutive coupling the county and national roads linking directly the cities of Botoşani and Iaşi may do the nodality transfer from the northern extremity of Moldavia to the main nodal point of the region, Iaşi, more easily. This sort of route would regard the balance created by the urban couple Suceava – Botoşani, would shorten with approximately 50 km the distance between the border crossing point of Siret and Iaşi Cities, providing at the same time the revitalization of some peripheral rural areas like those situated in the northern part of the Iasi County.

Depending on the aims of each particular study, the insufficiencies generated by the analysis at the level of nodal spaces may be further corrected by replacing them with an administrative *maillage*, such as communal clippings.

6 Conclusion

The article proposes a glossary suitable for reticular environments. Its advantage comes from the finely epistemological delimitations between closely related terms such as gross nodality, adjusted nodality, total nodality, reticular capilarization and reticularity. The conceptual limits between different terms are being established from the perspective of the methodology applicable to each of them.

Furthermore, the methodology allows the conversion of concepts in quantitative benchmarks, subsequently benefiting from the advantage of being easily transposable into cartographic materials. Using them can be a starting point in territorial planning processes due to transversal dimension of indicators. For example, the values of total nodality provide information about the existence of nodal regions and their polarising centres, about discontinuities inserted between different homogenous structures or about the subjacent dimension of some territorial points that can constitute pivotal areas in shaping future policies aimed at strengthening territorial cohesion or competitiveness.

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THE IMPORTANCE OF VULNERABLE AREAS WITH POTENTIAL TOURISM DEVELOPMENT: A CASE STUDY OF THE BOHEMIAN FOREST AND SOUTH BOHEMIA TOURISM REGIONS

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Vydra River in the Bohemian Forest in 2008.

The importance of vulnerable areas with potential tourism development: a case study of the Bohemian forest and South Bohemia tourism regions

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ABSTRACT: The significance of the vulnerability of nature-rich areas with high development potential for tourism was studied using three types of data: 1) spatial distribution of tourist attractions, 2) the appeal level of these attractions, and 3) the number of visitors. The Bohemian Forest and South Bohemia were chosen as study areas. Nine types of landscape spatial appeal were identified in the study area. Two most important types were defined based on their appeal where there are rare relic features in the natural environment dominated by the presence of peat bogs and natural habitats with scrub undergrowth or virgin forests. These types were also found in the areas with the greatest potential for tourism development. However, these areas are also the most important from the point of view of nature conservation and landscape protection in Central Europe.

KEY WORDS: geography, landscape, tourism, Czech Republic

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1 Introduction

The opportunity to develop recreational activities is among the main motives for creating national parks (Williams 1998) and tourism remains an important justification for park creation and development today (Hall and Lew 2009). Similar to the rural environment, these spaces offer opportunities for refreshment to people living in urban spaces that lack opportunities for everyday contact with the »environment of nature« (Olwig and Olwig 1979). Rural areas became an important space of large-scale tourism in the 1950s and 1960s for this reason (Hall and Page 2006), and then (in part since the 1990s) they also became a destination of ecotourism activities (Weaver 2006). For instance, in the United States the National Park System is part of the country's greatest tourist attractions, appealing to both domestic and international visitors (Goeldner and Ritchie 2009).

The ongoing degradation of the environment and its urbanization are further increasing the value of the pleasure periphery in tourism (Bushell et al. 2007). These kinds of environments are then increasingly exposed to pressures resulting from conflicts among different types of use of such areas (Jamal et al. 2002; McClanahan et al. 2009). The risk of the degrading impact of tourism increases with the rising number of visitors (Geneletti and Dawa 2009; Heydendael 2002; Marion and Leung 2001; Nepal and Nepal 2004; Vasiljević et al. 2011), which consequently results in people experiencing less satisfaction from the visit (Juutinen 2011). Disregarding the other influences, three interests clash at the intersection of these vulnerable areas from the tourism point of view: nature conservation (Hall and Lew 2009), ecotourism, and large-scale tourism activities (Epler Wood 2002; Weaver 2006). According to Anderson and Brown (1984), one of the main tools for preventing conflicts is recreational displacement – that is, a way in which all three interest groups are able to achieve maximal satisfaction (Hall and Page 2006).

Studies in tourism locations and the importance of these tourist attractions as location factors are the main areas of research in tourism geography (Williams 1998). This has taken place since the beginning of the twentieth century (Benthien 1997). The key approaches were crystallized in the late 1960s and the early 1970s (Hall and Page 2006). Studies and dissertations on these problems agree that core resources are fundamental for localization in tourism (following Ritchie and Crouch 2003), and the highest importance within these core resources is attributed to undeveloped recreation resources (Chubb and Chubb 1981) of natural or cultural origin (Ritchie and Crouch 2003). The basis for visitation management in particular locations of destination created by knowledge of the distribution of attractions (Kostrowicky 1970) and the extent of their importance for visitors (Linton 1968). This knowledge allows management to make decisions directed aimed at satisfying these two contradictory requirements. It is essential that these attractions not be performed separately in the space, but that they create spatial systems of tourism (Lau and McKercher 2007) that are geographically recognizable (Wall 1997) as the spatial types of a recreational landscape (Burger 2000). These types provide various motives for different types of visitors (Horner and Swarbrooke 1996) and similarly show the various values of habitats for nature conservation (Kučera 2005).

Accordingly, the main aim of this article is to present testing methods for evaluating the relative importance of vulnerable areas for tourism development in large areas.

2 Methodology

2.1 Study Area

This article examines the South Bohemian Region (Cz. *Jihočeský kraj*), an area with a temperate climate in the southern part of the Czech Republic along the border with Germany (Bavaria) and Austria (Upper Austria; Cetkovský et al. 2007; Švec et al. 2012). The selected area comprises two tourism marketing regions: South Bohemia and the Bohemian Forest (Cz. *Šumava*, Figure 1). The territory extends throughout a rather geographically diversified part of the Czech Republic. Bohemian Forest National Park (Cz. *Národní park Šumava*), the Třeboň Protected Landscape Area (Cz. *Chráněná krajinná oblast Třeboňsko*), the Bohemian Forest Protected Landscape Area (Cz. *Chráněná krajinná oblast Šumava*), and the Blanský Forest Protected Area (Cz. *Chráněná krajinná oblast Blanský les*; Figure 2) are the largest conservation areas in the region studied (Navrátil et al. 2012b).

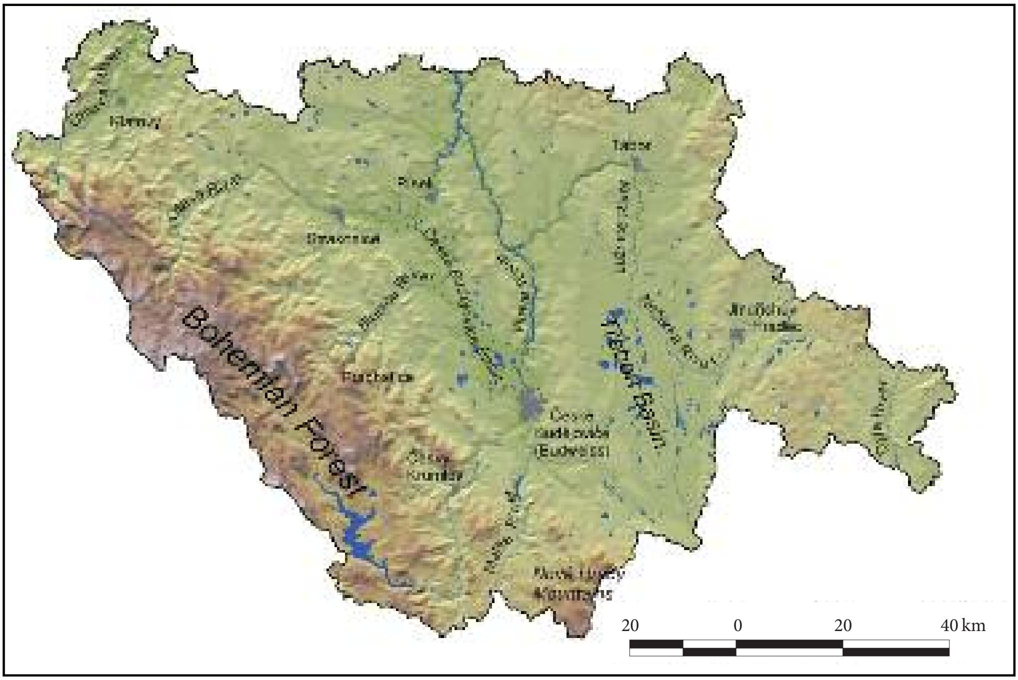

Figure 1: Topography of the study area (ArcData Praha, s. r. o.).

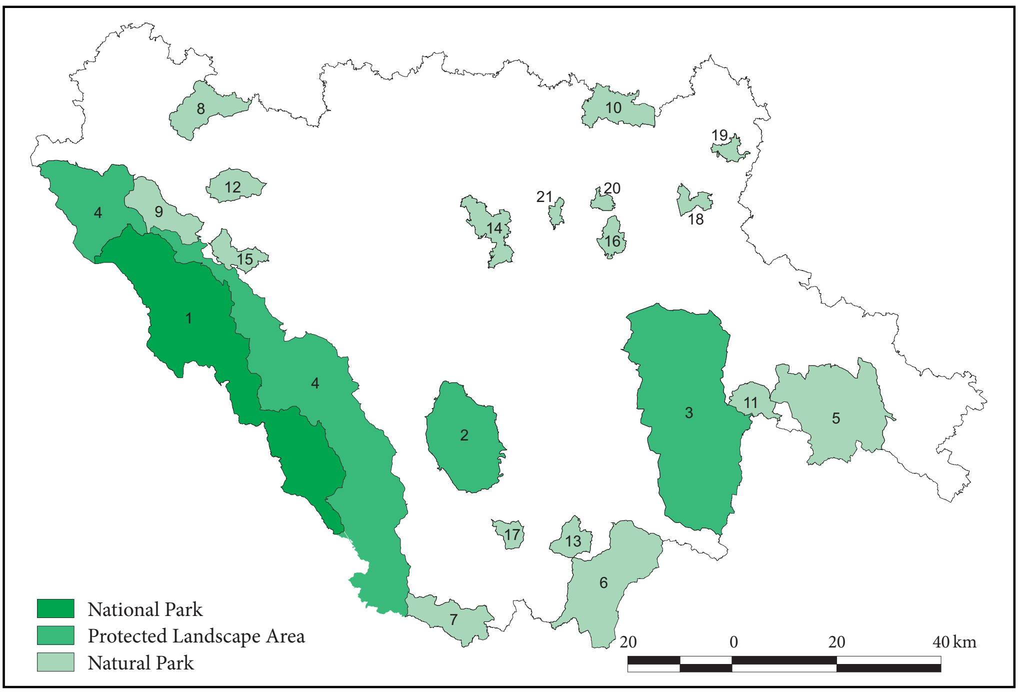

Figure 2: Conservation areas within the study area (1 – Bohemian Forest National Park, 2 – Blanský Forest Protected Area, 3 – Třeboň Protected Landscape Area, 4 – Bohemian Forest Protected Landscape Area, 5–21 – natural parks).

2.2 Data Collection

It was necessary to gather three types of data to accomplish the defined aim of this article: the spatial distribution of tourist attractions, the appeal level of these attractions, and the number of visitors in individual territorial units of the study area.

A database of potential attractions was created to identify the distribution of tourist attractions. The individual attractions were identified based on tourism geography literature (Mariot 1983; Ritchie and Crouch 2003; Hall and Page 2006; Kušen 2010). The database only covers permanent attractions; that is, those that cannot be moved or quickly rebuilt based on tourist demand (Gunn 1997). Primarily, this involves components of appearance, culture, and history (Ritchie and Crouch 2003). Sixty-nine attraction types were localized: those found statistically important for further calculations are shown in Table 1 (for the entire list, see Navrátil et al. 2013a).

The appeal of the destinations was investigated for partial segments of demand. They were identified by surveying visitors at important sights and areas within the study area and model segments. Visitors to the study area were surveyed on roughly sixty attractions in the study area from 2009 to 2011. A database of 3,776 completed questionnaires was developed. In addition, an experiment was carried out on three model segments of tourists on the eco-tourism/mass-tourism continuum. Students were utilized for this research (Palmer and Hofmann 2001). We chose university students as model segments:
- business students representing »large-scale tourists,«
- ecology students representing »eco-tourists,« and
- agriculture students representing »neutral tourists«; (these methods are based on Navrátil et al. 2013b).

The students filled out 396 questionnaires (the questionnaire return rate was 61%). The intensity of recreational activities during leisure activities away from a permanent residence was used as the basic element of segment identification: the questioning tool used is described in detail in Navrátil et al. (2010). The questionnaire was filled out by students representing particular model types of visitors. The students were also asked to complete a questionnaire seeking to identify the amount of appeal of the individual attractions. Q-sort methodology was used (Doody et al. 2009). A setup of eleven columns was used (Barry and Proops 1999; Steelman and Maguire 1999). The respondents were asked to sort the photographs of the attractions according to their perception of interest as a place to visit. In this Q-sort study, +5 indicates »This has crucial importance for me while choosing a destination« and –5 indicates »This has no importance for me while choosing a destination.« The number of attractions for the individual columns was constructed as close as possible to a normal distribution (1-2-4-7-12-17-12-7-4-2-1).

The numbers of visitors in the partial territorial units of the study area were taken from our previous research (Navrátil et al. 2012a). The methodology is described in detail in Navrátil et al. (2012a, 52 and 53). The GIS shapefile was used for the subsequent calculations in this article, which provided data on the total visitor frequency model of partial territorial units in a regular hexagonal net according to input data for 2010.

2.3 Data Processing and Analysis

The appeal of the area was evaluated in the identical artificial spatial units as the visitor frequency model of the study area: a regular hexagonal network with hexagons approximately 3 km^2 (Navrátil et al. 2012a). The presence of an attraction (in the case of a point shapefile) was ascertained in each hexagon. Polygonal and linear shapes had to be converted to points first. Lines and polygons were cut by the shape of the hexagonal artificial spatial units and then centroids of the new polygons and lines were calculated. Then the presence of these points in hexagons was ascertained.

The typology of the partial territorial units was based on a combination of the presence of the individual attraction types in each hexagonal artificial spatial unit. The TWINSPAN hierarchical divisive method (Hill 1979) was used. The division in TWINSPAN is made according to the results of the correspondence analysis on the first axis. This is processed by the settings of the »cut level« analytical operation that was chosen for levels 0%, 5%, and 25% in the representation of the attractions. This division was made in four degrees. The attractions with the highest fidelity were used (i.e., the highest fidelity to the group); those with a φ-coefficient value (Tichý 2002) greater than 10 were used to describe the newly created groups.

Table 1: φ-coefficient values of core resources for spatial attraction types (only resources with a φ-coefficient greater than 10 for at least one type of area are shown).

	1. Important non-forest habitats	2. Wooded rocky slopes	3. Abandoned border areas	4. Upland plains	5. Wild river valleys	6. Mountain foothills	7. Rural areas	8. Urban areas	9. Pond areas
Number of territories	161	226	226	144	210	951	2055	710	218
Peat bog	63.2	10	–	–	–	–	–	–	–
Virgin or near-virgin forest	5.1	57.2	–	–	–	–	–	–	–
Rocks and crags	9.5	40.5	–	–	–	–	–	–	–
Mountain landscape	0.2	13	1.7	–	3.3	–	–	–	–
Pre-WWII fortification	–	10.3	3.7	–	2	–	–	–	–
Dilapidated village	9	3.7	45.6	–	–	–	–	–	–
Spring with drinking water	–	7.2	26.6	–	–	–	–	–	–
Groomed ski hill or slope	–	8.8	12.9	2.5	–	–	–		–
Carved valley landscape	–	–	–	–	80.7	–	–	–	–
Climbing opportunity	–	6.7	–	–	20	–	–	–	–
Cave	–	1	–	–	11.4	0.8	0.3	0.8	–
Tower house	–	–	–	–	10.8	–	–	3.9	–
Ruins of tower house or other monument	–	1.2	–	–	10.2	–	–	1.7	–
Predominantly agricultural landscape	–	–	–	–	–	–	–	52.6	–
Church	–	–	–	–	1.4	–	–	35.7	–
Historical town building	–	–	–	–	0.9	–	–	25.9	1.9
Castle	–	–	–	–	3.1	–	1.2	20.3	–
Tennis court	–	–	–	–	1.9	–	–	16.4	3.7
Remnants of fortresses or fortified settlement	–	–	–	–	–	0.3	4.8	15.1	1.1
Town monument reservation	–	–	–	–	4.8	–	–	11.7	4.5
Jewish cultural monument	–	–	–	–	9.9	–	–	11	–
Calvary chapel	–	–	–	–	8.9	–	5.9	10.9	–
Broad flood-meadow landscape	–	–	–	–	–	–	–	5	45.5
Dam (pond, water barrier, artificial channel)	–	–	–	–	–	–	–	2.6	13.1
Monuments of popular architecture	–	–	–	–	3.3	0.9	2.8	0.5	10.4
Rare plant	59	23.4	–	–	–	–	–	–	8.6
Rare animal	54.2	17.1	–	–	–	–	–	–	9
High-elevation plateau landscape	16.5	3.7	4.2	31.6	–	–	–	–	–
Flatland landscape	13.7	–	–	–	–	–	–	–	67.5
Cirque landscape	–	10.8	–	13.9	–	–	–	–	–
Recreational fishing	–	–	–	–	57.8	–	0.1	1.5	13.2
Boating	–	–	–	–	41.1	–	–	–	21.1
Water-powered mill or iron mill	–	–	–	–	10.3	–	0.1	10.5	0.1
Pond landscape	–	–	–	–	–	–	16.6	–	59.8
Town landscape	–	–	–	–	–	–	–	20.5	27.3
Meadow vegetation near traditional farming	18.6	18	–	–	–	–	–	–	13.2
Hillsides and rocky mountain ridge landscape	–	35.3	38.2	33.6	–	2.5	–	–	–
Observation and viewpoint	–	10.9	16.3	7.3	–	–	–	11.9	–
Highland landscape	–	–	1.8	–	23.5	20.9	25.9	24.8	–
Forested landscape	–	–	3.6	–	20.7	14.7	22.5	13.8	–
Mixed forest, meadow, and field landscape	11.8	21.2	23.2	26.2	3.8	13.7	–	–	–

The demand segments were identified by cluster analysis (Ward Method, Euclidean distance) of the questionnaires from both surveys (the scale of the rate of participation on partial recreational activities). The estimated credibility loss ratio was 50% as in Real et al. (2000). The questionnaires from the model segments (i.e., students) were selected from the identified clusters. The average appeal value for the particular attractions for each demand segment was calculated. The means were converted into positive values (the results of the Q-sort experiment varied between –5 to +5) and then transformed by power because the data were obtained from the Q-sort study. The final appeal value of each attraction type for the demand segment was relatively expressed as a share of the appeal of the partial attraction type in the maximum appeal value achieved by the most attractive attraction type. These values were assigned to a particular attraction type included in the GIS database, individually for each demand segments.

The appeal of the particular types of territory was determined as a sum of the appeal of all of the attractions located in each hexagon for the partial demand segments. The differences in the average appeal among the types of areas were investigated by one-way ANOVA with Tukey unequal N HSD post-hoc tests (Quinn and Keough 2002).

Subsequently, the development potential of the types of areas was assessed. First it was necessary to standardize the data on the appeal rate and data from the visitor frequency model to make the calculation possible. The development potential was evaluated as the simple difference between the standardized appeal values and standardized values of visitor frequency model in each hexagonal artificial spatial unit. The differences in the average development potential (among the types of areas) were investigated using one-way ANOVA with Tukey unequal N HSD post-hoc tests.

The adjustments of the spatial data were carried out using Quantum GIS software (Athan et al. 2011). STATISTICA 10.0 software (StatSoft 2011) was employed for the cluster analysis calculations and one-way ANOVA. Calculation of TWINSPAN was done using JUICE software (Tichý 2002).

3 Results and discussion

Nine spatial attraction types were identified in the study area. A comparison of the values of φ-coefficients of the attractions of the partial types (Table 1) and spatial distribution of these types (Figure 3) makes it possible to confirm the validity of the database that was developed. The first type, called »important non-forest habitats« (Figure 4), is typical by appeal given by the presence of important (protected) species of plants and animals associated with peat bogs and meadows. High-elevation plateaus prevail in these types of landscapes. This type can especially be found in the high elevations of the Bohemian Forest. However, they can also be found in low-basin areas in the Třeboň Protected Landscape Area, whose peat bogs are of global importance and are protected within the Ramsar Convention on Wetlands as the Třeboň peatlands and Třeboň fishponds (Chytil and Hakrová 2001).

The second type of appeal is also indicated solely by the natural place of interest. In this case, the sites are linked to wooded slopes with rocks and landscapes with hillsides and rocky mountain ridges. Therefore it was named »wooded rocky slopes« (Figure 5). It is found in the highest parts of the Bohemian Forest and the highest parts of the Nové Hrady Mountains park.

The third type is spatially complementary to the previous ones. It is called »abandoned border areas« (Figure 6) because the abandoned and ruined villages originated with the expulsion of Germans from Czechoslovakia and the subsequent establishment of the Iron Curtain after the Second World War. Springs in these villages are typical for this type. These areas offer various opportunities to develop tourism; larger non-wooded areas can be found; these offer panoramic views and make it possible for tourism providers to build downhill ski areas. In addition to the Bohemian Forest and the Nové Hrady Mountains, this type can also be found in the Nová Bystřice Uplands (Cz. *Novobystřická vrchovina*).

The fourth type can be described as »upland plains« (Figure 7) because it is almost exclusively connected to high plateau areas in Bohemian Forest National Park and its appeal is especially due to its flat relief and adjacent forested cirque and slope areas. The plains themselves represent a unique type of landscape and are the largest Central European remnant from the Paleogene Period up to the Tertiary, with the paleo-relief character of the peneplain (Demek and Mackovčin 2006).

The appeal of the fifth type is determined by deep valleys with opportunities for fishing and boating. Pseudo-karst caves, scenic overlooks, tower houses, water-powered mills, iron mills, and opportunities

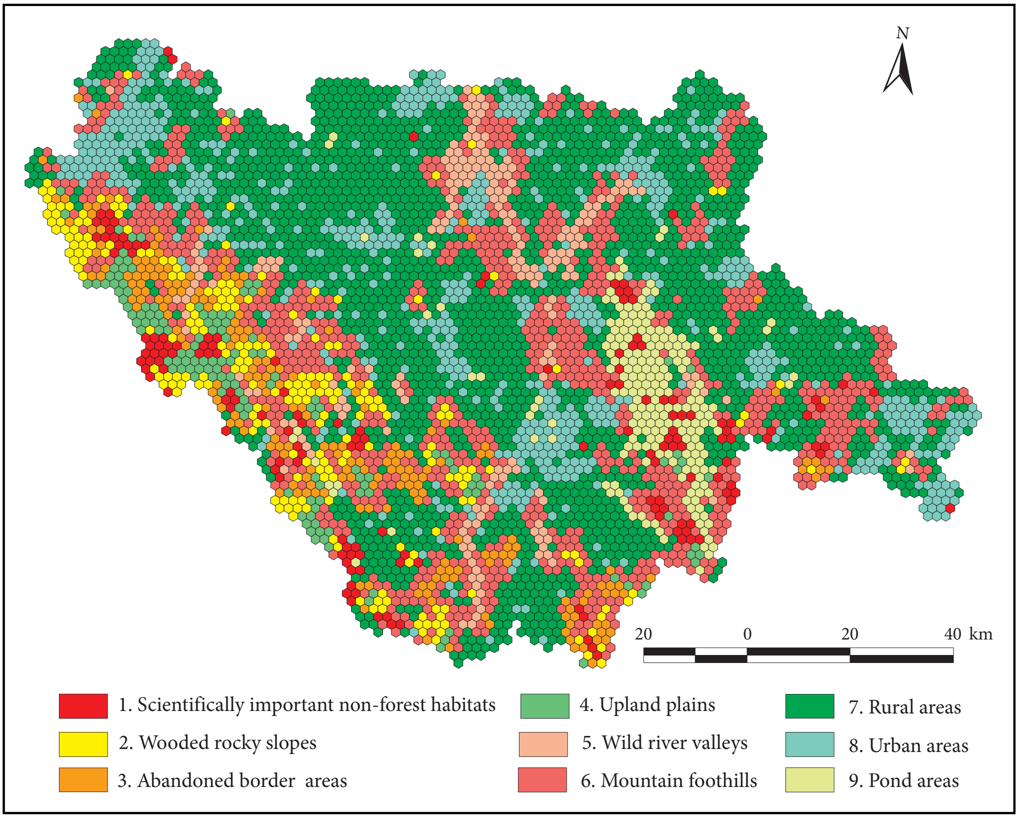

Figure 3: Appeal types in the Bohemian Forest and South Bohemia tourism regions; TWINSPAN results are displayed.

for rock climbing are linked to these valleys. This type has been named »wild river valleys« and can be found in the upper course and springs of the Otava River, along the Vltava River from Vyšší Brod to Boršov and from Zvíkov to Orlík, and on the Lužice River from Tábor to its confluence with the Vltava River.

The sixth type is formed by hilly Hercynian relief with a mix of forests, meadows, and arable land. It is named »mountain foothills« and it covers the lower elevations of the Bohemian Forest, the Nové Hrady Mountains and its foothills, and some other areas.

The seventh type covers the largest parts of the study area and its typical attractions are not significantly different from the previous type. However, the pond landscapes and landscapes without forests are more important for this type of landscape (Havlicek et al. 2012), and so it was named »rural areas« (Konečný 2014).

Some areas were separated from the seventh type and they create an eighth type with a very typical presence of urban and exclusively agricultural landscapes with both urban and rural settlements that are important from a cultural and historical point of view. This type is completed by the presence of cultural and historical core tourism sites (Ritchie and Crouch 2003) such as churches, castles, and places of Jewish history. This type is called »urban areas«.

The last type is determined by a flat landscape with ponds and the presence of historical urban and rural settlements, as well as important water features that are suitable for boating and fishing. This type is almost solely located in the central part of the Třeboň Protected Landscape Area and is named »pond areas«.

From the nine landscape appeal types identified in the study area, two types were selected whose appeal base is the presence of rare natural features dominated by peat bogs and natural habitats with scrub undergrowth or natural forests. In addition, many vulnerable ecosystems are linked to these types of plains, wild mountain river valleys, and vertically based ecosystems (Chytrý 2012).


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Figure 4: Important non-forest habitats: the Moss Peat Bog (Cz. *Rokytecká slať*), the Bohemian Forest (left) and wooded rocky slopes of the Giant's Castle Mountain (Cz. *Obří hrad*), the Bohemian Forest.

The individual types were primarily defined based on appearance (Ritchie and Crouch 2003). This is due to the natural combination of attraction types based on the natural environment (Hall and Lew 2006) and the opportunities for human use (Crang 1998). Nevertheless, a type dependent on cultural and historical attractions was also found (McKercher and du Cros 2008).

The total appeal for each hexagonal artificial spatial unit was then calculated. The most significantly attractive areas are those in the first and the second types, which cover important non-forest habitats and wooded rocky slopes (Figure 8). The following types have a medium appeal rate: wild river valleys, urban areas, abandoned border areas, and pond areas. A low appeal rate was calculated for rural areas, mountain foothills, and upland plains.

The comparison of the appeal in each hexagonal artificial spatial unit with the visitor frequency model makes it possible to identify areas where a relative surplus of appeal (with respect to visitors) is evident. There are two such area types: important non-forest habitats and wooded rocky slopes (Figure 9). A moderate appeal surplus was also detected in urban areas as well as in rural areas. However, visitor frequency is high in upland plains and pond areas (and less so for other types). Thus highly vulnerable areas are most important, where potentially increasing visitor numbers could impact other aspects of these areas (Pickering 2010), especially nature and landscape conservation (Bushell et al. 2007). Thus, using these areas for tourism activities is very problematic and undesirable because of continued degradation of the natural environment (Boucníková and Kučera 2005; Guth and Kučera 2005).

4 Conclusion

From the point of view of territory type, this model has identified naturally important non-forest habitats and wooded rock slopes as being the most attractive for tourism development. They are highly visited and they also have high further development potential. These areas are also among the most important ones from the point of view of nature and landscape protection in Central Europe (Chytrý 2012). This aspect of the research corresponds to reality because conflicts regarding different utilization of this study

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Figure 6: Abandoned border areas: the village of Pohoří na Šumavě, the Nové Hrady Mountains.

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Figure 7: Upland plains: the Gerl Glassworks (Cz. *Gerlova Hut'*), the Bohemian Forest.

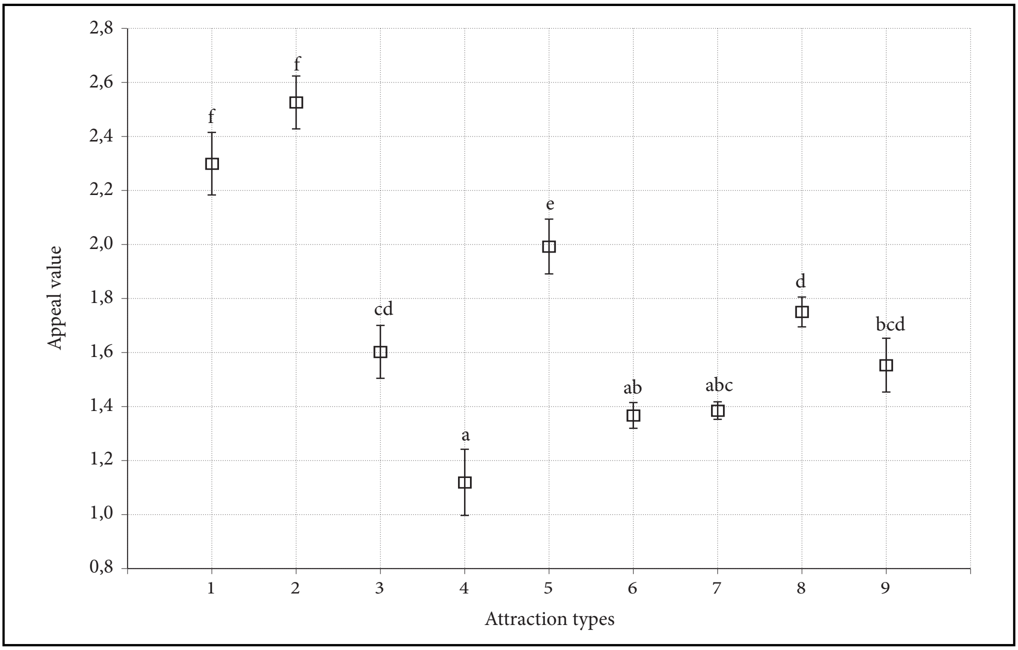

Figure 8: Appeal of individual attraction types (the numbers on the x axis correspond to the landscape types in Figure 3 and Appendix 1). The averages and 95% intervals of reliability are displayed. Result of one-way ANOVA ($F = 108.95$; d. f. = 8; $p < 0.001$). The averages marked by the same letter do not differ significantly (HSD Tukey post-hoc test for non-equal number of n, $p > 0.05$, $n = 4{,}901$).

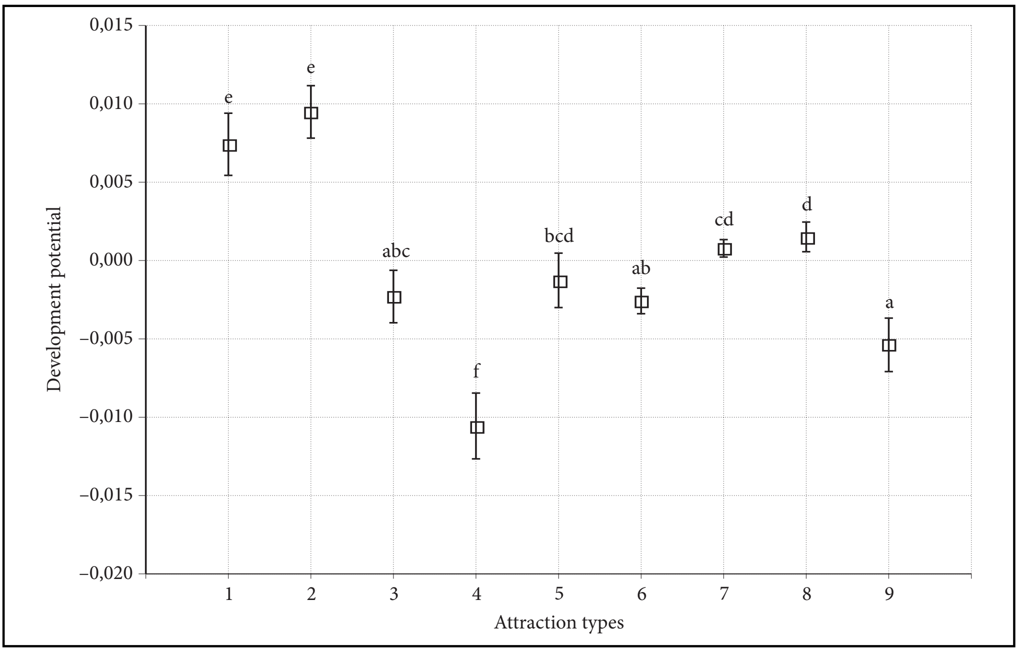

Figure 9: Identification of tourism development areas by attraction type (the numbers on the x axis correspond to landscape types in Figure 3 and Appendix 1). The averages and 95% intervals of reliability are displayed. Result of one-way ANOVA ($F = 47.15$; d. f. = 8; $p < 0.001$). The averages marked by the same letter do not significantly differ (HSD Tukey post-hoc test for non-equal number of n, $p > 0.05$, $n = 4{,}901$).

area have become an important political issue. It is especially a topic associated with the Bohemian Forest National Park Administration, which is the largest of this kind in the Czech Republic. With respect to the importance of the Bohemian Forest Tourist Region from the tourism and nature/landscape conservation points of view (cf. Prach 2010), these protected natural sites are constantly exposed to the pressure of seeking open free access (see Novinky 2010). Under such pressure along with the development drive of tourism (Hall and Page 2006), such areas are currently unable to cope with this stress (Holden 2008; Plesník 2010). With future increases in large-scale recreational tourism, the pressure of both tourists and tourism infrastructure will probably grow (Novinky 2011). Other regions in the Czech Republic, such as the Beskid Mountains with the Beskid Landscape Protected Area (Cz. *Chráněná krajinná oblast Beskydy*; Havrlant 2001), the Jeseník Mountains with the Jeseník Landscape Protected Area (Cz. *Chráněná krajinná oblast Jeseníky*; Havrlant 2010), or the Dyje Valley National Park (Cz. *Národní park Podyjí*; Foret and Klusáček 2011) have experienced a similar situation as well.

The methodological approach presented is based on a combination of different approaches for evaluating the appeal of the core sources of tourism (Ritchie and Crouch 2003), whose core lies not in typological-spatial analysis, contrary to the bulk of similar studies based on the cultural environment (e.g., Topole 2009; Vujičić et al. 2011), but in analysis of the relations of visitors to these areas. These analyses are not exceptional in Central Europe, of course (e.g., Polajnar 2008; Pompurová 2011); nevertheless they are not usually directly linked to concrete spatial elements and are usually related to the selection of tourism products or are the result of expert assessments (Bína 2002). The examples of the Bohemian Forest and South Bohemia tourism regions have proved that it is necessary and appropriate to employ the combined approach to evaluate of the importance of elements of natural and cultural-historical systems for the next stage of tourism development.

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LOCALIZATION FACTORS AND DEVELOPMENT STRATEGIES FOR PRODUCER SERVICES: A CASE STUDY OF BELGRADE, SERBIA

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New image of New Belgrade.

Localization factors and development strategies for producer services: a case study of Belgrade, Serbia

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ABSTRACT: This article highlights the patterns of Advanced Producer Services (APS) in Belgrade and relates them to contemporary spatial and economic intrametropolitan transformations. The locational strategies of APS have influenced the creation of another center called New Belgrade next to the traditional central business district (CBD). Over the last ten years, government planning documents and the location preferences of foreign firms have made New Belgrade the most attractive business location in Serbia. In a sample of the leading APS firms in Belgrade, 129 firms are analyzed in terms of firm sector, ownership, and location. The results confirm the multipolar-monocentric pattern, which appears to be a common feature in many European cities.

KEY WORDS: advanced producer services, location strategy, polycentrism, world city networks, Belgrade, Serbia

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1 Introduction

Advanced Producer Services (APS) are the key agents of cities and the economy (Stein 2002; Basens et al. 2010; Taylor et al. 2009; Lundquist, Oland and Henning 2008) as well as a standard unit of measurement for inclusion in the global network in the context of theories on global cities (Sassen 1991; Castells 1996; Taylor 2004). The increase in the significance of cities as centers of economic flows raises the question of whether it is possible for cities located in less-developed countries, such as Belgrade, to take a much higher position in the world city hierarchy compared to the countries they are located in. Here it is important to note Sassen's (2001) observation that the position on the world city scale depends on the economy, which is not necessarily national, which makes these cities independent of the national economic policy. This is where the opportunity for cities like Belgrade can be seen, because in the global cities theory capitals of post-communist countries are considered to be the most important actors in integrating national territories into global flows (Musil 1993).

Concerning APS and urban organization and structure, Hall (2001, 2004) states that today the traditional CBD is of greatest importance to the location of banks and financial institutions. However, it is also being supplemented by secondary business districts and other nodes. According to Hall (2001), previously established businesses remain inside the CBD, which is not the case with new companies. As the literature suggests, the internal spatial structure changes in two ways: the creation of polycentric metropolitan urban forms (Taylor, Evans and Pain 2006; Hall and Pain 2006) or development of a multipolar-monocentric urban structure (Bourdeau-Lepage and Huriot 2005; Halbert 2004). In most European cities, the last thirty years have witnessed the rise and frequently the externalization of high-order activities (producer services, financial services, headquarters of large firms) devoted to economic design, decision, and control, or more generally to economic coordination (Bourdeau-Lepage and Huriot 2005).

Geographical research on producer services has focused on three issues: regional location patterns, exportability of services, and the intrametropolitan location of service activities (Coffey 1995).

For the UK, Daniels (1995) found some intra-regional redistribution from large cities to adjacent towns, but the interregional pattern of producer services in Britain continues to be dominated by the southeast. Apart from deconcentration, a trend of increasing interregional and interurban specialization of APS can be observed. Examples of this are financial services in London, services auxiliary to a »control economy« in Paris, textile-engineering consulting in Lille-Roubaix-Tourcoing, services related to high-tech firms in Rhône-Alpes and southern France, engineering and software in Munich, accounting and consulting in Frankfurt, advertising in Hamburg and Düsseldorf, certification of ships in Oslo, environmental services in Copenhagen, »specialized« production areas in Portugal, and specialized engineering and management consulting in a variety of northern Italian cities and cities in Emilia Romagna (Mouleart and Todtling 1995).

The multipolar urban location pattern partly has to do with the appearance of new actors such as international firms, developers, and institutional investors promoting new tertiary centers, and partly with a decline in the attractiveness of central city locations. The Paris region (Île-de-France) shows an internal multipolarity and a displacement of part of the economic power towards the periphery (Halbert 2007; Shearmur and Alvergne 2002). However, despite the relative dispersal of service activities towards the west and southwest of the first and second *couronne*, control activities have not left Paris *intramuros* (Moualert and Gallouj 1995). A similar process of intra-urban and intra-regional dispersal can be identified for London and southeast England (Pratt 2008), the large German agglomerations (Schamp 1995; Luthi, Thierstein and Goebel 2010) and the Vienna region (Todtling and Traxler 1995). In the metropolitan area of Lisbon, in contrast, APS are still strongly concentrated in the city center; so far, suburbanization has been limited to trade and transport activities without APS (Ferrao and Domingues 1995). For the Nordic countries, Illeris and Sjøholt (1995, 218) found that »*… only a few business services really depend on a central city location for their contacts. Most of the firms that are still located in the center are there for prestige reasons or because they appreciate the environment. However, as car accessibility deteriorates and rents increase in the urban center, they tend to shift to suburban locations.*«

According to the 2008 report compiled by GaWC regarding well-known city connectivity measures, Belgrade belongs to the high-sufficiency category (GaWC 2008). The GaWC research team developed a new measure of the dynamics of contemporary cities devised by the GaWC research network. Unfortunately (according to *Global Buzz–The GaWC Monthly Monitor*, table 2010-07), Belgrade cannot be found among the sixty-two cities studied (GaWC, 2010). Of all the cities in transition, Moscow holds the best position, and apart from Moscow the analysis includes Budapest and Warsaw.

2 Methodology

In order to study the patterns of business activity in Belgrade metropolitan areas, we used descriptive case-study research. For this article it was important to select cases at three different levels: territorial selection, APS sector selection, and APS firm selection. The territorial selection of the Belgrade metropolitan area comes down to spatial zoning, where two city centers have been named: the wider CBD (the traditional zone of the work function agglomeration) and New Belgrade (the municipality that has been experiencing the most intensive business development since the beginning of the 1990s). The rest of the urban area is not characterized by marked growth of work function and is generally a zone of dispersed locations of companies. The CBD has been statistically precisely defined combining geographical regression of work function and spatial clustering methods (Ratkaj 2009). In addition, we distinguish the »wider CBD,« a statistically defined CBD expanded using Euclid's distance (buffering) of 500 m. The aim was to indicate the existence of APS firms that gravitate towards the CBD as those located within walking distance from the CBD. In this context, the wider CBD can be viewed as a functional CBD with more flexible borders.

APS encompass seven sectors: advertising, finance and banking, insurance, information technology (IT), law, consulting, and accounting. Consulting incorporates several subsectors: management consulting, business consulting, design consulting, and human resource consulting. The selection of the sectors was performed in compliance with the analysis of polycentric European regions (Taylor, Evans and Pain 2006). The same APS sectors form the basis of the interlocking network model developed by a team of Globalization and World Cities Research Network (GaWC) researchers for studying the world city network (Taylor et al. 2009).

The selection of APS firms was performed according to their rank. The sample included the best companies per sector ranked according to income in 2009. The availability of the data caused the samples to be unevenly distributed among sectors (Table 1). The literature suggests a sample that only consists of APS transnational corporations (TNCs). However, Belgrade's meager APS TNC sample was not enough to provide solid arguments. Therefore the sample included all foreign firms. The authors suggest that it is possible to equate foreign companies with TNCs. This supposition has been confirmed by the results of the analysis of the location of foreign APS firms in Belgrade that have the same location patterns as APS TNCs in global cities (Han and Qin 2009; Taylor et al. 2009; Hermelin 2007; Shearmur and Alvergne 2002).

2.1 Data sources

All of the data were gathered from secondary sources, such as various databases, census statistics, and Serbian Business Registers Agency databases. In order to identify APS firms in Belgrade, we used a two-step procedure. The first step consisted of identifying the most successful APS firms doing business in Belgrade, for which we used special publications from The Economist; in particular, *Top 300* (2009) for IT firms, and *Banks and Insurance Companies* (2009) for finance/banking, insurance and accounting firms. We also used *Taboo* magazine and its review »Results of Business Activities of Marketing Communication Agencies« (2009) for advertising firms, then Chambers et al. (Chambers … 2014) for law firms, *Gartner Special Reports Top 10 Consulting Services Companies for South-East Europe* (Internet 1), and the Belgrade Chamber of Commerce register of consulting agencies (Internet 2).

Table 1: Number of firms by sectors and capital.

Sectors	Number of firms	Domestic	Foreign
Advertising	24	20	4
Finance and Banking	21	6	15
Insurance	12	6	6
IT	7	2	5
Law	19	12	7
Consultancy	28	16	12
Accountancy	18	14	4
TOTAL	129	76	53

The second step consisted of checking the data for each of the firms in the Serbian Business Registers Agency national database (Internet 3). This database represents the official statistics of all firms and organizations in Serbia. It provided information on firms, including type of business activity in compliance with NACE Rev. 2 codes, current status (active or inactive), prevailing capital origin (domestic or foreign), and location (address).

3 Results

The findings suggest that the distribution pattern of producer services has gradually changed from dispersed to centripetal development towards the new business district. This article defines three aspects for distinguishing and analyzing APS firms: area, capital origin, and sector.

3.1 The CBD versus New Belgrade

Table 2 summarizes the data and relates them to the territorial division of the Belgrade metropolitan area. Of the total number of APS firms, 53% are located in the wider CBD. All sectors are present there except IT firms, which prefer New Belgrade or other areas. Consulting, law, and advertising firms are present in the greatest numbers, whereas there are only a small number of banks and insurance companies. Approximately 70% of the firms in the CBD were founded using domestic capital (Figure 1).

Table 2: Share of sectors in the CBD and New Belgrade.

	Advertising	Finance and Banking	Insurance	IT	Law	Consultancy	Accountancy	Total
CBD	20,3	15,9	7,2	–	20,9	20,3	15,9	100
New Belgrade	9,1	30,3	21,2	15,1	3,1	18,2	3,1	100

Approximately 26% of the total number of APS firms analyzed are located in New Belgrade. The rest of the APS firms studied (around 20%) are dispersed outside the CBD area and New Belgrade and were not considered further. New Belgrade has all seven APS firm sectors presented, with a clear predominance of banks, insurance, consulting, and IT companies. Law firms and accounting companies are fewest in number. Over 80% of APS firms located in New Belgrade are foreign, and less than 20% were founded using domestic capital.

3.2 Domestic versus foreign firms

Table 3 shows how business is distributed across the Belgrade metropolitan area in terms of whether firms are domestic or foreign. Domestic firms (founded by domestic capital) make up about 60% of the total number of APS firms in Belgrade. The structure of firms according to capital is uneven in the areas and sectors considered. In the CBD and the rest of the city areas outside New Belgrade, domestic firms are dominant, whereas foreign firms clearly dominate in New Belgrade.

Table 3: Share of domestic and foreign firms in the CBD and New Belgrade.

	The number of APS firms	Foreign firms	Domestic firms	Total
CBD	69	30,4	69,6	100
New Belgrade	33	81,8	18,2	100
Other	27	18,5	81,5	100

Territorial distribution of domestic firms is characterized by concentration: almost 90% of domestic firms are located within the CBD areas, and only 10% in New Belgrade. Foreign companies (where more than 50% of the initial capital originates from abroad) are distributed in a polycentric manner: they can be found in both areas, but a little more than half of them are located in New Belgrade. In terms of sectors, foreign capital is the major capital in more than 70% of the firms dealing with banking and information technologies, half the insurance companies, and more than 40% of consulting companies. Domestic firms make up more than 80% of the total number of marketing and accounting firms, as well as more than 50% of the total number of consulting and law firms.

3.3 Sectors

APS are divided into seven sectors, represented by a different number of firms (Table 1). However, the sample composition according to the ownership and locational strategy of the firms sampled is far more important than their number. The results are presented for each sector separately (Figure 1).

Advertising: twenty-four firms were analyzed, only four of which have foreign capital as predominant. They are territorially concentrated: 83% of advertising firms are located inside the CBD. For most of the marketing agencies, accessibility is top priority, which corresponds to the central city zone. The second strategy is locating the firm in relatively distant but highly prestigious zones, set outside the main public transport routes. New Belgrade did not prove to be an attractive location.

Finance and banking: twenty-one firms were analyzed, fifteen of which have foreign capital as predominant. Banks are characterized by polycentric distribution: they are almost evenly distributed among the CBD and New Belgrade. Two locational strategies were identified: location in the city center due to the importance of being accessible and centrally positioned, as well as location in New Belgrade due to the existence of open space suitable for the construction of new large buildings. However, even in New Belgrade, banks are located along main radial roads, which provide a quick link to the city center. In addition, they are located near densely populated New Belgrade areas. Out of ten banks located in New Belgrade, nine have foreign capital as predominant.

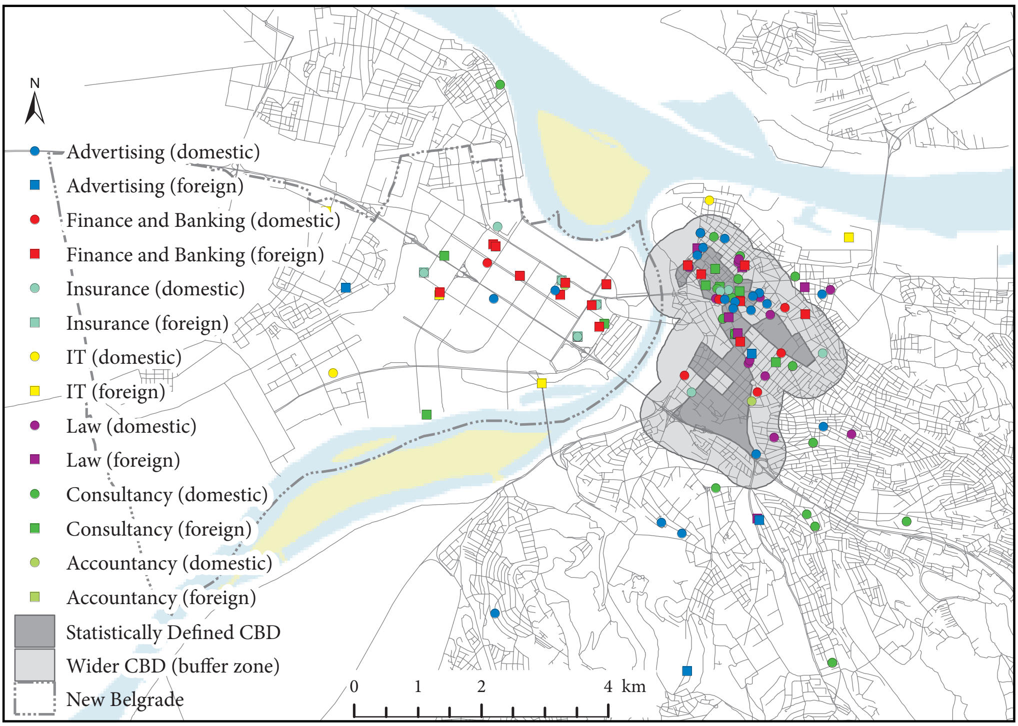

Figure 1: Location choices of firms, by sector and ownership.

Figure 2: New bridge on the Sava River.

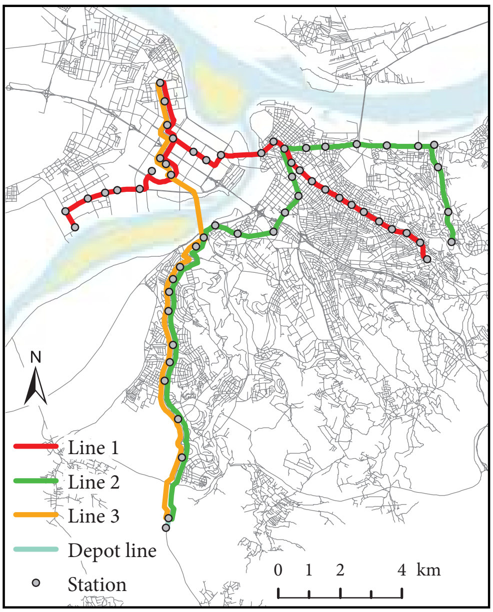

Figure 3: Belgrade subway plan – not yet under construction.

Insurance: twelve firms were analyzed, six of which have foreign capital as predominant. They are located in New Belgrade, with seven of them (six foreign) located in the CBD or zones gravitating towards it as well. The locational strategy is similar to the one the banks have, and foreign companies find New Belgrade especially attractive. Transport accessibility is also important.

IT: Seven firms were analyzed, five of which have foreign capital as predominant. They are mostly located in New Belgrade (five firms, four of which are foreign). None of them are located inside the CBD or its immediate vicinity. Four firms are located near the freeway. The two companies located near the harbor are not oriented to the domestic market, and so their ability to reach the local population via thoroughfares is not significant.

Law: nineteen firms were analyzed, seven of which have foreign capital as predominant. Only one (foreign) law firm is located in New Belgrade, whereas fourteen of them are located inside the CBD or a zone gravitating towards it. Centrality – that is, being accessible to the local market – is an extremely important factor for their location. The size of the premises is of no importance.

Consulting: twenty-eight firms were analyzed, twelve of which have foreign capital as predominant. They are mostly located in the CBD or in a zone gravitating towards it. There are only six consulting agencies in New Belgrade, all of which are foreign. Centrality is also important for their location, but foreign companies clearly recognize the attractiveness of New Belgrade.

Accounting: eighteen firms were analyzed. Four of them have foreign capital as predominant and most are located in the CBD or a zone gravitating towards it. Accounting companies can also be found in other city regions (six are located outside the wider CBD and New Belgrade). Unlike consulting companies, all accounting companies are located inside the CBD.

4 Discussion and conclusion

First, the high level of concentration of APS at the national level in the Belgrade metropolitan area was affected by several factors: the high-order position inherited from the settlement network of the former Socialist Federal Republic of Yugoslavia (SFRY) and Federal Republic of Yugoslavia (FRY), particularly the position of the capital city; the concentration of human capital; and the concentration of direct foreign investments. Important factors to increase APS in Belgrade were transition towards a market economy and economic globalization, and also strategic government decisions towards a knowledge-based economy, which later caused occupational structure changes (Gligorijević 2009).

The second conclusion of the APS pattern analysis is the high level of concentration in the CBD, similar to other large European cities. Urban amenities certainly play a major role in the preference of high-order functions for the CBD (Todtling, Lehner and Trippl 2006; Tonts and Taylor 2010; Wu 2003), which is closely related to prestige and place symbolism. The analysis by Castells (1989) shows that the CBD has a concentration of APS firms, and that the reasons for this lie in the need for face-to-face contact, a business social milieu with a unique culture, a prestigious location, existing office stock, and available ancillary services.

The third result of the research is recognition of intra-urban multipolar development. In the first phases of APS development in Belgrade, APS firms were concentrated in the CBD, and later on some firms dispersed around it. Findings suggest that the distribution pattern of producer services has gradually changed from dispersed to concentrated in the new business center: New Belgrade. It has fewer amenities than the CBD, but it attracts foreign firms and investments. The traditional CBD is still an important residential zone, with a lack of modern business space, which influenced the business shift towards New Belgrade. The advantages of New Belgrade, in comparison to the CBD, include modern transport infrastructure, vicinity of the airport and the highway, the absence of denationalization issues, and extensive open space.

From a socially relatively uniform »large dormitory« under communism, New Belgrade has transformed into a new business center marked by more prominent social stratification (Petrović 2000). Concentration of business facilities in selected zones of New Belgrade presupposes the influx and concentration of the new service class, for which high-quality residential buildings have been built. Based on interviews conducted with experts from the Institute of Architecture and Urban and Spatial Planning of Serbia, Barlov (2009) discusses »*the obsession with business-residential construction*« and the domination of »*investment urbanism*« and greenfield investments, and points out that a rapid urban transformation of New Belgrade is underway, leading to the gradual destruction of the functional city aspirations for the needs of the business interests of the minority.

The development of New Belgrade was also influenced by abandoning the centralized planning system and introducing neoliberal capitalism. These changes led to severe collapse of the monocentric structure of communist Belgrade. The urban development of New Belgrade is not a controlled and planned counterpart to the CBD, but an embodiment of the market economy. Urban experts face many challenges, but the biggest of all is to reduce the traffic volume and to improve connectivity between the old and new parts of Belgrade. A temporary solution to this problem is the construction of a new bridge on the Sava River (Figure 2) and designing a subway (Figure 3). In addition, New Belgrade's population increase requires social policy improvements, especially investment in schools and hospitals, regardless of the economic effects of these investments.

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MODELING OF THE ARAL AND CASPIAN SEAS DRYING OUT INFLUENCE TO CLIMATE AND ENVIRONMENTAL CHANGES

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The Caspian sea (Credit: NASA).

Modelling of the Aral and Caspian seas drying out influence to climate and environmental changes

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ABSTRACT: The complete drying out of the Aral and Caspian seas, as isolated continental water bodies, and their potential impact on the climate and environment is examined with numerical simulations. Simulations use the atmospheric general circulation model (ECHAM5) as well as the hydrological discharge (HD) model of the *Max-Planck-Institut für Meteorologie*. The dry out is represented by replacing the water surfaces in both of the seas with land surfaces. New land surface elevation is lower, but not lover than 50 m from the present mean sea level. Other parameters in the model remain unchanged. The initial meteorological data is real; starting with January 1, 1989 and lasting until December 31, 1991. The final results were analyzed only for the second, as the first year of simulation was used for the model spinning up.
The drying out of both seas leads to an increase in land surface and average monthly air temperature during the summer, and a decrease of land surface and average monthly air temperature during the winter, above the Caspian Sea. The greatest difference in temperature between dry and not dry cases have the same values, about 7–8 °C in both seasons, while daily extremes of temperature are much more pronounced. In the wider local/regional area, close to both seas, drying out leads to a difference in average annual temperatures by about 1 °C. On a global scale, the average annual temperature remains unchanged and the configuration of the isotherms remain unchanged, except for over some of the continents. In winter, Central Asia becomes cooler, while over Australia, southern Africa, and South America, it becomes slightly less warm. Furthermore, a new heat island occurs in western Sahara during summer.

KEY WORDS: Caspian Sea, Aral Sea, drying out, numerical simulation, air temperature, climate change

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1 Introduction

Since the beginning of Earth's history, climate has varied (Goosse et al. 2013). Its climate system is affected by many factors that can be classified into three major groups:

- astronomical factors, such as solar or Earth orbital variability;
- natural landscape factors, such as spatial distribution of land and sea, configuration and type of land surface, vegetation cover and
- anthropogenic factors, such as atmospheric composition and land use.

The latter influences climate only in recent centuries (e.g. Dahan 2010).

The study of current/recent climate change is focused on two main themes:

- the net overall climate change and
- constraining the relative influences of natural versus anthropogenic influences (Hansen and Sato 2012).

This paper examines the potential impact of the drying out of the Aral and Caspian seas on local, regional, and global climate and environment. In the case of the Aral Sea's recent progressive drying out process is mostly triggered only by anthropogenic factors. Current human influence on the hydrological regimes in catchments of the Aral Sea results in its reduced surface and volume (Peneva et al. 2004; Toman 2013), leading to its immanent final disappearance. In the case of Caspian Sea the human influence has not been so severe, although the sea level drop caused by big contractions on Volga River are reported since the 1950s (Vrišer 1953). Thus the disappearance of the Caspian Sea can be significantly accelerated in the case of major inflow decrease of water from the main tributaries, the Volga and Ural rivers. On the other hand, also natural influence on the hydrological regimes in the catchment of the Caspian Sea has been observed. The Caspian Sea is subject to large variations in the amount of water and water surface, as it was during the Late Pleistocene and postglacial periods (Kislov et al. 2012). Without going into the details of all of these processes, our study introduces a presumption that the drying out of the Aral and Caspian seas has happened in the last decades. The influence of drying out on air temperature will be considered. Beside the impact on the climate, the drying out of the inland seas would impact the environment and ultimately the human society.

It is a widely accepted view that the roots of today's civilization are linked to ancient human societies that existed in the valleys of major rivers, such as the Nile in Africa, the Tigris and Euphrates rivers in the Middle East, the Indus in South Asia, and the Yangtze and Yellow rivers in China. Many civilizations took advantage of natural flooding of rivers for agricultural development, and later developed irrigation and flooding control to further enhance farming conditions (Diamond 2005). Water management should be planned, including digging of channels to organize work in the fields, keeping accurate records, taking care of security, implementing control, synchronizing decisions and transmitting orders. Economy was subordinated to the very complex interface between human organization and management. Over time, these teams ensured the emergence and development of civilizations in the river valleys. Civilizations based on good water management survived the longest of all in the past, and are sometimes referred to as »hydraulic civilizations« (Gavrilov 2005). Multi millennial experience in water management has mainly brought blessings. Until recently, people did not notice the consequences of bad management.

1.1 Aral Sea

The Aral Sea is lying between Kazakhstan in the north and Uzbekistan in the south. It is a completely enclosed basin with a large inland catchment area. Most of the surrounding land is desert and almost all water entering the basin comes from two major rivers: Amu Darya and Sir Darya (Peneva et al. 2004; Toman 2013). The name of the Aral Sea roughly translates from old Turkish as »Sea of Islands«, referring to the more than 1,534 islands that once dotted its waters. Previously it was the fourth largest lake in the world with an area of 68,000 km^2 (Figure 1). The Aral Sea has been steadily shrinking since the 1960s after the Amu Darya and Sir Darya Rivers were diverted by Soviet irrigation projects. By 2007, it had declined to 10% of its original size, splitting into four lakes: the North Aral Sea, the eastern and western basins of the once far larger South Aral Sea, and one smaller lake between the North and South Aral Sea (Micklin and Aladin 2008). By 2009, the southeastern lake had disappeared and the southwestern lake retreated into a smaller water bodies at the far west of the former southern sea (Singh et al. 2012; Figure 2).

The shrinking of the Aral Sea has been called one of the planet's worst environmental disasters. The region's once prosperous fishing industry has been essentially destroyed, bringing unemployment and economic hardship. The Aral Sea region is also heavily polluted, with resulting serious public health problems. The retreat of the sea has reportedly also caused local climate change, with summers becoming hotter and drier, and the winters becoming colder and longer (Micklin 2007).

1.2 Caspian Sea

The Caspian Sea is situated in a semi-arid area between southern Russia, Kazakhstan, Turkmenistan, Iran and Azerbaijan (36°–47° N, 47°–54° E) and currently lies 27 m below sea level. It is the world's largest inland body of water without a connection to the world oceans, with a surface area of 390,000 km^2 and volume of 66,100 km^3 (Figure 3). It is a reservoir of brackish waters, highly sensitive to climate changes. It has large catchment area of approximately 3.5 million km^2 (Arpe and Leroy 2007; Arpe et al. 2012). The salinity of the Caspian Sea varies from the north to the south from 1.0 to 13.5 ‰. This difference is most marked in the north due to the freshwater supplied by the Volga River. In other areas, average water salinity is 12.5 ‰ (Dumont 1998). The Caspian Sea is divided into three basins but differing in depth and volume: the south (water depth up to < 1020 m), middle (< 900 m) and north (< 15 m) basins, which represent two-thirds, one-third and 1% of the total volume of water, respectively. The Caspian Sea was formed in the Pliocene, about 3 million years ago, after its separation from the Black and Pannonian seas. From that time, due to specific geomorphological conditions, it has experienced numerous transgressions and regressions with water level fluctuations of several tens of meters (Varuschenko et al. 1987), causing important changes in its shoreline, particulary in the north (Tudryn et al. 2013). The current environmental changes experienced in the area, especially the negative water budget in the northern and eastern shallow parts of Caspian Sea, indicate serious consequences.

2 The model

The atmospheric general circulation model ECHAM5 (Roeckner et al. 2003) was used for simulations presented in this study. This fifth-generation atmospheric general circulation model developed at the *Max-Planck-Institut für Meteorologie* (MPIM) in Germany is the most recent version in a series of ECHAM model versions evolving originally from the spectral weather prediction model of the European Centre for Medium Range Weather Forecasts (ECMWF), (Simmons et al. 1989).

The ECHAM5 is well designed for climatological studies (Roeckner et al. 2004), because there are many good solutions in numerics and physics of the model. It is important to note that a hydrological discharge model (Hagemann and Dümenil 1996; 1998; Hagemann et al. 2006), developed at MPIM, is included in the ECHAM5 model. Also, ECHAM5 has been used for research similar to these (e.g. Kislov et al. 2012).

The horizontal resolution (spectral transaction) of the ECHAM5 model is T42 (128 × 64 grid point or 221 × 221 km on latitude 45°), the model had 19 vertical layers and a time step of 1800 s. Other parameters of model were standardized and/or adapted to the capacities of computer used.

3 Geographical areas

The model used two types of global geographical areas. The first is the original geographical area, as used in the basic version model ECHAM5. This area is marked with G1. Part of G1 around the Aral and Caspian seas labelled as area A1, (32.1°–60.0° N, 39.3°–67.5° E) is shown in Figure 5.

The area A1 shows a distinct geographic configuration of land and sea on the surface and state borders before the collapse of the Soviet Union (the green lines) all around the Aral and Caspian seas. Also, A1 shows the values of the lake mask (LM) in equidistant grid points. Lake mask is a special value in ECHAM5, which is the ratio of areas of land and water per a box in the grid points, but only on the mainland (Hagemann 2002). LM takes values between 0 and 1, as markers for land 100% and for water 100%, all on the land, respectively. It should be noted that there is no value LM over the oceans and seas.

Second type of global geographical area is the modified geographical area, marked as G2. Part of G2 around the Aral and Caspian seas, previously marked as A1, is shown in Figure 6.

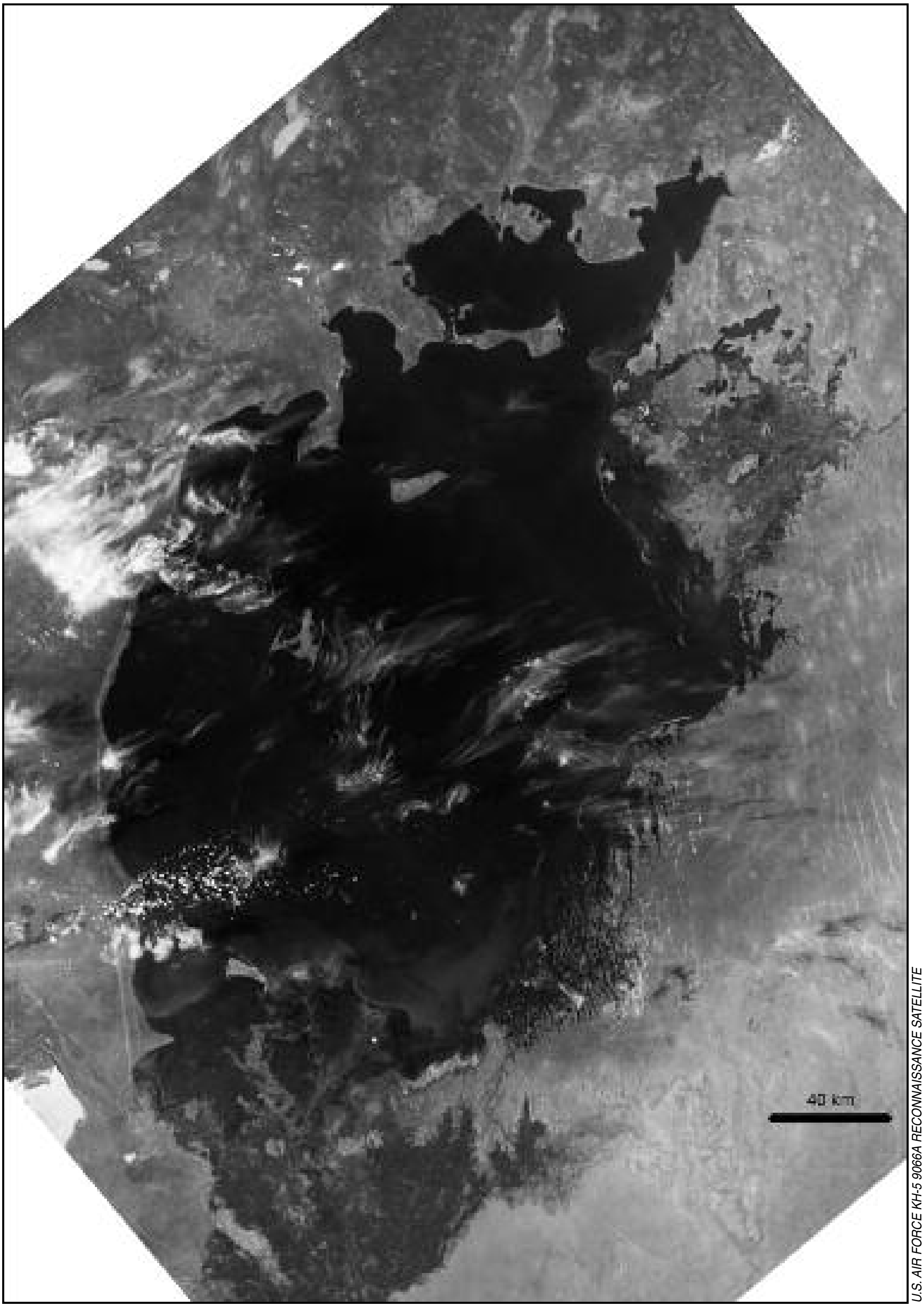

Figure 1: The Aral Sea in the year 1964 (Credit: NASA Earth Observatory).

NASA

Figure 2: The Aral Sea in the year 2009 (the black line shows the extend of the Aral Sea in the year 1960; Credit: NASA Earth Observatory).

Figure 3: The Caspian Sea is the world's largest inland body of water (Credit: NASA Earth Observatory).

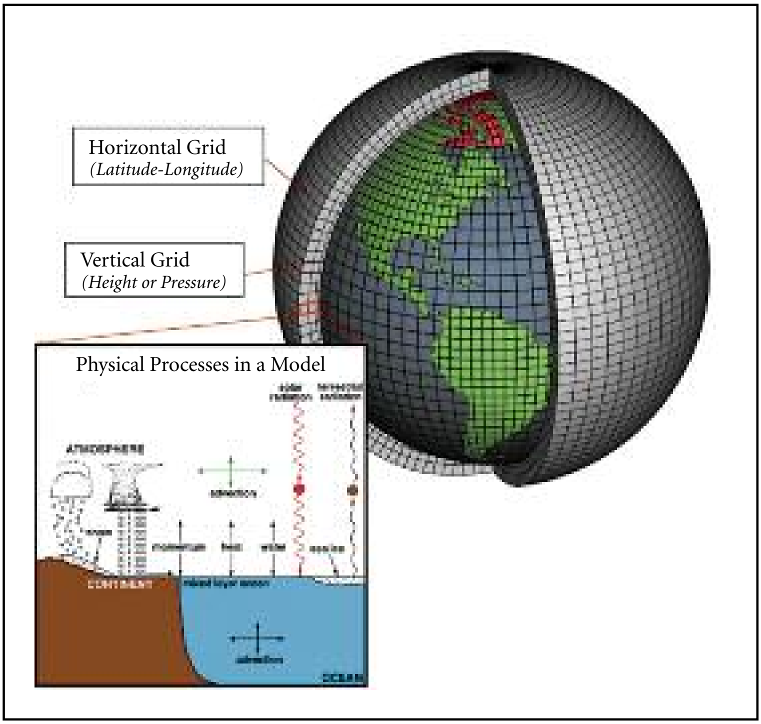

Figure 4: Schematic representation of the main components of the numerical model of the atmosphere (Internet 1). Besides horizontal (latitude-longitude) grid and vertical (height or pressure) grids in spherical geometry (Earth globe), can be seen the most important physical processes in the atmosphere, continents and oceans, such as solar and terrestrial radiation, advection, momentums, heat, water, clouds, precipitations, sea ice and mixed layer ocean. All the above mentioned components and processes are connected to natural laws, which are described by mathematical equations, whose are solutions obtain on the computers by using the initial data of the atmosphere, oceans and continents, and finally after a lot of calculations the output data are obtain as results of the model (Gavrilov et al. 2011).

G2 is identical to G1, but has the new values of the lake mask (LM) in a rectangular frame, marked as A2, (34.8°–48.8° N, 45.0°–64.7° E) that is embedded in A1. The area A2 was developed for the purposes of numerical simulation of the drying out of the Aral and Caspian seas. The drying out is achieved by putting 0 in all grid points in A2, making both seas disappear. Besides these, other changes in the model have not been carried out.

4 Data

In all cases the same initial set of global data from 1 January 1989 was used (ERA40 Reanalyse Data 01/01/1989). For this data an initialization procedure (e.g. Wiin-Nielsen 1978) was applied that adjusted the data to each other and on the normal/actual geographical area (G1). Therefore, the initial data had to be adjusted to the changing (modified) geographical area (G2).

5 Simulations

Only one numerical simulation was run for each of the two types of geographical areas: G1 and G2. It is clear that when geographical area G1 is used, both the Aral and Caspian seas are in the model. In contrast when geographical area G2 is used, both seas were omitted from the model. Both simulations were carried out for two years until 31 December 1991. The first year of simulation was used for the model

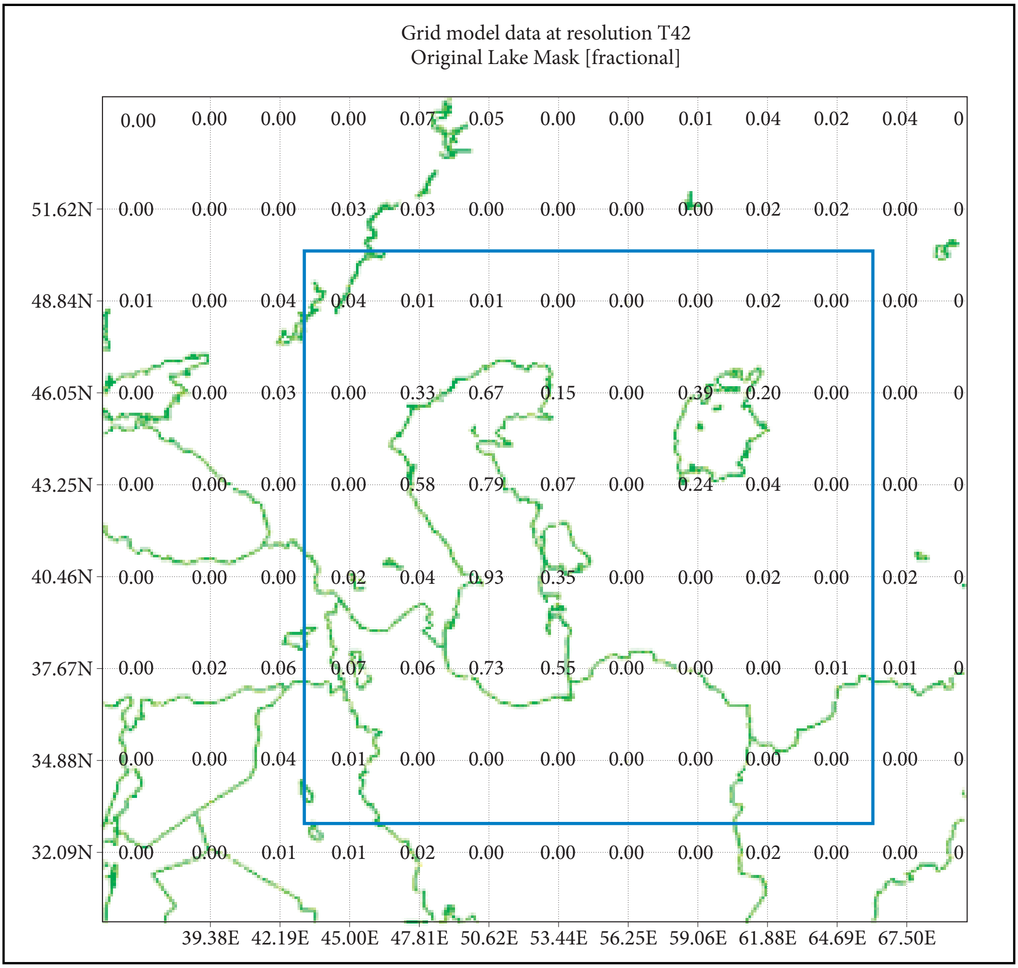

Figure 5: Area A1 as part of normal global geographical area (G1) in model ECHAM5 around the Aral and Caspian seas, showing the original lake mask (LM).

spinning up, while data from the second year was used for analysis. It is considered that this simulation of the entire climatological season is sufficient for adjustment to new conditions.

6 Results and analysis

All output data models are produced for both simulations with original (G1), and modified (G2) geographical areas. For this purpose, only air temperature is considered as the main climatic parameter. The temperature will be displayed in two cases; as a local/regional and as a global and continental indicator of climate change.

6.1 Local and regional impact

To investigate local/regional changes in the vicinity of both the Aral and Caspian seas, two parameters were used. One parameter is the average monthly temperature for January and August at two levels (at the surface and 100 m above it) along the meridian of longitude 50.625E.

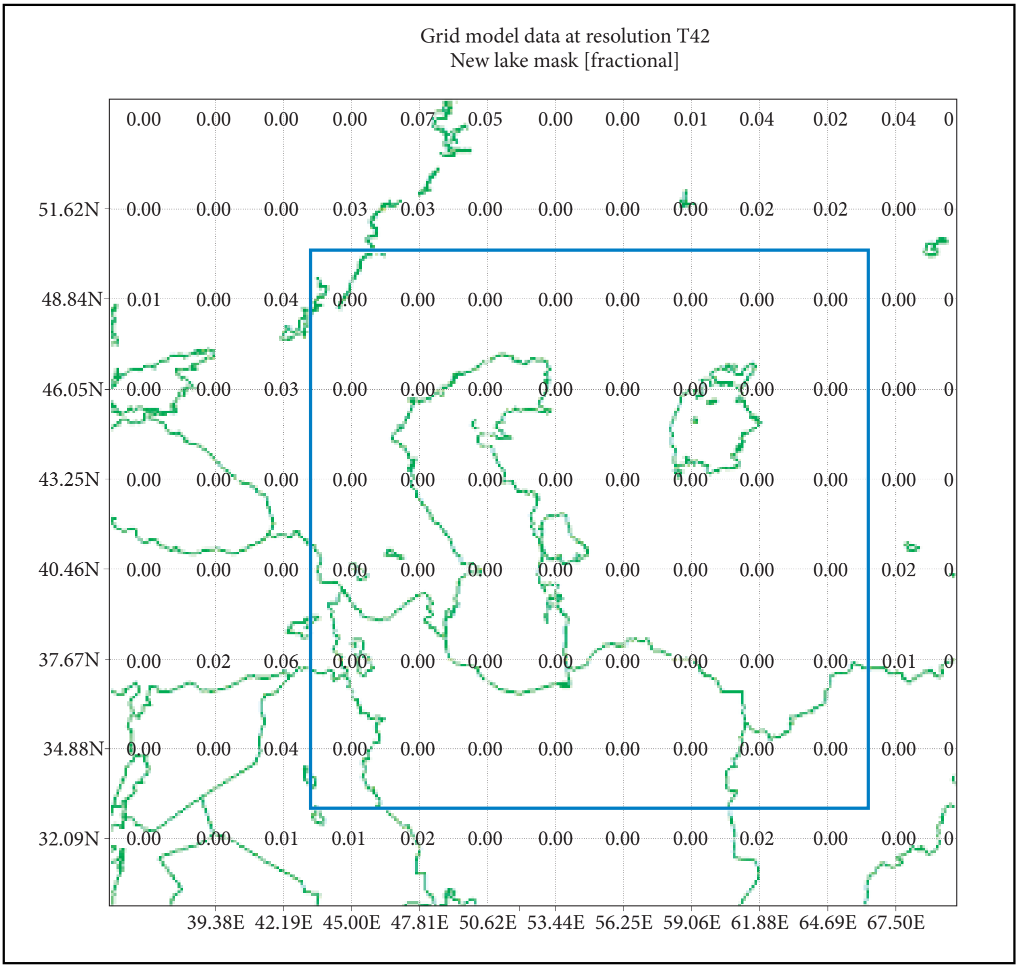

Figure 6: Area A1 as part of modified global geographical area (G2) around the Aral and Caspian seas, showing the new lake mask (LM) in the rectangular frame labelled as A2.

The average monthly temperature for January and August at both levels can be seen in Figures 7–10, respectively. Green indicates the temperature distribution in the original geographic area (G1), and red is the temperature in the modified geographic area (G2).

As shown in Figures 7 and 8, draining the Aral and Caspian seas leads to a decrease in January temperature at both levels along the longitudinal direction (50.625E). The greatest difference in temperature is about 7–8 °C around the centre line, and north and south of the centre line the difference in temperature monotonically decreases to about 1–2 °C in both cases. The lines are approximately matched at both levels. As can be seen, draining of the lakes reduces average monthly temperature during winter for about 8 °C, while the daily extremes of temperature drop may be much higher.

As shown in Figures 9 and 10, draining of the Aral and Caspian seas leads to an increase in temperature during August at both altitude levels along the longitudinal direction (50.625E). The greatest difference in surface temperature is about 7–8 °C in the regions from 37.67 to 43.25° N. The greatest differences in temperature are similar in height, with the exception of 40.46° N, where the difference is less than 2 °C. At the southern and northern ends of the longitudinal direction (50.625E), temperature differences disappear. Lines are approximately matched at both levels. Draining both of the lakes increases average monthly temperature during the summer for about 8 °C, while the daily extremes of temperature rise may be much greater.

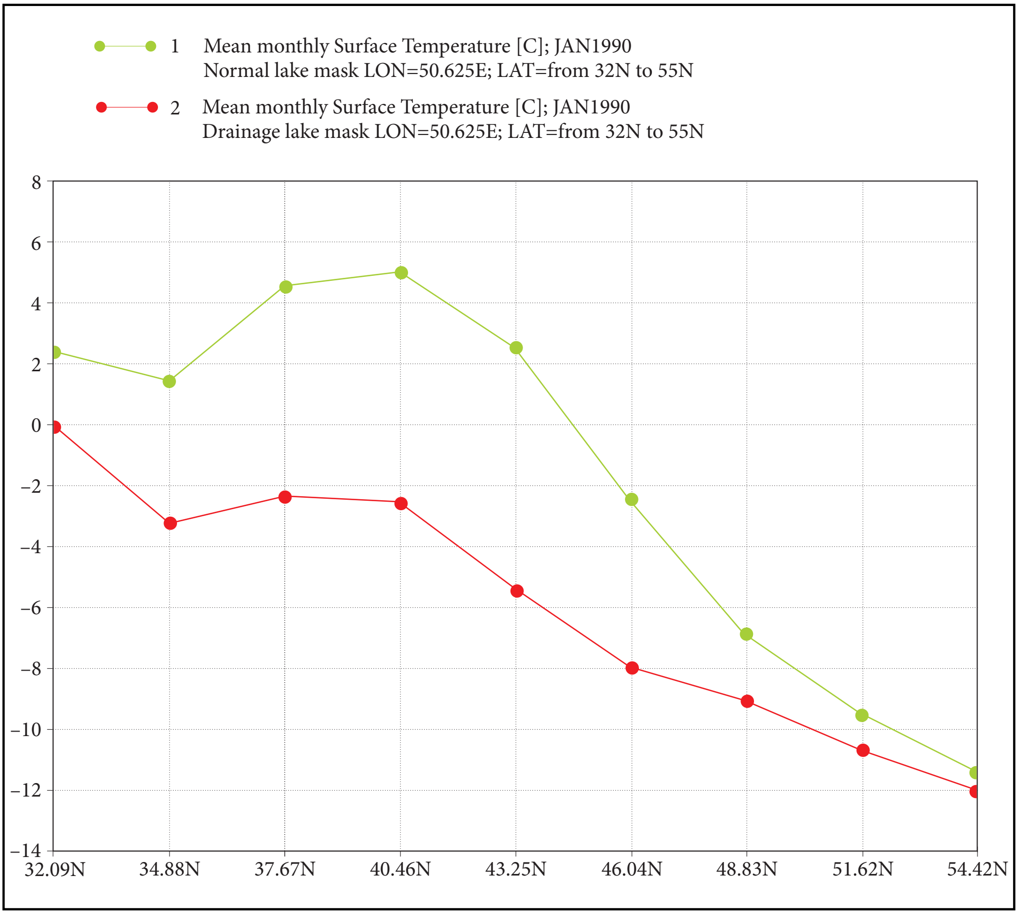

Figure 7: Surface average monthly temperature for January.

Another parameter of change is the average surface annual temperature in A2, as a local indicator, and in A1, as a regional indicator for both simulations. The values of these temperatures can be seen in Table 1.

Table 1: Average annual surface temperature in areas A1 and A2 for simulations G1 and G2.

	G1	G2
A2	14.73 °C	13.82 °C
A1	11.67 °C	10.51 °C

As shown in Table 1, draining the Aral and Caspian seas leads to an overall decrease in average annual surface temperature in both areas. Since the difference in temperature is slightly greater in area A1, it is considered that draining both lakes have a greater impact on the local rather than regional climate.

6.2 Potential global impact

In the second case, as global and continental indicator of climate change, we used two parameters. One parameter of change was the average annual global surface temperature. This temperature was the same,

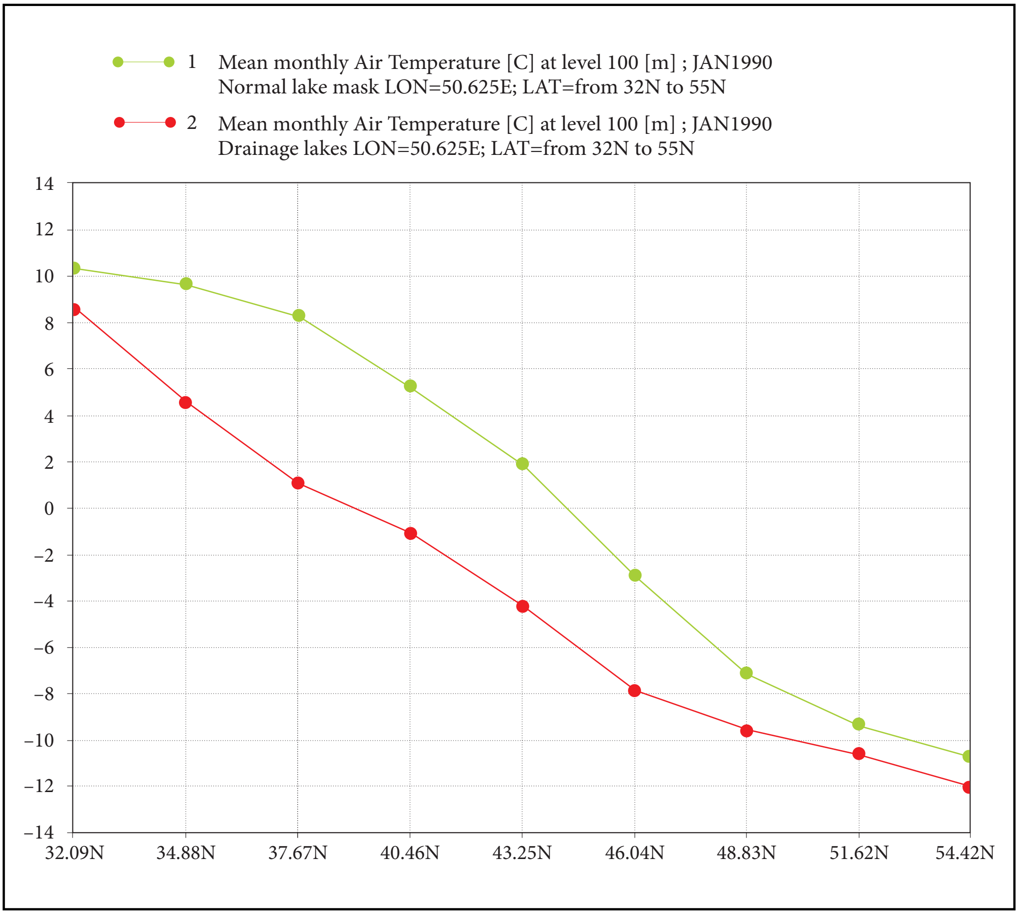

Figure 8: 100 m above average monthly temperature for January.

15.1 °C, for both simulations. As such, according to the model, draining the Aral and Caspian seas had no effect on the average annual global surface temperature. However, another set of parameters of change are the global distribution of average monthly surface temperatures for particular months, in this case January and August. These temperatures are shown on maps in Figures 11–14.

As shown in Figures 11 and 12, draining the Aral and Caspian seas lead to significant differences in temperature distribution over Asia during January. In the case of G1, the zero isotherm meanders through the middle of area A1, while in the case of G2 the zero isotherm has a zonal slope and extends to the south, almost to 30° N. Also, in the case of G1, the –20 °C isotherm is located in NE Asia to NW–SE direction, while in the case of G2 this isotherm penetrates the centre of the continent. It can be concluded that the removal of both seas lead to cooling of Asia during winter. By contrast, the configuration of isotherms in other parts of the world remains nearly unchanged. It may be noted that the warmest areas in Australia, southern Africa and South America are less pronounced in G2 than in G1.

As shown in Figures 13 and 14, draining the Aral and Caspian seas does not significantly change the configuration of August isotherms, but it does change the distribution of the hottest areas in Asia and Africa. In the case of the G2 simulation, on the locations of the Aral and Caspian seas is becoming warmer. Also, in addition to the three areas of extreme high temperatures in Asia (two in the Arabian Peninsula and third in Kashmir), there are additional areas of extreme temperatures in the western Sahara. Another significant trend is the cooling of the Tibetan plateau to a greater extent than the surrounding regions.

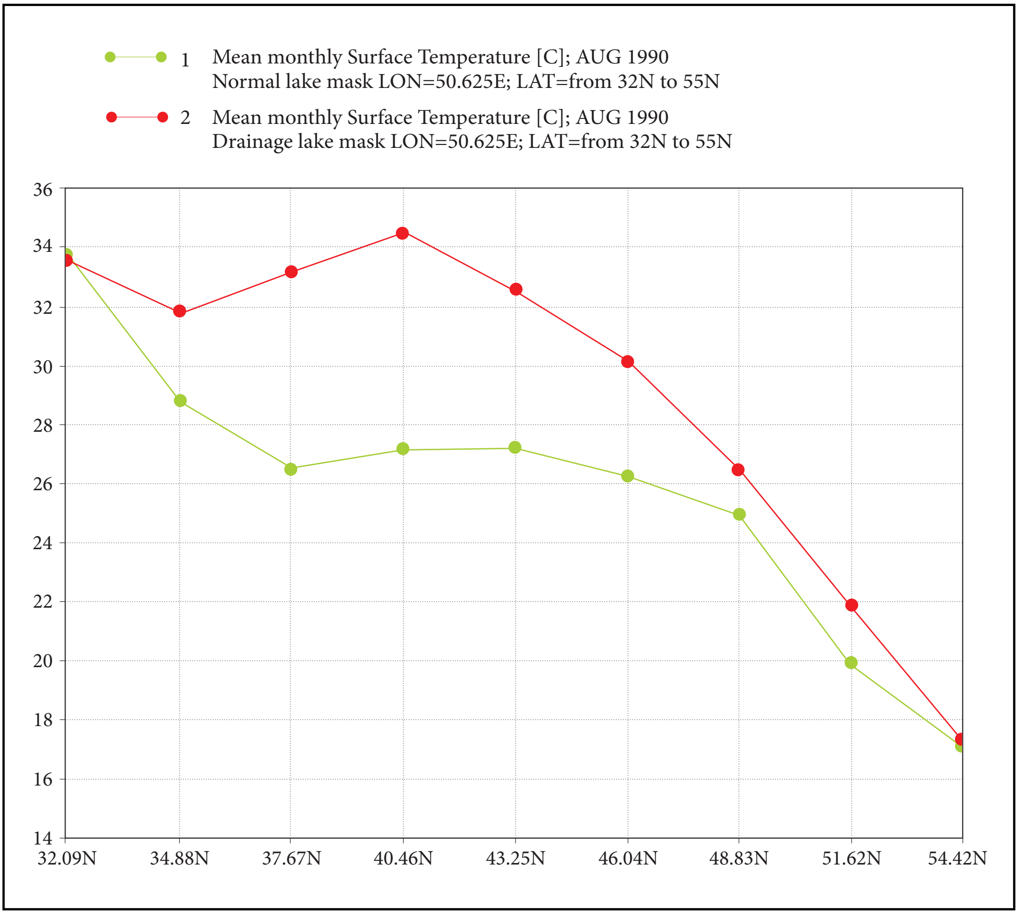

Figure 9: Surface average monthly temperature for August.

7 Discussion and conclusion

We evaluated climate and environmental changes in the case of a complete drying out of the two large inland seas of the Aral and Caspian seas, located in arid and semiarid continental areas. This kind of scenarios are quite plausible, as the Aral Sea is already almost completely dried up, while shallow parts of the Caspian Sea are being transformed into terrestrial ecosystems. As such, it is important to model the effects on both local and regional/global conditions.

The modelling results using the ECHAM5 model are quite dramatic. Comparing the temperature changes it was found that the drying out of both the Aral and Caspian seas leads to an increase in summer and decrease in winter average monthly temperature by the similar amount, from about 7–8 °C, while the daily extremes of temperature may be even more pronounced. In the wider regional zone, close to both seas, the average annual temperature is reduced by about 1 °C. However, at the global scale, average annual temperature remains unchanged, while the general configuration of the isotherms remains unchanged, except for some shifts over the continents.

Presented approach can also be applied to paleoclimatic research. Spatial and temporal changes of the Paratethys Basins can be regarded as a key factor responsible for Cenozoic climate changes (Ramstein et al. 1997). The results of this study demonstrate that the drying out of isolated sea basins such as the described ones can cause significant regional climatic and environmental changes. Similar was shown for the drying out

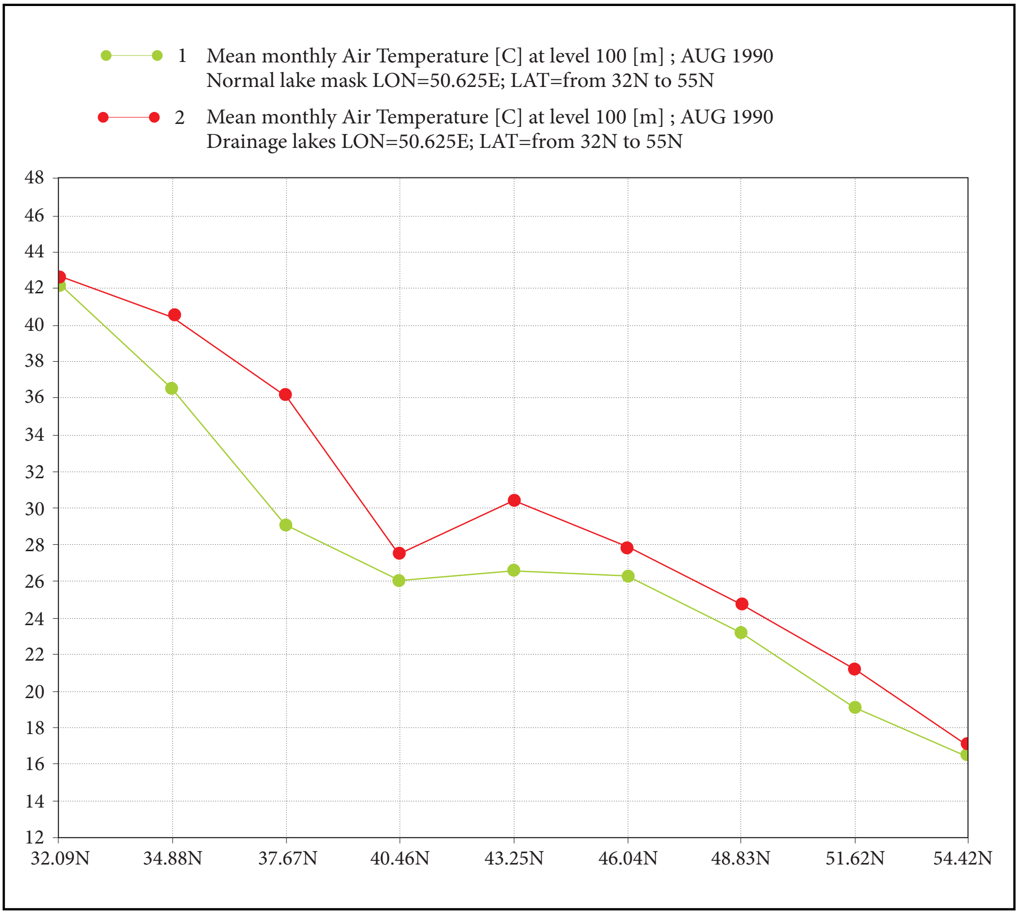

Figure 10: 100 m above average monthly temperature for August.

of Mediterranean Basin (Murphy et al. 2009), or drying out of Paratethys Basins, e.g. the present Pannonian Basin (Hamon et al. 2013).

8 Acknowledgments

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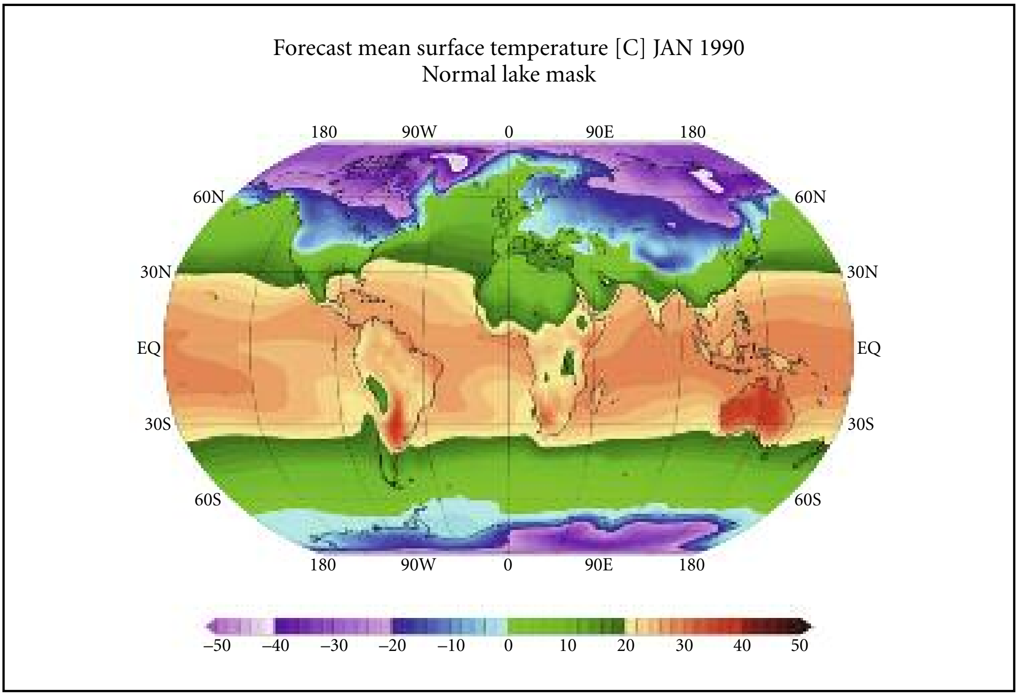

Figure 11: Global distribution of surface average January temperatures in G1.

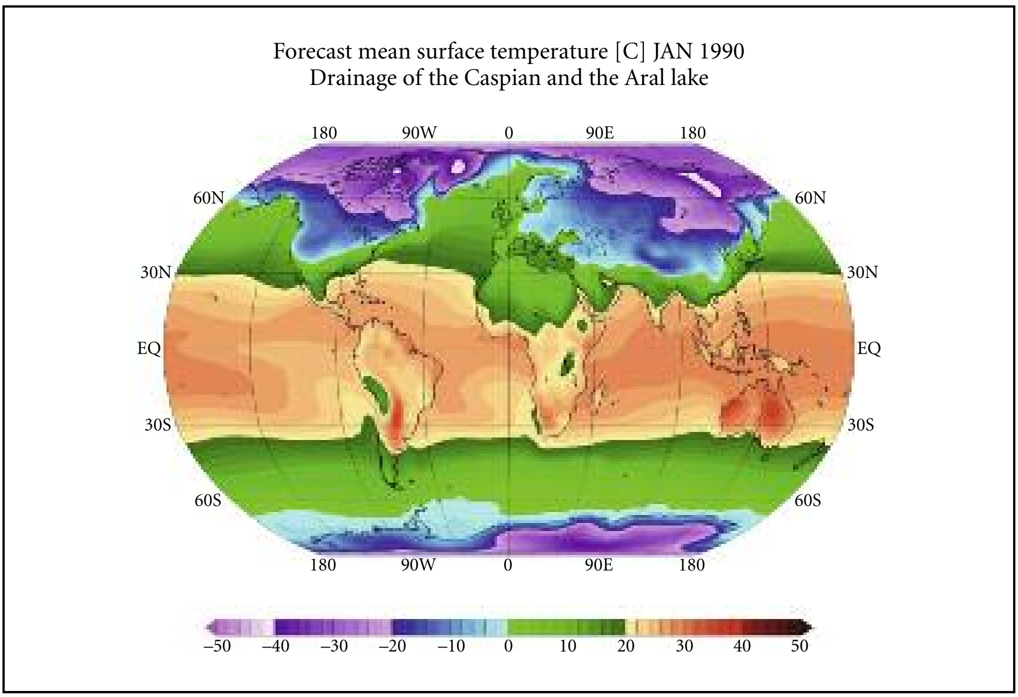

Figure 12: Global distribution of surface average January temperatures in G2.

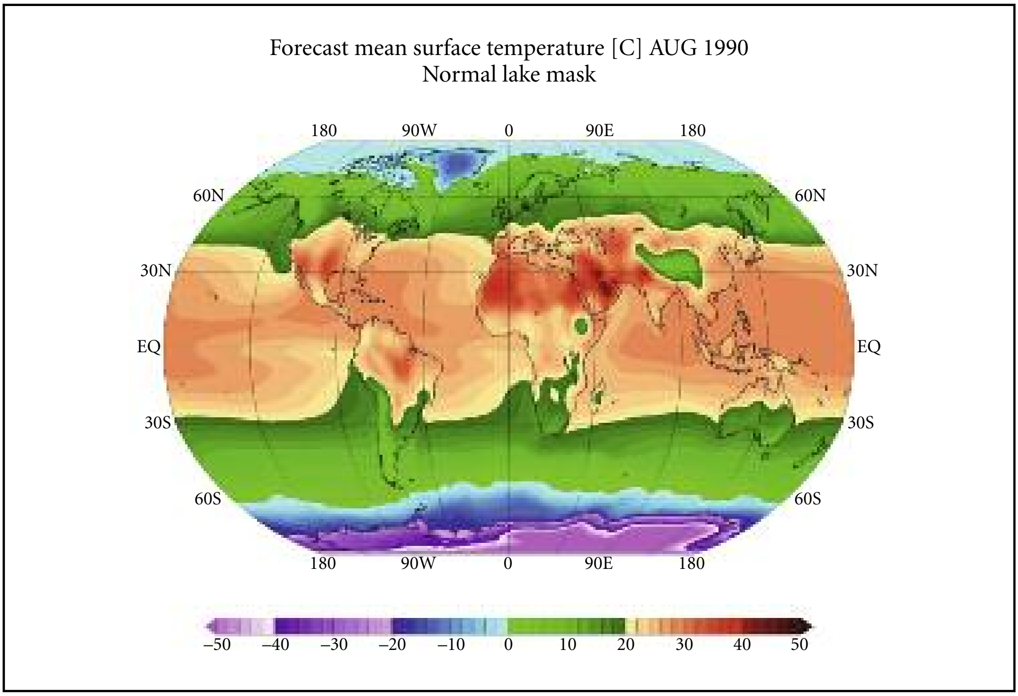

Figure 13: Global distribution of surface average August air temperatures in G1.

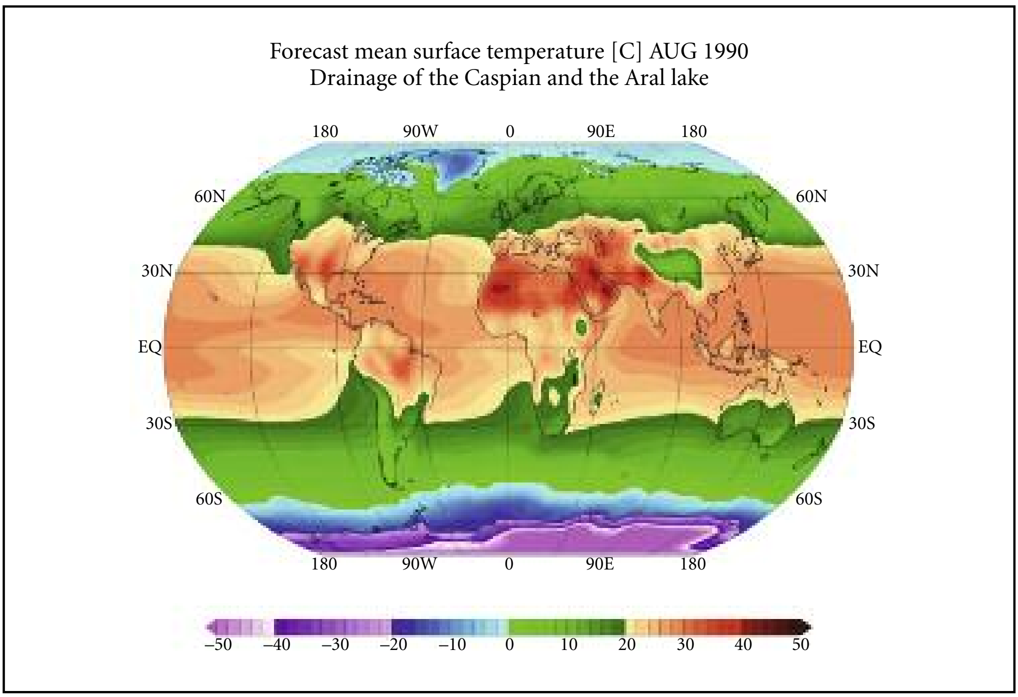

Figure 14: Global distribution of surface average August air temperatures in G2.

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RISK EDUCATION IN SERBIA

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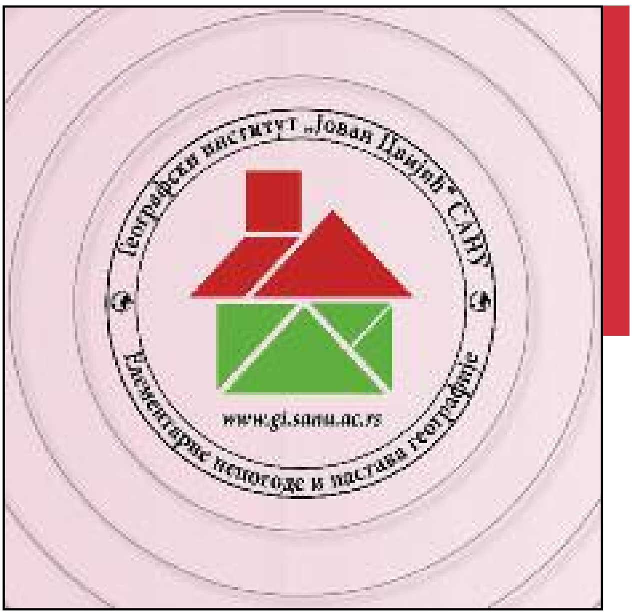

DESIGN: MILOVAN MILIVOJEVIĆ

Logo of the training program for geography teachers »Natural disasters and geography teaching«, one of the rare official activities related to systematic risk education in Serbia.

Risk education in Serbia

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ABSTRACT: Natural disaster risk reduction can be achieved through vulnerability reduction, as well as through strengthening the resilience of the population. One of the segments leading to these aims is a proper risk education. It is the public (compulsory) education system that reaches the greatest number of participants and represents a good platform for the natural disaster knowledge transfer. Geography, as a complex subject that includes both natural and social components, is the most appropriate to transfer the knowledge necessary to improve the resilience. Research done in Serbia (detailed analyses of curricula, textbooks, teachers' role and pupils' knowledge) shows that children do learn about natural disasters but not in a way which provides usable knowledge.

KEY WORDS: natural disasters, prevention, education system, geography teaching, knowledge transfer, Serbia

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1 Introduction

According to the majority of relevant references related to the issue of natural disaster risk reduction, various forms of education play an extensive role in this process (e.g. Agenda 21, Hyogo Framework for Action 2005–2015, UN Decade of Education for Sustainable Development 2005–2014, the UN campaigns »Disaster Reduction, Education and Youth« 2000 and »Disaster Risk Reduction Begins at School« 2006–2007, etc.). Education contributes to the realistic risk perceptions, to raising awareness of the possible outcomes, as well as to gaining the necessary knowledge about the proper protective behaviour. It is a platform for building a culture of prevention and disaster-resilient societies. According to Singh (2007), the final outcome of education is »*… to enable individuals to become proficient as citizens, having knowledge to make informed decisions that will either help them avoid hazardous situations or enable them to mitigate the effects of a natural disaster …*« (Singh 2007, 416). Zorn and Komac (2011, 8) state that prevention is »*… key activity in the field of protection against natural disasters.*«. Smaller number of casualties and reduced material damage are a proven outcome of prepared and educated societies (Izadkhah and Hosseini 2005). Education about natural disasters leads to risk reduction and fits to the Pressure-and-Release model defined by Wisner et al. (2004). Out of 8 types of vulnerability defined by Aysan (1993, cited in Alcántara-Ayala 2002), three may be substantially reduced through education: educational vulnerability (lack of access to information and knowledge), attitudinal and motivational vulnerability (lack of public awareness), and cultural vulnerability (related to beliefs and customs). Kuhlicke et al. (2011, 810) define the risk education as a »*… purposeful transfer of more generalised (thematic, organisational or technical) knowledge on hazards and risks from professionals in teaching institutions to usually (but not necessarily) younger persons within a formalised setting …*«.

The aim of this paper is to present a detailed analysis of the present level of education related to hazards and risk in Serbia. The initial research included the analysis of legislation, school curricula and geography textbooks. In the next steps, the research was extended in the direction of practical aspects – geography teachers' attitudes about inclusion of disaster issues in teaching, as well as evaluation of the present level of knowledge and preparedness of the pupils who experienced a relatively strong earthquake. A particular challenge of the whole research was the fact that the risk education is not included in the formal geography curriculum, so the participants in the process (experts, teachers) are about to find the alternative solutions to start the pioneer work in this field in Serbia.

2 Theoretical background

In the further text, we use the term »natural disaster« according to the explanation given by the UNISDR (2009, 09), which describes the notion of a natural disaster as a »*… result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences …*«.

2.1 Why children?

There are three main reasons why the children are in the limelight when it comes to hazard and risk education. The first, as stated by UNISDR (2007) and Ronan et al. (2012), is that the children are the most vulnerable part of a population in case of natural disasters. The second reason, as opposed to the first, is the fact that the children are most liable to change their views and behaviour patterns (Fridl et al. 2009) and at the same time possess considerable strengths, as stated by Peek (2008). The same author reminds that the children's creativity, energy, enthusiasm, and social networks are valuable in the process of risk reduction (Peek 2008), in which children can play an active part (UNISDR 2007). They are now not regarded merely as potential victims, but as catalysts for loss reduction (Clerveaux and Spence 2009). The third reason, considered in a longer time span, is that the children are regarded as »tomorrow's leaders« and »key agents for change« (UNICEF and UNISDR 2011), as well as the »powerful forces in behavioural change for the next generation« (Izadkhah and Hosseini 2005).

2.2 Why formal (compulsory) education?

In numerous studies and articles formal education is stressed because of its important role in learning on natural disasters (e.g. Wisner 2006; Fridl et al. 2009; Komac et al. 2010; Komac et al. 2011). Without diminishing the importance of informal learning, we insist on the role of formal and compulsory education, considering the fact that the majority of the population acquire this type of education. The effectiveness of school-based hazard education programs is claimed by many authors (e.g. Ronan et al. 2010; Gulay 2010; Finnis et al. 2010; Johnston et al. 2011).

Kuhlicke et al. (2011) highly recommended a combination of a) curriculum based, standardized education and b) participatory, locally embedded education, which correspond to formal and informal education. Although this is an ideal option, in reality it is sometimes difficult to organize the parallel implementation of both types. In case when the capacities are insufficient to provide the combination of two types of education, it is more efficient to opt for the first type, because the effective risk reduction requires a large proportion of the population who receives the best training possible, while informal education affect small parts of population.

2.3 Why geography?

Geographical knowledge, by joining and overlapping of physical (natural) and human (social) elements, is often regarded as a knowledge »for living«, having daily and vocational applications (Gritzner 2004), one of which is certainly the role in prevention of natural disasters. For the same reasons, according to Mitchell (2009), geography is the natural academic »home« for teaching about hazards. As the risk reduction certainly includes the Human-environment relations (HER), the necessary integrative approach is provided through geography as a science (Golledge 2002). Therefore, the position within the risk research is one of geography's greatest strengths (Cross 2009; Stoltman 2006). The same may be applied when discussing the position of geography as a subject in the system of formal (compulsory) education. The above mentioned references prove that geography is the adequate solution for the inclusion of risk education into the education system.

In Serbia, according to official statistics, about 70,000 pupils enroll each year in the 1st grade of primary school, which is compulsory and lasts for eight years (Statistical Survey of Serbia, 2012). Through eight years of primary education, risk education may be gradually included, in accordance with the age, through the subjects »Nature and Society«, »The World Around Us« (1st to 4th grade) and especially »Geography« (5th to 8th grade) (Figure 1).

Secondary education is not compulsory, but it is anyway enrolled by about 70,000 students each year (the majority of them finish this level). However, due to its shorter duration and different programs, it cannot be equally efficient in risk education.

A small number of the population enrolls higher education (university level) and informal types of education. Although some faculties do cover some natural disaster issues in relatively small parts of their curricula, this level of education has a lesser importance in the overall system of natural disasters prevention, due to small coverage. One of the examples in which this small part of population (studying natural disasters at the university level) may be valuable to the system of risk education is, for the beginning, to clear the terminological inconsistencies in the field of natural disasters. Even in expert circles (presentations, articles, and other literature) it often happens that the terminology is used incorrectly and randomly, which reduces the proper wider understanding of processes and interactions. For example, the term »risk« is generally overused, and in majority of cases its use actually refers only to hazard (i.e. does not include vulnerability and resilience).

3 Methods used

The actual situation in risk education in Serbia is analyzed at several levels:
- analysis of the official legislation structure related to the issue of risk education;
- analysis of geography textbooks for primary and secondary schools;
- analysis of geography teachers' opinions on the subject; and
- analysis of children's reactions, knowledge and attitude after a particular disaster event (M 5.4 earthquake in the town of Kraljevo).

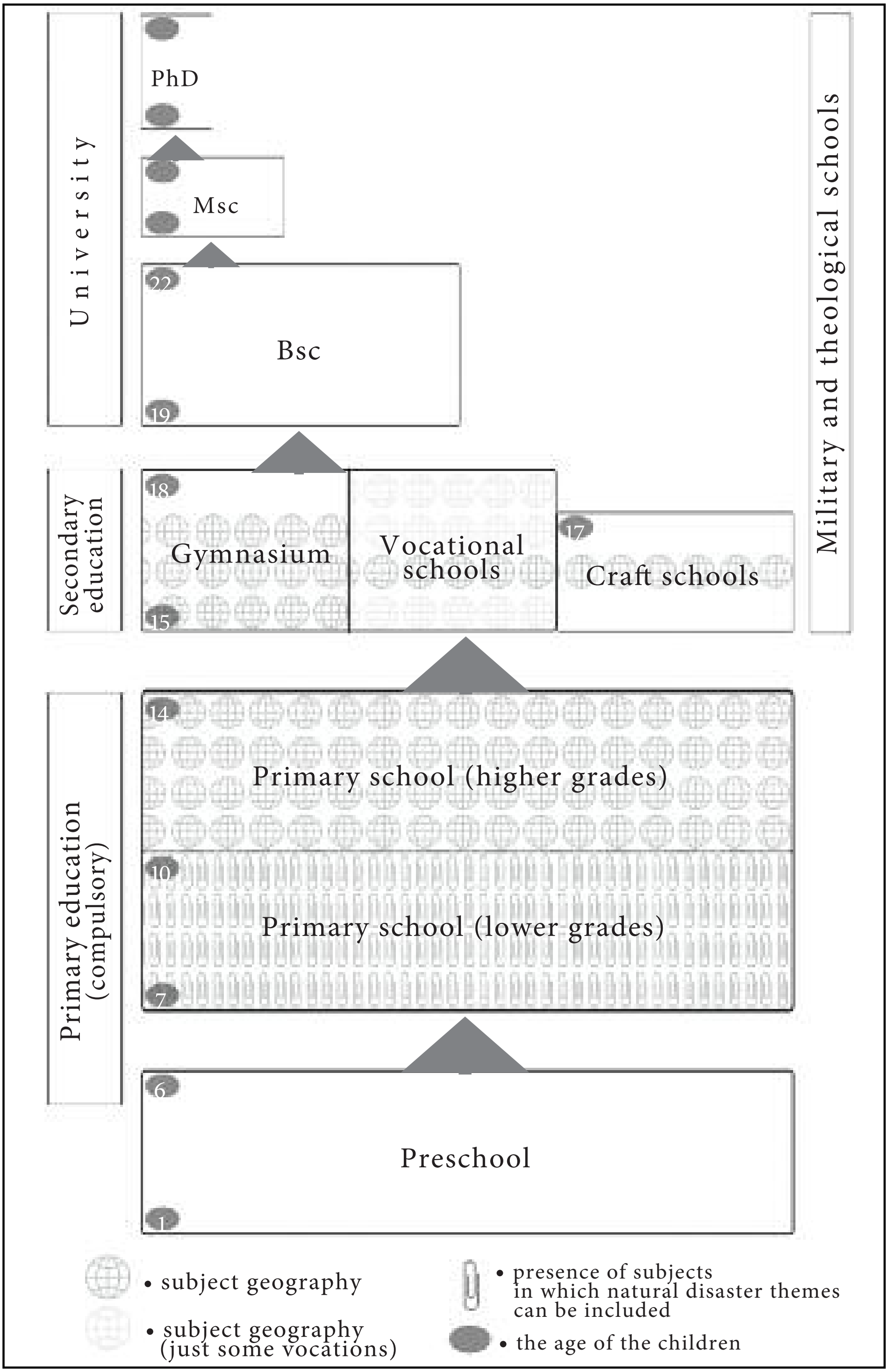

Figure 1: Educational system in Serbia.

Legislation structure analysis is related particularly to legislation within the Serbian educational system, which directly or indirectly regulates teaching about natural disasters. It includes laws, by-laws, strategies, regulations (rule books), but also the international conventions, which, after a ratification, automatically became parts of Serbian internal legislation.

The analysis of geography textbooks for primary and secondary schools was done on a qualitative basis, and included not only the texts, but also the illustrations (charts, sketches, photographs) and thematic maps.

The evaluation was done following the three main principles: perception principle, spatial principle and temporal principle.

- The perception principle considers various qualifications on particular natural processes, depending on textbook authors and their experiences. It is analyzed whether the particular processes are treated only as natural processes of increased intensity or, on the other hand, they are treated as a natural disaster (as defined in the chapter Theoretical background of this paper). If an event is treated only through its genesis and its influences on spatial physiognomy, it has a category of a hazard – a natural process of increased intensity. In cases where an event is treated through its impact on society and its transformation, it has a category of a natural disaster. There is also a third case – when the authors point to some positive impacts of natural processes of increased intensity.
- The spatial principle stands for the analysis of spatial distribution of natural hazards and disasters studied in textbooks (reactions of children are different for the events in Serbia than for the events abroad).
- The temporal principle stands for the analysis of time span between a disaster occurrence and the time when the information about it appears in the textbooks.

Analysis of teachers' opinions regarding teaching on natural disasters was done with participation of 361 teachers who attended a specialized training program »Natural disasters and geography teaching«. The research included two steps. The first step was a poll survey using a short questionnaire aimed at establishing whether the teachers are in a position to actually transfer the knowledge they gained at the training program. The close-ended question »Is this program applicable in practice, in schools?« was chosen to determine whether they can include this issue in their classes, regardless of the fact that it is actually not a part of the official curriculum. The offered answers were scaled in 5 options (ordinal-polytomous items), ranging from »I completely agree« to »I completely disagree«. The second phase was an interview aimed at detection of the reasons for the negative answers they gave in the questionnaire.

The analysis of children's behaviors, feelings and knowledge in case of a natural disaster, their knowledge about natural disaster threats in their living area, and sources of that knowledge, was done through a poll survey in the town of Kraljevo. Kraljevo faced a M 5.4 earthquake on November 3rd 2010 at 1:56 AM and suffered relatively large material damage, with two victims. The poll survey was carried out within a time distance of 16 months after the event. The research included a sample of 300 children: 153 primary school pupils from 5th to 8th grade (aged 11–15) and 147 secondary school students from 1st to 4th grade (aged 15–18). Among the primary school pupils there were more boys (52%), while in secondary schools the number of girls prevailed (60%). All participants have a permanent residence in the town of Kraljevo, 56% of whom live in individual residential facilities. The questionnaire consisted of 17 close-ended questions, five of which were selected for this particular research (activities and feelings during the earthquake, awareness about the seismic hazard in the area, sources of knowledge about earthquakes, and the type of future training they need). The response scales were nominal-polytomous or dichotomous. The results were processed using the SPSS software. The tests applied include descriptive statistics and non-parametric tests (Pearson chi-square test, binomial test).

4 Results

4.1 Legislation analysis

In the Republic of Serbia, the legislation related to risk education is defined by particular education laws, as well as by other laws which do not directly refer to education but mention the education issues in other contexts. Enacting of laws related directly or indirectly to risk education is under the jurisdiction of two ministries: Ministry of Education and Science and Ministry of Interior Affairs. Intersectoral collaboration in treating of these issues is generally not synchronized, which results in the lack of desired effects of enacted laws. In other words, up to now, the framework laws have not yet led to enacting of new proficient by-laws in the field of education.

Legislation on risk education in Serbia is composed of the following elements (figure 2):

International conventions: The Hyogo Framework for Action 2005–2015 has been one of the bases for enacting of the Law on Emergency Situations and the National Strategy on Protection and Rescue in Emergency Situations.

Particular laws on education and emergency situations are listed in Tab. 1. The Article 119 of the Law on Emergency Situations foresees that training is done through primary and secondary education, for getting knowledge on the dangers of natural and other disasters, as well as for protection.

The Article 4 Paragraph 5 of the *Law on the basics of education system* states that one of the general aims of the education process is to make children »capable of solving the problems, application of knowledge and skills in further education, professional work and everyday life«, which completely corresponds to the need for risk education.

The Laws on primary and secondary schools (Articles 20 and 24, respectively), declare that the curriculum is enacted by the Minister of education, according to the suggestion of the advisers for particular subjects.

Table 1: Laws in the Republic of Serbia related to education and risk management

Law	Official gazette number
Law on Emergency Situations	111/09
Law on the Basics of Education System	72/2009, 52/2011
Law on Primary Schools	50/92, 53/93, 67/93, 48/94, 66/94, 22/02, 62/03, 64/03, 101/05, 72/09
Law on Secondary Schools	50/92, 53/93, 67/93, 48/94, 24/96, 23/02, 25/02, 62/03, 64/03, 101/05, 72/09

Strategies: The National Strategy on Protection and Rescue in Emergency Situations (2011) says within the Strategic section 3 that »issues related to protection, rescue and disaster risk reduction should be incorporated into the curricula of all educational institutions«.

Curricula are defined in the Regulations enacted by the Ministry of Education (table 2). The analyzed regulations for the primary school curricula show that there is only one lesson related to some kind of natural disasters: »Volcanism and earthquakes« in the 5th grade. There are two kinds of secondary schools, with different curricula: gymnasium and vocational schools. In the 1st grade of gymnasium, there are three lessons partially related to natural disasters: Volcanism; Earthquakes (with seismically active zones in Serbia); and Precipitation. In other gymnasium grades there are no geographical lessons treating the issue of natural disasters. Among the vocational schools, only in the 2nd grade of touristic vocational school, there are two geography lessons related to natural disasters: Water-management problems in Serbia; and Natural disasters. The fact that Curricula are a bottleneck not properly transferring the legislation-provided possibilities towards the schools is one of the important conclusions we have reached in this study.

Table 2: Regulations on the school curricula in the Republic of Serbia

Regulations	Službeni glasnik (Official gazette – Educational gazette) number
Regulation on the Plan for the 2nd cycle of primary education and the Curriculum for 5th grade of primary education	6/2007, 2/2010, 7/2010, 3/2011
Regulations on the Curricula for 6th, 7th and 8th grade of primary education	5/08, 6/09, 2/2010
Regulation on the Plan for the gymnasium education and the Curriculum for 1st grade of gymnasium	110-00-32/97-01
Regulation on the Curriculum for 2nd, 3rd and 4th grade of gymnasium	11/2006

4.2 Geography textbooks evaluation

The perception principle: The above-mentioned Curricula directed the contents of geography textbooks. Within this research, 23 geography textbooks were analysed, all of which are formally approved by the Ministry

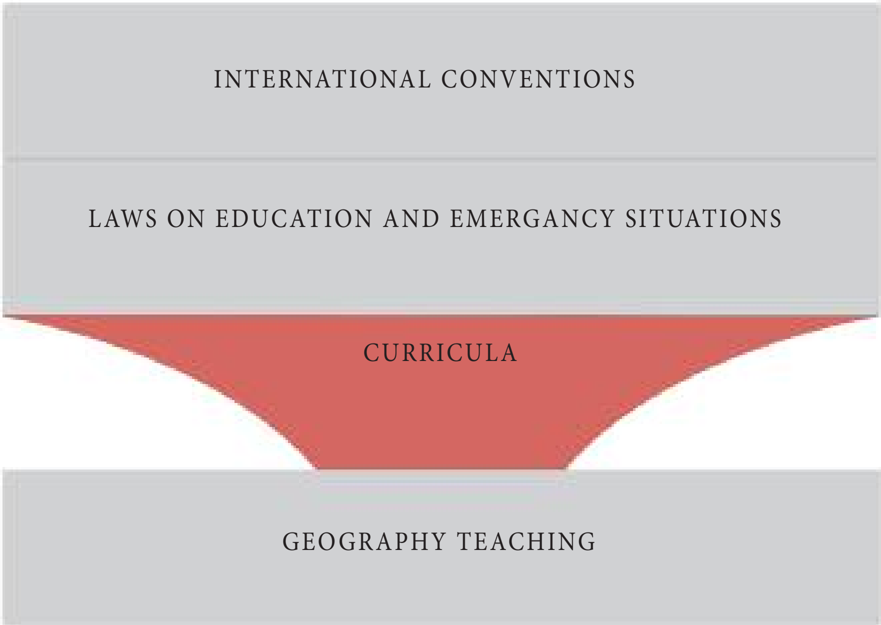

Figure 2: Legal framework for the establishment of Risk education in Serbia. The Curricula are a bottleneck not properly transferring the legislation-provided possibilities towards the schools.

of Education for usage in schools. Greater variety of textbooks is characteristic for the primary school, especially 5th grade (six different textbooks), while secondary school programs mostly have one available textbook per grade.

The lessons precisely defined by the curricula occur regularly in all textbooks, regardless of the publisher and the edition. Additional contents and aspects related to natural disasters occur randomly, depending on the authors of the textbooks. Unfortunately, the processes which are systematically studied in all textbooks are presented as hazards (natural processes) and not as natural disasters. Geography textbooks mention the following natural processes which may have the characteristic of a disaster: meteorites, earthquakes, volcanoes, tsunamis, landslides, avalanches, floods, tropical cyclones, tornadoes, hail (table 3). Only several authors mention these processes in the context of natural disasters. The example of the lesson Earthquakes (5th grade) shows that its main function is to explain the functioning of plate tectonics, which is common for all 5th grade textbooks. Only in two editions the lesson includes a short instruction on how to properly behave during an earthquake (Sitarica and Tadić 2010, Milivojević and Ćalić 2012).

In the lessons in human and regional geography, natural disasters are occasionally mentioned in a positive context. The most typical examples are the floods in the valleys of the Nile River and the Tigris-Euphrates River system, or the volcanic activity in Indonesia, which in longer time spans lead to formation of natural resources, such as high quality soils or ores (e.g. Jakovljević and Birovljev 2012; Đurić 2011) (Figure 3). The lessons on Egypt mention the Nile floods mostly as a process which enabled the formation and development of the whole country, while only few authors point also to the negative consequences of the Nile floods (Sitarica and Tadić 2010).

The spatial and temporal principles: The analysis of geography textbooks showed that the majority of the described examples of hazaZrds and disasters are situated out of Serbia – either in European or, even more often, non-European countries. The most obvious examples are earthquakes: many Serbian textbooks describe the M 9.1 earthquake in the Indian Ocean in 2004, while none mentions multiple M 5 events

Table 3: The overview of natural disaster related issues in the Serbian geography textbooks.

Natural disaster		Primary school (grades)				Secondary school – gymnasium or vocational education (grades)						
		V	VI	VII	VIII	I		II		III		IV
						gymna-sium	vocational education	gymna-sium	vocational education	gymna-sium	vocational education	
Disasters of extraterrestrial origin	Meteorites	▲	/	/	/	▼	/	/	/	/	/	/
Geophysical disasters	Earthquake	▼	▲	▲	/	▼	/	/	▼	▲	/	/
	Volcano	▲	▲	▲●	/	▲	/	●	▲	/	/	/
	Tsunami	▲			/	▼	/	/	/	/	/	/
	Hillslope processes	▲	/	/	▲	▼	/	/	▲	▲	/	/
Meteorological disasters	Tornado	/	/	▲	/	▲	/	/	/	/	/	/
	Tropical cyclone	/	/	▲	/	▲	/	/	/	/	/	/
Hydrological disasters	Floods	/	▼	▼●	▼	/	/	▲	▼	▲	/	/
	Avalanches	/	▼	/	/	▲	/	/	▲	/	/	/
Climatological disasters	Extreme temperatures	/	/	/	▲	▲	/	▲	▲	▲	/	/
	Drought	/	/	▲	/	▲	/	/	▼	▲	/	/
	Hail-storm	▲	/	/	/	▼	/	/	▼	/	/	/
	Wild fire	/	/	/	▲	▲	/	/	/	/	/	/

Legend:
▲ – studied only at the level of hazard (natural process)
▼ – studied as a natural disaster
● – treating a hazard in a positive context (see details in the text)
/ – not studied at all

in Serbia, which in fact have much greater impact on the real everyday situations. The reason for this paradox lies within the fact that textbooks tend to show the most intensive event of a kind, and these are almost never related to Serbia. In terms of spatial aspect, in some European countries there is the opposite case, meaning that content of geography textbooks is primarily related to their own countries (Senegačnik 2010). On the other hand, in Serbia, the fact that the 2004 Indian Ocean earthquake has its place in many textbooks shows a good temporal accordance between an event and the time of textbook response.

The greatest natural disasters in Serbia in the period 2000–2011 were: the floods of the Tamiš River in 2005, numerous landslides (e.g. Bogdanje) in the spring of 2006, extreme air temperatures (44.9 °C in Smederevska Palanka) in 2007, and the Kraljevo earthquake (M 5.4) in 2010. Although these disasters of

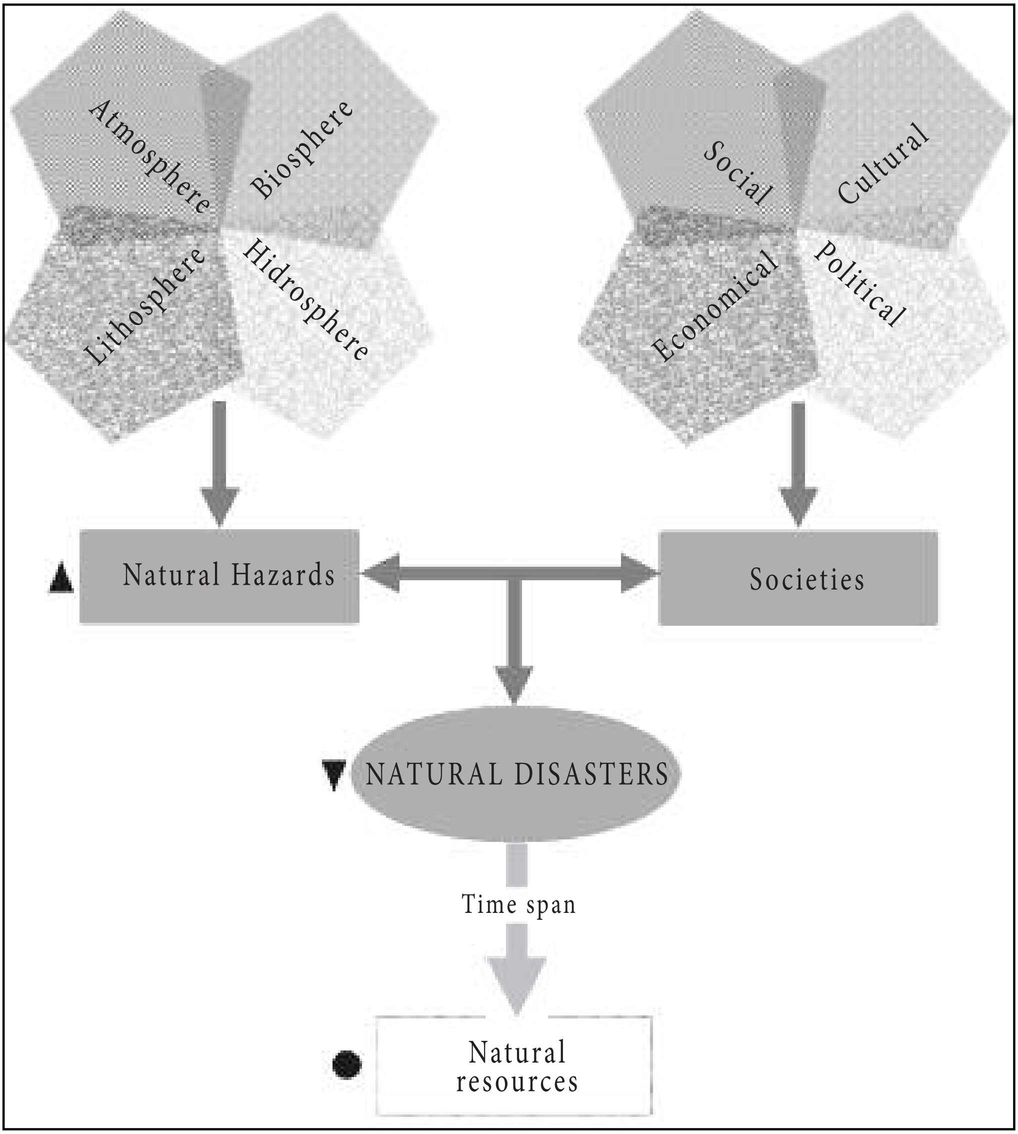

Figure 3: Sketch of the natural disaster system, with three levels at which the issue is treated in Serbian geography textbooks (▲ – hazard, ▼ – disaster, ● – resource; as in Table 3).

regional scale had the human victims, large evacuations and extensive material damage, none of them has been mentioned in geography textbooks up to now – neither in the lessons on natural processes, nor in the lessons covering the regions of the affected areas. We can conclude that there is neither temporal nor spatial coordination between the Serbian natural disasters and Serbian geography textbooks. This fact leads to the substantial decrease of awareness and preparedness for a potential event.

4.3 Teachers' opinion

The analysis of teachers' opinions shows that a large number (80%) of teachers believe their new knowledge could be applied in the classroom (Figure 4). A small number of teachers mostly agrees that they can apply the new knowledge (14%), while a small number of them partially agree (5%). Very few teachers believe that the theme of natural disasters would not be useful for their future work. Since the positive opinion on the applicability of new knowledge gained at the training program highly dominates, it can be interpreted as their will to teach about an attractive and important matter.

In the interview with the teachers, we discussed the reasons why some of them are anxious that the new knowledge on natural disasters is not sufficiently useful for their future work. The limitations they stated can be categorized into three groups:

- Formal limitations: extensive geography curriculum, but small number of classes per week, and no lessons on natural disasters. Solution of these problems requires a systematic approach, which means slow procedure. Therefore, the intermediate solution should be searched even prior to the modification of the curriculum (cf. Cummins 2010). Authors of textbooks should include innovations of this kind in textbooks, and publishers should support it. In Serbia, these changes occur slowly and there are rare examples of the positive outcomes of such initiatives (Milivojević and Ćalić 2012; Sitarica and Tadić 2010). Additional limitation in the implementation of these changes, as pointed by Grčić (2001), is the shaken position of geography in the system of sciences, which led to its suppression and destabilization in schools. This situation is caused by inaccordance between the curricula and pupils' perception, by excessive descriptive contents, by gaps in education and training of geography teachers, and the gap between university professors and teachers at schools (»university geography« vs. »school geography«) (Grčić 2001). Therefore, it is more difficult to impose the importance of geography as a science that teaches practical things in life.

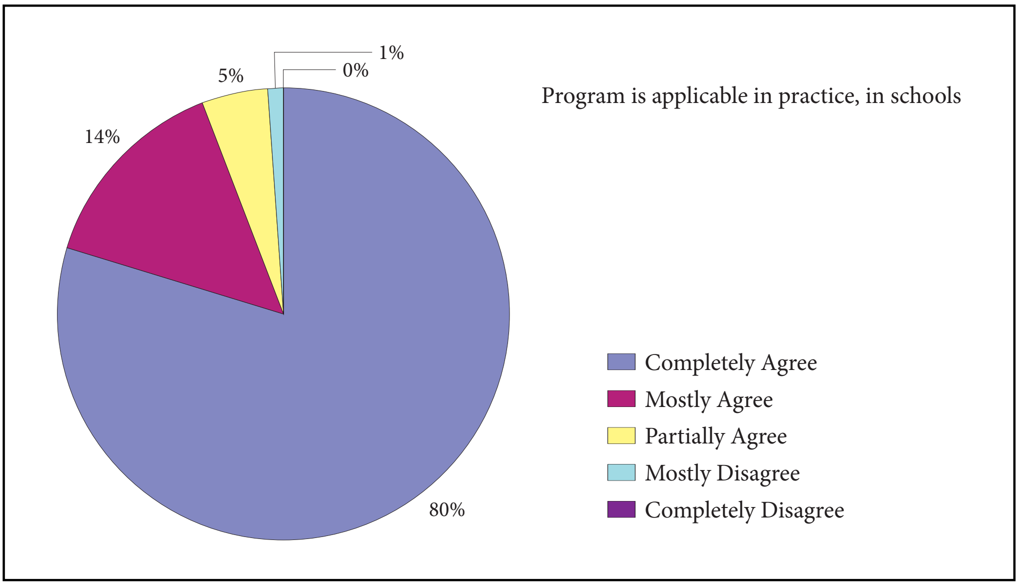

Figure 4: Applicability of additional knowledge about natural hazards in geography teaching, based on poll survey results (361 teachers).

- Pupils' motivation: the degree of their interest to learn is often reported to be low (correlation with age, gender, discipline in class, the teacher, the methods used in class). This could be overcome by the fact that the issue of natural disasters is usually attractive to children and offers the possibilities for creative work (Mitchell et al. 2008; Reinfried 2004).
- Teachers' motivation – the degree of their interest to use their right to be innovative in teaching. Many teachers are strictly adhering to the curriculum, and as a reason for not introducing innovations in teaching they even state a fear of rigorous control inspections if they depart from the curriculum. This practice urgently needs a substantial change. On the other hand, there are also teachers who notice the lack of information in textbooks and atlases (e.g. Simović, 2007). According to Mitchell et al. (2008, 171), »*… answering* why *we teach hazards is fairly straightforward, and more pressing question at present is this:* how *should we teach about hazards…*?«. Due to the marginal position of geography in education in Serbia (Grčić 2001) it is often difficult for some teachers to regain their lost self-confidence. The geographic scientific community should remind them that the future of geography lies in the »*… interdisciplinary themes, (…) global processes, environmental problems, natural disasters, demographic changes, uneven regional development…*« (Grčić 2001) and that they need just to redesign their knowledge (Annan 2006), understanding and accepting the new important role of geography. Generally speaking about the role of a teacher, Fridl et al (2009) note that their important role is to broaden their students' horizons by presenting and addressing a number of already existing and new topics differently.

4.4 Children's selfreported behaviors, feelings and knowledge

The poll survey about children's behaviors, feelings and knowledge on natural disasters, carried out in Kraljevo, showed some worrying results.

When asked about their reaction during the earthquake, 59% of the total group responded that they stayed in their homes not taking any measures of protection, while 24% said that they »*just ran out.*« Only 15% of participants reacted correctly, looking for an adequate shelter (under a table or within a door frame). The three mentioned answers are almost equally represented among pupils in primary and secondary schools. About 14% said that they reacted some other way (e.g. that they slept over mentioned event), which was a characteristic response for secondary schools (within this group, 73% are secondary schools students). More detailed analysis of primary schools student reactions during the Kraljevo earthquake was done by Panić et al. (2013).

When asked about their feelings at the time of the event, approximately 35% declared that they were frightened, whereas the feeling of complete helplessness expressed through »*I was completely frightened and I did not know what to do*,« was the answer of 20% of children. Among those who felt helpless, there were more girls (77%) compared to boys (23%). About 26% of the participants stayed calm during the earthquake, without any panic feeling, which is more common for the boys (62%) than for the girls (38%). About 18% did not choose any of the following categories (or they slept through the earthquake).

As for the question »*Where did you learn how to behave during an earthquake to protect yourself from harm?*«, 26% said that they listened to their parents and the advice received from them. This response was more common for girls (67%) and secondary school pupils (63%). About 25% of respondents singled out the school as the place where they learned something about behavior during the earthquake, which was more common for secondary school pupils (55%). The answer »mass media« was singled out by 21% of participants, and the internet by 9%. About 5% of participants were using some other sources, while 12% said they never heard of such information.

Extremly large number of pupils (77%) was not aware that they live in the area threatened by seismic hazard. A smaller group (23%) are those who were aware of the earthquake occurrence possibility, 56% of which in primary and 44% in secondary schools.

When asked about the presence of earthquake-related issues in geography textbooks, 33% said they thought that the present contents were enough, while 67% thought that the existing material »*should be expanded with the instructions on how to behave during an earthquake.*« This attitude is equally characteristic for primary and secondary school pupils, with the exception that 100% of students in the final year of secondary school gave this response.

Analyzing the poll survey results in total, it is conspicuous that over 70% of children (regardless of age) did not respond adequately at the time of the earthquake. Since at that time (01:56 AM) children were mostly in their homes, we can suspect that they largely relied on the advice and guidance of their parents. Thus, the results show that neither parents nor children reacted reasonably and correctly, due to the lack of basic knowledge and skills to cope with emergency situations. Taking this into account, it is not surprising that more than 50% were extremely frightened or they panicked.

As the earthquake prevention and protection measures are not developed in Serbia, and are not included in geography curriculum or textbooks, the poll showed that the parents are the most important source of information for children.

However, in the days following the earthquake, a great number of aftershocks occurred. In this period, the additional lessons dedicated to earthquakes were organized in Kraljevo schools (regardless of geography classes). There were also a lot of information spread through the media, and individuals searched for information themselves on the Internet. Therefore, the pupils realized that their previous knowledge was highly insufficient, which made them believe that it is necessary to expand the existing curriculum and include mentioned topics to the geography textbooks, together with the practical training. Apart from the lack of general information, there is also a considerable lack of the knowledge about the local environment. A dramatically large number of children were unaware that their hometown and its wider area are facing a relatively high seismic hazard.

5 Conclusion

In the process of prevention of natural disasters, it is important to strengthen the awareness of teachers and children they are a very important link in the transmission of information. One of the basic principles of the Hyogo Framework is a better exchange and access to information, which is very successfully enforced through the International Decade for Natural Disaster Reduction (IDNDR) 1990–2009, and is still carried out through the Building the Resilience of Nations and Communities to Disaster 2005–2015. As a good information exchange is an important condition for preparedness and readiness for action in the event of natural disasters, all the links in information transmission have an equal importance. The example in Fig. 5 shows the geographers (experts, teachers) and pupils as the important links in the process of information exchange.

Following the Chain of information exchange, children should have an equal role as adults. Considering our poll survey results they are aware that they do not want to be victims, but active participants (as already described in numerous references, e.g. Clerveaux and Spence 2009; Chen et al. 2013). The efficiency of such approach was comfirmed by the positive experience of school-based earthquake education in Iran (Parsizadeh and Ghafory-Ashtiany 2010).

In Serbia, presently we only have a partial hazard education, but still not a proper risk education. The coverage of hazards is systematic, while the coverage of risk is random and poorly represented. General legal capacities for the inclusion of risk education (which would be an upgrade of the present hazard education) do exist, but presently the lower range legislation (Regulations on Curricula) lags behind and fails to follow the recommendations of the international conventions and national laws. Regardless of the present flaws in the curricula, the formal (compulsory) education and geography teaching are the best framework for risk education. The possible solutions do require the changes of curricula, but before the new regulations are enacted, the teachers' interventions in the teaching process must compensate the present limitations.

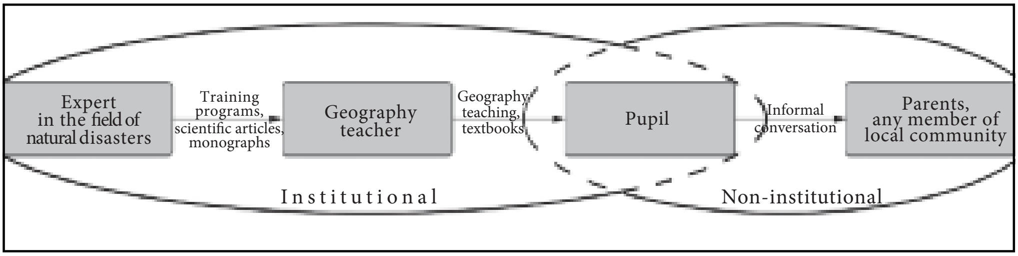

Figure 5: The chain of information exchange in the education process.

6 Acknowledgement

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THE PHYLOSOPHY AND APPLICABILITY OF ECOREMEDIATIONS FOR THE PROTECTION OF WATER ECOSYSTEMS

Zorica Svirčev, Svetislav Krstić, Tamara Važić

Ecoremediation – following nature.

The phylosophy and applicability of ecoremediations for the protection of water ecosystems

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ABSTRACT: The problem of accelerated eutrophication of the water ecosystems has not been appreciated proportionally to the development of human society today. Accelerated or fast eutrophication is detected destiny in majority of ecosystems today, mainly due to adverse human impact. This paper aims to introduce ERM methods in treating the problems arising from increased total capacity and saprobity and also accelerated eutrophication. In this way the broadness and importance of ERM as an ecosystem service for the water protection should be emphasized. The basic characteristics of ERM are its high buffer and self-protective capacities, and preservation of natural habitats and biological diversity. ERM represents the 'returning to nature' approach aiming to preserve or re-establish the natural balance of the ecosystems, but also a human endeavor that enables new jobs and by-side activities important for economic and social development of the human society.

KEY WORDS: ecoremediation, eutrophication, water quality, algal blooms, sustainable development

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1 Introduction

Humanity has emerged as a major force in the operation of the biosphere, with a significant imprint on the Earth System, challenging social–ecological resilience. This new situation calls for a fundamental shift in perspectives, world views, and institutions. Human development and progress must be reconnected to the capacity of the biosphere and essential ecosystem services to be sustained (Folke at al. 2011). The issue at stake is broader than climate change. It is about a whole spectrum of global environmental changes that interplay with interdependent and rapidly globalizing human societies. A key challenge for humanity in this new situation is to understand its role in the Earth System, start accounting for and governing natural capital and actively shape development in tune with the biosphere (Rockström et al. 2009). This is a new situation and it calls for new perspectives and paradigms on human development and progress-reconnecting to the biosphere and becoming active stewards of the Earth System as a whole.

Water ecosystems in this regard are particularly vulnerable. Immense pressures resulting from abstractions of surface and ground waters, input of numerous polluters in vast quantities and the global climate change processes have caused accelerated eutrophication and subsequent pollution of many ecosystems. It is therefore an urgent imperative to shift the historical view on waters as a resource towards their role as a life supporting systems, or the bloodstreams of the biosphere, with people as embedded part (Hoff 2009). Indeed, the new approaches linking water and ecosystem services, like adaptive water governance, are already emerging (Pahl-Wostl et al. 2011).

The knowledge on the use of ecoremediation (ERM) methods for wastewater treatment spread quite slowly during the 1970s and the early 1980s both in Europe and North America. The development of ecosystem methods has been taking place separately and inconsistently (Griesseler Bulc and Slak 2009). There are currently thousands of constructed wetlands throughout the world, but the use of these systems for treating wastewater is a relatively new technology in most countries (Vovk Korže and Vrhovšek 2006).

ZORICA SVIRČEV

Figure 1: A constructed wetland for a domestic waste water treatement, Slovenia.

Thirty years of the research on the use of constructed wetlands as the most common ERM method for various types of wastewater (Brix 1994; Scholz et al. 2007a) has proven that the great number of early worries and negative arguments has been successfully denied. For example, it has been shown that constructed wetlands may perform well under cold climatic conditions (Mander and Jenssen 2003). Also, constructed wetlands are commonly used in countries with high population densities, such as Denmark, Belgium or the Netherlands, while the U.S. government encourages the use of simple wetlands for economical treatment of sewage from small communities of less than 5000 people (Horne 2005). The use of constructed wetlands for various industrial effluents is also becoming quite common.

Ecoremediation method in broader sense is applied by Vrhovšek (Vovk Korže and Vrhovšek 2006) more than 20 years in the countries of ex Yugoslavia. The efficiency and genuinity of this idea has forced us in a more scientific, but also phylosophical approach which, we hope, will speed-up the practical implementation of ERM (Fig 1).

2 Ecoremediation – the philosophical approach

Ecoremediation as a system for protection, sanation and remediation of the environment can be appreciated from very different stand points. Globaly it can be said that ERM is a buffer system that enables the re-establishing of the disturbed ecological balance in its natural position. As an immune system of our planet, ERM is the preventive defence that protects against the system being in a not desirable modified stage. In general, ERM is consist of abiotic and biotic elements and processes that have a role in balancing the ecosystems.

Where is the recognition of ERM as a system for protection, sanation and remediation of the environment coming from? How was the ERM as a principle of human endevour recognised?

In millions of years, the nature and ecosystems evolved exceptional defensive and self-protective capacity to safeguard themselves against sudden and powerful impacts and to remove their harmful consequences.

ZORICA SVIRČEV

Figure 2: A natural wetland – reed belt along river and channels in Vojvodina, Serbia.

Through its history, the nature has experienced many catastrophes and survived them for this reason. Aquatic ecosystems and wetlands have a high retention capacity and could prevent flooding as well as severe and specific physical, chemical and toxic pollution. These ecosystems neutralize toxins and efficiently reduce various pathogenic organisms. Moreover, they increase biodiversity and contribute to many so far unknown or hardly known processes maintaining the equilibrium on our planet. Ecoremediation comprises systems and processes which function in natural and artificial ecosystems; it protects and restores the environment. It is comparatively inexpensive and highly efficient in protection of water resources, streams, rivers, lakes, groundwater and the sea. The basic characteristics of ERM, which can be utilized and improved, are its high buffer and self-protective capacities, and preservation of natural habitats and biological diversity (Vovk Korže and Vrhovšek 2006).

By observing the different ecosystem's ability for 'self reparation' after natural or anthropogenic impacts, the ERM system was recognized. Over the question *How has a certain ecosystem »learned« to survive and re-establish the functional relationships,* the basic ERM field is discovered. And, due to the complexity of ecosystems' properties, the term *ERM system* is used rather than *ERM methods.* ERM principles are the constitutional part of ecosystems' functioning since the begining of life on our planet. In the time scale of these global processes man is nothing but a tiny part. Nevertheless, on the scale of the impact on planet Earth, man is a very important and detrimental element (Rockström et al. 2009). Our attitude towards the planet has become a question of its survival. In this constalation, ERM becomes a survival phylosophy.

Natural selection of new solutions for ecosystem balance maintenance unequivocally leads us to ERM concept which incorporates: research, new technology development and education that together represent the new philosophical approach in line with the global paradigm of sustainable development.

3 The link between ecoremediation and eutrophication

The fact that biologists have often neglected the importance of abiotic factors has contributed to insufficient appreciation of the terms *oligotrophy* and *eutrophy* of the water systems. Dividing of water ecosystems to *oligo* and *eu* trophic ones is a separation to long and short living. Overall ecosystem elements that determine and define the organic matter quantity in the water are termed the *total capacity* of that water ecosystem. The total capacity is a whole chain of parameters whose combination (in a form of specific physic-chemical set-up) will guide the course of the eutrophication. Very specific elements which are part of, or influence the biomass synthesis in water ecosystems are essential for the primary production. Disproportion or lack of one element is therefore a relevant limiting factor.

One of the deadliest disturbances of water ecosystems is the accelerated production of biomass what leads to significant changes in natural balance and relations. These changes eventually lead to accelerated eutrophication which significantly shortens the life span of that particular water ecosystem. If there are no contra measures, or remediation measures, the consequences of increased saprobity get apparent and unpredictable. Due to constant increase of the total capacity via the increased saprobity, one of the most extreme consequences – the algal bloom is most probable, when the rapid multiplication of algae results in their visible apperance on the water surface (Bellinger and Sigee 2010). Blooming cyanobacteria might be very hazardous for whole ecosystem, but specially endangered are humans supplied with drinking water produced from blooming reservoirs and lakes (Svirčev et al. 2009; Svirčev et al. 2010; Dolinaj et al. 2011).

There are numerous missinterepretations of the stated definitions in the literature, what has lead to erroneous applications of the saprobic system in detection of the water quality (review on the matter can be found in Krstić et al. 2007). In order to establish the link between ecoremediation, total capacity, saprobity and eutrophication of the water ecosystems, we present the following comments.

In a case that the water ecosystem has such a primary organic production that corresponds in the intensity to the decomposition of the total biomass, the trophy (white circle T, Fig. 3) is about the same as saprobity (black circle S, Fig. 3 – the white and the black circle are same in size). The quantity of mineral matter in this system, which is utilized in the process of photosynthesis, is nearly equal to the quantity of mineral salts produced after the degradation of organic matter of the dead primary producers and food chain members. In those systems, there is no additional organic load and the aging process corresponds to the natural eutrophication.

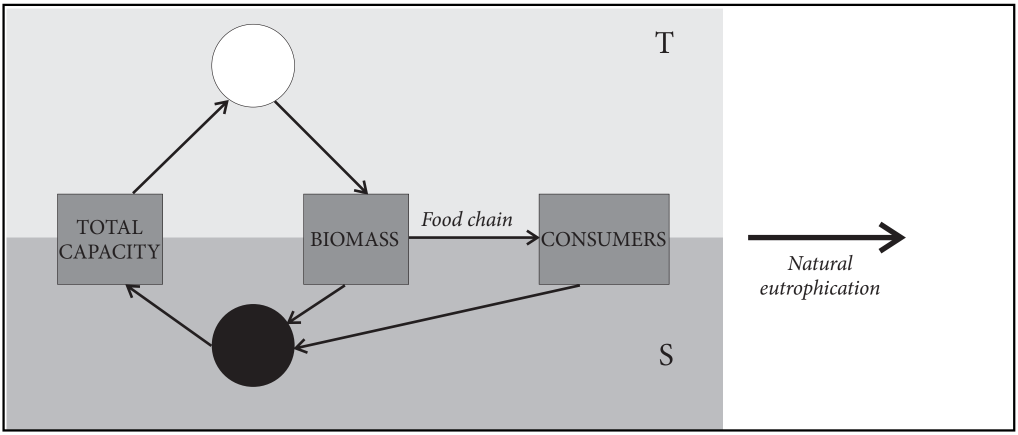

Figure 3: The elements and procceses of natural eutrophication (T – trophy; S – saprobity).

By entering of organic matter and mineral elements of whatever origin into the water ecosystem (human input or natural process), a certain amount of organic matter is decomposed, or the mineral salts are directly incorporated into the *total capacity* (Fig. 4 – the black circle is larger than the white circle). In both cases, there is an increase of the total capacity what results in increasing of the total organic production. The quantity of the newly generated biomass in the water ecosystem can no longer be attributed to the trophy, but more to the overall photosynthesis in the system, what increases the biomass of both primary producers and the food chain members (Fig. 4). Due to total biomass increase in the water body, similar amount of organic matter or equivalent amount of mineral matter enters the decomposition processes as in the case of immediate input of external matters into the system (Fig. 4). In fact, the self-purification process actually means that the water ecosystem successfully decomposes the organic matter. Nevertheless, a self-purification which will reverse the organic input on the quality and especially quantity level prior to organic load is impossible process. It is therefore recommendable to replace the term self-purification with more adequate expression,

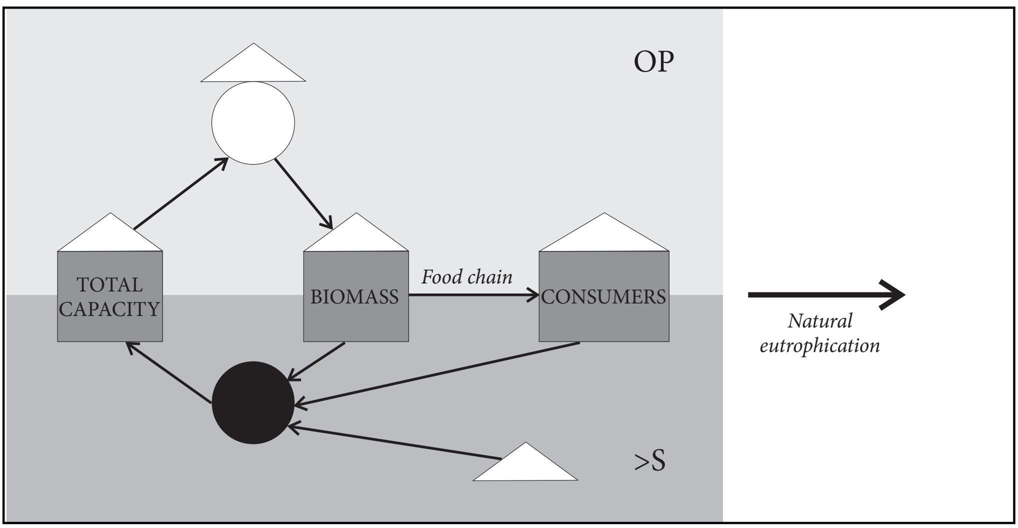

Figure 4: The elements and procceses of accelerated eutrophication (OP – organic production; S – saprobity)

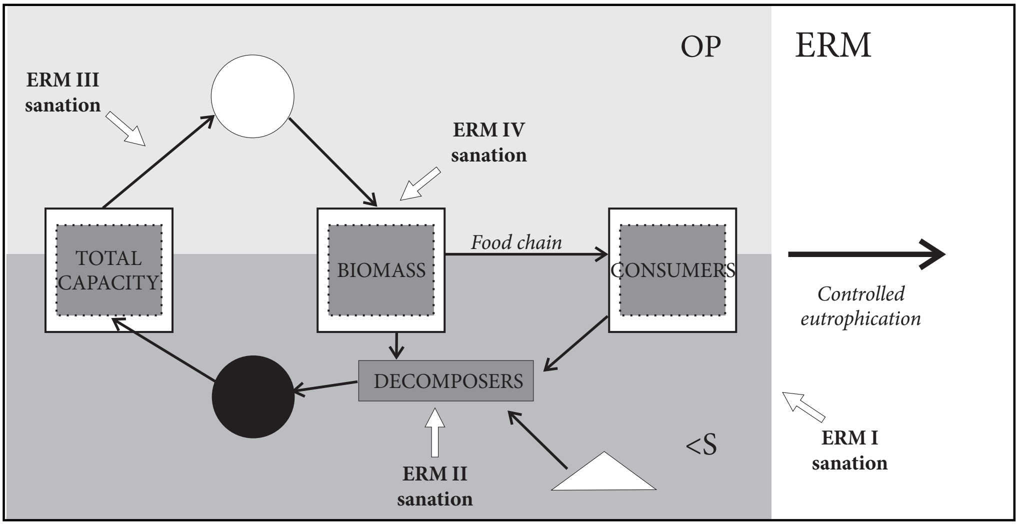

Figure 5: Ecoremediation as eutrophication menagement tecnique (OP – organic production; S – saprobity; ERM – ecoremediation).

such as 'auto-recovering'. In a case of saprobity increasing after a single or multiple incidents of organic and mineral input, there is an accelerated process of aging, or eutrophication. But, if the organic load is constantly present the water body can not be recovered and experiences rapid aging and intensive eutrophication.

Accelerated or fast eutrophication is detected reality in majority of ecosystems today, mainly due to adverse human impact. However, this process can be tackled by different activities, ERM having an especially important place. Eutrophication control can be achieved on four important levels in the functional dynamics of the ecosystems. Firstly, ERM is placed as key element in prevention, usually as channel constructed wetlands, in preventing the external influents in the ecosystem (Figure 5-I). In this case, the waterbody remains completely protected without the need of any additional purification system. But if there is an input of external compounds in the waterbody or nutrient liberation from the mud, ERM can be applied in the following three levels:

- Increasing of decomposition processes through different modes of aeration (rapids, waterfols …) in the ecosystem, completely stoping or significantly decrasing the mud formation in the same time (Figure 5-II);
- Decreasing of the total capacity of the ecosystem, usually via constructed wetlands for mud purification or re-direction (in lotic waters) and water course input (in lentic waters) via constructed wetlands aimed for purification of water's efluent (Figure 5-III);
- Planting and removing, or simply removing, of the riparian vegetation biomass only in cases when there is no disturbance in the ecosystems relations. In this way there is a decreasing in saprobity levels, but also in the total capacity of the ecosystem (Figure 5-IV).

It is important to stress that ecoremediation encompasses not only organic and mineral matter removal, but also the whole span of different pollutants. Ecoremediation methods eventually lead to overall decrease of the total ecosystem's capacity. Together with the bio-manipulation methods, ecoremediation represents a very effective system for purification of both water and soil ecosystems.

Certain processes that are functioning in the ecologically balanced systems, which might also be eutrophic ecosystems, belong to domain of 'technologies' which that system has 'implemented' in order to keep the current state. These technologies are usually seen in different aeration mehanisms, changes in system's configuration, effective biotransformation and biodegradation processes, as well as in specific microorganisms relations, vascular plants and predators. This technology of ecologically stable or 'successful' ecosystems might be called ***ecosystem technology***, while its recognition and transformation to a system of protection, revitalization and sanation of the environment are the basic elements of ERM system (Scholz et al. 2007b; Carty et al. 2008).

4 Ecoremediation – the applicative approach

ERM is used for multipurpose management of watercourses, lakes and wetlands, which enables integrated development of particular areas and contributes to the coexistence of man and nature. Therefore, the ecoremediation is among the most successful and sustainable methods of environmental protection, from the economic and ecological point of view (Vovk Korže and Vrhovšek 2006). Ecoremediation methods may reduce and avert the consequences of agricultural pollution, tourism, transport, industry, land fills and (over)population (Vovk Korže 2008; Griesseler-Bulc and Slak 2009).

Application of ecoremediation methods contributes to the quality of ecosystem resources such as food, drinking water, genetic resources, it has an effect on the regulation of climate, floods, disease and etc., and as a whole it contributes to the quality of life. Furthermore, it affects the reduction of costs for pretreatment processes (eg raw water in factories), improvement of the product quality in the field of fisheries, agriculture, and livestock, growing number of visitors in the recreational and tourist places. It also represents financially very cost effective and time-sustainable exploitation of resources, obtained from secondary ecological-remediation.

It is comparatively inexpensive and highly efficient in protection of water resources, streams, rivers, lakes, groundwater and the sea. The basic characteristics of ecoremediation, which can be utilized and improved, are its high buffer and self-protective capacities, and preservation of natural habitats and biological diversity (Vovk Korže 2008; Griesseler-Bulc and Slak 2009).

In its essence, ecoremediation represents the 'returning to nature' approach aiming to preserve or re-establish the natural balance of the ecosystems, but also a human endevour that enables new jobs and by-side activities important for economic and social (sustainable) development of the human society (Vovk Korže 2008; Griesseler-Bulc and Slak 2009). For example, decontamination of polluted media and the creation of a healthy environment also provide an opportunity for eco-tourism development in local communities, what contributes to their socio-economic prosperity. Successfully implemented ecoremediation system results in profit increase, which further leads to creation of new jobs and socio-economic development of the local communities.

In the last 30 years, several ecoremediation systems were installed in Slovenia: constructed wetlands, waste stabilization ponds (surface flow wetlands), vegetated drainage ditches, ecoremediation for restorations of landfill sites, and river revitalization. Constructed wetlands (CWs) were installed to treat sewage, industrial wastewater, landfill leachate, conditioning of drinking water, and for highway runoff treatment. Excavations were sealed with plastic membranes, clay, or with combination of both. The medium was mostly a mixture of different materials (peat, soil, sand, gravel), varying in grain size and proportion. Different wetland species were used such as *Phragmites australis*, *Carex gracilis*, *Typha latifolia*, *Schoenoplectus lacustris*, most often *Juncus effusus* and *Juncus inflexus*. The initial results showed similar values of average removal efficiency of chemical oxygen demand (COD), biological oxygen demand (BOD), ammonia, and total P (in sewage treatment: 86%, 89%, 85%, and 87% respectively) (Griesseler-Bulc and Slak 2009). Preliminary results of CWs that were used for water-conditioning at drinking water wells polluted with pesticides, herbicides, and pathogens, showed that removal efficiency of *Escherichia coli* was from 130–500 bacteria to 0–3 bacteria per 100 mL, while pesticide removal showed that bentazon was reduced from 1.8 mg/L to 0.06 mg/L, metholaclor from 0.73 to < 0.05 mg/L, and terbutylazine from 0.53 to < 0.03 mg/L (Griesseler-Bulc and Slak 2009). A pilot CW system that was set up for highway runoff in Slovenia showed that removal efficiency was 69% for suspended solids, 97% for settleable solids, 51% for COD, 11% for BOD_5, and 80% for Fe. Heavy metals such as Cu, Zn, Cd, Ni, and Pb were reduced in the system more than 90% (Griesseler-Bulc and Slak 2009).

For purifying raw water in a hypertrophic front of Lake Taihu, an aquatic vegetable bed (AVB) was implemented with local floating perennial aquatic plant *Ipomoea aquatica*. The results have shown that removal efficiency of *Mycrocystis* sp. in AVB averages 78%, while the removal rate of total microcystin-RR and microcystin-LR averages 63% and 66,7% respectively (Song et al. 2009). Very similar results were obtained by Li et al. (2010) after implementation of integrated ecological floating-bed. In all these cases the ERM approach and principles are very important which are fully natural and in coordinance with natural technologies. Defined as such, the ERM system means a constant search for the new forms of ecosystem technologies (Scholz et al. 2007b; Carty et al. 2008).

5 Conclusion

Humanity has emerged as a major force in the operation of the biosphere, with a significant imprint on the Earth System. This new situation calls for a fundamental shift in perspectives and world views, reconnecting human development and progress to the biosphere and becoming active stewards of our role in the Earth System. The current mental disconnect of human progress and economic growth from the fundamental interactions with the biosphere has altered the long-term capacity of natural resources to sustain human developments. Water ecosystems in this regard are particularly vulnerable.

Ecoremediations (ERM) is used for multipurpose management of watercourses, lakes and wetlands, which enables integrated development of particular areas and contributes to the coexistence of man and nature. Therefore, the ERM is among the most successful and sustainable methods of environmental protection, from the economic and ecological point of view. ERM as a system for protection, sanation and remediation of the environment can be appreciated from very different stand points. Globaly, ERM is a buffer system that enables the re-establishing of the disturbed ecological balance in its original position. As an »immune system« of our planet, ERM is the preventive defence that protects against the system being in not desirable modified stage. Using ERM methods, eutrophication control can be achieved on four important levels in the functional dynamics of the ecosystems. All of the methods are based on decreasing the total capacity and maintaining low saprobic level in water ecosystems.

Successfully implemented ERM system results in profit increase, which further leads to creation of new jobs and socio-economic development of the local communities.

6 Acknowlegments

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LANDSLIDE SUSCEPTIBILITY ZONATION: A CASE STUDY OF THE MUNICIPALITY OF BANJA LUKA (BOSNIA AND HERZEGOVINA)

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Infield or a landslide? Landslide in Banja Luka, April 2012.

Landslide susceptibility zonation: A case study of the Municipality of Banja Luka (Bosnia and Herzegovina)

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ABSTRACT: Along with flash floods, landslides are one of the most widespread and damaging natural hazards in Bosnia and Herzegovina. This paper determines areas susceptible to landslides in the Municipality of Banja Luka (Republika Srpska, northwest Bosnia and Herzegovina). Based on a terrain survey in a 55.4 km^2 area, 216 landslides were identified with a total area of 2.9 km^2 or 5.2% of the municipality. According to landslide susceptibility modeling, low susceptibility is present from one-quarter to one-half of the territory and very high susceptibility is present from several percentages up to one-third of the territory, depending on the model used. The results may support government mitigation programs and help in developing a landslide hazard and risk assessment model for the area.

KEYWORDS: landslides, landslide susceptibility, GIS, Banja Luka, Bosnia and Herzegovina

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1 Introduction

Landslides are recognized as an important »natural hazard« in many countries (e.g., Crozier and Glade 2005; Zorn and Komac 2007; Tošić et al. 2012). Along with flash floods, they are one of the most widespread and damaging natural hazards in Bosnia and Herzegovina. Population growth, increased urbanization, and expansion of urban and manmade structures into potentially hazardous areas leads to extensive damage that has dramatic effects on human life, infrastructure, and the environment (Luzi and Pergalani 1999; Zorn and Komac 2009; 2011; Komac et al. 2013). Determining the spatial and temporal extent of landslide hazard requires identifying areas that are, or could be, affected by landslides and assessing the probability of landslides occurring within a specified period of time. To reduce the risk from landslides, knowledge of landslide-prone areas is needed. This information is often described in the form of landslide susceptibility zonation (e.g., Aleotti and Chowdhury 1999; Guzzetti et al. 1999; Luzi and Pergalani 1999; Crozier and Glade 2005). A large number of studies on landslide susceptibility zonation have been carried out over the past 30 years (Crozier and Glade 2005). Overviews of various landslide susceptibility zonation techniques can be found in Carrara et al. (1991), van Westen et al. (1997), Guzzetti et al. (1999), and Zorn and Komac (2004; 2007). Many techniques use GIS and remote sensing to determine landslide-prone areas (e.g., Nagarajan et al. 1998; van Westen and Lulie Getahun 2003). With the help of GIS, it is possible to integrate different spatial data layers to determine landside-prone areas (e.g., van Westen 1994; Carrara et al. 1995; Aleotti and Chowdhury 1999). However, this type of research has not been applied in Bosnia and Herzegovina until now, and the investigation and study of landslides has been based only on the geo-technical approach (Perić et al. 1971).

In the Municipality of Banja Luka a large number of landslides in urban and peri-urban areas were triggered during the autumn of 2011 and spring of 2012. Because there is currently no landslide database (inventory) for the Municipality of Banja Luka, which is necessary for any land-use planning purpose, landslide susceptibility zonation was performed to determine landslide-prone areas. The creation of a landslide susceptibility map is the first important step for preventing and mitigating landslides in the study area.

The objective of this study is to assess the landslide susceptibility of urban and peri-urban areas of the Municipality of Banja Luka using various methods: the Index-Based Method (IBM), the Statistical Index Method (SIM), and Landslide Susceptibility Analysis (LSA).

2 Study area

The Municipality of Banja Luka is located in the northwestern part of Bosnia and Herzegovina (Figure 1). It occupies an area of 55.4 km^2, with around 226,450 inhabitants.

The entire area of the Municipality of Banja Luka belongs to the Pannonian region. According to morphostructural characteristics, the study area is a neotectonic depression whose formation begun during

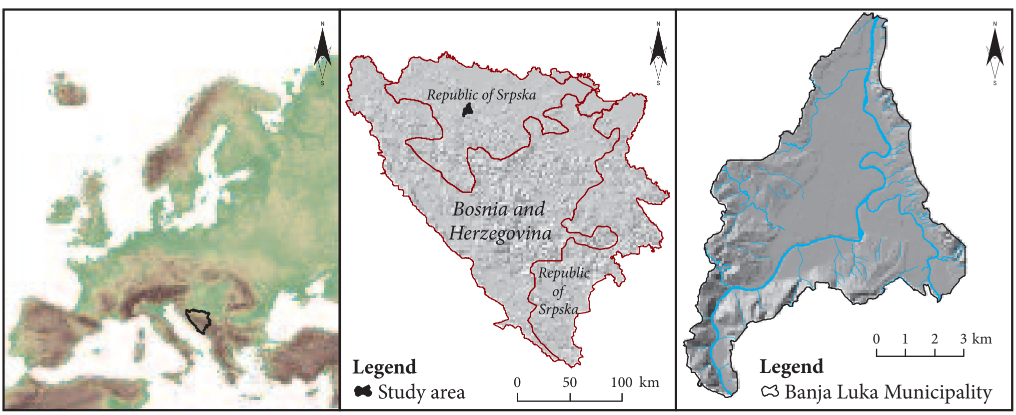


Figure 1: Location of the study.

Neogene tectonic activity (Vilovski 1970; Mojićević et al. 1976; Trkulja 1998). Figure 3 shows only major lithologic complexes, some of which have played a dominant role in the distribution of landslides: fluvial sediments, torrential sediments, slope material, flysch, Neogene sediments (sands, clays and marl), and Mesozoic rocks (limestone, dolomite and diabase-hornstone rock). The largest spatial distribution is that of fluvial sediments located in the center of the study area.

The terrain ranges from 137 to 432 meters above sea level. Alluvial plains with slopes less than 5° are dominant across the entire study area (within the Vrbas, Vrbanja, and Crkvena valleys; Figure 2). Hilly terrain encompasses the slightly rippled sides of peripheral parts of the Banja Luka depression. The northern and northwestern slopes have inclinations between 5 and 15° and only sporadically are there slopes with an inclination over 20°. Slopes with dominant inclinations over 20° are located in the southwestern and southern parts of the study area and intermittently in the southeast parts (Figure 3).

According to the dominant denudation process, the slopes of the southwestern and southern parts of the Banja Luka depression and river valley sides are subject to linear erosion. In higher parts of the slopes there are ravines, and torrents are frequent in the middle and lower parts. The northwestern parts of the study area, which are composed of Neogene sediments, do not experience extensive linear erosion processes, but frequently have landslides.

The climate has the characteristics of a moderate continental climate with an average annual temperature above 10 °C and annual rainfall of 1,050 mm (Tošić et al. 2013). In the study area there are two large rivers: the Vrbas and Vrbanja. The dominant soils are planosol (pseudogley), fluvisol, and gleysol (dystric, eutric, and mollic) (Burlica and Vukorep 1980).

3 Data and methodology

3.1 Data

The identification of influence factors for landslides is the basis of many methods of susceptibility assessment. These influence factors can be separated into three broad categories: topographic, geological, and environmental (Crozier and Glade 2005). In this study, ten influence factors were considered: lithology, land use, slope, aspect, relative relief, distance from faults, distance from streams, curvature (profile curvature), elevation, and seismic zone (Figure 3).

The data on elevation, slope, aspect, relative relief, and curvature (profile curvature) were derived from a digital elevation model (DEM) of the study area using the Surface Analyst tools in ArcGIS 10. Distance from streams was defined using the topographic database, the buffer was calculated at a value of 0 to 50 meters from a stream, and more than 50 meters from a stream. The lithology map was prepared from a 1 : 10,000 scale geological map (Vilovski 1970; Perić et al. 1971; Mojićević et al. 1976; Trkulja 1998).

Table 1: Spatial data layers used in the study.

Category	Layer	Data type
Digital elevation model (DEM; 5 meter resolution)	Elevation, slope, aspect, profile curvature, relative relief	Raster (grid)
Geological map; map of seismic micro-regionalization	Lithology, distance from faults, seismic zone	Vector (point and line)
Digital orthophoto Topographic database	Land use Distance from streams	Raster (grid) Vector (point and line)

The distances from faults were found using a geological map, the buffer was calculated at value of 0 to 50 meters from faults, and more than 50 meters from them (Vilovski 1970; Perić et al. 1971; Mojićević et al. 1976). The seismic map was prepared by using the map of seismic micro-regionalization of the Municipality Banja Luka (Trkulja 1998). Land use was determined according to CORINE Land Cover methodology (CORINE … 1994). Classification was generated from digital orthophotos of the Municipality of Banja Luka at a scale 1 : 1,000. After the data were collected, all vector data were converted to a raster grid with 5×5 meter cells (the resolution of the DEM used).

3.2 Methodology

There are two ways to approach landslide susceptibility zonation: qualitative and quantitative. Qualitative approaches (e.g., geomorphological mapping) were popular before the widespread use of information technologies. Quantitative approaches (statistical analysis, probabilistic approaches, fuzzy set–based approaches, and artificial neural networks) have become popular in recent decades thanks to the development of remote sensing and GIS (Aleotti and Chowdhury 1999; Guzzetti et al. 1999; Clerici et al. 2002; Santacana et al. 2003; Zorn and Komac 2004). GIS-based statistical approaches have become very popular in landslide susceptibility zonation due to their multiple advantages, such as effective data management, simultaneous use of several types of layers, graphic and attribute crossing of these layers, and providing accurate output data. In this study, the analysis of landslide susceptibility is based on quantitative methods, i.e. the application of an empirical method and two statistical methods.

The first step in our analysis was to create a landslide inventory map of active landslides in the study area. The landslide inventory map was completed using orthophoto images, topographic maps (1 : 1,000, 1 : 2,500, 1 : 5,000, and 1 : 10,000), and a terrain survey.

As mentioned, three methods were applied for landslide susceptibility zonation: the **Index-Based Method** (IBM), the **Statistical Index Method** (SIM), and **Landslide Susceptibility Analysis** (LSA).

The IBM uses a simple ranking and rating technique for landslide susceptibility zonation. The first step in this method is to select influence factors of slope instability in the study area. Each influence factor is then considered as a parameter map. The relative importance of each parameter map for slope instability is evaluated according to subjective experts' knowledge. On the basis of comparisons of different parameters, weight values are assigned to each parameter map. Subsequently, each parameter map is classified into several significant classes based on their relative influence on mass movements, and rating values are assigned to each class depending on their influence on slope instability. The rating values are also fixed according to expert opinions and estimates (e.g., Anbalagan 1992; Turrini and Visintainer 1998; Barredo et al. 2000; Zorn and Komac 2004). Finally, integration of the various factors and classes into a single landslide susceptibility index (LSI) is achieved by a procedure based on the weighted linear sum (Voogd 1983):

$$LSI = \sum_{j=1}^{n} \left(W_j \cdot W_{ij} \right) \tag{1}$$

in which LSI is the landslide susceptibility index, W_j is the weight value of parameter j, w_{ij} is the rating value or weight value of class i in parameter j, and n is the number of parameters. All LSI values were than separated into four classes using a natural breaks algorithm to present four categories (low, moderate, high, and very high) of the landslide susceptibility zone (LSZ). Similar techniques can be found in many studies (e.g., Barredo et al. 2000; Saha et al. 2002; Foumelis et al. 2004; Zorn and Komac 2004; Wati et al. 2010; Dragićević et al. 2012).

The SIM is a bivariate statistical analysis introduced by van Westen (1997) for landslide susceptibility analyses. A weight value for a parameter class (e.g., a certain lithological unit or a certain slope class) is defined as the natural logarithm of the landslide density in the class divided by the landslide density in the entire map. This method is based on the following formula (van Westen 1997):

$$W_{ij} = In\left(\frac{f_{ij}}{f} \right) = In\left(\frac{A_{ij}^{*}}{A_{ij}} \cdot \frac{A}{A^{*}} \right) = In\left(\frac{A_{ij}^{*}}{A^{*}} \cdot \frac{A}{A_{ij}} \right) \tag{2}$$

in which W_{ij} is the weight given to a certain class i of parameter j, f_{ij} is the landslide density within class i of parameter j, f is the landslide density within the entire map, A_{ij}^{*} is the area of landslides in a certain class i of parameter j, A_{ij} is the area of a certain class i of parameter j, A^{*} is the total area of landslides in the entire map, and A is the total area of the entire map. The SIM is based on statistical correlation of the landslide inventory map with attributes of various parameter maps. The W_{ij} value in Equation 2 is only calculated for classes that have landslide occurrences. In the case of no landslide occurrences in a parameter class, W_{ij} is valued as zero (e.g., van Westen 1997; Cevik and Topal 2003; Oztekin and Topal 2005; Magliulo et al. 2008; Zorn and Komac 2008).

In the study, every parameter map was crossed with the landslide inventory map, and the density value of the landslide in each class is calculated. Then these were summed up by Equation 3 to obtain the resulting LSI for the study area:

$$LSI = \sum_{j=1}^{n} W_{ij} \tag{3}$$

in which LSI is the landslide susceptibility index, W_{ij} is the weight of class i in parameter j, and n is the number of parameters. The same procedure as in the previous method was used for reclassifying the LSI values into different susceptibility zones and for map validation.

LSA is a simple bivariate method of analysis that aims to determine the importance of different variables for landslide occurrence. To evaluate the influence of each variable, weighting factors are determined, which compare the calculated density with the overall landslide density in the area (Süzen and Doyuran 2004) as follows:

$$W_{ij} = 1000\left(f_{ij} - f\right) = 1000\left(\frac{A_{ij}^{*}}{A_{ij}} \cdot \frac{A^{*}}{A}\right) \tag{4}$$

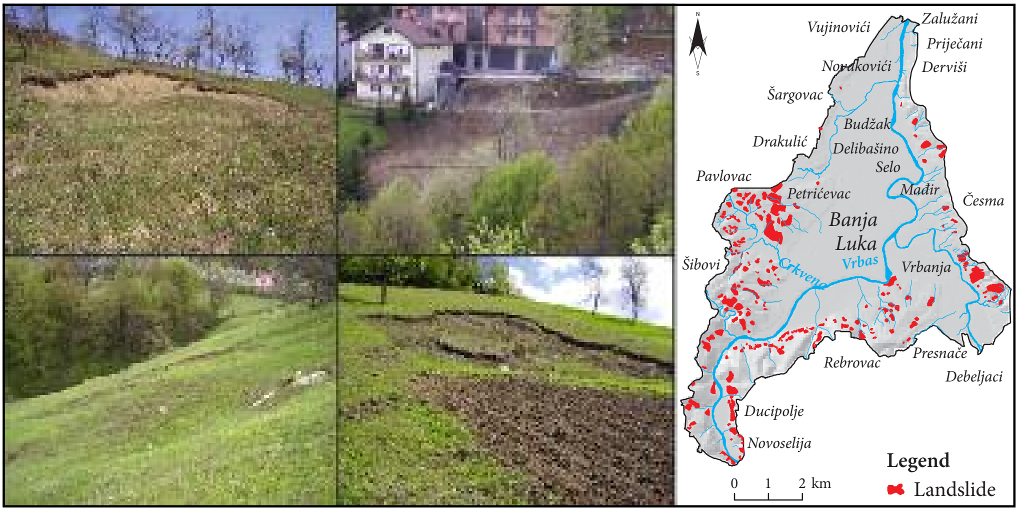
in which W_{ij} is the weight given to a certain class i of parameter j, f_{ij} is the landslide density within the class i of parameter j, f is the landslide density within the entire map, A_{ij}^{*} is the area of landslides in a certain class i of parameter j, A_{ij} is the area of a certain class i of parameter j, A^{*} is the total area of landslides in the entire map, and A is the total area of the entire map. In the next step, all weights are summed up as in Equation 3 in order to obtain a resulting LSI map for the study area. The same course of action as in the previous method is used for reclassifying the LSI values into different susceptibility zones and the map validation.

4 Results and discussions

Using the landslide inventory, we identified 216 landslides with a total area of 2.9 km^2 (5.2% of the municipality). Most landslides have depths between 1 and 10 meters. Their main characteristic is that landslides do not occur as isolated events, but rather as a group, mostly on the slopes of valleys and upper courses of streams. Terrain consisting of Neogene sediment has a high number of landslides. Landslides are also characteristic of flysch terrain (e.g., Zorn and Komac 2009); they mostly occur in regolith. This most often happens in the upper courses of streams and in lower slope areas where there are many slope deposits. Complex linear erosion features are most dominant on terrain consisting of diabase-hornstone rock, and landslides are related to regolith and slope material. Using analysis of the spatial distribution of landslides, it is possible to pinpoint several locations in the study area where landslides occur as a group, and also some locations where landslides occur as isolated events.

The area where landslides occur in groups is the settlement of Novoselija in the southwestern part of the study area. On the left side of the Vrbas Valley in that settlement, shallow landslides prevail on slope material. On the opposite side of the valley in this part of the settlement (the southeastern part of study area) a significant number of landslides have been recorded on flysch, slope material, and torrential sediments. The next area with a large number of landslides is in the eastern part of the study area, on slope material with 15 to 20° slopes. These landslides are up to 3 meters deep and sliding mass mostly rolls linearly. This means that the sliding plain is a unique, single surface between the rock mass and slope material. The third area that has a greater number of landslides is in the northeast part of the study area, where Neogene sands and clays are dominant. Rivers have cut their beds into these sediments and caused slope instability and landslides on the sides of the valley. Further north from this location, the slopes consist of diabase-hornstone series covered by slope material and clays. In this area there are also landslides mostly caused by cutting of slopes. Slopes in this location are unstable with a significant number of active landslides with depths ranging from 3 to 5 meters.

The fourth area is in the western part of the study area and is related to both sides of the Crkvena Valley. There are landslides on the left slopes related to terrace level and clay-like pebbles. These landslides



RADISLAV TOŠIĆ, MAY 2012

Figure 2: Some landslides in the study area (left, center) and the location of all landslides in the study area (right).

are deep (over 10 meters) because they expand not only into the slope material but also degrade Neogene sediments and clays. Hence, these are complex landslides, temporarily on hold, but their activity should not be questioned when bearing in mind numerous morphological indicators of landslide processes. Moreover, there are a significant number of smaller active landslides in the complex; the »body« of large landslides and these landslides are mostly related to the claylike slope material with pebbles reaching 5 meters in depth. Landslides located on the right side of the Crkvena Valley developed in Neogene sediments, consisting of slightly calcareous mudstones and sand covered by a thin layer of slope material up to 5 meters thick.

The fifth area, in the northwestern part of the study area, contains a smaller number of mostly isolated landslides. These landslides are related to slope material that is layered over Neogene sediments. The depth of these landslides is up to 10 meters. Currently active landslides on this location develop in gravel and other slope material (Figure 2).

After mapping landslides and creating a GIS database, maps of influence factors were developed. The selected landslide influence factors for the study area were carefully considered based on relevance, availability, and scale attributes. Consequently, we considered ten influence factors (Figure 3; Table 2): lithology, land cover / land use, slope, aspect, relative relief, distance from faults or line (lineaments), distance from streams, curvature (profile curvature), elevation, and seismic zones. Several studies considered elevation as an indirect factor related to other factors such as rainfall, temperature, soil development, and so on. In the study area, the elevation varies between 137 and 432 meters above sea level. This factor is not as favorable for instability as in mountainous areas, which often experience larger volumes of precipitation, both in rain and snow. The relation between aspect and landslide has been investigated for a long time, but no general agreement exists on aspect (e.g., Carara et al. 1991; Nagarajan et al. 1998). There is also no consensus about the influence of distances from structural elements (faults) on the occurrence of landslides. As a result, different distances are used with respect to structural elements (e.g., Anbalagan 1992; Luzi and Pergalani 1999). Table 2 shows the weights for each influence factor for all three methods.

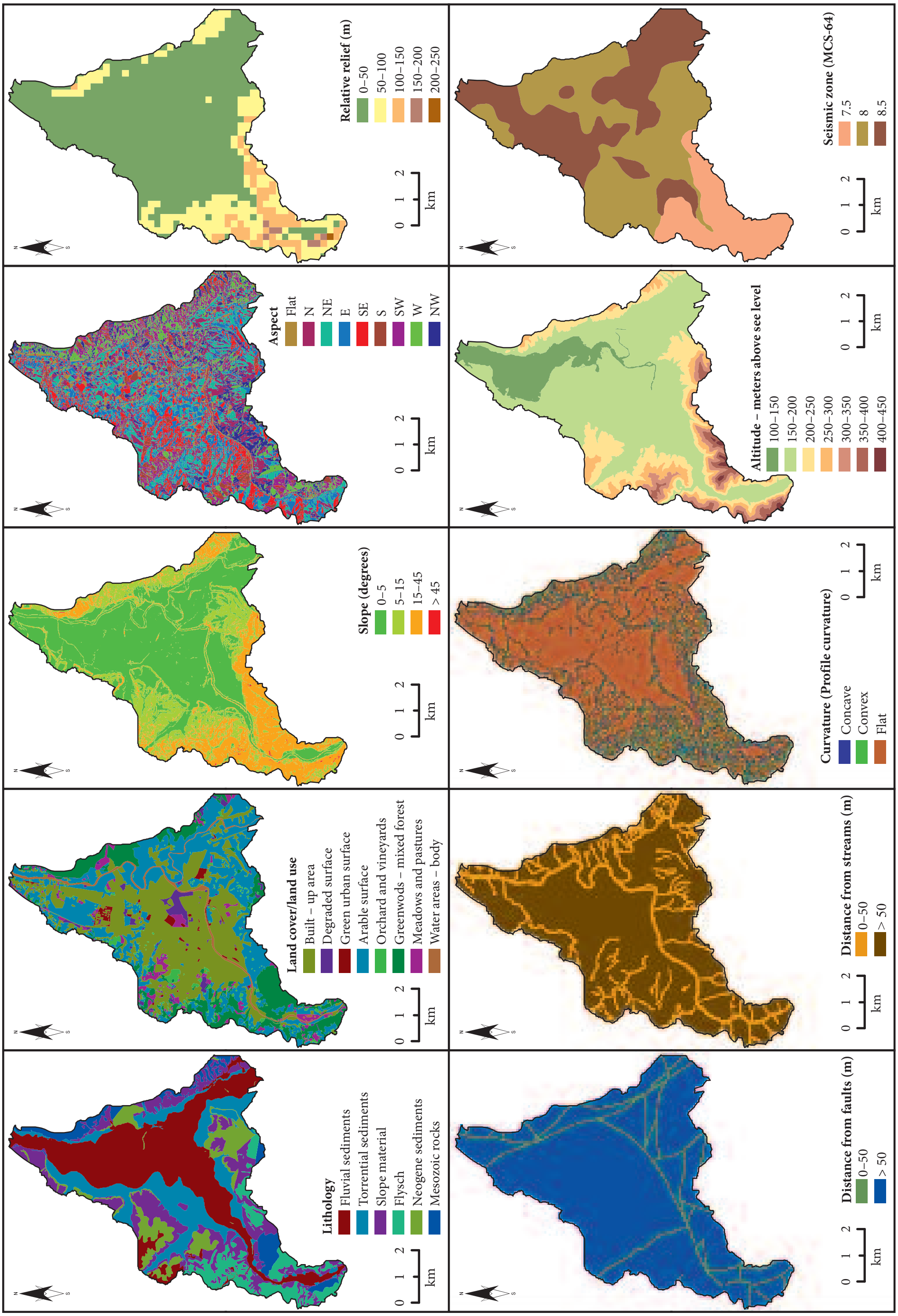
All three methods used are based on the calculation of weighting values for each selected influence factor's class. If the total weight is positive, the factor is considered to be favorable for the occurrence of landslides, and if it is negative the factor is not favorable for instability.

According to lithology, the highest W_{ij} were obtained for slope material and Neogene sediments. According to land use, positive W_{ij} were obtained for meadows, pastures, orchard, and vineyards. Positive W_{ij} were obtained for most slope angle classes, except for the classes 0–5° and > 45°. Among the relative relief classes, the highest W_{ij} were obtained for the classes 50–100 and 100–150 m. Significantly lower total weights were obtained for certain classes of other influence factors as a result of the small number of occurrences

Table 2: Influence factors and their total weights for methods used.

Factor	Class	Method		
		IBM (weight)	SIM (weight)	LSA (weight)
Lithology	Fluvial sediments	8	–2.0931	–45.8778
	Torrential sediments	16	–2.9685	–49.6415
	Slope material	48	0.8982	76.1437
	Flysch	32	0.1634	9.2904
	Neogene sediments (sands, clays and marl)	48	1.0309	94.3779
	Mesozoic rocks (limestone, dolomite and diabase-hornstone rock)	8	0.0180	0.9520
Land cover / land use	Built-up area	18	–2.2699	–46.9237
	Degraded surface	18	–0.5753	–22.8933
	Green urban surface	18	0.0000	–52.3303
	Arable surface	18	0.2961	18.0339
	Orchard and vineyards	54	1.4348	167.3904
	Deciduous-coniferous, mixed forest	9	0.3088	18.9361
	Meadows and pastures	27	1.4394	168.3982
	Water areas	0	0.0000	–52.3303
Slope (°)	0–5	10	–2.5878	–48.3959
	5–15	40	0.6827	51.2448
	15–45	30	0.7990	64.0188
	>45	20	–0.7458	–27.5076
Aspect	Flat	3	0.0000	–52.1821
	N	3	–0.2967	–13.4332
	NE	6	–0.3552	–15.6449
	E	3	–0.4195	–17.9294
	SE	9	0.0916	5.0174
	S	9	0.6529	48.2031
	SW	9	0.5071	34.5626
	W	9	0.2545	15.1636
	NW	3	–0.0034	–0.1750
Relative relief (m)	0–50	16	–0.6465	–24.9169
	50–100	20	0.8462	69.6348
	100–150	12	0.8647	71.9157
	150–200	8	0.0000	–36.5691
	200–250	4	0.0000	–52.3303
Distance from faults (m)	0–50	3	0.1014	5.5834
	>50	6	–0.0122	–0.6341
Distance from streams (m)	0–50	3	0.1116	6.1782
	>50	6	–0.0333	–1.7136
Curvature (profile curvature)	Convex	8	0.4078	26.3475
	Concave	12	0.4725	31.6107
	Flat	4	–0.0931	–4.6532
Elevation: meters (m)	100–150	2	0.0000	–52.3303
	150–200	2	–0.8977	–31.0047
	200–250	6	1.1264	109.0864
	250–300	4	1.0017	90.1619
	300–350	4	0.3205	19.7734
	350–400	2	0.0000	–29.4239
	400–450	2	0.0000	–52.3303
Seismic zone (MCS–64)	7.5	6	0.6989	52.9379
	8	9	0.1199	6.6685
	8.5	3	–0.9694	–32.4804

Figure 3: Thematic maps of influence factors used for creating landslide susceptibility maps. ➤


Lithology
Fluvial sediments
Torrential sediments
Slope material
Flysch
Neogene sediments
Mesozoic rocks
Land cover/land use
Built – up area
Degraded surface
Green urban surface
Arable surface
Orchard and vineyards
Greenwods – mixed forest
Meadows and pastures
Water areas – body
Slope (degrees)
0–5
5–15
15–45
> 45
Aspect
Flat
N
NE
E
SE
S
SW
W
NW
Relative relief (m)
0–50
50–100
100–150
150–200
200–250
Distance from faults (m)
0–50
> 50
Distance from streams (m)
0–50
> 50
Curvature (Profile curvature)
Concave
Convex
Flat
Altitude – meters above see level
100–150
150–200
200–250
250–300
300–350
350–400
400–450
Seismic zone (MCS-64)
7.5
8
8.5
0 1 2
km

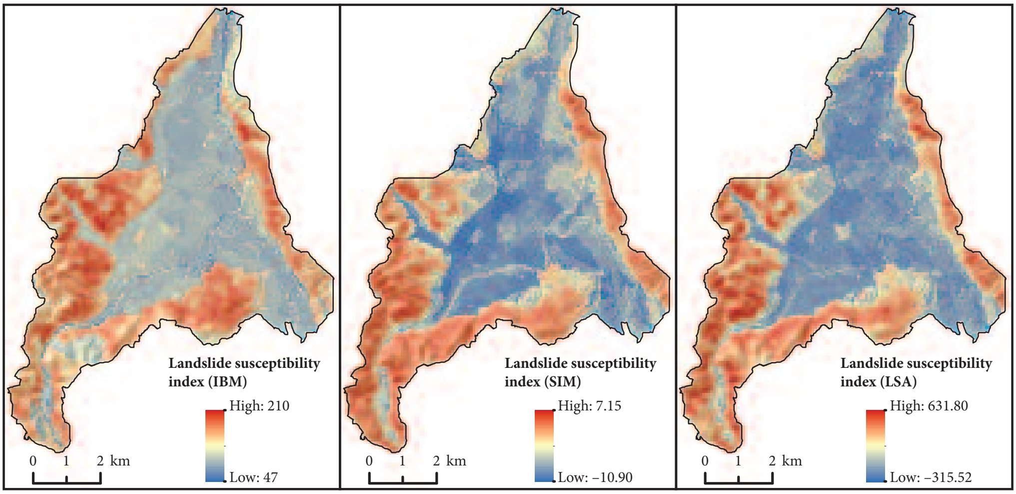


Figure 4: Landslide susceptibility index maps of the study area obtained with Index-Based Method (IBM), Statistical Index Method (SIM), and Landslide Susceptibility Analysis (LSA).

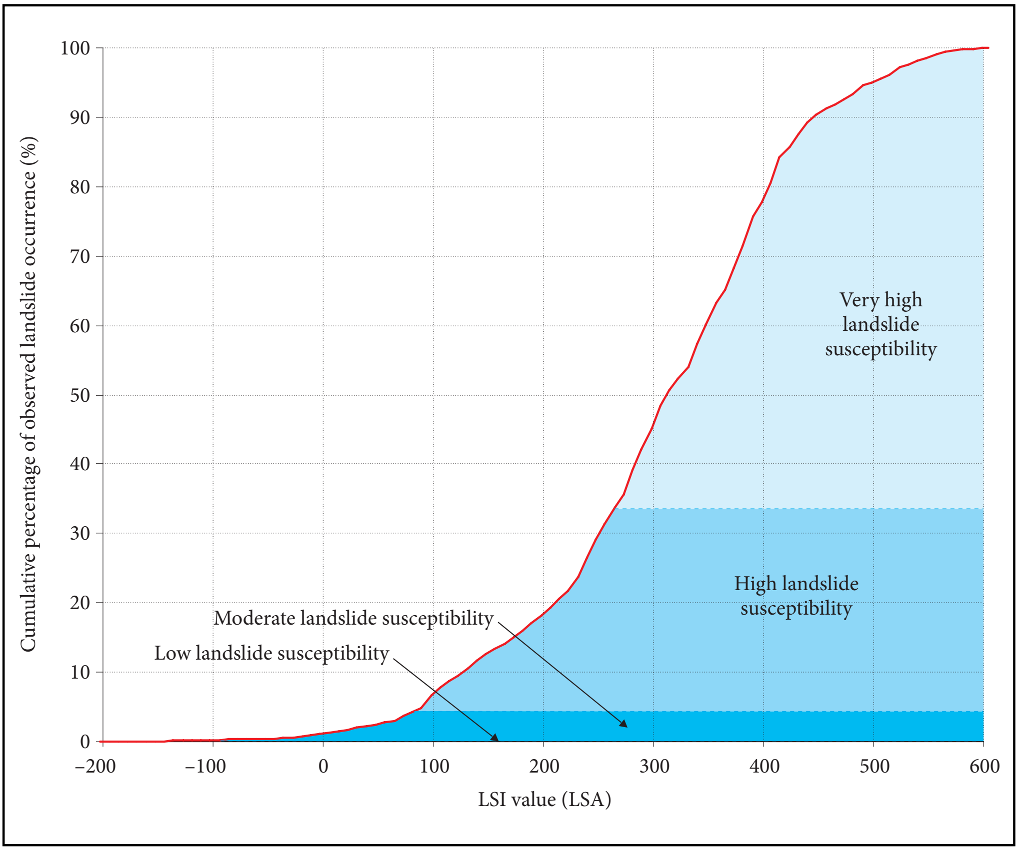


Figure 5: Cumulative percentage of observed landslides versus ranked LSI values resulting from the Index-Based Method (IBM), the Statistical Index Method (SIM), and Landslide Susceptibility Analysis (LSA).

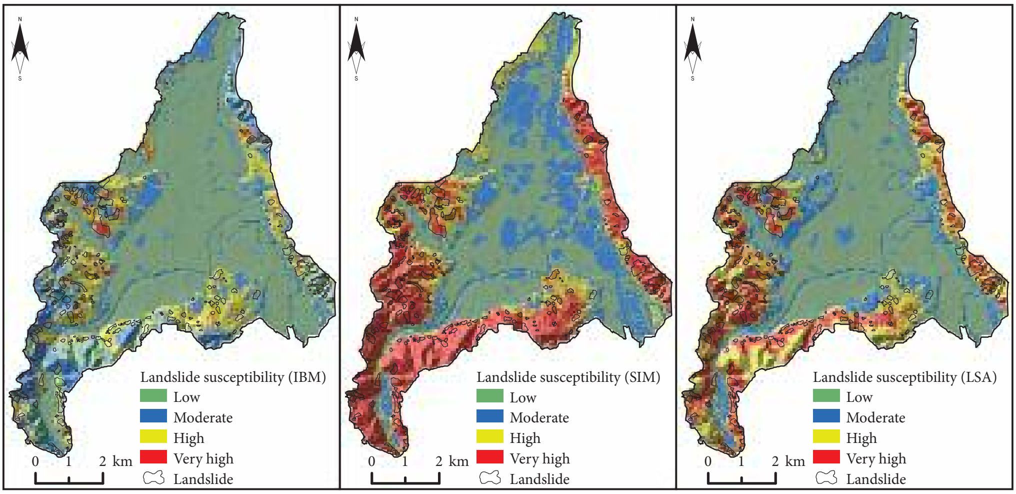


Figure 6: Landslide susceptibility zonation maps based on the Index-Based Method (IBM), Statistical Index Method (SIM), and Landslide Susceptibility Analysis (LSA).

of landslides in these classes. According to the relative importance (expressed in total weight), the main instability factors are lithology, land cover / land use, slope, and relative relief.

After calculating the weights for all influence factors, the weights were applied to create the landslide susceptibility index maps (LSI) for every method used (Figure 4). The integration of various influence factors and classes in a single LSI is accomplished using a procedure based on the weighted linear sum, Equation 3.

The LSI maps were compared to the landslide inventory map and the cumulative percentage of observed landslide values versus ranked LSI values were calculated (Figure 5). Three cut-off (»threshold«) percentages of observed landslides in the cumulative curve were used to identify the LSI scale value and four landslide susceptibility classes: low, moderate, high, and very high (Figure 6).

The final 1 : 10,000 susceptibility map is a raster grid with 5 × 5 meter cells. According to the methods used, the high and very high susceptibility classes range (together) from 25.06 to 48.07% of the study area. Areas with these classes are distributed in the peripheral part of the study area. Low and moderate susceptibility classes range from 51.93 to 74.94% (Table 3).

Table 3: Comparison of different landslide susceptibility zonation methods.

INDEX-BASED METHOD (IBM)			
LSI-classes	LSI scale value	Area (km^2)	Area (%)
Low susceptibility	47 to 101	28.08	50.37
Moderate susceptibility	101 to 135	13.69	24.57
High susceptibility	135 to 165	12.27	22.01
Very high susceptibility	165 to 210	1.70	3.05
STATISTICAL INDEX METHOD (SIM)			
LSI-classes	LSI scale value	Area (km^2)	Area (%)
Low susceptibility	–10.90 to –7.78	15.32	27.48
Moderate susceptibility	–7.78 to –3.96	13.63	24.45
High susceptibility	–3.96 to 0.71	9.81	17.61
Very high susceptibility	0.71 to 7.15	16.98	30.46
LANDSLIDE SUSCEPTIBILITY ANALYSIS (LSA)			
LSI-classes	LSI scale value	Area (km^2)	Area (%)
Low susceptibility	–315.52 to –114.91	24.92	44.71
Moderate susceptibility	–114.91 to 81.98	9.75	17.50
High susceptibility	81.98 to 264.02	11.96	21.46
Very high susceptibility	264.02 to 631.80	9.10	16.33

Table 4: Summary of the prediction accuracy of the final landslide susceptibility zonation maps.

Method	Number of landslides observed				Area of landslides observed			
	Good		Bad		Good		Bad	
	Number	%	Number	%	km^2	%	km^2	%
IBM	173	80.09	43	19.91	2.1785	74.67	0.7392	25.33
SIM	216	100.00	0	0.00	2.9041	99.53	0.0136	0.47
LSA	207	95.83	9	4.17	2.7893	95.60	0.1284	4.40

Susceptibility maps can be validated through comparison with the data obtained from a terrain survey. The quality of the landslide susceptibility method can be ascertained using the same landslide data used for the estimate, or by using independent landslide information that was not used for the assessment (e.g., Irigaray 1999; Remondo et al. 2003; Guzzeti et al. 2006; Zorn and Komac 2007). In order to select the final map of landslide susceptibility zonation, a cross validation technique was used to compare known landslide location data with the landslide susceptibility zonation map. In the study, we considered landslide prediction to be »good« if at least part of the landslide is in a »high« or »very high« susceptibility zone, and landslide prediction to be »bad« if at least part of the landslide is in a »low« or »moderate« susceptibility zone. Using SIM, all of the 216 landslides observed had good prediction, whereas using LSA 209 of the 216 landslides observed had good prediction, and only nine had bad prediction (Table 4).

Furthermore, using the IBM method 74.67% area of the landslides observed belong to the »high« and »very high« susceptibility class, whereas using the SIM and LSA methods 99.53% and 95.60% area of the landslides observed belong to the »high« and »very high« susceptibility class (Table 4).

The validation of our susceptibility assessment suggests that the application of a relatively simple methodology like IBM yields results that are quite different from those based on statistical methods. Although the input data were the same, it was shown that the use of IBM yields less reliable results, which is basically related to the subjectivity of the analysis, especially in defining weight coefficients for individual influence factors (e.g., van Westen et al. 1999; Fernández et al. 1999; Remondo et al. 2003; Guzzetti et al. 2006; Zorn and Komac 2008). The validation of the two statistical methods showed that they provide more accurate results. However, it should not be forgotten that the validation was carried out with the same set of landslide data that were used for the calculation and that the best way to check the accuracy of our final landslide susceptibility zonation maps would be using independent landslide data.

5 Conclusion

In the Municipality of Banja Luka, instable areas have significantly increased due to urbanization in landslide-prone areas. The study identified 216 landslides with a total area of 2.92 km^2 (5.2% of the municipality). In the study, three methods for landslide susceptibility zonation (IBM, SIM, and LSA) were applied to study the interrelations among the landslides observed and landslide influence factors.

Crucial factors for landslide susceptibility in the study area are lithology, land cover / land use, slope, and relative relief. According to lithology, two units are the most important: slope and Neogene sediments. The most important topographic factor is slope angle, especially from 5 to 15°. Land use has a significant impact on instability, especially in orchards, vineyards, meadows, and pastures, as a result of direct or indirect human activity. Other factors are of less importance, as indicated by the value of the total weight of these factors, or the weight of individual classes within the influence factors.

The results obtained show that statistical methods are important for creating landslide susceptibility maps and that an empirical method (IBM) can provide less accurate results, but can be useful when available data are limited (as in Bosnia and Herzegovina).

These study results can be used for better urban planning and landslide assessment purposes in Bosnia and Herzegovina, although they can be less useful at the site-specific scale (or microscale), where a geo-technical approach has some preference.

6 Acknowledgments

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1 Aims and scopes

Acta geographica Slovenica – *Geografski zbornik* is the main Slovenian geographical scientific journal published by the Anton Melik Geographical Institute of the Scientific Research Centre of the Slovenian Academy of Sciences and Arts.

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The journal was first published in 1952, and fourteen issues appeared periodically until 1976. Granted more permanent government funding, it has been published annually since 1976. From 2003, it is published twice a year. The journal is subsequently published in print and on the Internet in both Slovenian and English since 1994 (http://ags.zrc-sazu.si/). Each year, it is distributed in exchange for 200 scientific journals from around the world. The articles on the internet are read in more than 100 countries.

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The titles of chapters and subchapters in the article should be marked with ordinal numbers (for example, 1 Introduction, 1.1 Methodology, 1.2 Terminology). The division of an article into chapters is obligatory, but authors should use subchapters sparingly. It is recommended that the article include Introduction, Conclusion and References chapters. The titles should be short and comprehensible. Authors should avoid using footnotes and endnotes.

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- Melik, A. 1955b: Nekaj glacioloških opažanj iz Zgornje Doline. Geografski zbornik 5.
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- Šifrer, M. 1997: Površje v Sloveniji. Elaborat, Geografski inštitut Antona Melika ZRC SAZU. Ljubljana.

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- Digitalni model višin 12,5. Geodetska uprava Republike Slovenije. Ljubljana, 2005.
- Državna topografska karta Republike Slovenije 1 : 25.000, list Brežice. Geodetska uprava Republike Slovenije. Ljubljana, 1998.
- Franciscejski kataster za Kranjsko, k. o. Sv. Agata, list A02. 1823–1869. Arhiv Republike Slovenije. Ljubljana.
- Buser, S. 1986a: Osnovna geološka karta SFRJ 1 : 100.000, list Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.
- Buser, S. 1986b: Osnovna geološka karta SFRJ 1 : 100.000, tolmač lista Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.

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- Does not fit the aims and scopes of the AGS journal.
- Is not an original scientific paper.
- The presentation of the results is poor.
- The paper is of very low quality.
- The paper has already been published elsewhere.
- Other (see comments below).
- Other reasons for rejection of the paper.

12 Acta geographica Slovenica review form

1 RELEVANCE

1a) Are the findings original and the paper is therefore a significant one?*
yes
no
partly

1b) Is the paper suitable for the subject focus of the AGS journal?*
yes
no

2 SIGNIFICANCE

2a Does the paper discuss an important problem in geography or related fields?*
yes
no
partly

2b Does it bring relevant results for contemporary geography?*
yes
no
partly

2c What is the level of the novelty of research presented in the paper?*
high
middle
low

3 ORIGINALITY

3a Has the paper been already published or is too similar to work already published?*
yes
no

3b Does the paper discuss a new issue?*
yes
no

3c Are the methods presented sound and adequate?*
yes
no
partly

3d Do the presented data support the conclusions?*
yes
no
partly

4 CLARITY

4a Is the paper clear, logical and understandable?*
yes
no

4b If necessary, add comments and recommendations to improve the clarity of the title, abstract, keywords, introduction, methods or conclusion:*

5 QUALITY

5a Is the paper technically sound? (If no, the author should discuss technical editor [rok.ciglic@zrc-sazu.si] for assistance.)*
yes
no

5b Does the paper take into account relevant current and past research on the topic?*
yes
no
Propose amendments, if no is selected:

5d Is the references list the end of the paper adequate?*
yes
no
Propose amendments, if no is selected:

5e Is the quoting in the text appropriate?*
yes
no
partly
Propose amendments, if no is selected:

5f Which tables are not necessary?

5g Which figures are not necessary?

6 COMMENTS OF THE REVIEWER

Comments of the reviewer on the contents of the paper:
Comments of the reviewer on the methods used in the paper:

7 RECOMMENDATION OF THE REVIEWER TO THE EDITOR-IN-CHIEF

My recommendation is:
Please rate the paper from 1 [low] to 100 [high]:
Personal notes of the reviewer to editor-in-chief.

Navodila avtorjem za pripravo člankov v *Acti geographici Slovenici* – Geografskem zborniku

1 Uvod

Acta geographica Slovenica – Geografski zbornik je osrednja slovenska znanstvena revija za geografijo, ki jo izdaja Geografski inštitut Antona Melika Znanstvenoraziskovalnega centra Slovenske akademije znanosti in umetnosti.

Revija je namenjena predstavitvi znanstvenih dosežkov s področja fizične, družbene in regionalne geografije ter sorodnih ved. Objavlja pregledna znanstvena besedila, to je pregled in sintezo že objavljenih najnovejših del o določeni temi, ter izvirna znanstvena besedila, to je prvo objavo originalnih raziskovalnih rezultatov v takšni obliki, da se raziskava lahko ponovi, ugotovitve pa preverijo.

Revija je prvič izšla leta 1952 in je do leta 1976, ko je bila natisnjena štirinajsta številka, izhajala občasno. Leta 1976 je zaradi trajnejše finančne pomoči države začela izhajati redno, od leta 2003 pa izhaja dvakrat letno v tiskani in elektronski obliki na medmrežju. Od leta 1994 izhaja enakovredno v slovenskem in angleškem jeziku (http://ags.zrc-sazu.si). Vsako leto jo razpošljemo v izmenjavo na več kot 200 naslovov po celem svetu. Članke na medmrežju berejo v več kot 100 državah sveta.

Acta geographica Slovenica – *Geografski zbornik* v objavo sprejema geografske članke iz Slovenije ter Jugovzhodne in Srednje Evrope. Objavljamo tudi članke geografiji sorodnih ved, katerih znanstveno in raziskovalno delo lahko obogati geografske poglede na pokrajino.

Acta geographica Slovenica objavlja članke v slovenskem in angleškem jeziku. Članki, pri katerih je vsaj eden od avtorjev iz Slovenije, morajo imeti tudi slovenski prevod. Članki avtorjev iz tujine in članki posebnih izdaj so objavljeni samo v angleškem jeziku. Članke, ki prispejo v slovenskem jeziku, je po pozitivni recenziji treba prevesti v angleščino. Če za prevod poskrbi uredništvo, je strošek prevoda za avtorje 500 €. Če avtorji sami poskrbijo za profesionalni prevod članka, je treba članek lektorirati, strošek lekture v višini 200 € pa nosijo avtorji. Za lekturo slovenskega dela članka poskrbi uredništvo. Članke, ki prispejo v angleškem jeziku, je po pozitivni recenziji treba nujno lektorirati. Za lekturo poskrbi uredništvo, strošek v višini 200 € pa nosijo avtorji.

2 Sestavine članka

Članki, objavljeni v znanstveni reviji *Acta geographica Slovenica* – Geografski zbornik so urejeni po shemi IMRAD (uvod, metoda, rezultati in razprava; angl.: *Introduction, Method, Results And Discussion*) oziroma v skladu z navodili o oblikovanju periodične publikacije kot celote in članka kot njenega sestavnega dela, ki jih je izdala Agencija za raziskovalno dejavnost Republike Slovenije, ki denarno podpira izhajanje.

Članki, poslani v objavo, morajo imeti naslednje sestavine:

- glavni naslov v slovenskem in angleškem jeziku;
- izvleček dolžine do 800 znakov skupaj s presledki;
- do osem ključnih besed;
- članek v angleškem ali slovenskem jeziku, ki naj skupaj s presledki obsega do 20.000 znakov.
- seznam uporabljenih virov in literature, urejen v skladu z navodili.

Besedilo člankov mora biti enakovredno v angleškem in slovenskem jeziku.

Članek naj ima naslove poglavij in naslove podpoglavij označene z vrstilnimi števniki (na primer: 1 Uvod, 1.1 Metodologija, 1.2 Terminologija). Razdelitev članka na poglavja je obvezna, podpoglavja pa naj avtor uporabi le izjemoma. Zaželeno je, da ima članek poglavja Uvod, Sklep in Literatura. Naslovi člankov naj bodo jasni in čim krajši. Avtorji naj se izognejo pisanju opomb pod črto na koncu strani in naj bodo zmerni pri uporabi tujk.

3 Citiranje v članku

Avtor naj pri citiranju med besedilom navede priimek avtorja, letnico ter po potrebi številko strani. Več citatov se loči s podpičjem in razvrsti po letnicah, navedbo strani pa se od priimka avtorja in letnice loči z vejico, na primer: (Melik 1955, 11) ali (Melik, Ilešič in Vrišer 1963, 12; Kokole 1974, 7 in 8). Če ima citirano delo več kot tri avtorje, se citira le prvega avtorja, na primer (Melik s sod. 1956, 217).

Enote v poglavju Viri in literatura naj bodo navedene po abecednem redu priimkov avtorjev, enote istega avtorja pa razvrščene po letnicah. Če je v seznamu več enot istega avtorja iz istega leta, se letnicam dodajo črke (na primer 1999a in 1999b). Zapis vsake citirane enote skladno s slovenskim pravopisom sestavljajo trije stavki. V prvem stavku sta navedena avtor in letnica izida (če je avtorjev več, so ločeni z vejico, z vejico sta ločena tudi priimek avtorja in začetnica njegovega imena, med začetnico avtorja in letnico ni vejice), sledi dvopičje, za njim pa naslov in morebitni podnaslov, ki sta ločena z vejico. Če je citirana enota članek, se v drugem stavku navede publikacija, v kateri je članek natisnjen, če pa je enota samostojna knjiga, drugega stavka ni. Izdajatelja, založnika in strani se ne navaja. Če enota ni tiskana, se v drugem stavku navede vrsta enote (na primer elaborat, diplomsko, magistrsko ali doktorsko delo), za vejico pa še ustanova, ki hrani to enoto. V tretjem stavku se za tiskane enote navede kraj izdaje, za netiskane pa kraj hranjenja. Pri navajanju literature, ki je vključena v sistem DOI (Digital Object Identifier), je treba na koncu navedbe dodati tudi številko DOI. Številke DOI so dodeljene posameznim člankom serijskih publikacij, prispevkom v monografijah in knjigam. Številko DOI najdete v samih člankih in knjigah, oziroma na spletni strani http://www.crossref.org/guestquery.

Nekaj primerov (ločila so uporabljena skladno s slovenskim pravopisom):

1) za članke v revijah:
- Melik, A. 1955a: Kraška polja Slovenije v pleistocenu. Dela Inštituta za geografijo 3. Ljubljana.
- Melik, A. 1955b: Nekaj glacioloških opažanj iz Zgornje Doline. Geografski zbornik 5. Ljubljana.
- Perko, D. 2002: Določanje vodoravne in navpične razgibanosti površja z digitalnim modelom višin. Geografski vestnik 74-2. Ljubljana.
- Fridl, J., Urbanc, M., Pipan, P. 2009: The importance of teachers' perception of space in education. Acta geographica Slovenica 49-2. Ljubljana. DOI: 10.3986/AGS49205

2) za poglavja v monografijah ali članke v zbornikih:
- Lovrenčak, F. 1996: Pedogeografska regionalizacija Spodnjega Podravja s Prlekijo. Spodnje Podravje s Prlekijo, 17. zborovanje slovenskih geografov. Ljubljana.
- Mihevc, B. 1998: Slovenija na starejših zemljevidih. Geografski atlas Slovenije. Ljubljana.
- Komac, B., Zorn, M. 2010: Statistično modeliranje plazovitosti v državnem merilu. Od razumevanja do upravljanja, Naravne nesreče 1. Ljubljana.

3) za monografije:
- Natek, K., Natek, M. 1998: Slovenija, Geografska, zgodovinska, pravna, politična, ekonomska in kulturna podoba Slovenije. Ljubljana.
- Fridl, J., Kladnik, D., Perko, D., Orožen Adamič, M. (ur.) 1998: Geografski atlas Slovenije. Ljubljana.
- Perko, D., Orožen Adamič, M. (ur.) 1998: Slovenija – pokrajine in ljudje. Ljubljana.
- Oštir, K. 2006: Daljinsko zaznavanje. Ljubljana.

4) za elaborate, diplomska, magistrska, doktorska dela ipd.:
- Richter, D. 1998: Metamorfne kamnine v okolici Velikega Tinja. Diplomsko delo, Pedagoška fakulteta Univerze v Mariboru. Maribor.
- Šifrer, M. 1997: Površje v Sloveniji. Elaborat, Geografski inštitut Antona Melika ZRC SAZU. Ljubljana.

5) za vire brez avtorjev in kartografske vire:
- Popis prebivalstva, gospodinjstev, stanovanj in kmečkih gospodarstev v Republiki Sloveniji, 1991 – končni podatki. Zavod Republike Slovenije za statistiko. Ljubljana, 1993.
- Digitalni model višin 12,5. Geodetska uprava Republike Slovenije. Ljubljana, 2005.
- Državna topografska karta Republike Slovenije 1 : 25.000, list Brežice. Geodetska uprava Republike Slovenije. Ljubljana, 1998.
- Franciscejski kataster za Kranjsko, k. o. Sv. Agata, list A02. 1823–1869. Arhiv Republike Slovenije. Ljubljana.
- Buser, S. 1986a: Osnovna geološka karta SFRJ 1 : 100.000, list Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.
- Buser, S. 1986b: Osnovna geološka karta SFRJ 1 : 100.000, tolmač lista Tolmin in Videm (Udine). Zvezni geološki zavod. Beograd.

Avtorji vse pogosteje citirajo vire z medmrežja. Če sta znana avtor in/ali naslov citirane enote, potem se jo navede takole (datum v oklepaju pomeni čas ogleda medmrežne strani):

- Vilhar, U. 2010: Fenološka opazovanja v okviru Intenzivnega spremljanja stanja gozdnih ekosistemov. Medmrežje: http://www.gozdis.si/impsi/delavnice/Fenoloska%20opazovanja_Vilhar.pdf (19. 2. 2010).
- eGradiva, 2010. Medmrežje: http://www.egradiva.si/ (11. 2. 2010).

Če avtor ni poznan, se navede le:
- Medmrežje: http://giam.zrc-sazu.si/ (22. 7. 2011).

Če se navaja več enot z medmrežja, se doda še številko:
- Medmrežje 1: http://giam.zrc-sazu.si/ (22. 7. 2011).
- Medmrežje 2: http://zgs.zrc-sazu.si/ (22. 7. 2011).

Med besedilom se v prvem primeru navede avtorja, na primer (Vilhar 2010), v drugem primeru pa le medmrežje, na primer (medmrežje 2).

Zakone se citira v naslednji obliki (ime zakona, številka uradnega lista, kraj izida), na primer:
- Zakon o kmetijskih zemljiščih. Uradni list Republike Slovenije 59/1996. Ljubljana.
- Zakon o varstvu pred naravnimi in drugimi nesrečami. Uradni list Republike Slovenije 64/1994, 33/2000, 87/2001, 41/2004, 28/2006 in 51/2006. Ljubljana.

Če ima zakon dopolnitve, je treba navesti tudi te. Med besedilom se zakon navaja s celim imenom, če gre za krajše ime, ali pa z nekaj prvimi besedami in tremi pikami, če gre za daljše ime. Na primer (Zakon o kmetijskih zemljiščih 1996) ali (Zakon o varstvu … 1994).

V poglavju *Viri in literatura* morajo biti navedena vsa dela, citirana v prispevku, ostalih, necitiranih del pa naj avtor ne navaja.

Avtorji naj upoštevajo tudi navodila za navajanje virov lastnika podatkov ali posrednika, če jih le-ta določa. Primer: Geodetska uprava Republike Slovenije ima navodila za navajanje virov določena v dokumentu »Pogoji uporabe geodetskih podatkov« (http://e-prostor.gov.si/fileadmin/narocanje/pogoji_uporabe_podpisani.pdf).

4 Preglednice in grafične priloge v članku

Priloge morajo prav tako oddati natisnjene v digitalni obliki v ustreznem formatu. Fotografije in druge grafične priloge morajo avtorji, če je le mogoče, oddati v obliki, primerni za skeniranje, sicer pa v digitalni rastrski obliki z ločljivostjo vsaj 300 pik na palec ali 120 pik na cm, najbolje v formatu TIFF ali JPG in končni velikosti slike. Če avtorji ne morejo oddati prispevkov in grafičnih prilog, pripravljenih v omenjenih programih, naj se predhodno posvetujejo z uredništvom (rok.ciglic@zrcč-sazu.si).

Vse ***preglednice*** v članku so oštevilčene in imajo svoje naslove. Med številko in naslovom je dvopičje. Naslov konča pika. Primer:
Preglednica 1: Število prebivalcev Ljubljane po posameznih popisih.
Preglednica 2: Spreminjanje povprečne temperature zraka v Ljubljani (Velkavrh 2009).

Vse ***grafične priloge*** – Slike (fotografije, zemljevidi, grafi in podobno) v članku so oštevilčene enotno in imajo svoje naslove. Med številko in naslovom je dvopičje. Naslov konča pika. Primera:
Slika 1: Rast števila prebivalcev Ljubljane po posameznih popisih.
Slika 2: Izsek topografske karte v merilu 1 : 25.000, list Kranj.

Avtorji morajo za grafične priloge, za katere nimajo avtorskih pravic, priložiti fotokopijo dovoljenja za objavo, ki so ga pridobili od lastnika avtorskih pravic.

Grafične priloge naj bodo široke točno 134 mm (cela širina strani) ali 64 mm (pol širine, 1 stolpec), visoke pa največ 200 mm. V primeru, da želimo imeti celostransko sliko ali zemljevid, mora biti njuna velikost 134 × 192,3 mm (podnapis h grafični prilogi je enovrstičen) ali 134 × 200 mm (podnapis h grafični prilogi je naveden na sosednji strani).

Slikovno gradivo (zemljevidi, sheme in podobno) naj bo v formatih .ai ali .cdr, fotografije pa v formatih .tif ali .jpg.

Zemljevidi naj bodo izdelani v digitalni obliki. Zaželeno je, da so oddani v vektorski obliki, pripravljeni s programom *Corel Draw* ali *Adobe Illustrator*, zlasti če vsebujejo besedilo. Možno jih je oddati tudi v rastrski obliki z ločljivostjo vsaj 300 pik na palec ali 120 pik na cm, najbolje v formatu TIFF ali JPG in končni velikosti slike.

Pri tistih zemljevidih in shemah, izdelanih s programom ArcGIS, kjer so poleg vektorskih slojev kot podlaga uporabljeni tudi rastrski sloji (na primer .tif reliefa, letalskega ali satelitskega posnetka in podobno), oddajte tri ločene datoteke. V prvi naj bodo samo vektorski sloji z izključeno morebitno prosojnostjo poligonov skupaj z legendo in kolofonom (izvoz v formatu .ai), v drugi samo rastrska podlaga (izvoz v formatu .tif), v tretji, kontrolni datoteki pa vektorski in rastrski sloji skupaj, tako kot naj bi bil videti končni zemljevid v knjigi (izvoz v formatu .jpg). To je nujno, da tudi natisnjeni zemljevid ohrani ustrezno kakovost.

Zemljevidi naj bodo brez naslova, ker je naveden v podnapisu.

Pri izbiri in določanju barv za slikovne priloge uporabite zapis CMYK in ne RGB oziroma drugih.

Za legendo zemljevida je potrebno uporabiti tip pisave *Times new roman* velikosti 8 pik, za kolofon pa isto vrsto pisave velikosti 6 pik. V kolofonu naj so po vrsti od zgoraj navzdol v angleškem in slovenskem jeziku navedeni: merilo (grafično ali tekstovno), avtor vsebine, avtor zemljevida, vir in ustanova oziroma nosilec avtorskih pravic. Kolofon mora biti v angleškem in slovenskem jeziku razen kjer to zaradi prostorskih omejitev ni možno. Primer:
Scale/merilo: (grafično, tekstovno)
Author of contents/avtor vsebine: Drago Perko
Author of map/avtorica zemljevida: Jerneja Fridl
Source/vir: Statistični urad RS, 2002
© Geografski inštitut Antona Melika ZRC SAZU, 2005

Pri zemljevidih in shemah, izdelanih v programih CorelDraw ali Adobe Illustrator, oddajte dve ločeni datoteki; poleg originalnega zapisa (format .cdr ali .ai) dodajte še datoteko, ki prikazuje, kako naj bo videti slika (format .jpg).

Grafi naj bodo izdelani s programom *Excel.* Na posameznem listu naj bodo skupaj z grafom tudi podatki, na podlagi katerih je bil izdelan.

Fotografije mora avtor oddati v digitalni rastrski obliki z ločljivostjo vsaj 240 pik na cm oziroma 600 pik na palec, najbolje v formatu .tif ali .jpg, kar pomeni približno 3200 pik na celo širino strani v reviji.

Slike, ki prikazujejo računalniški zaslon, morajo biti narejene pri največji možni ločljivosti zaslona (ločljivost uredimo v: Nadzorna plošča\Vsi elementi nadzorne plošče\Zaslon\Ločljivost zaslona oziroma Control Panel\All Control Panel Items\Display\Screen Resolution). Sliko se nato preprosto naredi s pritiskom tipke print screen, prilepi v izbran grafični program (na primer Slikar, Paint) in shrani kot .tif. Pri tem se slike ne sme povečati ali pomanjšati oziroma ji spremeniti ločljivost. Po želji lahko uporabite tudi ustrezne programe za zajem zaslona in shranite sliko v zapisu .tif.

5 Sprejemanje prispevkov

Za objavo v Acti geographici Slovenici sprejemamo le izvirne oziroma nove znanstvne članke. Avtor s podpisom potrdi izjavo o izvirnosti vsebine in podobe članka ter dejstvo, da članek še ni bil posredovan v objavo drugam oziroma drugje ni že bil objavljen.

Avtorji morajo besedilo prispevkov oddati v digitalni obliki (na disku, zgoščenki ali po elektronski pošti), zapisane s programom *Word.*

Wordov dokument naj avtor naslovi s svojim priimkom (na primer: novak.doc), slikovne priloge pa z opisom priloge in številko priloge, ki ustreza vrstnemu redu prilog med besedilom (na primer: slika01.tif, slika02.cdr, slika12.ai, preglednica17.xls).

Zaradi morebitnih sprememb v postopku recenzije in urejanja naj članek najprej oddajo v slovenskem jeziku, po sprejemu za objavo pa še v angleškem. Prevod je strošek avtorja.

Digitalni zapis besedila naj bo povsem enostaven, brez zapletenega oblikovanja, samodejnih naslovov, poravnave desnega roba, deljenja besed, podčrtavanja in podobnega. Avtorji naj označijo le mastni (krepki) in ležeči tisk. Besedilo naj bo v celoti izpisano z malimi črkami (razen velikih začetnic, seveda), brez nepotrebnih krajšav, okrajšav in kratic.

Avtorji člankov morajo priložiti preslikano (prepisano ali natisnjeno), izpolnjeno in podpisano Prijavnico, v okviru katere je tudi izjava, s katero potrjujejo, da se strinjajo s pravili objave v *Acti geographici Slovenici* – Geografskem zborniku. Prijavnica nadomešča spremni dopis in avtorsko pogodbo. Prijavnica je na voljo tudi na medmrežni strani *Acte geographice Slovenice* – Geografskega zbornika: ags.zrc-sazu.si.

Če besedilo slovnično ali vsebinsko ni ustrezno napisano, ga uredniški odbor avtorju lahko vrne v popravek, zahteva lektoriranje ali članek zavrne. Datum prejetja članka je objavljen za angleškim prevodom izvlečka in ključnih besed.

Avtorji naj prispevke pošiljajo na naslov glavnega urednika:
Blaž Komac
Geografski inštitut Antona Melika ZRC SAZU
Gosposka ulica 13, SI – 1000 Ljubljana, Slovenija
E-pošta: blaz.komac@zrc-sazu.si.

6 Recenziranje člankov

Članke najprej pregleda eden od področnih urednikov. Avtorji člankov so potem običajno pozvani, da članek ustrezno dopolnijo ali popravijo. Sledi recenzentski postopek, ki je praviloma anonimen. Recenzenta prejmeta članek brez navedbe avtorja članka, avtor članka pa prejme recenzijo brez navedbe recenzenta. Če recenzija ne zahteva popravka ali dopolnitve članka, se avtorju članka recenzij ne pošlje. Avtor dovoljuje, da uredništvo prispevek krajša ali drugače prilagodi, da bo primeren za objavo. Na predlog uredništva ali recenzenta se lahko zavrne objavo prispevka.

7 Avtorske pravice

Za avtorsko delo, poslano za objavo v *Acti geographici Slovenici* – Geografskem zborniku, vse moralne avtorske pravice pripadajo avtorju, materialne avtorske pravice reproduciranja in distribuiranja v Republiki Sloveniji in v drugih državah pa avtor brezplačno, enkrat za vselej, za vse primere, za neomejene naklade in za vse medije neizključno prenese na izdajateljico. Avtor dovoljuje objavo članka ali njegovih delov na medmrežju.

Avtor sam poskrbi za profesionalni prevod članka ter obvezno navede ime in priimek prevajalca. Avtorji so dolžni sodelovati v procesu lektoriranja besedila in urejanja članka.

Če obseg avtorskega dela ni v skladu z navodili za objavo, avtor dovoljuje izdajatelju, da avtorsko delo po svoji presoji ustrezno prilagodi.

Izdajatelj poskrbi, da se vsi prispevki s pozitivno recenzijo, če so zagotovljena sredstva za tisk, objavijo v *Acti geographici Slovenici* – Geografskem zborniku in na medmrežju, praviloma v skladu z vrstnim redom prispetja prispevkov in v skladu z enakomerno razporeditvijo prispevkov po temah. Naročeni prispevki se lahko objavijo ne glede na datum prispetja.

Prispevki v reviji *Acta geographica Slovenica* – Geografski zbornik niso honorirani niti niso honorirani recenzenti.

Avtorju pripada 1 brezplačen izvod publikacije.

8 Priprava kontrolnega seznama v sistemu OJS

Kot del postopka oddaje članka morajo avtorji preveriti skladnost članka in navodil. Uredništvo si pridržuje pravico, da avtorjem vrne članek v popravek, če ta ni pripravljen skladno s temi navodili. Avtorji morajo upoštevati naslednja navodila:

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2. Datoteka je shranjena v formatu Microsoft Word.
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7. Velikost dodatnih datotek ne presega 50 MB.

9 Izjava o zasebnosti

Imena in e-poštne naslove, vneseni v tej reviji mestu se bodo uporabljali izključno za navedene namene te revije in ne bodo na voljo za kakršne koli druge namene ali za katero koli drugo stranko.

10 Naročanje

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