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SPONTANEOUSLY ABANDONED SETTLEMENTS IN SERBIA – PART 2

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Abstract: This is the second part of the article "Spontaneously abandoned settlements in Serbia", the first part of which was published in No. 60-2 of this Journal. Geomorphological indicators pointing at unsustainability of the studied settlements are singled out. The indicators are classified as morphometric (quantitative) and morphologic (qualitative). Geomorphometry has been used for determination of quantitative indicators. The coefficient of settlement isolation (Ki) is defined, which is a product of road coefficient (Kr) and real relative height (RRH). Morphological indicators refer to the position of a settlement on a certain geomorphological unit (ridge, valley, valley side), as well as to the geomorphological homogeneity of space, determined by geomorphological mapping. The defined indicators of unsustainability are presented in detail as a case study of the abandoned village Smilov Laz, in the municipality of Novi Pazar.

Key words: spontaneous abandonment of settlements, geomorphometry, coefficient of settlement isolation, Serbia

Geomorphometric indicators of unsustainability

The analysis of geospatial characteristics of settlements, using topographical maps and field research, showed certain geomorphological regularities. They refer to morphological position (ridge, valley, valley side), geodiversification, and height difference (relative height). Geomorphological characteristics cause considerably larger length of roads between the settlements and their municipal centers, compared to the distance as the crow flies.

Geomorphometric analysis showed that the relative height and the road curvature coefficient are significant indicators of natural isolation of a settlement. Relative height shows the height difference that needs to be surpassed in order to get from the point A to the point B. High road curvature coefficient points to the existence of at least one of these situations:

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– high inclination of relief - in order to surpass it efficiently, it is necessary that a road has serpentines. Large relative height additionally increases the road length;
– relief forms which are difficult to surpass (deep transversal valleys, escarpments, screes) cause a traffic bottleneck, which leads to considerable detours and thus increases the road length.

Relative height and road curvature can be precisely numerically expressed, if the points A (municipal center) and B (studied settlement) are defined. The standard expression of relative height (simple height difference) is irrelevant in the majority of cases, because the roads between these points usually do not have a constant slope. Various obstacles, such as mountain ridges or deep transversal valleys require more height to surpass than indicated through a standard relative height. In cases when an obstacle is higher than a studied settlement, the highest point along the road is taken into calculation of the "real relative height" (RRH; Figure 1).

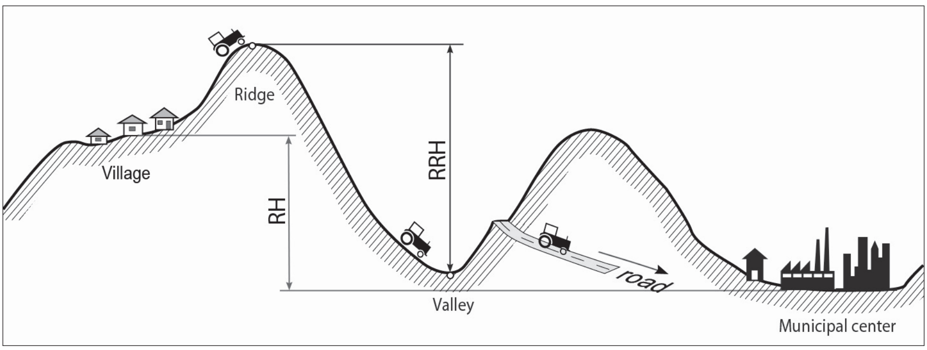

Figure 1. Determination of the real relative height (RRH) of a settlement

Lower limit of the real relative height is the elevation of the closest access to the municipal or some other center. The point where a local road reaches a higher category road whose inclinations do not exceed 10% is taken as a lower limit for RRH calculation. Municipal center elevation is not always appropriate for RRH calculation, because the center can be at considerable distance (even more than 20 km) from a junction of a local road and a higher rank road. With 10% inclination, this results in 200 m of height difference, which cannot be relevant for the studied issue. Moreover, sharp changes of inclination are often present at the places of junctions and the inclination of a higher rank road is insignificant compared to the inclination of a local road. In cases when a higher rank road is reached by descending to a valley floor and later ascending to a junction, the lower limit of the real relative height is the elevation of a valley floor or a bridge on a river. If the inclination between a municipal center and a settlement is continuous, the elevations of their centers are taken into calculation of the real relative height.

The criteria for determination of mathematical elements for the definition of road curvature coefficient between the points A and B must be established as well. It is necessary to calculate the total length of the road between the points (Rd), as well as the shortest distance (as the crow flies; Cd). Using the formula for the road curvature coefficient (Kr), the direct relation between these values is obtained:

$$Kr = Rd / Cd,$$

where Rd and Cd must be expressed in the same units (mostly km/km or m/m).

These two quantitative indicators very obviously express the notion of settlement isolation. However, due to the need of further synthetisation and expressing of isolation with a single coefficient, it was necessary to properly combine these indicators.

The most appropriate way to obtain a single coefficient of settlement isolation is to use the following formula:

$$Ki = (RRH\ m / 100) \times Kr$$

Where the elements stand for:
Ki – coefficient of settlement isolation,
RRH – real relative height,
Kr – road curvature coefficient.

Coefficient of settlement isolation (in further text: isolation coefficient) is a quantitative indicator of morphological isolation of a settlement in relation to a municipal center or another reference point.

Table 1 shows both indicators which influence the isolation coefficient. The smallest coefficient is 2.7 and the highest is 13.8. This clear quantitative difference incorporates also some concrete qualitative differences.

Table 1. Quantitative characteristics of settlement position and isolation coefficient

Settlement	Administrative position		Isolation coefficient	
	Present state border	Administrative border (autonomous province) or historical state border		
Repušnica	+		considerably isolated	6.9
Papratna		+	isolated	3.6
Golešnica			moderately isolated	2.8
Prača		+	considerably isolated	6.6
Verzar		+	considerably isolated	6.3
Koritnjak			extremely isolated	10.5
Manastir			moderately isolated	2.7
Gornji Rinj			considerably isolated	7.2
Javorje			isolated	8.5
Ostrozub			extremely isolated	13.8
Kolunica	+		considerably isolated	9.0
Pljačkovica			extremely isolated	11.2
Đorđevac		+	considerably isolated	7.5
Uzovo	+		isolated	4.0
Gare		+	considerably isolated	7.4
Vukojevac		+	considerably isolated	5.9
Tačevac		+	considerably isolated	7.1
Rastelica		+	considerably isolated	7.7
Smilov Laz		+	extremely isolated	10.5
Poda	+		considerably isolated	5.6

100 % mountain villages (see Table 2 in Milošević et al., 2010),
66,7 % on borders,
76 % considerable or extreme isolation,
91,5 % isolation coefficient above 3

Table 1 shows both indicators which influence the isolation coefficient. The smallest coefficient is 2.7 and the highest is 13.8. This clear quantitative difference incorporates also some concrete qualitative differences. Three out of four settlements having the isolation coefficient less than 4 pass through some kind of spatial re-utilization. They transform into so-called “weekend settlements” with either luxurious country houses (e.g. Manastir, Ki = 2.7) or modest houses (e.g. Golešnica 2.8, Papratna 3.6). With the increase of the coefficient to Ki > 5, the isolation turns drastic. The differences in ways of land use depend on several factors, one of the most significant being the distance of other settlements. If an abandoned settlement is close to a larger settlement or relocation took place, the traces of some human activities can be found, even in settlements whose isolation coefficient is larger than 10 (Pljačkovica 11.2 and Koritnjak 10.5). The villages in the zone Ki > 10 where the traces of human activities are completely absent are Smilov Laz and Ostrozub.

The obtained data and the amplitude of isolation coefficient allow the following classification of settlement isolation within the local surroundings:

– Moderately isolated settlements Ki = 2 – 2.9 (2 settlements; 10 %)
– Isolated settlements Ki = 3 – 4.9 (2 settlements; 10 %)
– Considerably isolated settlements Ki = 5 – 10 (12 settlements; 60 %)
– Extremely isolated settlements Ki = 10 – 15 (4 settlements; 20%)

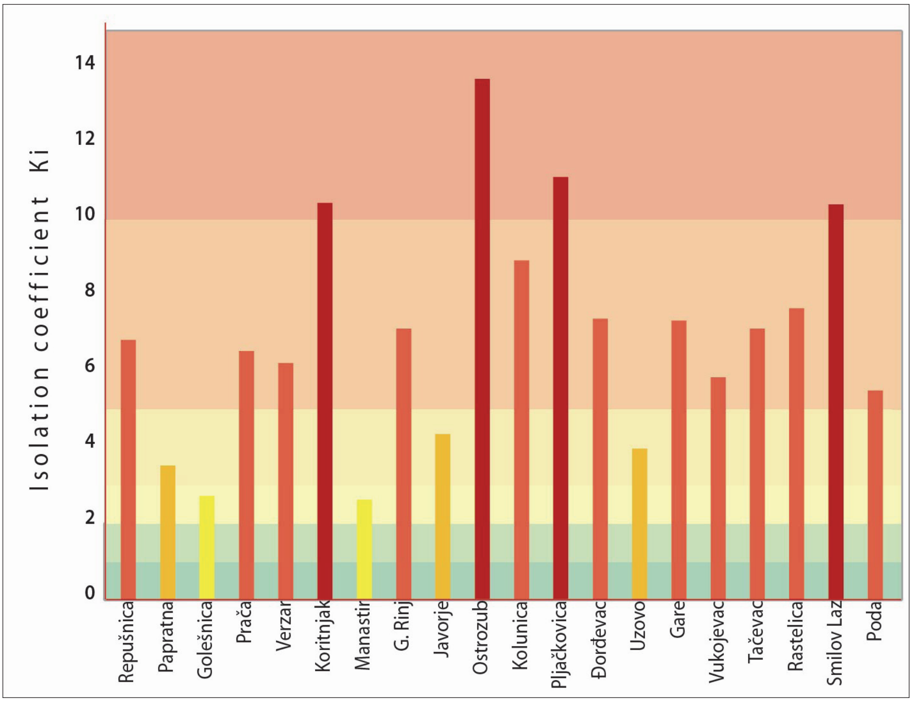

Figure 2. Isolation coefficients of the studied settlements

We consider that this methodology of isolation coefficient calculation can be used for most of the territory of the Republic of Serbia, as well as the surrounding countries. Nevertheless, one should be cautious because each area has its specific characteristics which cannot always be clearly represented by this coefficient. Judging by the field research of over 40 villages, this method can be used rather effectively for the areas of central Serbia and the province of Kosovo and Metohija. In low land areas, there are certain limitations of the method, because the relative height is minimal, so the isolation coefficient is close or equal to zero, although the actual isolation may be considerable (e.g. settlements close to marshes, surrounded by canals or other water courses, etc.). Similar problems occur on mountain plateaus, where relative height can be insignificant.

Table 2. Factors of unsustainability and their distribution

Settlement	RRH	Rd	Cd	Kr	Ki	Location	River
Repušnica	430	30	19	1.6	6.9	V	1
Papratna	280	23	17.5	1.3	3.6	V	2
Golešnica	230	9.3	7.8	1.2	2.8	V	1
Prača	330	12.0	6.0	2.0	6.6	V	1
Verzar	300	11.8	5.6	2.1	6.3	V	1
Koritnjak	350	3.9	1.3	3.0	10.5	V	1
Manastir	180	8.0	5.5	1.5	2.7	V	1
Gornji Rinj	550	12.0	9.5	1.3	7.2	V	1
Javorje	500	17.0	10.0	1.7	8.5	V	1
Ostrozub	550	20.0	8.5	2.5	13.8	V	1
Kolunica	600	31.0	20.0	1.5	9.0	V. Λ	1
Pljačkovica	700	6.4	4.0	1.6	11.2	V	1
Đorđevac	500	18.0	12.0	1.5	7.5	V	1
Uzovo	200	10.0	8.1	2.0	4.0	V	1
Gare	350	16.5	8.0	2.1	7.4	V	1
Vukojevac	390	22.0	15.0	1.5	5.9	Λ	1
Tačevac	420	22.0	13.0	1.7	7.1	Λ	1
Rastelica	550	18.0	12.5	1.4	7.7	V	2
Smilov Laz	750	23.0	16.0	1.4	10.5	Λ	1
Poda	350	24.5	40.0	1.6	5.6	V	1

The analysis of topographical map at the scale 1:300.000, sheet Kragujevac, it was detected that over 90% of villages that exceed the population of 1000 have the Ki ≤ 1.This proves the competence of this method in quantitative analysis of settlement isolation due to natural characteristics. Natural isolation of an area has a direct impact on population density, and it is inversely proportional to the total number of inhabitants.

The analysis of natural macro-position, isolation coefficient and administrative-political position of the studied settlements, it can be concluded that the mentioned factors are present in high percentages from 66 to 100%. This means that the mentioned factors stimulate depopulation processes (Table 2).

Morphological indicators of settlement unsustainability

By analysing the meso-position of 20 spontaneously abandoned settlements, taking into account the historical context and their geomorphological position, two cases can be singled out:

– The settlements are formed on concave morphological structures;
– The settlements are formed on convex morphological structures.

The position of a settlement on concave morphological structures is a characteristic of villages spontaneously formed in source areas of mountain rivers. These source areas have a continuously inclined topography where so-called domicile waters are formed. From the anthropocentric perspective, such areas are morphologically isolated, without the elements of transmission function. Ontologically, it is exactly this characteristic that made these areas favorable during the historically repressive periods, as optimal places for formation of permanent settlements. In these cases, the economical criterion was not significant.

The characteristic of these morphological units is also a low geodiversification, morphometrically represented by continuous inclinations. As a consequence of homogeneous physio-geographical structure, there were no conditions for any re-structuring of agriculture or for development of some other economic branch. The village of Smilov Laz in Novi Pazar municipality is a good example of spatial homogenity, because only denudational relief type is present (Figure 4), topographical inclinations mostly exceed 12º (Figure 3), while the village is morphologically oriented opposingly to the direction of the municipal center (source area of the river Smilovska Reka is morphologically opened towards the municipality of Zubin Potok; Figure 5).

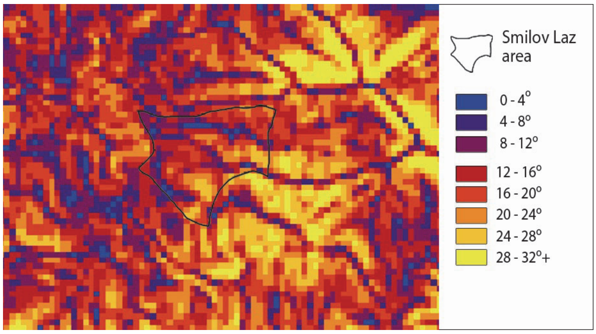

Figure 3. Inclinations in the vicinity of the village Smilov Laz (grid 90 x 90 m, SRTM)

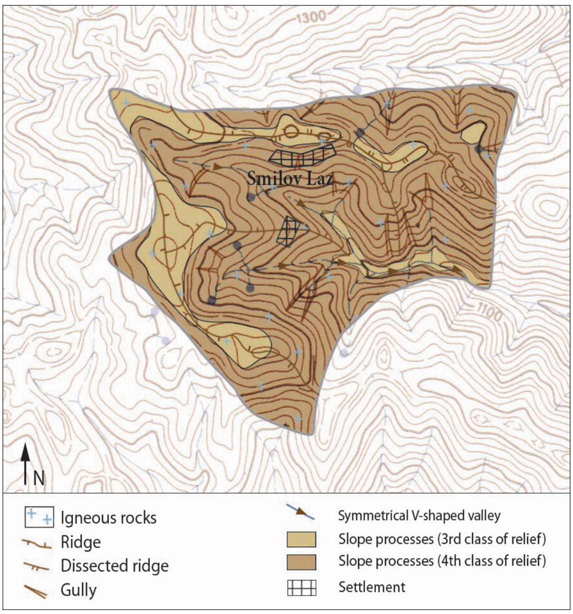

Figure 4. Geomorphological map of the village Smilov Laz

Position of a settlement on convex morphological structures is characteristic for the settlements founded on purpose, for a military and security function. In order to have a good strategic position, such settlements were positioned along the mountain ridges in the border zone between Serbia (after the Berlin Congress 1878) and the Ottoman Empire. Along that line, in the area between the villages Prepolac and Rastelica, the military zone was populated by colonists from

Montenegro and Herzegovina at the end of the 19th century. In that time, the villages Vukojevac, Tačevac and Rastelica were formed.

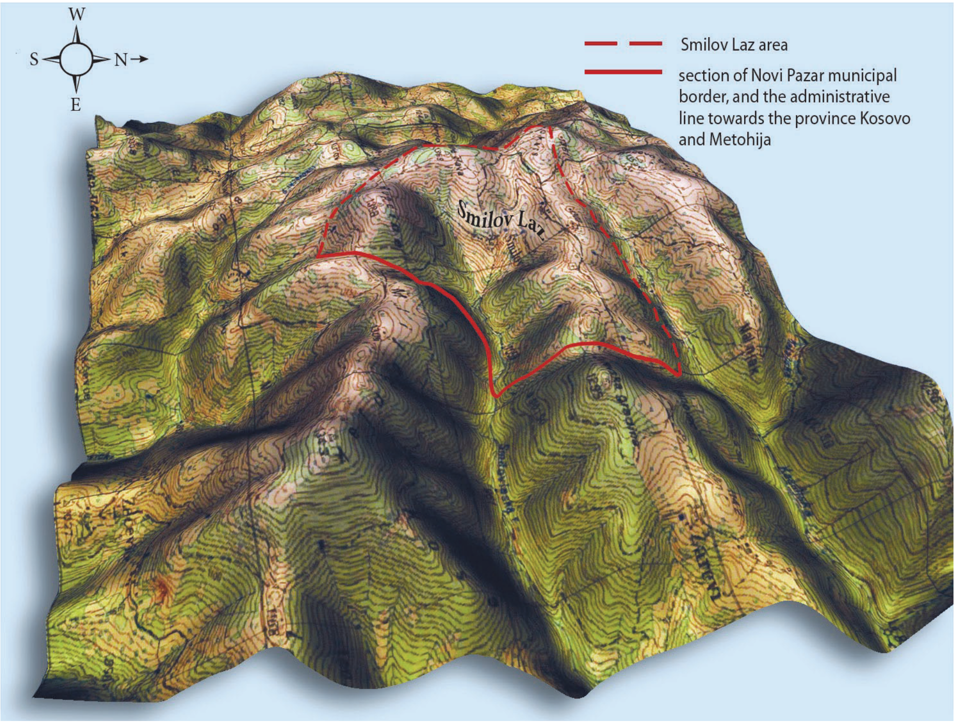

Figure 5. Digital elevation model of the village Smilov Laz (SRTM DEM)

The analysis of micro-position of the studied settlements differentiated certain morphological regularities. As a consequence of morphometric structures, the isolation can even exist within the settlement itself. It depends on the distribution of houses and their mutual position in relation to the morphological differentiation of the area. Nucleated villages differ considerably from dispersed settlements, with hamlets and houses located on several various landforms (valleys, valley sides, ridges, etc.). Three types of settlements according to their position on landforms can be distinguished (Figure 6):

a) settlements on one landform
b) settlements on two landforms
c) settlements on several landforms

The first morphological type is characteristic for spontaneously formed settlements positioned on valley sides. Considering the fact that all spontaneously abandoned settlements are positioned in the river valleys without the developed alluvial plain, the only two available morphological units are ridges (watersheds) and valley sides. In the case of mining settlements, it has been noticed that micro-position is of greater significance for the location than the meso-position. The reason for this is ore melting *in situ*, and the need for usage of wood as a necessary fuel for melting. Thus, the mining settlement Kolunica is positioned on three landforms, and Smilov Laz on two landforms. Similar conclusions on morphological differentiation were presented by Gešev et al. (1998), within the research of mountain villages in Bulgaria.

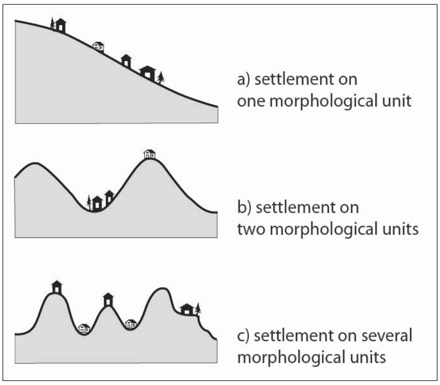

Figure 6. Position of a settlement in relation to landforms

Conclusion

Geomorphological meso-position of settlements was one of the most relevant factors in the genesis of settlements of central Serbia from the 16^{th} to th 19^{th} century (Milošević et al., 2010). It was the meso-position that determined the relation of a settlement towards significant communication directions or towns of that time. In the mentioned period, the quality of position was reflected in isolation, as a consequence of difficult political circumstances. Quantitative indicator of this characteristic is the coefficient of settlement isolation (Ki). From the viewpoint of present civilizational needs, natural conditions which provide isolation are not favorable any more, and they are now considered a serious limitation, i.e. a push factor of most emigrational areas. Such conditions lead to serious demographic and economical consequences, and point to unsustainability of these settlements, whose abandonment is mostly a consequence of a wider global process known as “humanization of the ecumene” (explained by Radovanović, 1989; see also Toniolo, 1937).

The criteria for selection of these locations during the historical time were often the reflection of instinctive (psychologically necessary) reactions on unfavorable historical circumstances (for safety, material basis, protection against epidemics, etc.). This refers to most of the spontaneously formed villages). Therefore, the criteria of valorization are not absolute (neutral), but optimal, meaning that the population chooses the location which is the most favorable in the exact historical moment, in accordance with the social-economical-political circumstances. At present time, revitalization is not a realistic option for the completely abandoned settlements. This wide process would need to encompass a series of other processes, first of all demographic stabilization by return migrations and increase in birthrate, which would require a number of inhabitants in fertile age. Instead of revitalization, it is more appropriate to consider reutilization of resources of a given area. Population dynamics in spontaneously abandoned settlements point to the fact that future activation of these resources cannot count on the intensive investments and labor, regardless of the natural conditions in the area.

The results shown in this paper should not be considered axioms, but premises for the new hypotheses related to the research of spontaneously abandoned settlements, which would contribute to the further studies on this issue.

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