

Природна ранјивост карстних издани средњетријаских кречњака у области између река Бистрице, Увца и Лима

Branislav Petrović, Veljko Marinović, Zoran Stevanović



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PRIRODNA RANJIVOST KARSTNIH IZDANI SREDNJETRIJASKIH KREČNJAKA U OBLASTI IZMEĐU REKA BISTRICE, UVCA I LIMA

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Ključne reči: karstna izdan, Priboj, prirodna ranjivost izdani, COP metoda

Ocena prirodne ranjivosti izdani od zagađenja predstavlja neophodnu osnovu za planiranje i upravljanje podzemnim vodnim resursima u pogledu njihove zaštite, procene rizika od zagađenja, kao i preduzimanje preventivnih mera u pogledu očuvanja kvaliteta podzemnih voda. Pojam ranjivosti izdani se bazira na pretpostavci da prirodno okruženje određuje zaštitu izdani nasuprot ljudskom uticaju, s obzirom na zagađivače koji mogu dospeti u podzemlje. Uprkos postojanju brojnih metoda procene ranjivosti podzemnih voda, do sada nijedna nije dala neke opšte standarde za odabir i procenu parametara iako su učinjeni veliki naporu u okviru Evropske unije da se postigne taj cilj. Karte ranjivosti podzemnih voda pokazuju manje ili više subjektivno viđenje kapaciteta potpovršinskog okruženja da zaštiti podzemnu vodu, pre svega u smislu kvaliteta vode. Subjektivnost se ogleda u tome što se mora odgovoriti na zahteve i uslove koje je postavio korisnik karte. Karta ranjivosti područja između tri reke Uvac, Bistrica i Lim je izrađena uz primenu GIS tehnologije i upotrebu COP metode kartiranja ranjivosti. S obzirom da COP metoda daje odlične rezultate u okruženjima gde se javljaju karstni tereni, ali i tereni izgrađeni od drugih tipova stena (i poroznosti), ova metoda je odabrana za ocenu ranjivosti izdani na navedenom istražnom prostoru.

Prostor za koji je izrađena karta ranjivosti podzemnih voda nalazi se između reka Bistrice, Uvca i Lima, a administrativno pripada opštinama Priboj i Nova Varoš. Opština Priboj pripada grupi opštinskih centara jugozapadne Srbije, čiji se vodosnabdevanje bazira na kombinovanoj upotrebi podzemnih voda karstne izdani i površinskih voda. Vodosnabdevanje gradskog područja Opštine Priboj odvija se preko tri karstna vrela – Čelice, Bjeličkovica i Saračevina, koji doprinose ukupnom vodosnabdevanju stanovništva pijaćom vodom u iznosu od prosečnih 45 l/s, 25 l/s i 15 l/s, respektivno. Vrela Bjeličkovica i Saračevina se nalaze nedaleko od sela Kratovo (teritorija Opštine Priboj), na levoj obali Kratovske reke na oko 2 km pre njenog ušća u reku Lim. Vrelo Čelice, iako kaptirano za Priboj, nalazi na teritoriji Opštine Nova Varoš (selo Čelice), u jugozapadnom podnožju Velikog Oštika (1283 m.n.m.). Pored pomenuta tri karstna vrela, dodatne količine pijaće vode obezbeđuju se preko cevovoda iz akumulacije Radojnjskog jezera, na reci Uvac. Jedan od zadataka koje je trebalo rešiti prilikom definisanja zona sanitarne zaštite izvorišta malomineralizovanih podzemnih voda karstnih vrela Bjeličkovica i Čelice bio je i izrada karte ranjivosti izdani.

Na karti ranjivosti podzemnih voda dobijenom COP metodom se jasno vidi da je prostor sa najvećim stepenom ranjivosti područje otvorenog karsta, na kome se atmosferske vode direktno infiltriraju u podzemlje. Vrednost COP indeksa ranjivosti na istražnom prostoru se kreću u rasponu 0,15 do 6,4 pri čemu visoke vrednosti indeksa označavaju visok stepen prirodne zaštite i male ranjivosti. U okviru terena koji pripada pojedinačnim oblastima prihranjivanja vrela Čelice i vrela Bjeličkovica (vrelo Saračevina je obuhvaćeno slivom Bjeličkovice) veliki deo odlikuje se veoma visokom ranjivošću, sa indeksom ranjivosti od 0,0 do 0,5. U pogledu površina to je 5,39 km², što čini 67,47 % površine sliva vrela Bjeličkovica, dok u slučaju vrela Čelice ta površina iznosi 1,87 km² ili 58,9% površine. Klasa Visoka ranjivost, sa indeksom ranjivosti od 0,5 do 1, pokriva 0,17 km² (2,18%) površine sliva vrela Bjeličkovica i 0,07 km² (2,07%) površine sliva vrela Čelice. Na osnovu analize ranjivosti, može se zaključiti da na terenu postoji mogućnost zagađenja podzemnih voda, pa se stoga propisane mere za održavanje zona sanitarne zaštite izvorišta moraju strogo primenjivati u cilju očuvanja dobrog kvaliteta podzemnih voda.

INTRINSIC VULNERABILITY OF KARST AQUIFERS OF MIDDLE TRIASIC LIMESTONES IN THE AREA BETWEEN BISTRICA, UVAC AND LIM RIVERS

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Assessment of intrinsic vulnerability of aquifer is a necessary basis for planning and management of groundwater resources in terms of their protection, risk assessment of pollution, as well as taking preventive measures to preserve groundwater quality. The term vulnerability of aquifer is based on the assumption that the natural environment provides the protection of aquifer against human influence, given the pollutants that can reach the underground. Despite the existence of numerous methods for assessing groundwater vulnerability, so far none has provided any general standards for the selection and assessment of parameters, although great efforts have been made within the European Union to achieve this goal. Groundwater vulnerability maps show a more or less subjective view of the capacity of the subsurface environment to protect groundwater, primarily in terms of water quality. Subjectivity is reflected in the fact that the requirements and conditions set by the map user must be answered. The vulnerability map of the area between the three rivers Uvac, Bistrica and Lim was made using GIS technology and using the COP vulnerability mapping method. Since the COP method gives excellent results in environments where karst terrains occur, but also terrains built of other types of rocks (and porosity), this method was chosen to assess the vulnerability issued in the specified exploration area. The area for which the groundwater vulnerability map was made is located between the rivers Bistrica, Uvac and Lima, and administratively it belongs to the municipalities of Priboj and Nova Varoš. The Municipality of Priboj belongs to the group of municipal centres of southwestern Serbia, whose water supply is based on the combined use of karst groundwater and surface water. The water supply of the urban area of the Municipality of Priboj takes place through three karst springs Čelice, Bjeličkovića and Saračevina, which contribute to the total water supply of the population with drinking water in the amount of 45 l/s, 25 l/s and 15 l/s, respectively. The springs Bjeličkovića and Saračevina are located near the village of Kratovo (territory of the Municipality of Priboj), on the left bank of the Kratovska River, about 2 km before its confluence with the Lim River. Vrelo Čelice, although captured for the Municipality of Priboj, is located on the territory of the Municipality of Nova Varoš, at the southwestern foothill of Veliki Oštrik. Besides the mentioned three karst springs, additional quantities of drinking water are provided through the pipeline from the accumulation of Radoinja Lake, on the Uvac river. One of the tasks that needed to be solved during the determination of the sanitary protection zones of the springs of low-mineralized groundwater of the karst springs Bjeličkovića and Čelice was design of a vulnerability map. The groundwater vulnerability map obtained by the COP method clearly shows that the area with the highest degree of vulnerability is the area of open karst, where atmospheric water directly infiltrates underground. The values of the COP vulnerability index in the research area range from 0.15 to 6.4, with high values of the index indicating a high degree of natural protection and low vulnerability. Within the terrain that belongs to the catchment area of the karst springs Čelice and Bjeličkovića (the Saračevina spring is included in the Bjeličkovića catchment area), a large part is characterized by Very high vulnerability, with a vulnerability index of 0.0 to 0.5. In terms of area, it is 5.39 km², which is 67.47% of the area of the Bjeličkovića catchment area, while in the case of the Čelice catchment area this is 1.87 km² or 58.9% of the area. The High vulnerability class, with a vulnerability index of 0.5 to 1, covers 0.17 km² (2.18%) of the Bjeličkovića catchment area and 0.07 km² (2.07%) of the Čelice catchment area. Based on the analysis of vulnerability, it can be concluded that there is a possibility of groundwater pollution, so the prescribed measures for the maintenance of defined sanitary protection zones of karst springs must be strictly applied in order to preserve good groundwater quality.