ARTICLES

IDENTIFICATION AND TOURIST VALORIZATION OF THE SPRINGS IN THE UNA RIVER SYSTEM

AUTHORS
Aida Korjenić, Amra Banda, Amina Sivac
Department of Geography, Faculty of Science, University of Sarajevo,
Zmaja od Bosne 33-35, 71000 Sarajevo, Bosnia and Herzegovina,
e-mail: aidakorjenic@yahoo.com; e-mail: amra.catovic@yahoo.com;

UDK: 911.3 : 338.48 (282.03)(497.6 Una)

ABSTRACT
Identification and Tourist Valorization of the Springs in the Una River System
The Una valley with its tributaries, high-yield karst springs, as well as numerous hydrogeomorphological objects of great aesthetic value, represent a unique complex that could greatly affect the development of tourism in Una catchment area. Springs as separate hydrogeomorphological objects can be an important natural potential for tourism development. The Una River System is located in the northwest of Bosnia and Herzegovina and it partly includes the territory of the neighboring Croatia. Concerning its specific geographical position, as well as the physical-geographic determinants, which determine it, the development of tourism industry in this area could be an important source of revenue for the administrative units to which it belongs to.

KEY WORDS
springs, hydrographic potentials, tourism, the Una River System

1. Introduction

The Una is a border river between Bosnia and Herzegovina and Croatia, and its catchment area includes parts of the territory of both countries. The Una River system drains water from the area, in part or in whole, 20 Bosnian and Herzegovinian, while in the neighboring Croatia, this area is 8 municipalities. In the Republic of Croatia, it includes parts of 3 Counties: Sisak-Moslavina in the north, Lika-Senj in the west and Zadar in the southwest of the basin.

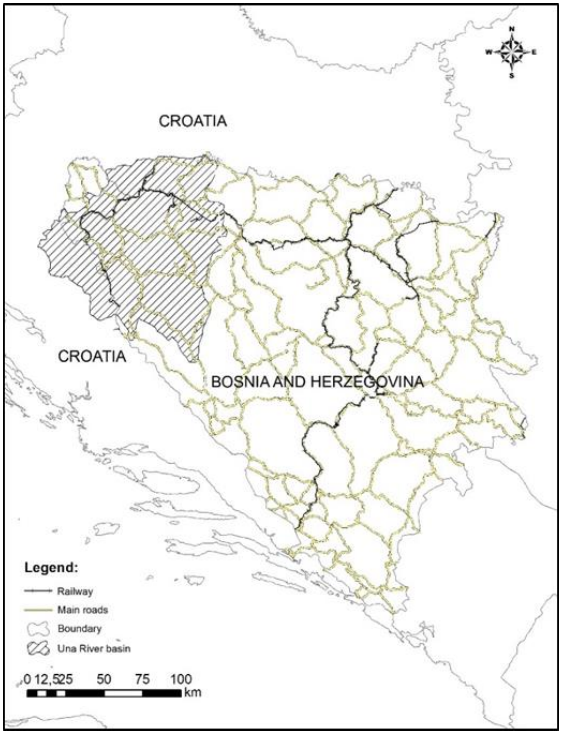

Figure 1: Position of the Una River Basin.
Source: Authors according to GIS database

The Una Basin has a favorable traffic and geographical position because it occupies the area on the direction of the main corridor Western Europe – the Mediterranean – the Middle East, and in a certain sense it represents a transit region. Traffic communications are very well connected with the Republic of Croatia, and therefore with other European countries on one side, and with the Adriatic Sea on the other. The most important routes are: E 59 Karlovac - Bihać - Split and E 761 Bihać - Ključ - Jajce, then main roads Velika Kladuša - Cazin - Bihać, Bihać - Bosanska Krupa - Bosanski Novi, Bihać - Bosanski Petrovac - Ključ and Prijedor - Sanski Most - Ključ.

The proximity to the highway in Croatia (A1 – Dalmatia highway) as well as the existing network of roads largely define the tourist position of this area's basin.

1.1. Methodology

The analysis of the river system and morphometric indicators have been obtained by working in the Arc GIS program with topographic maps 1 : 25.000. Considering all permanent and largest occasional flows, data came to light on the length of the watercourses in the Una basin area, amounting 10.190,6 km. The length of the occasional flows is 6.012,8 km, and of the permanent ones 4.177,8 km. Measurement of artificial channels with a total length of 34,2 km was performed as well, and it refers to channels Gomjenica and Gornji (Upper) peripheral channel. Also, identification of hydrogeological objects, springs and sinks has been performed, followed by a mapping method showing their location in the basin. Considering that this paper discusses springs as separate hydromorphological objects, evaluation, too, has been done according to the methods used in the analysis of geomorphological localities. There is a great number of methods that are used worldwide for evaluation, and for this purpose, modified and adapted method by Pereira et al. (2007) was chosen, which does not evaluate only the quality of the site, but also its benefits, or potential for use.

Table 1: Evaluation criteria and maximum grades (modified by Pereira et al., 2007, Misilo, 2016).

Criteria		Max
Scientific value	Rarity. Preservation. Representativeness of hydrological and geomorphological processes and pedagogical significance. Paleographical meaning. Level of scientific knowledge on hydrological issues. Number of relevant (interesting) hydrological and geomorphological forms and/or characteristics-diversity.	5,5
Additional values	Ecological value. Aesthetic value. Contrast. Vertical dissection and spatial structure. Chromatic contrast comparing to the surroundings. Cultural value.	4,5
Economic Value	Availability. Visibility. Currently usage of hydrogeomorphological values. Currently usage of natural and cultural values. Legal protection and usage limitation. Accommodation and accompanying services.	7,0
Protection value	Preservation. Vulnerability as a consequence of the use of a hydromorphological site.	3,0

Evaluation and valorization of natural-geographic, and in this case hydrographic tourist potentials, springs, was carried out on the basis of the following criteria: scientific value, additional values, usage possibility and protection value. By evaluating these parameters for a certain tourist potential, its quality and importance are determined.

2. Discussion and results

2.1. Identification of springs in the river system of Una

The Una River spring has typical karst characteristics, and because of this, the upper part of this flow is included in the karst flows. From the spring to Adrapovci, the Una flows through the karst and has hydrographic characteristics of the karst, i.e. the absence of a large number of tributaries and poor branched valleys of tributaries. The one, main spring of the Una is near Suvaja, and the others, two smaller, at Neteka. The main spring is located 1,5 km south of Suvaja, below the Jendek section in amphitheatric depression. It is located in Triassic dolomites, close to contact with the Verfenic, conditioned by the crack that has direction N-E. It is a very strong ascending type karst spring. The water temperature is 9,5° C and the average flow $Q_{sr} = 0,8\ m^3/s$. The depth of the spring has not been fully investigated, so far it is known as 248 m (Kovačević and Alić, 2016).

At Rađenović, the Una receives a larger tributary, the Krka, whose main spring is near Borova Glavica. The karst spring "Krka", with yield $Q_{min} = 0,7\ m^3/s$ and $Q_{max} = 27\ m^3/s$, is fed diffused and concentrated from Dugo polje, Trubar and partially from Resanovačko polje. It is located on the right bank of the river Krka in Triassic dolomites, several hundred meters below the contact of these dolomites with Jurassic limestone. The water temperature of this spring is 9,8° C, and the same temperature has a series of smaller permanent gravity type springs, located about 100 m downstream along the right bank of the Krka River. The creek Celija, which springs from the Borova kosa (810 m), also in the Verfenic slates in the village of Boboljuška, flows into the Krka. On the right side of Milušovac there is a shape of a spring that dries in summer, because its aquifer was lowered below the Una level.

In the Rmanj basin in Martin Brod, on the right side, the Unac streams into the Una. It originates from the Mlinski potok, which emerges from the Šator Lake at a height of 1485 m, and water courses of Ljeskovica and Gudaja, from springs formed in Triassic dolomites at a height of about 1.000 m, with a total minimum yield of $Q_{min} = 0,05\ m^3/s$. From the Unac tributary, there can also be distinguished: Visućnica, Drobnjak and Drvara.

The largest distribution in the basin includes completely karstificated limestone, of which the entire right side of the Unac basin has been built, and there is no water stream or even a larger spring in them. The occurrence of permanent sources is related to the bottom of the basin, built of freshwater lake sediments.

Figure 2: Spring of the Una River.
Source: www.unaspringoflife.com/hr

Source "Dronjkuša", with Q_{min} = 0,023 m^3/s, was captured for the purpose of water supply of Drvar, and it was formed in dolomites. From this spring, waters flow from the south. In the Drvar basin there is also a large spring "Bastašica" (Bastuško vrelo), which emerges from a sinkhole on the right side of the Unac, south of Drvar. It is located along the SW edge of the Drvarsko polje, considering that the spring itself and a part of the riverbed are found in limestones. It has very beautifully worked out and large dimensioned spring shape. It emerges from the basin in the form of a calm overflow, and it is conditioned by the contact of dolomite and limestone and cracks which direction is directed to the direction of its flow. Mostly overgrown with high growth forests. The "Bastašica" spring has large yield oscillations which amount $Q_{min} : Q_{mid} : Q_{max}$ = 0,030 : 2,6 : 12 m^3/s (Žigić et al., 2009).

The yield of the spring grows, after precipitation, in Resanovačko polje and the Kamenica area. The privileged flow directions in the aquifer are predisposed by the fault system of the northwest-southeast direction. The water temperature of 9° C is constant throughout the year. Downstream from "Bastašica" in the Unac canyon, there is occasionally spring "Okovir" on the right side of the river.

This spring occurs only during high precipitation in the Osječenica area and is active only for 6-7 months a year. The maximum yield of this occasional spring is very high and amounts to Q_{max} = 5 m^3/s. Upstream from the mouth of the Unac into the Una, about 2,5 km, there is a "Black Spring", which in a dry period fully ensures the Unac constant flow. The spring is broken type, the water emerges in three places: left, middle and right, with a total minimum yield of Q_{min} = 3,2 m^3/s. All of these are gravity type springs. The largest spring emerges below the limestone section and it is ascending type. Tracing tests in the Petrovac field proved an underground connection with the right source of the Black Spring which emerges from the talus; coloring from Resanovac (Bosanski Grahovo) has been established a connection with the left spring, while the middle spring that appears in the alluvium of the Unac bed has an underground connection with Mokronoge and Drvar basin.

After receiving Unac, the Una from Martin Brod to Bihać gets an average Q_{mid} = 44 m^3/s, and a minimum Q_{min} = 3,5 m^3/s of water. In this section, larger springs of "Ostrovica" (Q_{min} = 0,76 m^3/s; Q_{mid} = 4,9 m^3/s and Q_{max} = 12 m^3/s), “Toplica” (Q_{min} = 0,06 m^3/s and Q_{max} > 1 m^3/s); “Crnać” (Q = 1,2 m^3/s); and “Đakulin” (Q_{min} = 0,018 m^3/s) have been registered. These springs are located on the left side of the Una. Springs of Ostrovica, Klisa, Toplica, Đakulin and Crnać are formed by emptying the accumulation formed in Lika (Croatia) in the regions of Mazin and Lapac. The spring "Ostrovica" (Ostrvica) is located in the town of Kulen Vakuf, on the left side of the Una River valley. It appears at the contact of Jurassic permeable limestone and Miocene impermeable clastites. The spring is broken type with ascending-overflow outflow mechanism, and it appears from 17 cracks at a length of about 50 m. The water temperature in these springs is equal, and it amounts 9,7° C. The spring "Toplica" is located below the Dubrava massif in the immediate vicinity of Klis village. It appears in the Una faults zone within the Jurassic permeable limestone.

The spring is broken type with ascending-overflow outflow mechanism. The outflow in the times of small and medium waters is done between the so-called "Una railway" and the road Klisa-Kulen Vakuf. The primary outflow is below the embankments, or the failures on the rails. In the length of about 10-15 m the water flows out in several places. Upstream of the rail in the hydrological period of large waters, occurrences of occasional water outflow with flows exceeding 2 m^3/s have been registered. Springs "Crnać" and "Đakulin" are located near the village of Nebljusi on the Una’s left side. They appear at the contact of Cretaceous permeable limestones and Miocene impermeable clastites. The spring "Crnać" appears in the riverbed, and "Đakulin" flows out from a smaller cave.

The springs are of concentrated type and most likely an ascending outflow mechanism. In addition to the mentioned ones, springs with relatively lower river yield, such as "Draga", "Točila" and "Vrelac" appear in this area as well. From Rmanj to Gečet, in the gorge-shaped valley, the Una does not receive tributaries, but larger and smaller springs are observed along the bottom of the valley. In the Klis – Kulen Vakuf basin, the Una receives several tributaries, and the largest ones are Orašac, Rajnović and Draga. The Orašac is called Dulib in its upper course. In the canyon, from Pod to Lohovo, several smaller streams flow into the Una, mostly from the right side. These are short streams, and the biggest one is Slop with a branched net. This one, and another smaller stream, which flows into the Una at Loskun, have been inversely developed to the Una flow. From the left side, also at the Buk, the Una receives only one smaller stream.

Downstream of Lohovo, many springs appear along the periphery of the Bihać valley. Karst springs that occur in the southwest part of the Bihać basin are formed by emptying the accumulation of underground waters formed in the areas of Krbavsko, Bijelo and Koreničko polje (Croatia), and in greater part of the carbonate massif Plješevica. The major springs are "Dobrenica" (Q_{min} = 0,20 m^3/s); "Privilica" (Q_{min} = 0,030 m^3/s); "Lisa" Q_{min} = 0,04 m^3/s); “Panjak” (Q_{min} = 0,02 m^3/s); “Klokot” (Q_{min} = 2,4 m^3/s) and “Žegar“(Q_{min} = 0,02 m^3/s). The springs mostly occur near the contact of Cretaceous permeable limestones and Miocene impermeable clastites, they are concentrated type and with ascending-overflow outflow mechanism (Žigić et al., 2009). They are related to the limestone diaclases in limestones at the villages of Klokot, Vedro Polje, Privilica and Sokolac, and they are fed by karst water. From the tributaries in this part, the Una receives springs of Vilsko, Mrežnica, Toplica, Kamenica, Jaruga, Panjački Potok, then Dobrenica and Klokot. Dobrenica in its upper part collects water starting from the surfaces of Skočaj and Melinovac, from where it descends into the basin by gorge. The stream near Žegar, Drobinica, originates from several smaller streams, also on the surface of Skočaj and Zavalj.

The Klokot spring is the most important water-rich spring. The largest outflow is carried out in two places in a zone about 100 m wide, on the "Klokot 1" spring, which is primary karst spring in this locality, and on the "Klokot 2" spring, which is secondary spring. It is located along the SW edge of the Bihać field, between the alluvial plane and higher limestone terrain. The spring is a little bit more drawn in the limestone rim so that the initial part of its flow bed is totally in limestone. Two larger cracks caused the separation of water in two directions, and thus the appearance of the two already mentioned springs, which are separated by a lower limestone cape.

The total minimum yield of "Klokot" spring is Q_{min} = 2,4 m^3/s, and the maximum registered volume is about 70 m^3/s. The length of the Klokot River is 6 km, the average width is 18 to 22 m and the depth are 5 to 7 m, and flows in the direction west - east.

Figure 3: Spring of the Klokot River.
Photo: Korjenić,2014

From the Bihać basin to Bosanska Krupa, the Una flows through the canyon and there are no major tributaries in this part. At Ostrožac, on the right side it receives two short flows. Along the canyon there spontaneously emerge strong springs, of which the "Black Lake" is especially pronounced, which emerges at the level of the Una river bed, 160 m above sea level. According to Spahić M. (1988), it is an eye-shaped spring, in which the water emerges from a strong Vauclusian sub lacustrine spring under the Cretaceous limestone section. Cracks predisposed. Mostly it is fed with water from the karst plateau, about 340 m above sea level, located in the spring's hinterland. The spring yield is estimated because most of the year it was flooded with the Una River water (Q_{min} = 0,08 m^3/s and Q_{max} > 1 m^3/s).

From Bosanska Krupa to Rudice, from the right side the Una receives larger tributaries: Krušnica, Bukovska and Vranovina, and from the left one: Ljusina, Baštra and Glodina, as well as other smaller streams. Krušnica has a strong spring where the water emerges from a cave formed in the zone of faults, which stretches from Krnjeuša through the Risovac sinkhole to the "Krušnica" spring, and it has large yield oscillations (Q_{min} = 1,2 m^3/s and Q_{max} = 100 m^3/s). The spring is gravity type, and the sides of the spring shape are steep and high over 80 m. Parallel to this fault, there is a fault which runs along the Suvaja valley where sinkholes are located.

Karst springs on the left side of this river, between Bosanska Krupa and Bosanska Otoka belong to the Una catchment area. These are: “Dobrenica” - Prošići (Q_{min} = 0,08 m^3/s), “Grmuša” (Q_{min} = 0,150 m^3/s), “Crno vrelo” (Q_{min} = 0,180 m^3/s), “Vodomut” (Q_{min} = 0,060 m^3/s) and “Voloder” (Q_{min} = 0,110 m^3/s). By coloring of “Stijena” and “Pištaline” sinkholes, the underground connection with the springs "Grmuša" and "Black Spring" has been proved, while surface waters from the Kamenica creek, sinking into limestones, appear on the "Voloder" and "Vodomut" springs. The spring "Grmuša" is located in the Una canyon opposite to the Grmuša railway station. It emerges from a cave in a very impervious canyon. Karst springs of "Voloder" and "Vodomut" are located not far from Bosanska Otoka. They emerge on contact with the Upper Jurrasic limestone and Lower Triassic impermeable clastites. The springs are of contact-overflow type, and most likely an ascending outflow mechanism. Water outflow in springs is concentrated in a zone of 10-15 m wide. They show very large yield oscillations in range of 0,110-1 m^3/s ("Voloder") and 0,060-1,020 m^3/s ("Vodomut") (Žigić et al., 2009). Downstream towards Bosanski Novi, the Una receives its left-bank tributaries Javornik and Svinica, the right-bank tributaries Vojskova and Vidorija, and numerous smaller currents. In this lower part of the basin, the Una tributaries in their upper streams are widely branched.

Figure 4: Spring of the Krušnica River.
Source: www.visitbih.ba/odmor-na-obalama-prelijepe-une/

At Bosanski Novi, from the right side, it receives its biggest tributary, Sana. In this catchment area, significant accumulations of groundwater have been formed which are emptied in the karstic springs of the Sana, Ribnik, Okašnica, Sanica, Korčanica, Dabar and Zdena. The Sana is made of 3 springs ("Palolić", "Čajdarevo" and "Main Sana spring"), which are located at a length of 300-400 m, with a minimum yield Q_{min} = 1,6 m^3/s.

The water of these springs is merged into one flow at a length of 1,5 km. The Main Sana spring, to the far right, is located below the slopes of Oštra and Hodža's head in the upper Cretaceous limestone, predisposed by cracks. Very strong spring with larger variations in flow. Palolić spring is an extremely left source spring, crevice-predisposed in the direction of N-S. Čajdarevo spring is the central spring of the Sana River, it emerges from a cave hole, gravity type.

The first large tributary, Medna, comes to it from the right side. Downstream, in the direction of Ključ, terrain is built by Permo-Triassic deposits what caused groundwaters to flow in the direction of the "Ribnik" and "Okašnica" springs. The spring "Ribnik" appears at the contact of the Cretaceous limestone and the Lower Triassic clastites. The spring yield has large oscillations (Q_{min} = 1,25 m^3/s; Q_{mid} = 15,5 m^3/s and Q_{max} > 100 m^3/s). It is broken type and ascending outflow mechanism. The outflow is carried out on two permanent and more occasional springs. Ribnik is the largest tributary of the Sana in its upper course. In the gorge Durmiševica, there is a karst spring called "Okašnica". It is a crevice eye-shaped karst spring, and it was used to run mills. On the spring "Okašnica" "(Q_{min} = 0,08 m^3/s; Q_{mid} = 0,555 m^3/s and Q_{max} = 2,5 m^3/s) discharge of groundwater accumulations is carried out from water bodies formed in the Srnetica mountain and from the karst plains of Bor and Palež (Žigić et al., 2009). A series of small but permanent springs, was formed in a basin built of Triassic marls, clay and conglomerates.

At Vrhpolje, from its left side, the Sana receives its largest tributary, Sanica. The spring "Sanica" is located in the village of the same name south of Sanski Most. It appears in the contact zone of permeable limestones and impermeable Perm-Triassic clastites, in the faults' zone. The spring is broken type and ascending outflow mechanism. The outflow of water is carried out from the canals of three springs: "Sanica", "Varda" and "Jezero". The spring "Sanica" is hypsometrically the lowest one, it emerges from a cave hole and is gravity type. The other two have occasional springs' character. According to the data of long-term observations, the yield of "Sanica" is: Q_{min} = 0,8 m^3/s; Q_{mid} = 8,9 m^3/s and Q_{max} = 40 m^3/s. The springs "Korčanica" and "Sanica" belong to the same basin, and they are created by emptying the accumulation of underground waters formed in the karst terrains of Mijačica, Ogumovača and Bravski.

The spring "Korčanica" is located in the Kopjenica region, southeast of Sanica. It appears in the contact zone of permeable limestones and impermeable Perm-Triassic clastites. It emerges from a sinkhole in period of high and middle waters, and at minimum, it remains in the bottom of the sinkhole at a depth of 8-10 m. Permanent spring emerges in the bed downstream at a 100 m step. According to the observation data, the minimum yield of the "Korčanica" is Q_{min} = 0,3 m^3/s, and maximum Q_{max} = 20 m^3/s.

Figure 5: Spring of the Sana River. Photo: Korjenić, 2008

Figure 6: Spring of the Sanica River. Photo: Korjenić, 2008

Dolomites of the Lower Jurassic developed in the anticline in the area of Bosanski Petrovac and Drinić caused the formation of a watershed between the Ribnik and Sanica basins in the southeast and karst springs in the Unac canyon in the southwest. In the Grmeč syncline, an Upper Cretaceous flysch is developed that directs underground waters to the south. After shorter surface currents, the waters sink in Smoljani and appear on the spring of Sanica. There are several sources from the Upper Cretaceous flysch in Smoljani, among which are the two largest ones captured for the needs of the water supply of Bosanski Petrovac ("Smoljani" Q_{min} = 0,004 m^3/s and "Crno vrelo" Q_{min} = 0,003 m^3/s).

In the basin of Sanski Most, Sana receives water from larger tributaries: Bliha, Zdena and Dabar, and several smaller ones. The northeastern slopes of the Grmeč mountain and the whole area of the Lušcipalanačko field are discharged in the springs "Dabar" and "Zdena". The underground connection with the Dabar and Zdena springs was established by the coloring of the sinkhole in the Jelašinovačko field. The underground connection was proved in period of high waters when 20 m^3/s outflow from the Dabar. The spring "Dabar" emerges from a hole on the right side of the Dabar's cave in Triassic limestone. The water temperature is 10,5° C. The yield of the spring has large oscillations (Q_{min} = 0,9 m^3/s; Q_{mid} = 1,2 m^3/s and Q_{max} = 150 m^3/s).

The spring "Zdena" is about 3 km southwest of Sanski Most, a crevise type and ascending outflow mechanism. Outflow of water in the spring is carried out concentratedly out of the Lower Cretaceous limestone. The spring has large yield oscillations (Q_{min} = 0,32 m^3/s; Q_{mid} = 1,6 m^3/s and Q_{max} = 5,6 m^3/s), with a water temperature of 12,8° C.

On the northern edge of the Jelašinovačko field, the springs of the "Pobrnjača" (Q_{min} = 0,012 m^3/s), "Miljevačko vrelo" (Q_{min} = 0,010 m^3/s) and "Podgora" (Q_{min} = 0,008 m^3/s) are registered from Lušci Palanka to Podgora. They were formed in the area of pulling over of Triassic limestone to the Jurassic dolomites and limestone. In the south side of the Jelašinovačko field, along the very edge of Grmeč, an occasional spring "Eye" is formed, which is active only in period of high waters, when the source of yield Q_{max} = 50 m^3/s comes from the depth of 30 m (Žigić et al., 2009). The Una, after conflux with the Sana, from Bosanski Novi to Kostajnica accepts the water of a series of larger and smaller streams. From the right side of the river, the following streams flow into the Una: Tunjica, Strižna and Strigova, while from the left side there come tributaries: Žirovnica near Dvor, Divuša, Lorić and Volinja. Going downstream to Bosanska Dubica and the very mouth of the Una into the Sava, several tributaries can be distinguished for feeding the Una River with water in its down flow.

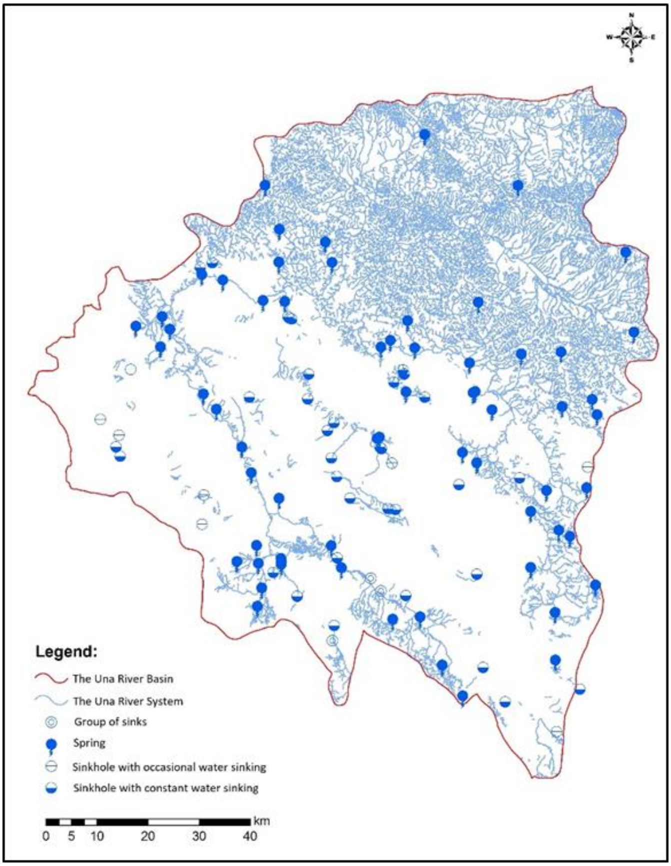

Figure 7: The Una River Basin with significant hydrogeological forms.
Source: Authors according to GIS database

These are Vučijak and Petrinjica with narrow and deep valleys, Slabinja, Mlječanica and Binjacka with wide valleys on the right side, while on the left side there are Krivaja and Ivančevac. In addition to the Miljenica, as the right tributary in this, lower part, the streams of Mošćanica and Rakovica have also remarkebly wide valleys. These two streams come from the south, i.e. from Kozara, where they receive numerous smaller tributaries.

2.2. Tourist valorization of springs

Tourist valorization is the establishment or assessment of the value of tourist attractions, that is, the assessment of the tourist attractiveness of all those phenomena, facilities and spaces that have, in addition to other characteristics and features, that they are attractive to tourists and that through them, tourists can satisfy their touristic (cultural or recreational) needs. In this part of the paper, the evaluation of the most important springs in the Una river system was performed for the purpose of their tourist valorization and completion of the tourist offer in this region. It should be noted that all springs in the Una River basin are not permanent, but they depend on pluviometric regime, so they cannot be valorized throughout the year. In this paper, only those springs having a permanent hydrographic function are presented and evaluated according to the above-mentioned method. Thirteen springs in the Una river system were analyzed, which with their representativity, scientific and aesthetic value, deserve to be tourist valorized and preserved in their uniqueness.

The hydromorphological value of the site amounts 10 points in total, and is evaluated through two groups of secondary indicators: scientific value and additional values. The scientific value carries a maximum of 5,5 points and additional value of 4,5 points. The management value of the site amounts 10 points in total, and is evaluated through two groups of secondary indicators: the economic value and the protection value. The economic value makes a total of 7,0 points, and the protection value is 3,0 points. The economic value assesses availability, visibility, protection value, usage level and the like, where it is primarily an accent on the availability of the site itself, that is, on the quality of traffic connections with some of the urban centers. The total tourist value of the site can have a maximum of 20 points.

After the evaluation of all the springs, according to the achieved results, their division into five groups was made in terms of quality and tourist significance. The classification was made according to the modified division (Jovičić, 1989), with scales from 1 to 5, where the total value is:

<10 – insufficient quality, not for tourist presentation,
10 – 12,50 – quality meets local tourist character,
12,51 - 15 – good quality, has a regional tourist character,

15,1 – 17,50 – very good quality, has a wider regional significance,
17,51 - 20 – international tourist character.

A detailed analysis found that one spring, the Black Lake, located along the main road Bihać - Bosanska Krupa has the lowest total tourist value of 9,11, and as such insufficient quality, it is not for a tourist presentation. Local tourist importance is due to the springs of Krka, Bastašica, Ostrovica, Ribnik and Zdena. All these springs have a higher management value than hydromorphological one. Most of them have nearby arranged picnic places and arranged access, as well as the proximity to larger settlements and by that proximity to accommodation facilities, except Krka. The Krka and Bastašica springs due to the Una NP have greater promotion, protection and usage, along with other natural and cultural values.

The highest quality and regional tourist significance, according to this estimation, belong to the springs of the Una, Black Spring, Klokot, Krušnica, Sana, Sanica and Dabar. The highest value is in the Una spring, with a hydromorphological value of 7,5 points and a slightly lower management value of 7,09 points. Of all the analyzed springs, this has the highest scientific and additional value. It should be added that, although not part of the Una NP, it has a good promotion as a cross-border area and is offered in the brochures of the tourist communities of the area that gravitates to the Una NP. Black spring, concerning its position in the Una NP, tourist signalization and traffic accessibility, are considered as site with regional tourist significance although it has lower hydromorphological value with 3,96 points. Spring Klokot has significant hydromorphological value, but also the management value, with 5,75 and 8,5 points. The accessibility of the localities and traffic connections with Bihać as a larger urban settlement, scientific and aesthetic value, the possibility of studying the interior of the spring itself, caves, channels and extensions that make up its interior, biogeographic diversity, and the generosity (yield) of the spring have classified this hydromorphological object into the area of regional tourism character.

Krušnica, also of good quality for tourist valorization, has somewhat lower management value, but higher hydromorphological value than the previous spring. The reason for this is the impossibility of road access, but only by river, waterway, and distance from accommodation facilities. This spring is abundant with marvelous underwater channels and extensions in the very spring, the richness of water and plant and aquatic organisms. The way of genesis, vertical dissection, contrast of shapes and colors influenced the scientific and additional value of this site, which amounts to 6,125 points. The Sana, Sanica and Dabar springs, belonging to the Sana river system, the largest tributaries of the Una, are also included in hydromorphological objects of regional tourist significance.

These springs have a slightly higher management value because they are commercially available and have well-kept picnic places. In addition to the management one, their hydromorphological value, too, is at an enviable level. The richness of the morphological forms, the quality and the yield of water, the aesthetic experience influenced the high score of these sites. The Dabar spring, beside that, can complement its offer with archeological and cultural goods connected with the cave at the very spring, as a prehistoric site.

Table 2: Total tourist value of the analyzed springs in the Una River System.

Springs	***Hydromorphological value***	***Management values***	***The total tourist value***
Vrelo Une	7,5	7,09	14,59
Krka	3,505	7,04	10,545
Bastašica	4,505	7,03	11,535
Crno vrelo	3,96	9,03	12,99
Ostrovica	3,63	8,03	11,66
Klokot	5,75	8,5	14,25
Crno jezero	2,08	7,03	9,11
Krušnica	6,125	6,95	13,075
Vrela Sane	5,255	7,87	13,125
Ribnik	3,585	8,04	11,625
Sanica	5,505	8,23	13,735
Dabar	6,255	6,81	13,065
Zdena	2,21	8,62	10,83

Considering the available tourist values, it can be concluded that springs as hydrographic tourist motives can play an important role in development of tourism in this area, as separate tourist sites, but also as complementary to other tourist potentials of this area, both natural and anthropogenic. Although they have an enviable hydromorphological value, there is still a lot to do to improve the management values of these areas, economic and protection values, as it is evident that no locality has the highest number of points, which is 10.

3. Conclusion

The attraction of rivers for tourists depends on the possibilities of swimming and other sports and recreation. The attraction of rivers is also related to some curiosity phenomena on them, such as, among other things, in this case, river springs. The tourist value of rivers and springs is large, due to possibility of psychic rest, aesthetic experience and sightseeing, the development of fishing tourism, swimming, speleology and other activities.

Springs are visited mainly by domestic tourists, but they can also gain international reputation. From the analyzed 13 springs in the Una river system, the existence of 7 springs with regional tourist significance was determined, 5 of them have a local tourist significance, while 1 spring is not for tourist presentation.

The unification of the tourist offer related to hydrographic facilities in the Una River basin would lead to the creation of recognizable and unique ambience with a wide tourist offer. Planned action would result in harmonious spatial balance between objects and the natural environment. However, the success of tourism exploitation of springs as hydrographic facilities in the Una basin is conditioned by capacity building, quality of promotion of the entire area, rational usage and regulation.

Annex

Tables for evaluation criteria and grades (modified by Pereira et al., 2007, Misilo, 2016).

Table 3: Criteria for evaluating the scientific value of spring.

a) Rareness (relative to the research area)	
0 Not one of the 5 most important	
0,25 Not one of the 3 most important	
0,5 One of the 3 most important	
0,75 The most important	
1 The only example	
b) Preservation	
0 Very damaged as a result of anthropogenic activity	
0,25 Damaged as a result of natural processes	
0,5 Damaged, but important hydrological and geomorphological characteristics are preserved	
0,75 Mildly damaged, but still maintains essential hydrological and geomorphological characteristics	
1 No visible damage	
c) Representativeness of hydrological and geomorphological processes and pedagogical significance	
0 Low representativity and without pedagogical significance	
0,33 Partial representativity, but with little pedagogical significance	
0,67 A good example of the process, but difficult to explain to non-experts	
1 A good example of a process and / or a good pedagogical resource	
d) Paleographical meaning	
0 No paleogeographical meaning	

0,25 Little significance	
0,5 Medium significance	
0,75 A great significance	
1 Very big significance	
e) Degree of scientific knowledge on hydrological issues	
0 None / no	
0,25 Medium: articles at the national level, tourist works, brochures	
0,5 High: international papers, dissertations	
f) Number of interesting hydrological and geomorphological forms and / or characteristics - diversities	
0 One (1)	
0,33 Two (2)	
0,5 Three (3)	
1 More than three (> 3)	
Scientific value = a + b + c + d + e + f	

Table 4: Criteria for evaluating additional values of spring.

a) Ecological value	
0 No relation with biological forms / phenomena	
0,38 The presence of interesting flora and / or fauna	
1 One of the best places to watch interesting flora and / or fauna	
1,50 Hydrogeomorphological forms important for the ecosystem	
b) Aesthetic value (1 + 2 + 3)	
1 Viewpoints	
0 None (0)	
0,125 One (1)	
0,250 2 or 3	
0,375 4, 5 or 6	
0,50 > 6	
2 Contrast, vertical separation and spatial structure	
0 Low	
0,25 Medium	
0,5 High	
3 Chromatic contrast in relation to the environment	
0 Same colors	
0,25 Different colors	
0,5 Contrast colors	
c) Cultural value	

0 No cultural goods (forms) or cultural goods that damage the locality	
0,25 Cultural goods without a link with hydrological forms	
0,5 Significant cultural goods without a link with hydrological forms	
0,75 Intangible cultural goods connected with hydrological forms	
1 Material cultural goods associated with hydrological forms	
1,5 Significant material cultural goods associated with hydrological forms	
Additional values = a + b + c	

Table 5: Criteria for evaluating the economic value of spring.

a) Availability	
0 Very difficult, only with special equipment	
0,21 Footpath to the hiking trail	
0,43 By terrain vehicles, macadam road and > 500 m walking trail	
0,64 Terrain vehicles, macadam road and < 500 m walking trail	
0,86 By car, asphalt and / or macadam road and > 200 m walking trail	
1,07 By car, asphalt and / or macadam road and < 200 m walking trail	
1,29 By bus, asphalt road and > 100 m walking trail	
1,5 By bus, asphalt road and < 100 m walking trail	
b) Visibility	
0 Very difficult or not visible at all	
0,30 Visible only with the use of special equipment (eg artificial lights, ropes)	
0,60 Limited visibility due to trees or low vegetation	
0,90 Good visibility, but a tour is required for complete observation	
1,20 Good visibility for all important hydrogeomorphological characteristics	
1,50 Excellent visibility for all important hydrogeomorphological characteristics	
c) Current use of hydrogeomorphological values	
0 No promotion or use	
0,33 No promotions with usage	
0,67 Promoted and / or used as a landscape locality	
1 Promoted and / or used as a hydrogeomorphological locality	
d) Current use of other natural and cultural values	
0 No other value, promotion or use	
0,33 With other values, but without promotion and use	
0,67 With other values and their promotion, but without the use	
1 With other values and their promotion and use	
e) Legal protection and restrictions on use	
0 Complete protection and complete prohibition of use	

0,33 Limited use protection	
0,67 Without protection and without limitation of use	
1,00 With protection, but without restriction or with very low limit	
f) Accommodation and accompanying services	
0 Accommodation and accompanying services are located > 15 km	
0,25 Accommodation and accompanying services 10 - 15 km away	
0,5 Accommodation and accompanying services 5 - 10 km away	
1,00 Accommodation and services < 5 km	
Economic value = a + b + c + d + e + f	

Table 6: Criteria for evaluating the value of spring protection

a) Preservation	
0 Very damaged as a result of anthropogenic activity	
0,25 Damaged as a result of natural processes	
0,50 Damaged, but important hydromorphological characteristics are preserved	
0,75 Slightly damaged, but still retain essential hydromorphological characteristics	
1,00 No visible damage	
b) Vulnerability as a consequence of the use of the hydrogeomorphological locality	
0 Very vulnerable, with the possibility of complete loss	
0,50 Hydromorphological forms may be damaged	
1,00 Other, non-geomorphological forms may be damaged	
1,50 Damage can only occur along the access structures	
2,00 Not vulnerable	
Protective value = a + b	
Hydromorphological value + Management value	

4. References

Čavlek, N., Bartoluci, M., Prebežac, D., Kesar, O., i sur. 2011: Turizam, Ekonomske osnove i organizacijski sustav, Školska knjiga, Zagreb.
Dukić, D. 1984: Hidrologija kopna, Naučna knjiga, Beograd.
Gardiner, V. 1975: Drainage Basin Morphometry, Tehnical Bulletin of the British Geomorphological Research Group, vol. 14, 1-48, Norwich.
Jovičić, Ž. 1989: Turistička geografija, Beograd.
Korjenić, A., Sivac, A., Okerić, Š. 2017: Geological Characteristics and Density of the Una Water System as a Factor of Spatial Planning, B&H, Journal of International Environmental Application & Science, Vol. 12, No. 1, p. 63 – 72.
Kovačević, T., Alić, M. 2016: Kamena galaksija - Zrmanja 2016., Hrvatska vodoprivreda br. 217, XXIV, Zagreb.
Misilo, M. 2016: Reljefni diverzitet Parka prirode Blidinje, Doktorska disertacija, Prirodno-matematički fakultet u Sarajevu.
Pereira et al. 2007: Geomorphosite assessment in Montesinho Natural Park (Portugal), Univesity of Minho, Braga.
Reynard, E., Fontana, G., Kozlik, L. & Scapozza, C., 2007, A method for assessing scientific and additional values of geomorphosites, Geographica Helvetica, 62 (3), pp. 148-158.
Riđanović, J. 1993: Hidrogeografija, Školska knjiga, Zagreb.
Spahić, M. 2000: Rijeka Una – potamološke odlike, Naučna tribina „Sedra rijeke Une i Una bez sedre“, Bihać.
Žigić, I., Pašić-Škripić, D., Srkalović, D., Ališehović, H., Alić, E. 2009: Tijela podzemnih voda na teritoriji Federacije Bosne i Hercegovine, knj. I, Zavod za vodoprivredu d.d. Sarajevo, Sarajevo.
Vrelo Une. Internet: http://www.unaspringoflife.com/hr (19.09.2018).
Krušnica. Internet: http://www.visitbih.ba/odmor-na-obalama-prelijepe-une/ (25.09.2018).