

GEOECOLOGICAL EVALUATION OF NATURAL RESOURCES OF THE UPPER GOSTELJA DRAINAGE BASIN

Semir Ahmetbegović¹, Avdul Adrović², Elvir Babajić³, Senad Gutić¹ and Željka Stjepić Srkalović¹

University of Tuzla, Faculty of Sciences and Mathematics, Department of Geography¹,

Department of Biology², Faculty of Mining, Geology and Civil engineering³

Univerzitetska 2 and 4, Tuzla, Bosnia and Herzegovina

For the paper purpose, the physical geographical analysis of the researched area was made. The area is situated in the upper Gostelja river basin located in the northern part of the Kladanj municipality in Bosnia and Herzegovina, in the area of the Internal Dinarides. By the research, the state of geodiversity of the upper basin of Gostelja and the level of environment preservation were evaluated. The conducted researches of the environment are in a function of adequate protection and conservation. The component analysis of natural resources was carried out, and the socio-economic activities that violate or potentially violate the quality of the environment of the study area were registered. Conducted researches indicate that the upper basin of Gostelja is characterized by typical geodiversity, i.e. this is an area with relatively preserved natural resources, with the presence of a negative anthropogenic influence.

Keywords: *Geoecology, geodiversity, natural resources, environment, drainage basin, Gostelja, Bosnia and Herzegovina*

INTRODUCTION

The Gostelja basin is located in northeastern Bosnia, in the area of Internal Dinarides, spreading on 192 km², where the watercourse and its tributaries, for the most part, has been cut into the mountain morphostructures. Gostelja river is created by merging of a mountain watercourses of Zatoča and Suha in the Stupari settlement. It is a right tributary of the river Oskova which belongs to the Black Sea basin, i.e. to the hydrosystems of Spreča, Bosna and Sava. The Gostelja basin is characterized by different degrees of anthropopressing.

The lower drainage basin of Gostelja river goes behind the area of Upper Spreča tectonic depression, which is a significantly anthropogenic. This area is not the subject of this paper research, especially considering that because of the surface coal exploitation, the southwestern parts of the basin are almost completely devastated. The upper river basin belongs to mountain morphostructures of Konjuh and Javornik, and as such has preserved the natural environment. The subject of this paper is the geodiversity evaluation and environment preservation of the upper Gostelja basin.

The main goal of this paper is to acknowledge the diversity of environment of specified area in the function of adequate protection and conservation. For the study, it was necessary to componently explore the natural environment, to register socio-economic activities that impair or potentially impair the natural environment quality, and to determine the value of geo-diversity as well as the extraordinary, typicality, preservation and rarity. The paper is based on the assumption that the upper river basin of Gostelja is characterized by a typical and preserved geodiversity threatened by a negative anthropogenic influence.

For the physical-geographical and geocological research purposes, the numerous scientific research methods were used, beginning from the analysis of the available literature and sources. The field researches were made, for a geological and biogeographical sampling, and numerous informations were gathered by the direct observation method.

In the paper were also used: the cartographic methods to obtain the data on terrain and drafting of thematic maps, statistical method for processing morphometric, climate, hydrographic and biogeographic data, causal method to determine the causes and consequences of human activities on the genesis of destructive processes and phenomena in the natural environment and the comparative method to compare the study area and its environment.

Numerous studies of the natural heritage in this area were carried out, and most of them are geological and hydrogeological. The first informations about the lithological structure gave F. Katzer (1906), and significant geological researches R. Jovanović (1957, 1961 and 1963), M. Milojevića and associates (1959), B. Đerković (1963) and J. Pamić (1963, 1964 and 1965). Hydrogeological analyses of this terrain were recently made by: A Mešković and associates (2006), I. Žigić and associates (2007), A. Mešković and I. Kadić (2007), I. Žigić and associates (2009), D. Srkalović (2011). Some quality data about the living world was given by V. Beus, (1998) and I. Horvat with associates (1974). The detailed researches on ichthyofauna of the study area watercourses gave A. Adrović (2012).

This paper is a product of research project "Research of the recent physical-geographical processes and environmental changes as a result of anthropogenic impacts in the Gostelja basin", funded by the Federal Ministry of Education and Science, the Internal call for financing/co-financing of projects in the field of science of importance for the Federation of Bosnia and Herzegovina in 2015.

STATE OF THE NATURAL RESOURCES IN THE GOSTELJA UPPER DRAINAGE BASIN

The geographical position of the Gostelja upper drainage basin

The analyzed area of the river Gostelja upper drainage basin (146 km²), mostly represents the terrains of the northern part of Kladanj municipality, in the Federation of Bosnia and Herzegovina. Territorially, much smaller part of the researched area (watersource of the Suha river basin) belongs to the neighboring Republic of Srpska entity. This mountainous area is orographically marked by slopes of Konjuh mountain 1,326 m a.s.l., Djedinska Mountain 1,158 meters, Javornik 1,067 meters and is located on the border of northern and central Bosnia macroregions in conditions of moderate, submountain and mountain climate. On pedologic cover, which predominantly consists of eutric and distric cambisol (Burlica & Vukorep 1983), the forest vegetation is represented by beech with abies (*Piceo-Abieti-Fagetum*), the beech and abies forests (*Abieti-Fagetum*.) and, sessil oak and common hornbeam forests (*Quercu-Carpinetum-illiricum*) (Horvat i sar., 1974).

The Gostelja river upper basin is located in northeastern Bosnia, in the area of Internal Dinarides, whose watercourse and its tributaries, for the most part, are truncated into the mountain morphostructures. In the geological structure of the upper basin Gostelja the Mesozoic formations are dominant, while the Quaternary formations are poorly represented and occur along the Gostelja river and its tributaries lower streams. The Mesozoic formations are represented by Triassic and Jurassic sedimentary rocks.

Triassic (T_2 and $T_{2,3}$) is predominantly represented on the western side of the Gostelja upper basin, and presented mainly by massive limestones. Middle Triassic limestones are often cracked and the cracks are filled with calcite. Jurassic formations ($J_{2,3}$) build the eastern side of the basin, and are represented by a diabase-chert melange of sedimentary character.

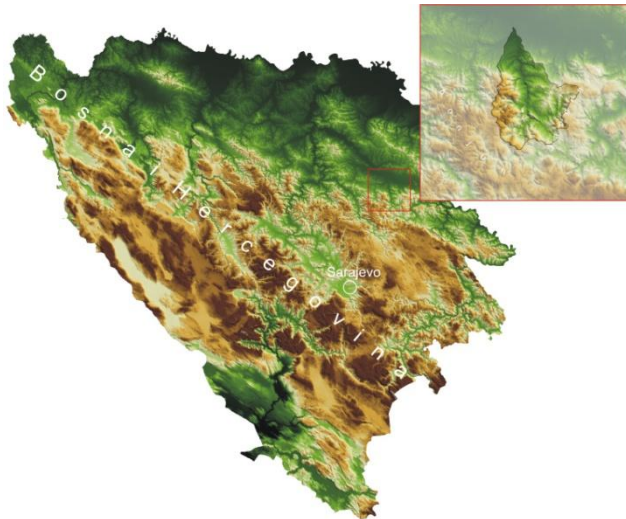


Fig. 1. The geographical position of the Gostelja basin

The basic physical geographical characteristics of the Gostelja upper drainage basin

Quaternary (Q) is represented by a terraced sediments, proluvium, diluvium, rock creeps and alluvium (BGM Vlasenica 1: 100,000). Geotectonically, the wider area is in lithologically heterogeneous volcanogenic-sedimentary complex which represents subunits of Central dinaric ophiolite zone.

"The composition of this tectonic subunit is represented by rocks formed during the volcanogenic-sedimentary formations, and sediments inserted as olistoliti" (Interpreter of BGM Vlasenica 1: 100,000). The whole ophiolitic complex has often been caught by Alpine orogeny which reflects in polyphasic tectonic deformations.

The Central Dinaric ophiolitic zone has very complex tectonics, which marks the area of the upper Gostelja basin. Faults are easily detected and classified, and their most common direction is the northwest-southeast bearing. By its size and position the fault in the Tarevčica valley is accentuated. Also, on the east side of the Tarevčica basin, a fault is expressed because of its size, and is situated along the Gostelja downstream from Stupari, which sets in Sprečko polje, in the north-south direction. It is clear that this fault had a primary role in the formation of the Gostelja basin.

Although it is a relatively small area, the upper basin of the Gostelja river is varied and interesting to explore in terms of the relief. Geomorphologically, the two relief units are emphasized: a mountainous, dominated by the mountain range of Konjuh, and hilly consisting of Konjuh, Djedinska Mountain and Javornik mountain slopes. It is hilly-

mountainous area, whose structure is represented by mountain ranges with foothill stairs and plateaus on carbonate rocks and deep composite river valleys (Fig. 2).

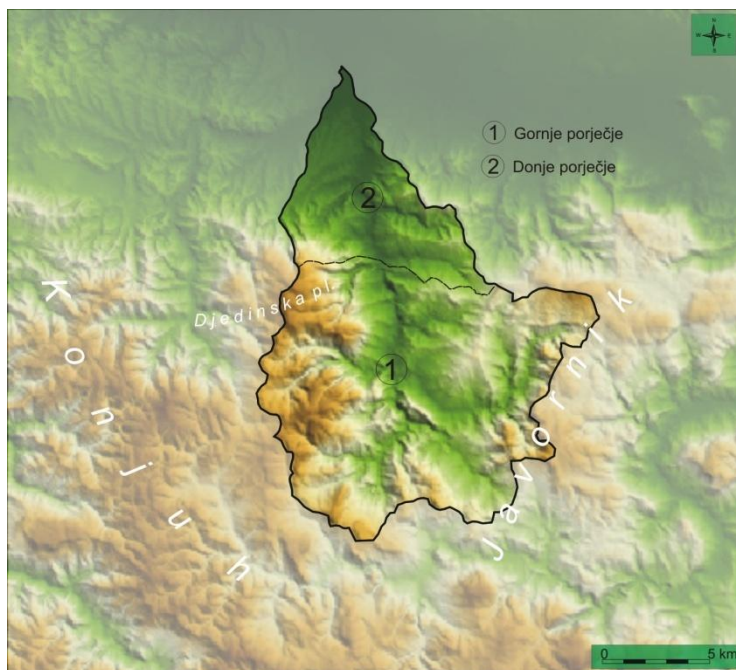


Fig. 2. Morphological map of Gostelja drainage basin

The factors that had a significant influence on the today's relief forms are recent tectonic movements. The area is tectonically fractured and faulted. The Konjuh massive was under repeatedly tectonic disturbances within the Alpine orogeny, which caused a distinct vertical relief dissection. Vertical dissection is represented by the highest altitudes in the basin, which is 1,207 m, while the height of the Gostelja riverbed, where it incises by merging of the rivers Zatoča and Suha is 450 m. The lowest point in the study area is at 275 m, so the height difference is 932 m. Karst relief, developed in Triassic limestones, is characterized by smaller karst valleys, depressions, potholes and caves. The researched area is characterized by "shallow karst". It covers green karst (merokarst) where the arable land, pastures and forests appear, i.e. it is the incomplete karst in which karst forms are not so pronounced. Also, the underground karst features are numerous (pothole Godijelji), but of smaller dimensions compared to those that occur in holokarst. "River basin of the Tarevčica is characterized by a smaller sink zones, with a strong circulation and significant differences in morphologic (orographic) and hydrogeological (groundwater) watersheds" (Baraković et al. 2012).

The relief is characterized by the different microforms, terraces caused by the numerous landslides, alluvial fan etc. The deep river valleys are characterized by the absence or very narrow alluvial plains, much younger than the other forms that build specified area. In the Mid Triassic limestones, the riverbeds of the Gostelja upper course and

deep gorges of its tributaries Zatoča and Tarevčice were incised, while the Suha valley, (east side of a drainage basin) was notched into the Jurassic limestones. The riverbeds of the Gostelja in the upper course and its tributaries of Suha, Zatoča and Tarevčica are characterized by a unconformed longitudinal profile (Fig. 3).

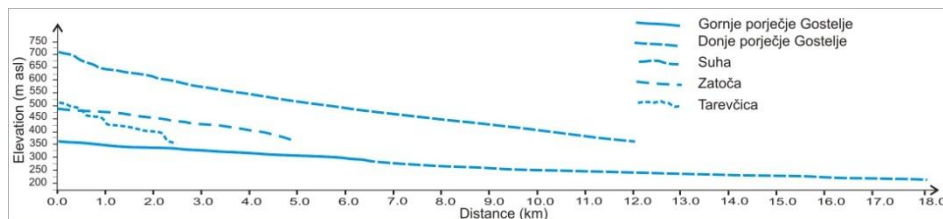


Fig. 3. Longitudinal profiles of the Gostelja river and its tributaries in upper drainage basin

The flows of Gostelja and its tributaries are characterized by sudden breakages and small differences in slope inclinations in the spring area, and in the middle part of the course and at the mouth of a river. The valleys are deeply incised with steep sides, i.e. with a characteristic of a gorge. Valleys of Zatoča and Suha are separated by a ridge of Hrdar (786 m) of Dinaric direction (NW-SE).

Geomorphological typicality is shown in the valley of Tarevčica, which is the left tributary of the Gostelja river.

It is a smaller, but extremely composite river valley, which in the middle course has less steeped valley sides in relation to the ones at the spring and the river mouth. In this part of the river course, the left valley slope is made by the plateau where the Tarevo settlement is located (Fig. 4).



Fig. 4. Tarevo settlement

This is the eroding terrace, formed in earlier incision stages, inclined downstream and toward the river flow, and consistent with the relief slope inclination, from the source to the river mouth and can be characterized as conformal eroded river terrace. At the Tarevčica and Gostelja river mouth, local tectonic movements are manifested with a strong uplift that catches the river incision, and valley shows the character of antecedent valley or a gorge. In this part of the stream, the Tarevčice valley is of the ravine type with steep sides, fractures and rapids in the river bed.

The upper Gostelja basin belongs to moderate continental climate zone, with moderately cold winters and moderately warm summers. Mountainous areas receive slightly higher amounts of rainfall, with precipitations evenly distributed throughout the year, and due to a larger absolute height and greater representation of northern exposures, they have a lower air temperature. Mountain and valley areas of the Gostelja upper basin are characterized by an average annual temperature of 9.7°C.

The Gostelja river emerges in the Stupar settlement by a merging of two smaller rivers, Suha and Zatoča. Not far from the place where it emerges, the Gostelja receives its first left tributary, the river Tarevčica.

The other right tributaries such as the Matijevski stream and Ljuča, and left tributary Radašnica needs to be mentioned (Fig. 5). In its upper course the Gostelja river has the characteristics of a mountain river that breaks through the gorge-narrowing in direction of south-north. In this part of the stream a series of small waterfalls and cascades was formed.

The Gostelja and its tributaries regime is of nival-pluvial character. The upper basin of Gostelja, mostly belongs to the mountain relief type, which implies the existence of snow retention which indicates that in the colder part of the year, snowfall does not appear immediately in the hydrosystem, but remain for a longer period of time in the basin and take part in the river regime in the spring hydrologic period. Therefore, there is a complete harmony between the annual distribution of rainfall and river regime.

Flow rate (Q m. year.) of the Gostelja river, downstream of the study area is $3.50 \text{ m}^3/\text{s}$ (Grupa autora 2015). The highest medium monthly values are recorded in March. The March water levels and flow rates ($5,55 \text{ m}^3/\text{s}$) does not correspond with the maximum of rainfalls that occurs in June in the Gostelja basin. The elevated water levels occur in June with a tendency of decreasing to the minimum water levels in August and September. The smallest flow rates are in August ($0.26 \text{ m}^3/\text{s}$).

On pedologic covering which is predominantly made of eutric and distric cambisols (Burlica & Vukorep 1983), the forest vegetation is represented by beech with abies (*Piceo-Abieti-Fagetum*), the beech and abies forests (*Abieti-Fagetum*), sessil oak and common hornbeam forests (*Quercu-Carpinetum-illiricum*) (Horvat i saradnici, 1974). In the mountain regions, the calcocambisol mostly takes part in the average height belts and some gentle inclinations on karst plateaus, where the specific microrelief of the karst base is expressed. The maximum depth of the total profile rarely exceeds 60 cm, and the transition from the soil to bedrock is sharp and uneven, because the rocks sporadically appear at the surface and it can occur that the soil penetrates into the limestone through rock fissures. The depth of humus horizon stands in inverse proportion to the depth of the entire profile, and usually does not exceed 15 cm (Ćirić, 1991).

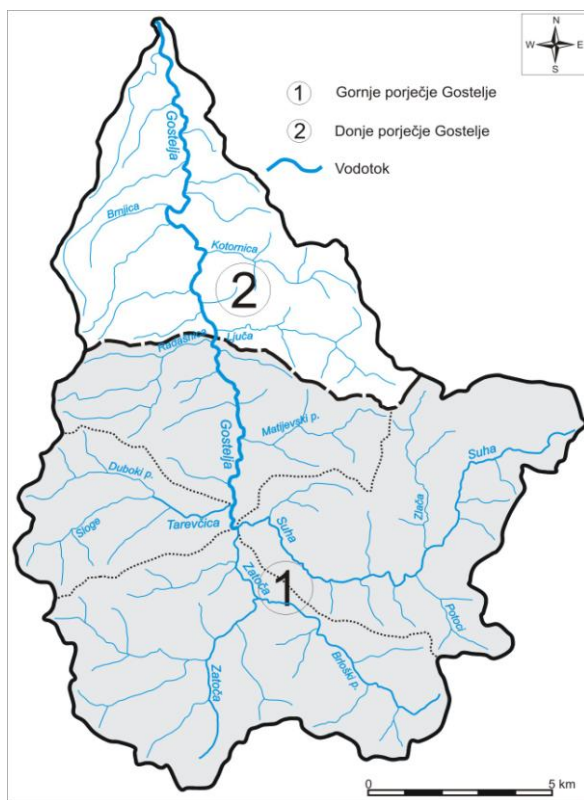


Fig. 5. The river Gostelja drainage basin

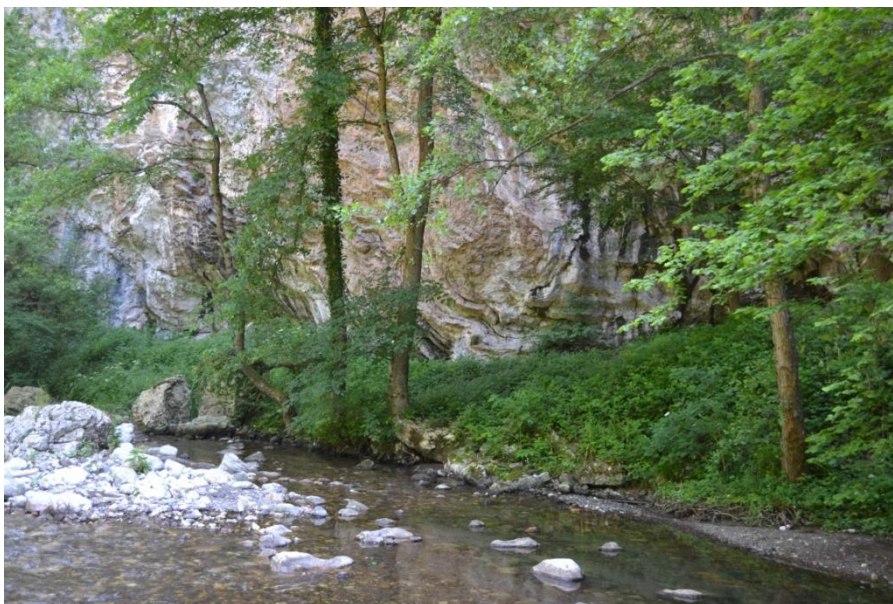


Fig. 6. Zatoča riverbed near the mouth

The eastern and western side of the upper area pedologically differs significantly. The western side of the upper Gostelja basin, from north to south, is characterized by brown acidic soils on schist, lithochromatogenic soils on sandstones, rendzinas on the compacted limestones, poorly developed soils on schist (regosol), brown acidic soils on shales and sandstones and brown soils on compact limestones. The eastern side of the study area is characterized by podzolic-pseudogley slope and terraced soils and brown acidic soils on sandstones. They're separated by narrow riverbed belt of alluvial-delluvial humogley soils (Pedologic map 1: 50000).

The most of the upper Gostelja basin is characterized by a well-developed vegetation of forests of beech and abies with spruce (*Picea-Abieti-Fagetum*) and, beech and abies forests (*Abieti-Fagetum*). Due to various anthropogenic influences, the primary forest vegetation, in the lower regions is heavily modified (Beus, 1998), where they have maintained only sporadically and within the mosaic of agricultural land (Fig. 7).

In the earlier researches, an analysis of qualitative-quantitative composition of zoobenthos, based on collected rehearsals, was taken by a Surberov's network at a six locations of longitudinal profile of the Gostelja river. The results showed that the composition of macrozoobenthos is made by a 193 individuals from 20 different taxons.

The most numerous species was the Suha locality where the 41 units were registered, and the smallest number of identified units was founded in the lower part of the Gostelja, on the Đurđevik locality, only 12 units. Based on the indicators obtained by analyse of the benthos samples, it can clearly be seen a change in composition along the longitudinal profile. In its upper course, the members of the aquatic insects are dominated, such as *Ephemeroptera*, *Diptera* and *Trichoptera* with significant participation of the *Nematodes* (Adrović, 2012) (Fig. 8).



Fig. 7. Vegetation of the Gostelja upper drainage basin



Fig. 8. Macrozoobentos (Tarevčica, May 2016)

The fish diversity researches show that the Gostelja river is inhabited by 21 species from eight families. In the total sample, the largest number belongs to the family of *Cyprinidae* (11 species), the family of *Salmonidae*, *Cobitidae* and *Percidae* are represented with two species, while the family of *Petromyzontidae*, *Balitoridae*, *Cottidae* and *Centrarchidae* are represented by one specie (Table 1).

Table 1. The representation of the ichthyofauna in the streams of the Gostelja upper drainage basin

Locality	Summer-Autumn		Winter-Spring		Total	
	No. of units	%	No. of units	%	No. of units	%
Suha-Rujići	318	28,65	111	24,83	429	27,55
Zatoča	153	13,78	40	8,95	193	12,40
Stupari	186	16,76	77	17,23	263	16,89
Podgajevi	453	40,81	219	48,99	672	43,16
Total	1.110	100,00	447	100,00	1.557	100,00

Data source: Adrović, 2012: *Ribe Modraca. Ihtiološka monografija, NAMM, Tuzla*

DISCUSSION

The changes in the natural environment of the upper Gostelja basin, caused by anthropogenic influences, and related primarily to changes made by exploitation of mineral resources, forest resources and the expansion of agricultural land and settlements. In the area of the upper Gostelja basin, conditioned by the geological structure of the terrain, the technical stone (limestone) is exploited and used mostly for the construction of the lower, the roadcarrier buffer layer and for the construction of concrete and asphalt mixes. In this area, the exploitation of limestone is carried out at two sites: "Hrdar Kosa" which is located about 3 km southern of Stupari, next to the main road Tuzla-Sarajevo, and the other site, located directly on the right bank of the river Gostelja, about 2 km downstream from the Stupari settlement. It is clear that the expansion of exploitation fields completely devastates the pedologic and vegetational covering and increases the amount of suspended materials in the Gostelja river.

In this area, in 25 settlements, lives 5,064 inhabitants, or 35 inhabitants/km², of which 7 settlements are without inhabitants (Census, Bosnia and Herzegovina, 2013). There are

noticeable changes in the relief caused by anthropogenic influence. Upper basin of the Gostelja is characterized by extreme vertical relief dissection, slope inclinations and relief energy. The felling of forest trees, building settlements and road infrastructure are developing the destructive slope processes such is creeping, landsliding, dredging and creeping.

It is evident that a number of landslides are increasing, which is reflected in the development of new and reactivation of older sliding bodies of different area, and which is directly influenced by an anthropogenic factor. By the expressed, and sometimes, by a total slopes deforestation, the delluvial process is intensified, and evidence is shown as a finer sediment fractions in mountain watercourses riverbeds (Fig. 9 and 10).



Fig. 9. Fine sediment fractions in Duboki potok riverbed



Fig. 10. Intensive deforestation (Duboki potok)

The researched area is characterized by a clean air. However, the minimal violation of air quality is in lower areas and colder part of the year, and contaminants are domestic fireplaces and traffic. The numerous water pollutants were registered, but they can all be classified into two categories: direct and indirect sources of pollution. The first category refers to the waste waters. The pollution of the Gostelja river is direct consequence of the lack of development of the sewage network and absence of a system for the treatment of waste waters (Fig. 11).

Indirect pollution sources are pollutants that incur in the water courses from the soil by the underground waters and by precipitation from the atmosphere. The traffic emissions of high traffic road Tuzla-Sarajevo cannot be neglected, too. The waters in the Gostelja river and its tributaries is indirectly polluted by the numerous illegal dumps. Although, the most settlements have organized solid waste removal, the local residents still dispose the large quantities of waste in the rivers or along the rivercourse. The many sites outside of the settlements are not spared of the garbage, especially in the areas covered by forest. Based on this, we can notice that the environmental awareness of the locals is not at a satisfactory level (Fig. 12). However, by the field researches and by comparison with the previous period, it can be concluded that the today's situation is a little better. The water quality is considerably better in the tributaries, and the water from the Zatoča and Tarevčica streams is included in the water supply of Tuzla.

Based on the previous analysis, we can conclude that the Gostelja upper basin has a diverse and preserved vegetation fund. The forest resources are notable, and this is confirmed by the fact that 77% of the total study area is covered with forests. The field

researches showed that deforestation leads to the serious problems in the ecosystem, and in some areas, the soil erosion leads to a large loss of biodiversity.



Fig. 11. Direct watercourses pollution



Fig. 12. Waste disposal by the riverbeds

The western part of the basin is richer in forests, while the eastern is more populated with a higher prevalence of agricultural land. The major problem are areas that are contaminated with mines, left from the period of aggression on Bosnia and Herzegovina (1992-1995) in the eastern and southeastern parts of the study area, i.e. in the Suha basin.

CONCLUSION

Through the research, it was found that the Gostelja upper basin is characterized by a typical and preserved geodiversity, i.e. this is an area with relatively preserved natural basis, where the negative anthropogenic influence is present and which threatens to reduce the environment quality. Changes in the natural environment of the upper Gostelja basin, caused by direct anthropogenic impact, relate primarily to changes caused by exploitation of mineral resources, forest resources and the expansion of agricultural land and settlements.

Although in the numerous sites, at the smaller areas, the surface mining of limestones is present, and this type of activity in the area did not significantly reduce the quality of the natural environment, except that significantly impairs the micro-location aesthetic values. There are notable changes in the relief, caused by slope processes that have emerged as a result of anthropogenic activities. There is an apparent increase of a new landslides and reactivation of older sliding bodies of different volume, which are directly influenced by anthropogenic factors.

The quality of atmospheric complex is satisfying, while the water quality in some hydrological facilities is significantly disturbed. The water quality of the Gostelja river is the most compromised, due to the lack of a system for waste waters and the occurrences of solid waste disposal in the riverbeds. The water quality in Gostelja tributaries is satisfying as zoobenthos and ichthyofauna research has shown.

The Gostelja upper river basin has a diverse and preserved vegetation fund, particularly rich forest resources. By the field researches, it was determined that deforestation leads to a serious problems in the ecosystem. So, expressed negative anthropogenic influence can be seen in direct and indirect pollution of watercourses and uncontrolled exploitation of forest resources.

Literature and sources

- Adrović, A. 2012: Ribe Modraca, Ihtiološka monografija, NAMM, Tuzla;
- Baraković, A. i sar. 2008: Geomorfološko-hidrografska analiza sliva rijeke Tarevčice, Zbornik radova, III Savjetovanje geologa BiH sa međunarodnim učešćem, Neum, str. 513-522;
- Beus, V. 1998: Karakteristike šumske vegetacije, ANU – BiH, Simpozij Korišćenje zemljišta i vode u funkciji održivog razvoja i zaštite okoliša, Sarajevo;
- Burlica, Č. Vukorep I. 1983: Pedološka karta SR BiH, Šumarski fakultet u Sarajevu, Katedra za ekologiju šuma, Geodetski zavod u Sarajevu, štampa Geokarta Beograd;
- Čičić, S. 2002: Geološki sastav i tektonika Bosne i Hercegovine, Earth Science Institute, Sarajevo;
- Čirić, M. 1991: Pedologija, Zavod za udžbenike i nastavna sredstva, Svjetlost, Sarajevo;
- Grupa autora 2015: Plan upravljanja vodama za vodno područje rijeke Save u Federaciji Bosne i Hercegovine, Prateći dokumenta br. 7, Hidrološke analize, IPA Program Europske Unije 2011;
- Horvat I. i sar. 1974: Vegetation Südosteuropas, Gustav Fisher Verlag, Stuttgart;
- Strajin V. i sar. 1972: Osnovna geološka karta, R 1:100 000, Institut za geološka istraživanja, Sarajevo;
- Strajin V. i 1978: Osnovna geološka karta, R 1:100 000, Tumač za list Vlasenica, "Geoinženjering", OOUR Institut za geologiju, Sarajevo;
- Osnovna geološka karta 1: 100 000, Tumač za list Vlasenica L34-134, Geoinženjering, Sarajevo;
- Popis stanovništva, domaćinstava i stanova u Bosni i Hercegovini 2013: Agencija za statistiku Bosne i Hercegovine, Sarajevo, 2016.

Authors

Semir Ahmetbegović

Doctor of geographical science, assistant professor at the Faculty of Sciences and Mathematics, University of Tuzla, Bosnia and Herzegovina. In 2012. he defended PhD Thesis "Relief as population gathering factor in Bosnia and Herzegovina" on Geography Department of Faculty of Natural Sciences and Mathematics, University of Sarajevo. Author and coauthor 25 scientific and technical articles and one book.

Avdul Adrović

Doctor of biological science, professor at the Faculty of Sciences and Mathematics, University of Tuzla, Bosnia and Herzegovina. In 2007. defended PhD Thesis "Biodiversity and ecological characteristics of ichthiipopulation in hydroacumulation of Modrac" on Biology Department of Faculty of Natural Sciences and Mathematics, University of Sarajevo. Author and coauthor of over 60 scientific and technical articles, one university publication and three chapters in international publications.

Elvir Babajić

Doctor of geological science, assistant professor at the Faculty of Mining, Geology and Civil engineering, University of Tuzla, Bosnia and Herzegovina. In 2009. defended PhD Thesis "Petrological-geochemic and geotectonic characteristics of Krivaja-Konjuh ofiolite complex" on Geology Department of Faculty of Mining, Geology and Civil engineering, University of Tuzla. Author and coauthor numerous scientific and technical articles.

Senad Gutić

Magister of geographical sciences, elected for associate assistant at the Faculty of Sciences and Mathematics, Department of Geography in Tuzla, scientific field Physical geography. Author and coauthor of several Physical geography scientific and professional papers.

Željka Stjepić Srkalović

Magister of geographical sciences, graduated at the Faculty of Sciences and Mathematics, University of Tuzla. Elected for associate assistant at the Faculty of Sciences and Mathematics, Geography Department in Tuzla, scientific field Physical geography. Author and coauthor of several scientific and professional papers published in scientific journals.