



## ZALOMKA AND EASTERN HERCEGOVINA SOILS

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### ABSTRACT

Soil is one of the basic natural resources, and as a natural good in functions in plant production for food production. The territory of the Republic of Srpska is divided into two river basin districts: 1. River Sava basin with rivers: Una, Vrbas, Ukrina, Bosna, Drina, and 2. The regional river basin of the Trebišnjica river consists of river basins: the Trebišnjica basin and the Neretva basin. Gacko and Nevesinje field is a karst field and is virtually the only oasis of arable land in the region studied. Nevertheless, nothing significant has been done in this area over the past decade to protect land resources from damage and permanent destruction. The entire area of the Gacko and Nevesinje fields has a karst character and is scarce with surface watercourses, especially in the summer months. Zalomka is an underground stream. It springs at the Gacko field, and in the upper stream, it is also called Djeropa. Zalomka stretches across the Nevesinje field and it springs in numerous sinks. During the dry period, Zalomka gets dry, while in the humid, rainy, period it is richer in water. Watercourses in this area are particularly full in the spring after snow melts. When the time of drought occurs afterward, only the deepest sinks remain for a long time filled with water. So the sink of Zalomka has got always water in its middle course and makes it one of the most important summer water reservoirs. Profile No. 13 represents the fluvial soil of the studied area (Gradina site). The construction of the reservoirs Nevesinje and Zalomka on the river Zalomka (whose waters flows in underground stream towards the spring of Buna and Bunica) will also provide protection form the floods of the now endangered, primarily, agricultural areas of the Gacko and Nevesinje Fields.

**KEY WORDS:** Zalomka, underground stream, fluvial soil

### Introduction

Soils are very complex and diverse ecosystems that serve many functions, including future food production, with the ability to provide long-term service to people. Soils are property of all generations of the humane population and the care for its preservation should be the obligation of all its users (Resulović, 1986; Fušić, 1989; Kopittke et al., 2019).

The Republic of Srpska has about 0.85 ha of agricultural soil per capita, of which about 0.60 ha is arable (ploughland, gardens, orchards, vineyards, meadows) i.e. about 0.40 ha of ploughland and gardens. Currently, only about 0.20 ha per capita is cultivated. The above data show that the degree of utilization of the natural resources in the Republic of Srpska is low with a trend of reduction. Throughout the world, the surface of 0.10 ha of arable land per capita is considered the lower limit (Agricultural Development Strategy of the Republic of Srpska until 2015). Annual losses of soil, in the Republic of Srpska, in the process of its destruction, amount to more than 1,500 hectares (Nature Protection Strategy of the Republic of Srpska). In Bosnia and Herzegovina, according to NEAP's data for 2003, 900 ha disappears in open pits and 300 ha in dumps annually.

The territory of the Republic of Srpska is divided into two river basin districts: 1. River Sava basin with rivers: Una, Vrbas, Ukrina, Bosna, Drina, and 2. The regional river basin of the Trebišnjica river consists of river basins: the Trebišnjica basin and the Neretva basin (Integrated Water Management Strategy of the Republic of Srpska, 2015).

Gacko and Nevesinje field is a karst field and is virtually the only oasis of arable land in the region studied. Nevertheless, nothing significant has been done in this area over the past decade to protect land resources from damage and permanent destruction (Tunguz, 2015).

### Characteristics of the studied areas

Besides the uniformed look, the geological structure of this karst's area is very different. Basic geological structure is made of Mesozoic carbonate rocks but they are different to petrographic

characteristics. From quarter sediments and alluvium sediments are present as well as lake sediments. In RS there are three different climate zones, without strongly marked borders such as the abstemious area of North Bosnia and Posavina, central mountain area of central Bosnia and maritime influence area of Hercegovina. Average rainfall is quite significant, around 1250mm but very disadvantaged area as per rainfall and weather conditions. Rainfall is very limited in areas with the best quality soils (Semberija, Posavina, around 700/750mm) while the highest level of rainfall is in karst areas of Dinaridi (over 1500mm). Limited rainfall is recorded during the most needed periods for water, especially present in maritime influence areas where rainfall levels are highest during the winter period (Integrated Water Management Strategy of the Republic of Srpska, 2015).



**Figure 1.** External morphology of fluvial soil at Gacko in autumn (Tunguz, 2018)



**Figure 2.** External morphology of fluvial soil near Nevesinje in spring (Tunguz, 2018)

The Climate of the wider area of Gacko is the continental mountains climate, which means long and cold winters (from the second half of November to the first half of April with temperature occasionally reaching  $-30^{\circ}\text{C}$ ) and very short summers (June to August) with temperature sometimes reaching above  $30^{\circ}\text{C}$ . The biggest studied area is covered by grazing grasslands and some natural grass fields (Tunguz, 2015).

In the past, this area was covered by barley, rye and oat fields while today these areas are used mostly for cattle grazing. In the area of the Herzegovina karst, especially in the Trebisnjica basin, the surface hydrographic network is very poorly developed. Based on the geological structure of the terrain, smaller streams often subside and the downstream water flows from the higher horizons to the lower (Development Strategy of the Municipality of Gacko 2010-2020).

During the dry period, Zalomka gets dry, while in the humid, rainy, period it is richer in water. Some of the waters that spring in the Nevesinje field appear on the spring of the Buna River. Watercourses in this area are particularly full in the spring after snow melts. When the time of drought occurs afterward, only the deepest sinks remain for a long time filled with water. So the sink of Zalomka has got always water in its middle course and makes it one of the most important summer water reservoirs (Tunguz, 2015).

### Field Research

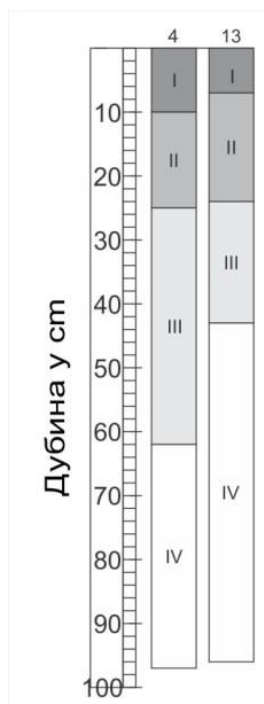
A topographic map 1: 25000 (TK-25) was used for determining the position of the profiles, sheets: Rilja, Slato, Nadanići, Gacko, Donja Meka Gruda, Stepeni, Vratkovići (VGI, 1972-1975). The external and internal morphology is described for all pedological profiles (Munsell Soil Color Charts, 1954), soil samples in a disturbed state were taken for all genetic horizons and described (Škoric et al., 1985). Soil samples in undisturbed conditions were taken from individual genetic horizons, in three repetitions, by cylinders of Kopecký. The average soil samples were taken too (Belić et al., 2014).

### Fluvial soil

During the studied area, two profiles of fluvial soil were open, and profile no. 13 represents the fluvial soil of the studied area (Gradina site).



**Figure 3.** External morphology of fluvial soil at the site Gradina, between Gacko and Nevesinje (Tunguz, 2015)



**Chart 1.** Average horizons depths of fluvial soil (Tunguz, 2015)

The minimum value of Amo-horizon is 7.00 cm, maximum 10.00 cm (Chart 1), and mean value of Amo-horizon 8.50 cm. The minimum value of the I-layer is 15.00 cm, 17.00 cm maximum, mean value of I-layer is 16.00 cm. The minimum value of II-layer is 19.00 cm, 37.00 cm maximum, mean value of II-layer is 28.00 cm. The minimum value of C-horizon is 35.00 cm, 53.00 cm maximum, mean value of C-horizon is 44.00 cm. The prevalence of this type of soil in the studied region is not great due to the extremely hilly-mountainous terrain and large space occupied by karst. These soils were formed at the foot of the hills and mounds in the narrow river valleys by bringing material in erosion processes, sedimentation and displacement by the watercourses. The recent river deposit, due to the permanent deposition of fresh suspensions, does not have a developed humus horizon (up to 10 cm), the reduction processes in it are poorly manifested or completely absent in the profile. Soils from this group are characterized by the presence of layers at different depths. The depths of both profiles do not exceed more than 100 cm (Tunguz, 2015).

In the soils formed on the layered alluvial or diluvial drifts, horizons are masked by stratification of the parent material itself. Therefore, in the study of their morphology, profile differentiates into layers that are marked by Roman Numerals: I layer, II layer and so on. The same marks are used to indicate lithological continuity. If there is evidence of lithological discontinuity, the Roman numeral: I C, II C or A-E II B, etc. is placed with the mark of the horizon where a change occurs. The frame of the soil profiles may be emphasized differently. In one case, horizons are clearly observed in the soil profile, and in the second, they are poorly manifested. This depends mainly on the type and age of the soil and the characteristics of the parent substrate. In the younger soils, the genetic horizons are poorly emphasized (Dugalić and Gajić, 2012).

#### Profile 13

Location: Gradina

Altitude: 945 m

Relief: flat

Vegetation: meadow

On the pedological map of BiH R 1:50000 soil described as: Alluvial-delluvial gley soil AD<sup>G</sup>



**Figure 4.** Internal morphology of fluvial soil (Tunguz, 2015)

Order: Hydromorphic soils  
Class: Layers or undeveloped (A)-G or (A)-C  
Type: Fluvial or alluvial (fluvisol)  
Subtype: Carbonate  
Variety: Medium deep  
Profile: Amo-I-II-C  
Form: Loam - Pell- PeGIII

(A) (0-7 cm) - mollic, accumulative-humus horizon, light brown (10 YR 4/4) when dry and when wet brown color (10 YR 3/2). Texture is loam, powdery structure, calcareous, strongly imbued with veins of vegetation.

I (7-24 cm) –Layer of light brown color (10 YR 4/4) when dry and when wet brown color (10 YR 3/2). Texture is loam, powdery structure, calcareous, imbued with veins of vegetation.

II (24-43 cm) –Layer of light brown color (10 YR 5/4) when dry and when wet brown color (10 YR 4/3). Texture is sandy loam, crumb structure, calcareous.

C (43-96 cm) –Layer of light brown color (10 YR 5/4) when dry and when wet brown color (10 YR 4/3). Texture is sandy clay loam, crumb structure, calcareous.

#### Profile 4

Location: Zalom

Altitude: 920 m

Relief: flat

Vegetation: meadow

On the pedological map of BiH R 1:50000 soil described as: Alluvial-delluvial gley soil AD<sup>G</sup>





**Figure 5.** Internal morphology of fluvial soil (Tunguz, 2015)

Order: Hydromorphic soils  
Class: Layers or undeveloped (A)-G or (A)-C  
Type: Fluvial or alluvial (fluvisol)  
Subtype: Carbonate  
Variety: Medium deep  
Profile: (A)-I-II-C  
Forms: loamy

(A) (0-10 cm) - mollic, accumulative-humus horizon of brown color (2.5 YR 3/4) in the dry and in the wet brown color (2.5 YR 2/4). Texture is loamy, powdery, carbonated, heavily permeated with veins of vegetation.

I (10-25 cm) - layer of brown color (2.5 YR 3/4) in the dry and in the wet brown color (2.5 YR 2/4). Texture is loamy, powdery, carbonated, permeated with veins of vegetation.

II (25-62 cm) - layer of brown color (2.5 YR 3/2) in the dry and in the wet brown color (2.5 YR 2/2). Texture is powdery loam, crumbly structure, carbonate.

C (62-97 cm) - layer of brown color (2.5 YR 3/2) in the dry and in the wet brown color (2.5 YR 2/2). Texture is powdery loam, crumbly structure, carbonate, skeletal.

In Nikšić field surface waterways exist, primarily due to the coverage of karst rocks with impermeable sediments (clay). Likewise, the waterways were disappearing in abysses relatively quickly on the peripheral parts of the field (Study of nature protection, Nikšić, 2014).

## Conclusion

The construction of the reservoirs Nevesinje and Zalomka on the river Zalomka (whose waters flows in an underground stream towards the spring of Buna and Bunica) will also provide protection from the floods of the now endangered, primarily, agricultural areas of the Gacko and Nevesinje Fields. In karst fields, a very important factor in forming some types of soil is water that stagnates on lower terrains and especially in depressions as underground or “upper” groundwater. Extremely uneven regimes in space and time require the implementation of very complex integral water management systems, with various degrees of accumulations of flow regulation, and with the shifting of water to greater distances.

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## Zalomka i zemljišta istočne Hercegovine

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### SAŽETAK

Zemljište je jedan od osnovnih prirodnih resursa koje kao prirodno dobro u biljnoj proizvodnji služi za proizvodnju hrane. Teritorija Republike Srpske je podjeljena na dva oblasna riječna sliva: 1. Oblasni riječni sliv Save, koga sačinjavaju riječni slivovi: Une, Vrbasa, Ukrine, Bosne, Drine, i neposredni sliv Save. 2. Oblasni riječni sliv Trebišnjice sačinjavaju riječni slivovi: sliv Trebišnjice i sliv Neretve. U protekloj deceniji na ovom području nije urađeno ništa značajno na zaštiti zemljišnih resursa od oštećenja i trajnog uništenja. Cijelo područje Gatačkog i Nevesinjskog polja ima karstni karakter i oskudno je površinskim vodotocima, posebno u ljetnim mjesecima. Zalomka izvire u Gatačkom polju, u gornjem toku naziva se i Đeropa. U sušnom periodu Zalomka presuši, dok je u vlažnom, kišnom periodu bogatija vodom. Vodotoci u ovom kraju su posebno puni u proljeće nakon otapanja snijega. Ljeti samo najdublji ponori ostaju dugo ispunjeni vodom. Korito Zalomke uvijek ima vodu u svom srednjem toku i čini ga jednim od najvažnijih ljetnjih rezervoara vode. Tokom proučavanog područja otvorena su dva profila fluvijalnog zemljišta, a profil br. 13 predstavlja fluvijalno zemljište proučavanog područja (lokacija Gradina).

**KLJUČNE REČI:** Zalomka, ponornica, fluvijalno zemljište