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The Influences of Anthropogenic Activities on Soil Characteristics and Hydrogeological Regime on the Lower Course of the Bega River

Ioana Alina Creţan [1]   Vasile Gherman[1]

Abstract: In the low plain of the Bega River Basin, the anthropogenic influences manifested since the second half of the eighteenth century and imposed by the need to carry out surface drainage works of areas covered by swamp favoured the accumulation of harmful salts in the soil due to slow flow of the groundwater. The main component of groundwater composition is sodium followed by magnesium and calcium, and as anions we find bicarbonates and sulphates. A major influence over the qualitative evolution of the soil profiles is generated by the groundwater bodies. On the lower course of the Bega river were identified the groundwater bodies: GWBA 01, GWBA 02, GWBA 03, GWBA 04 located in the plain area in alluvial deposits (sands, gravels, silt, subordinate marl and clay intercalations) of quaternary age. The chemical analyses of the water samples collected from the quality monitoring boreholes, revealed exceedances of the maximum allowed concentration values, according to the regimentations of the Law on the quality of the drinking water no 458/2002 for the indicators: manganese, sodium and chlorine, therefore GWBA 01, GWBA 03, GWBA 04 are subject to qualitative risk.

Keywords: groundwater bodies, monitoring, water and soil pollution.

1. INTRODUCTION

The Bega Hydrographic Basin is located in western Romania, occupying the northern part of the Banat Hydrographic Area.

The largest part of the Bega Catchment Area extends to the geological structures of the Western Plain. The relief of the plains section crossed by the Bega River and its tributaries presents certain particularities such as the descent in steps in the east-west direction, each of these steps representing phases of stagnation of the waters of the Panonic Lake in retreat. We can differentiate the following: the step of the under the hill plain, the step of the tabular plain and the step of the subsidence plain, the first two representing high portions, over 100 m altitude, covered with loess and generally protected from floods, and the last one is in the form of a low sector, 80-90 m, in the past a marshy plain with divergent waters [1]. At the same time, this plain is also characterized by the existence of an extensive and smooth interfluvial fields resulting from the transformation of the terraces.

The Western Plain has a simple petrographic constitution. Above the crystalline blocks of the foundation sedimentary formations have been formed belonging to the Tartonian (sands, clays, limestone, sandstone), the Sarmatian (marls, sands, sandy marls), the Panonian (marls, clays, sands, gravels); Quaternary age deposits (gravel, sands, clays, red clay, loess) cover the entire plain.

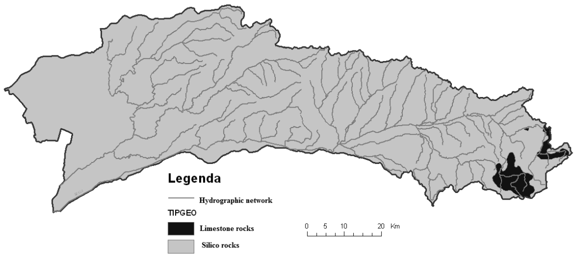

Figure 1. Catchment area for the River Bega - geology

Indeed the rock through the high volume conferred to the soil 80-90%, influences its genesis; detailing this aspect we can say that the physical composition of the parent rock determines the thickness of the soil, the granulometric composition, the physical-mechanical and hydro-physical properties, and the petrographic nature influences the mineralogical, chemical composition and the regime of accumulation and circulation of soluble substances in the soil, conditioning the pedogenic processes and fertility level.

The soil profile is strongly influenced by the hydrological factors because the water entering the rock participates in different chemical reactions, causing the rock to disintegrate, these actions resulting in alteration of the mineral and organic substances in the soil [2]. Due to the circulation of water, soluble salts, bases, mineral and organic colloids are displaced and the exchange of nutrients between soil and plant takes place. Pedophreatic waters are an important element in characterizing the set of pedogeographic factors due to their high level.

According to Ianoş [3], the groundwater in the Bega Hydrographic Basin generally presents an east-west flow direction, with slight local variations to the

[1] Politechnica University of Timişoara,, Faculty of Civil Engineering, Department of Hydrotechnical Engineering, George Enescu Street, no.1A, Zip code 300022,Timisoara, Romania

collecting valleys, presenting a drainage slope of 3 ‰, in the Piedmont plain and from 1,5 - 0,2 ‰ in the depths of 0.5-5 m, as opposed to the Piedmont and mountain areas where the water drops to 5-10-20 m depth. From the point of view of the degree of mineralization, a differentiation is observed depending on the soil lithology so that it takes values from 0,5 g/l in sandy areas, 11,5 g/l in loess materials and 35 g/l in areas with salted soils. The main component of their composition is sodium followed by magnesium and calcium, and as anions we find bicarbonates and sulphates. The critical depth of pedophreatic water positioning is correlated by Florea with the total concentration of salts being the main cause of the occurrence of salted soils which in combination with the area lithology and geomorphology explains the insular appearance of the halomorphic soils.

In 1977 Ungureanu drew up a map of the hydrochemical characteristics of the groundwater in the Banat Plain, and in the low plain of the Bega River Basin we find bicarbonate-sodium, bicarbonate-magnesium and bicarbonate-chloride-type waters with calcium, magnesium, magnesium, sodium subtypes, calcium, sodium-magnesium and calcium-magnesium.

Another determining factor in the qualitative evolution of the soils in this area is the anthropic present from the second half of the 18th century due to the desiccation works of the marsh-covered territories, which favoured the accumulation in the soil of harmful salts due to the slow circulation of groundwater, a process that has accentuated with the development of society and the emergence of pollution phenomenon from different domestic, Western Plain. In this plain, the aquifer layer directly influences the soil profile, because it is found at industrial or hydromorphological sources [4].

2. MATERIALS AND METHODS.

A major influence on the qualitative evolution of the soil profiles is the groundwater bodies. According to the Framework Directive 60/200/EC when delimiting groundwater bodies, only bodies with exploitable flows greater than 10 m^3/day were taken into account, in the delimitation process, the geological, hydrodynamic and quantitative criteria also intervene the quality of water bodies. Thus on the lower course of the Bega river, the groundwater bodies were identified: GWBA 01, GWBA 02, GWBA 03, GWBA 04 located in the plain area in alluvial deposits (sands, gravels, silt, subordinate marl and clay intercalations) Quaternary age. GWBA 01 and GWBA 02 are cross-border in nature.

In order to know the quality of the groundwater resources, data from:

- local drilling networks for pollution monitoring;
- drilling of the national monitoring network;
- various works related to the exploitation of groundwater.

The chemical analysis of the water samples collected from the quality monitoring boreholes, revealed exceedances of the CMA values, according to the provisions of the Law on the quality of drinking water no. 458/2002, on the indicators of oxidability, ammonium, nitrates, nitrates, sulphates, iron, manganese, sodium and chlorine so that GWBA 01, GWBA 03, GWBA 04 are subject to qualitative risk.

Table 1

Cod/ name	**Surface (mp)**	**Geological/hydrogeological Characteristics**			**Pollutants**	**Overall protection degree**	**Risks**		**Cross-border/Country**
		Type	**Under pressure**	**Covering layers**			**qualitative**	**quantitative**	
1.GWBA01/ Lovrin-Vinga	1376/ ?	Porous	Nu	1,0 – 3,0	Industrial Agrarians	Medium	Yes	No	Yes/ Serbia
2.GWBA02/ Fibis	782	porous	Nu	3,0 – 10,0	Agrarians	Good, Very good	No	No	Nu
3.GWBA03/ Timisoara	2577/ ?	porous	Nu	3,0 – 5,0	Industrial Agrarians Domestically	Medium, good	Yes	No	Yes/Serbia
4.GWBA04/ Lugoj	1702	porous	Nu	3,0 – 5,0	Industrial Agrarian	Medium, good	Yes	No	No

3. RESULTS AND DISCUSSIONS

For the groundwater body GWBA 01 (fig.nr.1), in 2002 there were exceeded the CMA value in the indicators of: oxidability (Valcani locality), sodium (Biled, Lovrin, Sânpetru Mare, Uiheiu Valcani localities), sulphates (Ohaba Lunga and Teremia Mare localities), chlorides (Lovrin, Ohaba Lunga, Teremia Mare localities), iron (Becicherechu Mic, Biled, Bulgăruş, Calacea localities), ammonium (Becicherecu Mic, Calacea, Dudeştii Noi, Gottlob localities) and nitrates (Periam locality).

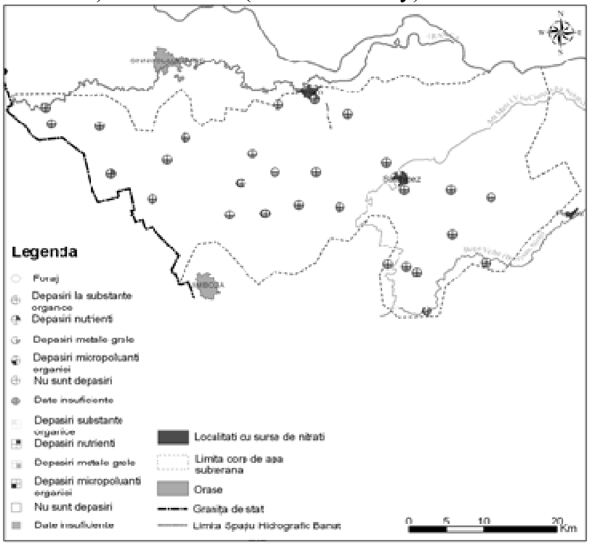

Figure1. Underground waterbody at risk GWBA01 [6].

In this area we find soils of the Cernisoils class, in particular gleic Chernozem along with the vertex-gleic and vertex-sodium; Cambic and gleic Chernozem and on small portions appear Argic Chernozem and in the same class with Chernozem we find Faeoziom but on smaller portions. In the form of island areas we find Solons in the Salsodisoils class and also on smaller portions occupy Preluvosoil and Luvosoil in the Luvisoils Class.

For GWBA 02, there are exceedances of the CMA in the oxidability (Sustra), iron (Pischia, Sustra localities), manganese (Giarmata, Pischia, Sustra localities), ammonium (Masloc, Sustra localities) and nitrogen (Masloc localities) indicators.

At GWBA 03 (fig. No. 2), the excesses of the CMA are recorded in the indicators of oxidability (Banloc, Bild localities), sodium (Becicherecu Mic, Biled, Jimbolia, Urseni localities), sulphates (Jimbolia and Otelec localities), chlorides (Bild, Cebza-Ceacova, Cenei, Otelec and Urseni localities), iron (Banloc, Becicherecu Mic, Beregsău Mare, Biled localities), manganese (Cebza-Ceacova, Cenei, Jebel, Jimbolia, Liebling localities), ammonium (Jimbolia, Moraviţa, Otelec localities) and nitrogen (Birda and Moravita localities).

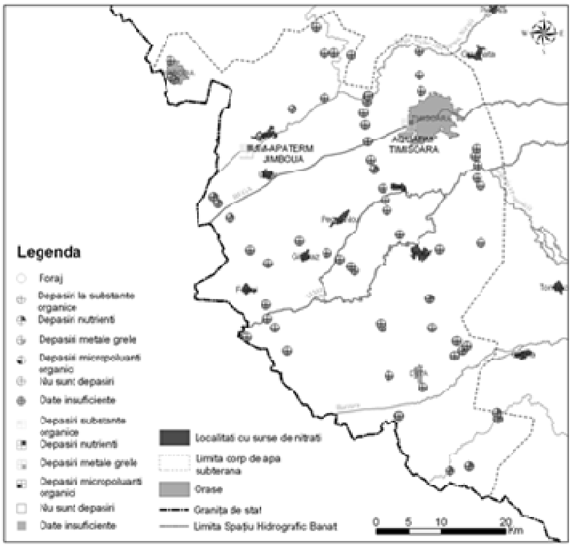

Figure 2. Underground water body at risk GWBA03 [6].

The main types of soils that are above this groundwater body are Chernozems associated with Solonet or Eutricambosols; Phaeosomes that may be adjacent to Preluvosols; Gleiosols and on small portions Vertosoles and Aluvioslores.

GWBA 04 (fig.nr.3) registers exceedances of the CMA at the oxidability indicators (Gâvojdia, Hitiaş, Margina, Remetea Mare localities), iron (Balint, Caransebeş, Chevereşu Mare, Sustra localities), manganese (Balint, Caransebeş, Gavojdia localities), ammonium (Balint, Sustra localities) and nitrogen (Margina locality).

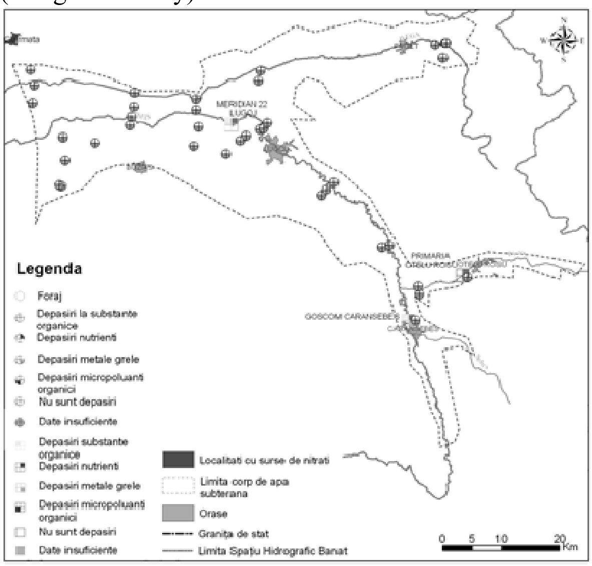

Figure.3. Underground waterbody at risk GWBA04 [6].

These changes in the quality of the groundwater influence the soils of the Luvisoils, Preluvosoils and Luvosoils class, the soils of the Protisols class, namely the Aluviosoils and the restricted areas, also influence the Stagnosoils and Eutricambosoils.

In the determinations made, there are still difficulties related to the fact that not all parameters are monitored according to the Framework Directive [5,6]; the insufficient knowledge of the possible polluting emissions for the groundwater bodies; the effects of all types of pressures depending on the coating layer are not known; The evolution of groundwater levels is not known for some unexpected catchments with monitoring system.

Also, a number of uncertainties are caused by:

- the small number of physico-chemical analyses taken into account when assessing the qualitative risk;
- uneven distribution of quality monitoring points;
- non-existence of protected areas at all catchments.

4. CONCLUSIONS

Due to the intensive improvement work carried out in this area, especially drying, the soil profiles have undergone changes in their composition, most often manifesting the phenomenon of gleization. The process of salt migration in soil profile, especially of sodium in the upper horizon, was also emphasized. To this was added the phenomenon of pollution that seriously affected the quality of groundwater in this area being present 3 bodies of groundwater subjected to qualitative risk, as shown by the data from the monitoring network.

Most soil types have undergone transformations. Chernozems in this territory are mostly hydromorphic (12.03%). In the central and western sector, limestone Chernozem appears and in the Low Plain of the Torontal and southwest of the Timiş Plain, the Chernozem appears. Also in the entire low western plain are saline-sodium Chernozems spread in Varias, Biled, Satchinez, south of Sânandrei, Sânmihaiu Român, Diniaş, Ionel, Parţa localities and in areas with finely textured parental material such as Diniaş, Foeni, Ionel, Moravita localities appear associated with Solonets. Saline cambic Chernozem (sulphates, chlorides) appear in the low subsidence plains on restricted surfaces.

We can say that on the lower course of the Bega River there is a permanent danger of salting due to the high level of groundwater associated with the exudative water regime. There are no special problems regarding drinking waters.

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