

ANALYSIS OF THE MOLDAVIAN PLATEAU POTABLE WATER SOURCES QUALITY PARAMETERS

ANALIZA PARAMETRIILOR DE CALITATE LA SURSELE DE APĂ POTABILĂ DIN PODIȘUL MOLDOVENESC

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Abstract. Potable water sources worldwide have started to decline in volume and deteriorate in quality. This situation is present in Romania, in the plain and plateau area of Moldova. This area has a small number of viable drinking water sources from groundwater, rivers and lakes. Rural settlements in this area are the most affected by the lack of unpolluted water sources. The natural pollution occurs due to the nature of the rocks from the water sources' site, where the presence of sulphates and chlorides is predominant. The researches show exceedings to almost the entire nutrient group. The highest concentrations of nitrates are recorded in the Jijia and Bahlui hydrographic basin. The analyses carried out in Iași area regarding the groundwater quality parameters have highlighted high concentration of sulphates. This exceeds the standardised value so that the groundwater source is improper for catchment and usage as drinking water for the population.

Key words: water scarcity, pollution, hydrological parameters

Rezumat. Sursele de apă potabilă la nivel mondial au început să se diminueze ca volum, iar calitatea să se degradeze. Această situație este prezentă în România, în zona de câmpie și podiș a Moldovei. Acest areal dispune de un număr redus de surse de apă potabilă viabile provenite din subteran, râuri și lacuri. Localitățile rurale din acest areal sunt cele mai afectate de absența surselor de apă nepoluată. Poluarea naturală este dată de natura rocilor din amplasamentul surselor de apă, unde prezența sulfatilor și clorurilor este preponderentă. Cercetările efectuate arată depășiri la aproape toată grupa de nutrienți. În bazinele hidrografice ale râurilor Jijia și Bahlui se înregistrează concentrațiile cele mai mari de azotați. Analizele efectuate în zona municipiului Iași privind parametri de calitate ai apei subterane au evidențiat concentrația ridicată în sulfat. Aceasta depășește valoarea standardizată, astfel că sursa subterană este improprie captării și folosirii ca apă potabilă pentru populație.

Cuvinte cheie: reducerea surselor, poluare, parametri hidrologici

INTRODUCTION

The quality parameters of water sources from the Moldavian Plateau are a constant concern in the water supply systems management. The way in which available water resources are being used, the human activity carried out and the natural factors present in the catchment area directly affect the quality of water

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from aquifers and rivers downstream sections.

Among the elements with degradation potential for water quality parameters it can be mentioned: mining activities, action of hydrotechnical works (river regulation works, dams, dikes, micro hydro power plants, intakes), wastewater discharge from localities and industry, road structure works, the animal husbandry farms density, the use of pesticides and fertilisers in agriculture, the lack of rural sewerage systems, inadequate waste management etc.

MATERIAL AND METHOD

The research material consists of the characteristics which define the Moldavian Plateau (fig.1) and how they affect the water sources confined in this geographic space.

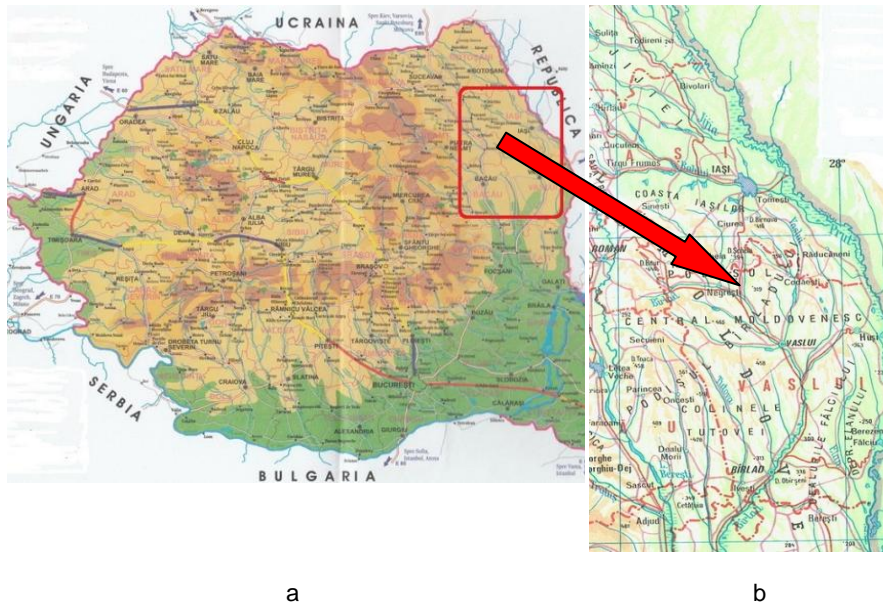


Fig. 1 Framing of study areas in the Moldavian Plateau and Plain:
a - location of the study area; b - physical map of the study area

In the analysed area relief forms resulted from erosive slope processes (landslides, layers caving-in, drainage or torrential bodies formation in the shape of ravines) are found, which chemically influence the quality of confined underground and surface water.

The Moldavian Plateau geomorphology determines the collection and chemical quality of water from groundwater and surface sources. In the analysed area, the relief consists of "low hills", which are hilly surfaces characterised by altitudes less than 200 m and "medium hills", for which the altitude is between 350 and 200 m (fig. 2). The hills are bordered by numerous versants with ridge aspect which allow erosion formation and the transport of alluvial material (Encicl. Geogr., 1982).

The research method aims to highlight and analyse the parameters which influence the water sources quality in the studied area. The geotechnical and

hydrogeological characteristics of the Moldavian Plateau influence the water resources from their way of formation, through usable volumes, physico-chemical and bacteriological parameters. Geotechnical characteristics also influence the depth of catchment facilities, the complexity of treatment plants, the investment costs and the final price of water distributed to consumers.

RESULTS AND DISCUSSIONS

The Moldavian Plateau area extends over two large hydrographic basins: Prut and Siret (fig. 2). The only surface water sources with acceptable quality and quantity parameters in this area are Prut, Moldova and Siret rivers. However, these rivers do not meet quality requirements imposed by the standards in force in all the catchment sections or during a whole year. Groundwater and surface water resources in the Prut River basin are characterised by a significant and variable content of chemicals.

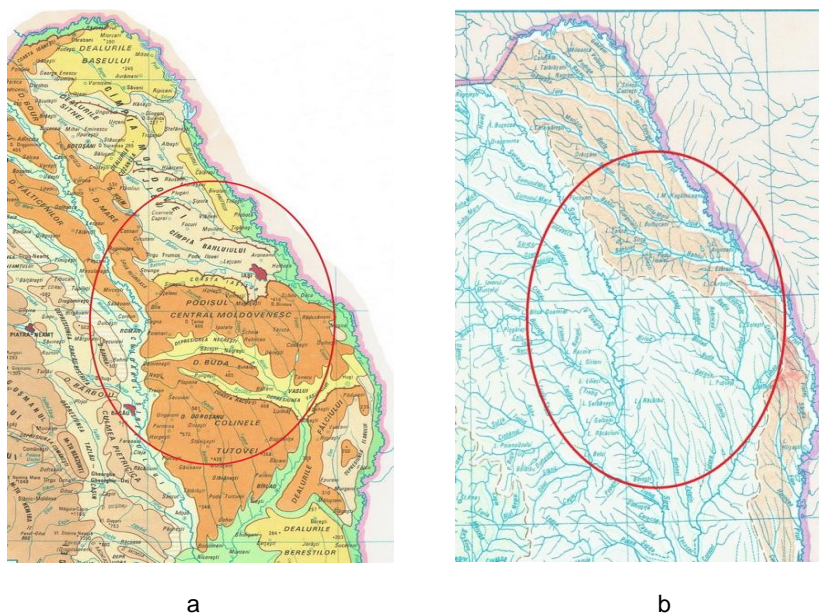


Fig. 2 Study area framing in the Moldavian Plateau and Plain relief and hydrography:
a – relief features in the study area; b – study area hydrography.

The groundwater and surface water quality parameters result from the monitoring activity. The data from continuous monitoring of water sources indicates the state, consequences and possible directions of action which can be taken for the qualitative remediation of water bodies. Monitoring results often reveal the risk situation in which water sources fall, largely due to the degradation of quality parameters under natural and anthropic actions. The lack of continuous surveillance of groundwater and surface water leads to the amplification of this phenomenon.

Prut - Bârlad hydrographic area is characterised by surface water sources amounting to 3661 mil. m³/year, of which approximately 960 mil. m³/year can be used. It includes 72 storage lakes with a total usable volume of 614.85 mil. m³. The estimated groundwater resources are 251.4 mil. m³, of which phreatic ones total 35.7 mil. m³ and the depth ones 216.7 mil. m³. The water volumes confined in this hydrographic space are low and have an uneven temporal and spatial distribution, which is below the national average (ABA Prut-Bârlad, 2016).

Prut River basin groundwater is found in sandy deposits with clayey interlayers and gypsum horizons. The lithological conditions, correlated with the presence of salts from soils washed by precipitation and infiltrated in the groundwater, determine the groundwater's sulphated character, with high mineralization and hardness degree. Some water resources are found in river beds but have a low flow rate.

Approximately 75% of the available water resources in Iași County come from surface sources and the remaining 25% from groundwater sources. The total potential and technical resources usable from 2011 to 2014 varied annually with values between 6 and 20 million m³ (fig. 3).

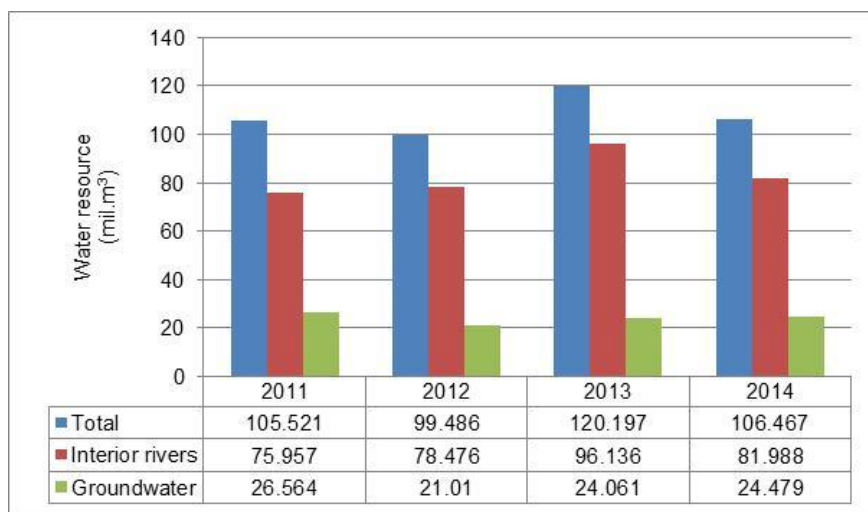


Fig. 3 Iași County - available water resources (ABA Prut-Bârlad, 2016)

The year 2013 is marked by the largest recorded value of the total water resource used in the urban and rural water supply systems. However, out of 120.197 million m³, only 24.061 million m³ are groundwater resources, the remaining 96.136 million m³ coming from interior rivers. In all the years studied it is noticed that the volume of groundwater varies in a tight range compared to the evolution of volumes from interior rivers. This phenomenon occurs irrespective of the total water resource's ascending or descending evolution.

The water demand evolution during 2011-2014 shows a steady increase, with

a slight decrease in 2012. However, the extraction fails to cover the water requirement of all consumption categories. The water volumes extracted for population and industry are decreasing. At the same time, those for agriculture have increased by about 45% in 2013 and have remained constant around 57-58 million m³. Figure 4 shows the evolution of water volumes extracted for population, agriculture and industry. The values evolution is justified on the one hand by investments in water infrastructure, which have significantly reduced the losses (reflected in the decrease in consumption for the population and industry) and on the other hand by the irrigation systems' expansion which have led to increased agricultural water consumption.

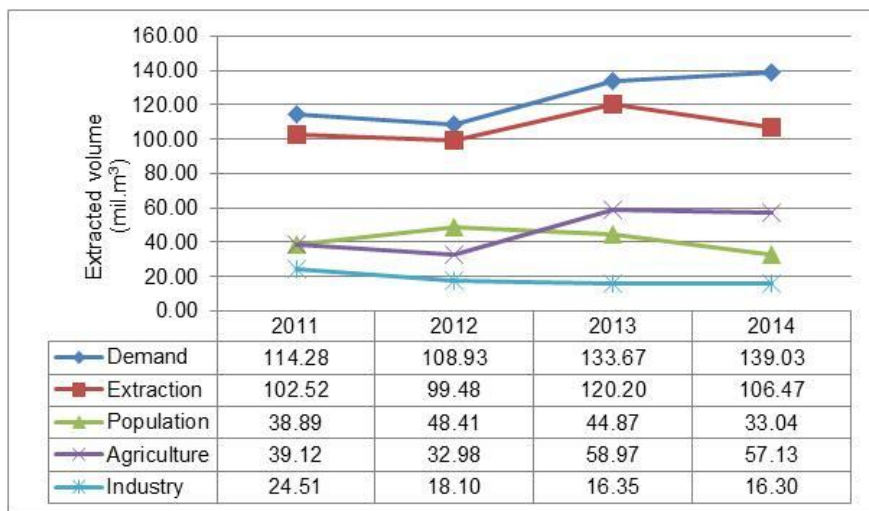


Fig. 4 Volumes extracted by activity type (ABA Prut-Bârlad, 2016)

From the total of seven groundwater bodies monitored, only four are characterised by good chemical status, the other three having a poor chemical status. In terms of surface water, the quality of lakes' water is classified as "not meeting the quality objective" in a moderate degree, and in terms of ecological potential, only two water bodies out of six "meet the quality objective". The ecological status of Prut basin rivers, assessed in relation to the total length, shows that 48.85% are in good ecological status, 36.12% in moderate status and 20.03% in poor status (Administrația Națională "Apele Române", 2016).

The lack of investments in the extension of sewerage systems and in the upgrading and rehabilitation works for the waste water treatment plants is felt significantly in the Moldavian Plateau space. These elements are risk sources which affect the quality parameters of water confined in the study area. Prut - Bârlad hydrographic basin is characterised by a high risk potential caused by the human settlements not connected to sewerage systems (77.03% of the 1341 identified negative impact factors), followed by the risk of waste water evacuation

from treatment plants (6.64%) (ABA Prut-Bârlad, 2016). In addition to these hazards, geomorphological pressure factors (regulation works, dykes, dams construction) sum up to 14.62% of the 1341 identified factors.

CONCLUSIONS

1. Worldwide drinking water sources have begun to decrease in volume and their quality to deteriorate, situation also present in Romania, especially in the Moldavian Plateau.

2. Human factors, such as the lack of sewerage systems, the animal husbandry farms development, and natural ones, such as the characteristics of the rocks found in the establishment areas, have led to significant changes in the quality of water bodies with potential for human consumption.

3. The situation of drinking water sources in the Moldavian Plateau is a continuous challenge in the water supply systems management, in terms of optimal use of good quality available volumes.

4. In the context of the continuous development of the water supply systems in the rural areas of the Moldavian Plateau, it is necessary to make complementary investments in centralised sewage systems and waste water treatment plants in order to protect the quality parameters of water sources.

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