GROUND WATER QUALITY FROM PRIVATE WELLS. CASE STUDY: TARNA MARE - SATU MARE COUNTY

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Abstract. **Ground Water Quality from Private Wells. Case Study: Tarna Mare - Satu Mare County.** The purpose of the present research was to assess the ground water quality from nine private wells from Tarna Mare commune located in Satu Mare County. Tarna Mare the northernmost commune of Satu Mare County, it has a population of 3.774 inhabitants and a total surface of 44 km^2. The commune is located along the Tarna Valley at the foothills of Oas Mountains. Tarna Mare background is rich in complex ores of non-ferrous metals (copper, lead, zinc, gold and silver).

In order to evaluate the water quality, several physico-chemical parameters (pH, redox potential, total dissolved solids, electrical conductivity and salinity) were investigated. The samples were collected in October, November, December 2015 and January 2016. The results showed that the waters were acidic having the pH between 4.7 and 7.52, considerably lower than the limit imposed by national legislation (between 6.5 and 9.5). The investigated wells proved to have a relatively high contented of dissolved salts, having the electrical conductivity between 83.6 µS/cm and 908 µS/cm and the salinity between 0 and 0.4 ‰. Regarding the cations concentrations (mg / L) those ranged between: 21.55 – 318.19 for Na^+, 16.42 – 556.43 for Ca^{2+}, 5.27 – 149.48 for Mg^{2+} and 5.7 – 481.83 for K^+. Li^+ and NH_4^+ were not detected in analyzed samples.

Keywords: ground water, physico-chemical parameters, dissolved cations, Tarna Mare, mining area.

INTRODUCTION

Fresh water is essential for human existence (Akoteyon, 2011). The pollution of groundwater resources can reduce its supply and by consuming contaminated water can lead to serious health problems (Adhikary and Dash, 2012). Groundwater resources can be used both for irrigation and for personal needs so it is very important to know their quality, since most of us use the groundwater but without knowing their chemical and biological composition.

STUDY AREA

The purpose of the present research was to assess the ground water quality from nine private wells from Tarna Mare commune, which is located in Satu Mare County. Tarna Mare the northernmost commune of Satu Mare County, it has a

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population of 3.774 inhabitants and a total surface of 44 km^2. The commune is located along the Tarna Valley at the foothills of Oas Mountains ***(Fig. 1.*** and ***Fig. 2.)***. Tarna Mare background is rich in complex ores of non-ferrous metals (copper, lead, zinc, gold and silver) (www.tarnamare.ro, Iacob, 1999).

In general the population from the study area are consuming water from their private wells. Even if the household benefits from tap water, the inhabitants are using the groundwater as the main source of drinkable water.

The purpose of this paper was to evaluate the water quality in the area by analyzing the physico-chemical parameters (pH, redox potential, total dissolved solids, electrical conductivity and salinity) and dissolved cations: calcium, magnesium, lithium, sodium and potassium.

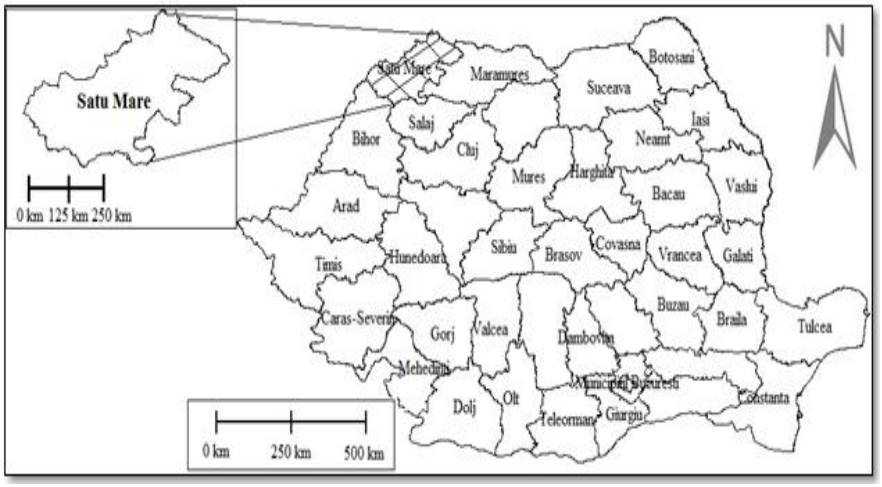

Fig. 1. ***Location of Satu Mare County on Romanian Map***

Fig. 2. ***Study area with sampling points.***

METHODOLOGY

36 groundwater samples were collected from 9 private wells from Tarna Mare town. The wells were chosen in order to obtain a significant answer regarding the groundwater quality from study area.

Due to the fact that physico-chemical are climate dependent those parameters like pH, ORP (mV), EC were analyzed *in situ* using a portable (WTW Multi 350i).

In laboratory using an ion chromatograph (DIONEX ICS1500) were analyzed dissolved cations like : sodium (Na^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), potassium (K^+), lithium (Li^+). The dissolved ions were determinate for samples W1, W2, W4, W5 collected in December 2015. These wells were chosen taking into account the electrical conductivity values for those samples.

RESULTS AND DISCUSSIONS

The variation of physico-chemical parameters values are presented in Fig. 3. to Fig. 7.

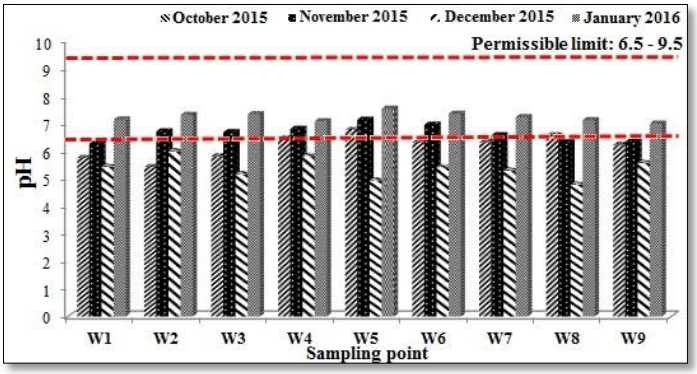

Fig. 3. ***Variation of the pH values, depending on the sampling point***

The collected groundwater samples proved to be slightly acidic to alkaline, having a pH value between 4.77 – 7.52. 53% from samples had a pH value below the minimum permissible limit (6.5) (Law 458 / 2002) (Fig. 3.). The more acidic the water is the higher the heavy metal concentration may be. Those acidic waters may be a result of mining activities developed around study area.

Regarding the oxido-reduction potential 53 % from samples had a positive value. The ORP values ranged between -37.1 mV and 100.9 mV (Fig. 4.).

A negative ORP value indicates that the environment is a powerful antioxidant, absorbing the free radicals and leading to a better oxygenation of the body (www.askahealer.com).

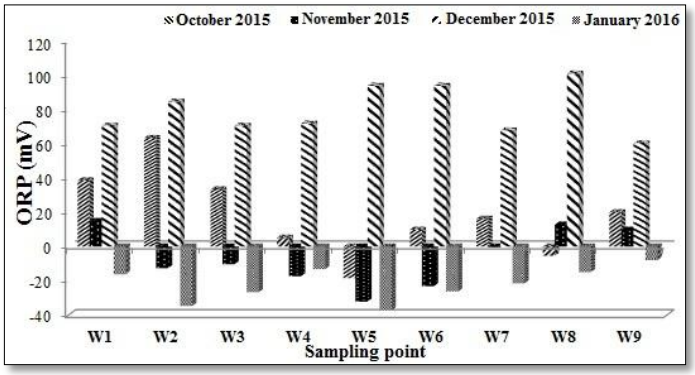

Fig. 4. ***Variation of the ORP (mV) values, depending on the sampling point***

In terms of electrical conductivity none of the monitored groundwater samples exceeded the maximum permissible limit (2500 µS / cm) (Law 458 / 2002). The EC values ranged between 83.6 µS / cm (W8) and 908 µS / cm (W1) (Fig. 5.). Those high electrical conductivity values reflect the presence of high contents of dissolved ions.

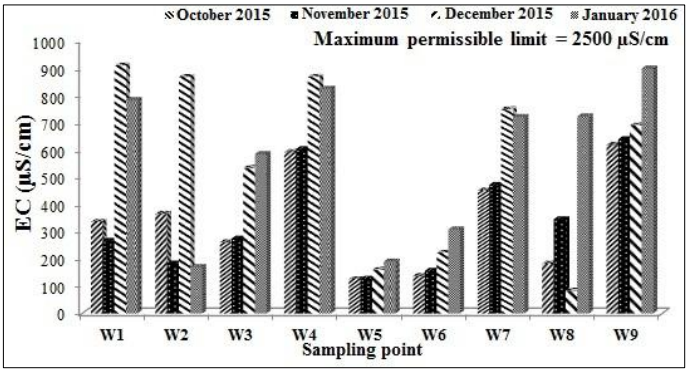

Fig. 5. ***Variation of the EC (µS / cm) values, depending on the sampling point***

Total dissolved solids had values between 53 mg / L (W8) and 590 mg / L (W1). TDS content is not legislated into national law regarding groundwater quality, but referring to the United States limits (500 mg/L), a total of 15 % from groundwater samples excedeed the maximum permissible limit (Fig. 6.).

According to the World Health Organization the drinking water is classified into five quality classes: excellent if the TDS value is less than 300 mg / L; good if the TDS value is between 300 mg / L and 600 mg / L; acceptable if the TDS value is between 600 mg / L and 900 mg / L; bad if the TDS value is between 900 mg / L and 1200 mg / L and not recommended for consumption if the TDS value is greater than 1,200 mg / L (www.who.int).

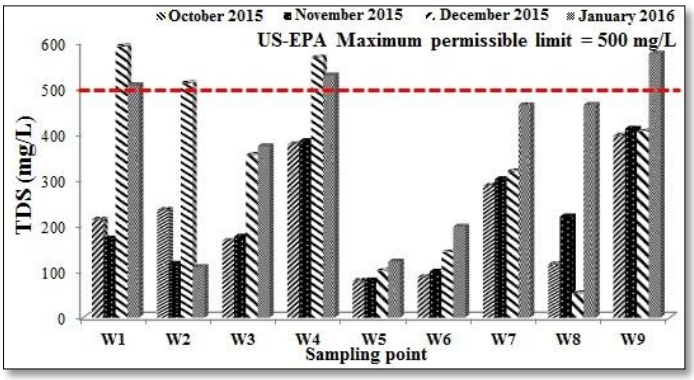

Fig. 6. ***Variation of the TDS (mg / L) values, depending on the sampling point***

In the present study 53% from samples belong to excellent class according to total dissolved solids and 47% belong to good class.

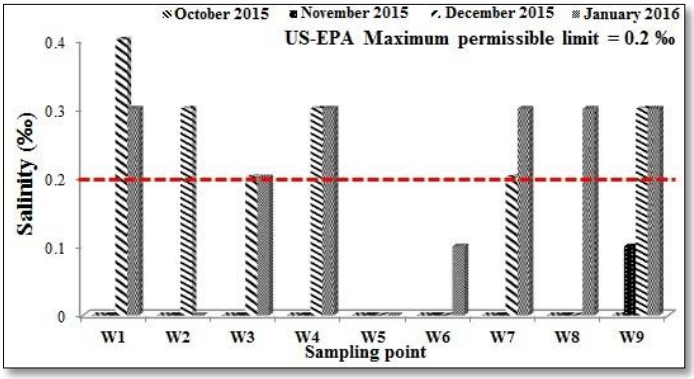

Fig. 7. ***Variation of the salinity (‰) values, depending on the sampling point***

In Romania in terms of salinity we do not have a maximum permissible limit but according to US-EPA limit 33 % from samples exceeded the maximum permissible limit. A high value of salinity can affect the crops and plant growth if those water sources are used as irrigation water (www.waterboards.ca.gov) (Fig. 7.).

The cations lithium and ammonium were not detected in analyzed samples.

The calcium, magnesium, sodium and potassium concentration (Fig. 8.) can be because of their mineralogical origin in the soils but also the agricultural activities carried out in the study area may lead to an increase in sodium and potassium concentration (Singh et al 2012).

Sodium was detected in all analyzed samples, but only one sample (W1) exceeded the maximum concentration level (200 mg / L, Law 428 / 2002). Sodium can be naturally found in groundwaters but its concentration can increase from various anthropogenic sources (www.env.gov.bc.ca.).

A high sodium concentration can increase the blood pressure and can make the water unfit for irrigation (Haritash et al, 2008, www.hsph.harvard.edu).

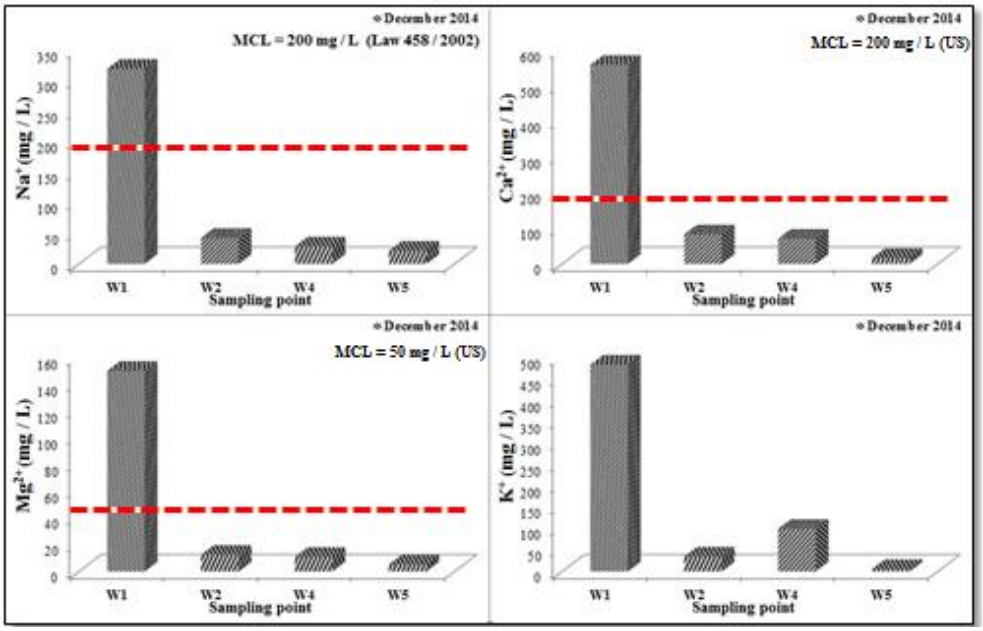

Fig. 8. ***The dissolved cations values depending on the sampling point***

Calcium and magnesium concentration were found in all analyzed groundwater samples, the highest concentrations were detected in W1, which is a private well. Both calcium and magnesium are essential for our bodies. In general calcium concentration in groundwater depends on the type rocks (Thakor et al, 2011).
As sodium, calcium and magnesium the highest potassium concentration was found in sample W1. Potassium has the opposite effect of sodium, because potassium can relax the blood vessels and remove the sodium (www.hsph.harvard.edu).

CONCLUSIONS

In general, due to the detected pH value the groundwater samples were acidic to neutral, 53 % had the pH value below the minimum permissible limit (6.5) (Law 458 / 2002).

The maximum permissible limit for total dissolved solids imposed by US-EPA was exceeded in 15 % of samples but according to World Health Organization 53% of samples belong to excellent class according to total dissolved solids and 47% belong to good class.

The electrical conductivity and salinity values for groundwater samples ranged between 83.6 µS / cm – 908 µS / cm and 0.0 ‰ – 0.4 ‰, presenting the same variation during the monitoring period.

According to the cations concentrations the sampling point W1 has a chemical composition similar to mineral water, so the consumption of this well water should be monitored as curative medicine water, rich in calcium, potassium, magnesium and sodium.

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