Water Salinization in Iran: Spatial Variation of Salinity in Groundwater Resources of North West (Urmia Lake)

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Abstract
This study presents the quality of drinking water in terms of salinity in the western margin of Urmia Saline Lake (USL), Iran. During the study a total of 121 samples from 116 wells and 5 springs were collected which constitute drinking water resources of 301 villages in the study area. Approximately more than 30% of the water resources were brackish or saline. The maximum EC is recorded at 3060 µs/cm, which is more than 2500 µs/cm recommended by the European Union. The minimum EC is 410 µs/cm with an average of 980± 495µs/cm. The brackish water resources were located in the northern parts, middle parts and also in the southeast. Unfortunately, in water resources of the study area, salinity seems to be high. This issue should be addressed as a serious concern by managers of water sector.
Keywords: water quality, groundwater, salinity, Electric Conductivity

1. Introduction

One of the important characteristics of drinking water supplies is the amount of salts measured in the form of total dissolved solids (TDS) or salinity. Based on salinity water is classified as fresh, brackish or saline (Chhabra, 1996). Taste of drinking water is unacceptable at salinity above 1000mg/l. World health organization (WHO) considered the palatability of water with a TDS level of less than about 600 mg/l as good (WHO, 2017). According to the Iranian national standard for drinking water (1053), desired limit and permissible limit for TDS is 1000 and 1500 mg/L, respectively (INSI, 2010). TDS 1500 mg/L is almost considered equal to 2500 µs/cm electric conductivity (EC). The aim of this study was to investigate the amount of salinity in the drinking water resources of the western margin of the USL in the northwest of Iran as the second largest hypersaline lake in the world.

2. Material and Methods

2.1 Sampling and analysis

Samples were collected from rural drinking groundwater resources of five cities including Salmas, Urmia, Naghadeh, Mahabad and Miandoab. 121 samples were taken from 116 wells and 5 springs which constitute drinking water sources of 301 villages in the study area (Shakerkhatibi and Mosaferi, 2017). All data were entered into a spatial database and spatial variations of the results were developed using inverse distance weighting (IDW) method using Arc GIS software.

3. Results and Discussion

Figure 1 shows the amount of EC by studied counties. The shape of the box plots indicates the abnormal distribution of electrical conductivity in the some parts studied areas. In some of the water sources, EC is higher than the desired value of 850 µs/cm (= TDS 600 mg/l by WHO). In total, 68.6% of the samples had an EC value of less than 1000 µs/cm. The maximum EC is recorded at 3060 µs/cm, which is more than 2500 µs/cm recommended by the European Union. In other words, most water sources are brackish and in two cases the water sources are saline. The minimum EC was 410 µs/cm and the average was 980± 495 µs/cm. According to the permissible limits for classes of irrigation water, water with EC of 750-2,000 µs/cm is considered as Class 3 which is permissible for irrigation. However, water with EC of 3000 µs/cm is considered as Class 5 which is unsuitable for irrigation. Regarding chloride as the main anion of salinity, in the most water sources the measured value is less than the maximum allowed level of 400 mg/l, but in three sources this amount exceeds the maximum permitted level up to 950 mg/l, indicating the salinity of water sources. According to the figure 2, distribution of electrical conductivity in analyzed water resources is not similar throughout the studied region. As the brackish water resources are more visible in the northern parts, middle part and also in the southeast. It appears that the amount of TDS in water in the areas adjacent to USL is higher than non-adjacent areas. In other words, the salinity of some water resources close to USL may be increased due to the salt water intrusion or over-impressions, incorrect irrigation practices, as well as naturally processes due to saline geology (Jalali, 2007).

4. Conclusion

According to the present study, approximately more than 30% of the water resources are brackish or saline. This issue should be addressed as a serious concern. Water managers in the country needs to have the appropriate policy to deal with the salinity of water resources. It is recommended to study the trend of salinity of the all plains and aquifers throughout the country (Moameni, 2011).

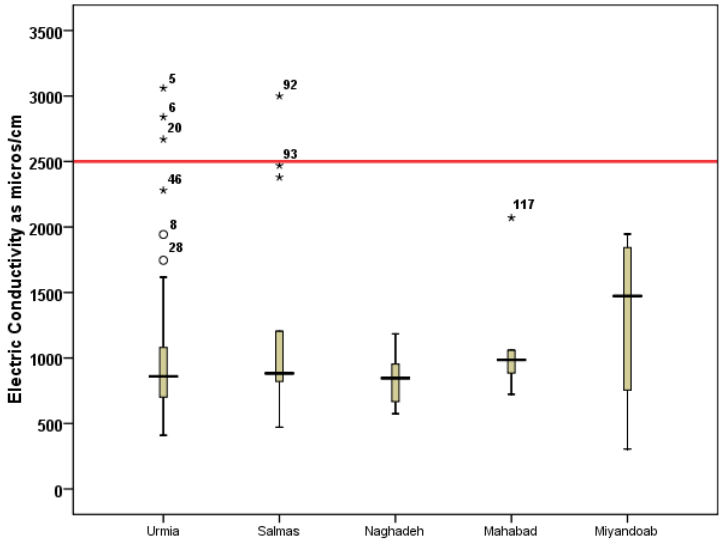

Figure 1. Range of EC in groundwater resources of the study area

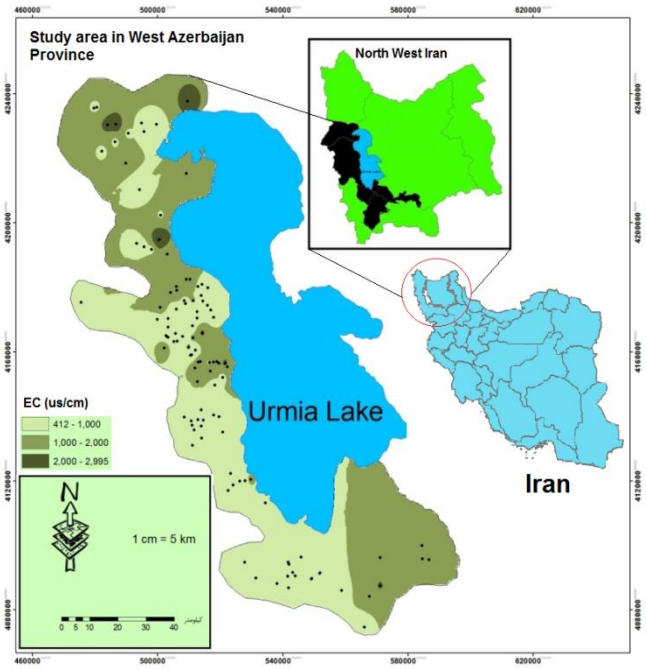

Figure 2. Spatial distribution of EC in the drinking groundwater resources of the study area

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