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Investigating the groundwater of Qorveh-Chaharduli plain in terms of drinking affected by environmental pollutions

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Abstract

Groundwater resources contamination caused by environmental pollutions including both chemical fertilizers and industrial and domestic waste leachate is currently one of the most important environmental issues which has exposed the humans life to risk in some regions. The data of Qorveh plain located in Kurdistan were used in 10-year statistical periods (2002-2012). After selecting the best evaluated resources, considering the data accuracy and distribution, statistics reconstruction and control were conducted and after investigation of Kolmogorov-Smirnov test, it was found that, the data were not normal and consequently, the data logarithm was calculated to be normalized, then, the best variogram model was fitted to spatial structure of the data (SO_4, Cl, Na, TDS and TH) using GS+ software. To draw the water zonation map according to Schuler, overlap of the five layers in ArcGIS was used. For the year 2012, most of the eastern parts of the plain (south east and north east) and a small part of the west, totally by an area of 200.2 km^2 have poor quality of water for drinking.

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Introduction

Ground water is one of the main resources of water supply for drinking, industry and agriculture in many countries including Iran, and the use of this resource has been always proposed as an option beside surface water control. Although there has been a strong tendency for surface waters control to resolve the water problem during the recent years, but, considering the unique characteristics and advantages of groundwater compared to the surface waters, the necessity of this resource becomes clear in water supply studies. Also, during the recent years, the groundwater quality has been intensively dropped particularly in terms of drinking as the result of consuming life and increasing use of chemical materials dissolved in water, various types of chemical fertilizers and environmental pollutions. Therefore, the importance of qualitative investigation of groundwater in terms of extent and type of contamination as well as pollution diffusion mechanism in various environments is clearly felt (Saeidifar, 2004). Groundwater is a critical resource of water supply and meeting the human societies' needs. Nowadays, this store helps economic growth of various societies. By uncontrolled increase of population in Iran and the lack of attention to scientific utilization of groundwater, this critical resource has been changed dramatically just like the other resources and now, we observe this resource pollution in many parts of the country. With regard to the mentioned items, understanding of qualitative and quantitative spatial and temporal variations of the groundwater becomes necessary. About investigation of drinking water in terms of pollution, some studies can be mentioned including Safari (2002), Delbari *et al.* (2004), Rangzan *et al.* (2005), Latif *et al.* (2005) and Mohammadi Qaleney *et al.* (2011).

In this region don't have investigation of water quality for drinking and irrigation then the previous study in this region is poor.

The aim of this study is investigation of water drinking in Ghorveh-Chardoli plain, because this region have a lot of land to agriculture and then farmers added to land a lot of fertilize. Then in this plain, groundwater is in the exposure of pollution.

Materials and methods

Study area

The study area is located in the south east of Qorveh city and almost 40 km away from the north west of Hamedan city between the eastern longitudes of 47^0 22′ 51″ and 51^0 47 ′ 36 ″ and northern latitudes of 34^0 50′ 54″ and 35^0 7′ 3″. The study area is composed of two parts including: the big Chaharduli (Qorveh city of Kurdistan province) and the small Chaharduli (Asadabad city of Hamedan province). The present study focuses on the big Chaharduli. This plain is limited by Hamedan city (Bahar and Asadabad cities) from the south and south west, by Sonqor from the north west and Goltappeh village from the north east. The mentioned plain has an area by 540 km² (Fig.1).

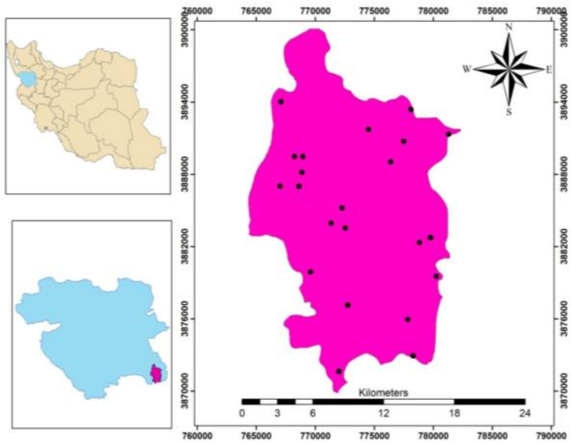

Fig. 1. The study area.

Fig. 1. the location of the study area in country and province.

Research methodology

In the present study, the data of 21 observational wells in the studied area were gotten and then, a number of wells were eliminated due to statistical defect, in order to prediction of spatial distribution of qualitative parameters of groundwater. The common temporal base was selected. The statistics validity is more related to Homogeneity or heterogeneity of the data so that, even by having detailed statistics in a station, the data heterogeneity can occurred (Mahdavi, 2008).

Variogram

The main objective of variogram calculation is to investigate variability of the variable about spatial or temporal distance. In this regard, total squared difference of the points with clear distance (h) to each other is required to be calculated and drawn in front of (h) (Hasani Paak, 2001).

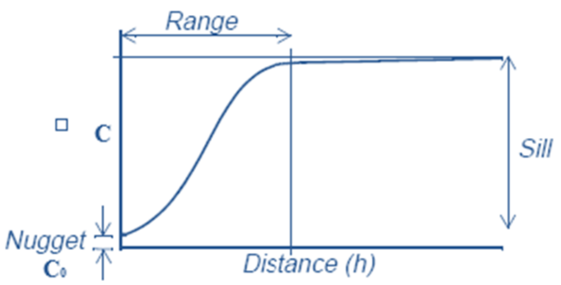

Fig. 3.3. Variogram and its components.

Results and discussion

Sectorial impact

In many cases, h tends to zero but, the amount of variation indicator does not show zero. This means that, if some new sample are prepared from the previous location, the results will be somewhat different. This task has several reasons including the errors of sampling, preparation and analysis as well as the existence of accidental components in the variable distribution. Hence, the intercept of the variation indicator curve is called sectorial impact.

Range of effect

Radius or range of effect is a distance out of which the samples have no effect on each other and the variation indicator becomes horizontal. A short range of effect represents high variability while, a long range of effect represents homogeneity of the studied population. Therefore at the recent state, the sampling distance can be increased (Akhavan *et al*., 2009).

Threshold

By increase of (h), the variation indicator tends to a constant limit. Accordingly in some variation indicators, the almost constant value of which variations are only accidental, are called threshold. Of course, some variation indicators have no tendency to become close to a constant limit in the range of considered distances (sampling space). Such variation indicators can represent existence of trend in the studied area.

To draw the drinking water zonation map according to Schuler, overlap of five maps of total hardness, total dissolved solids, sodium, chlorine and sulfate in ArcGIS was used.

Map of sulfate

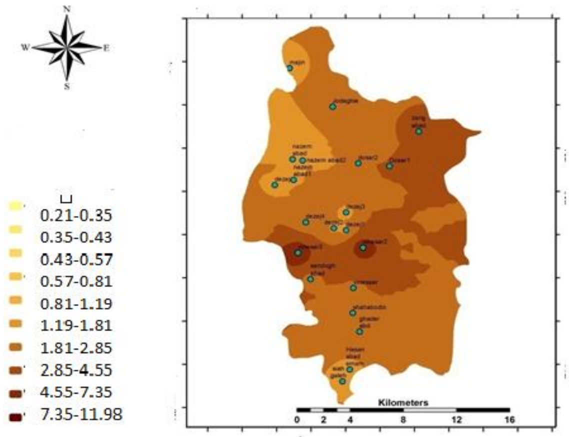

Fig. 2. Map of sulfate.

Map of chlorine

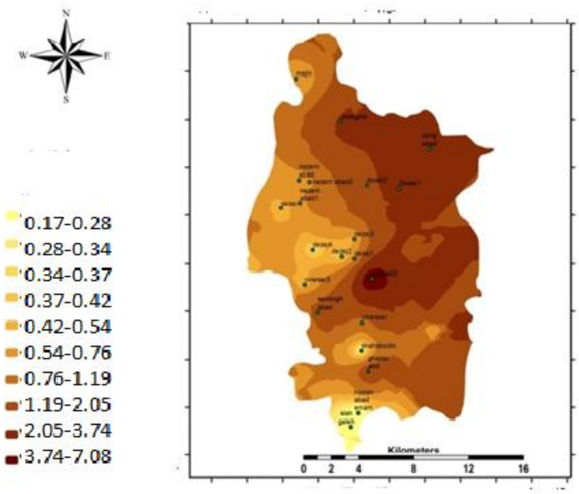

Fig. 3. Map of chlorine.

Map of sodium

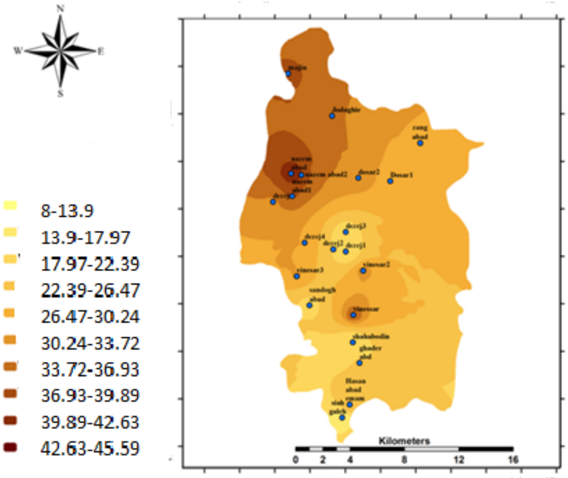

Fig. 4. Map of sodium.

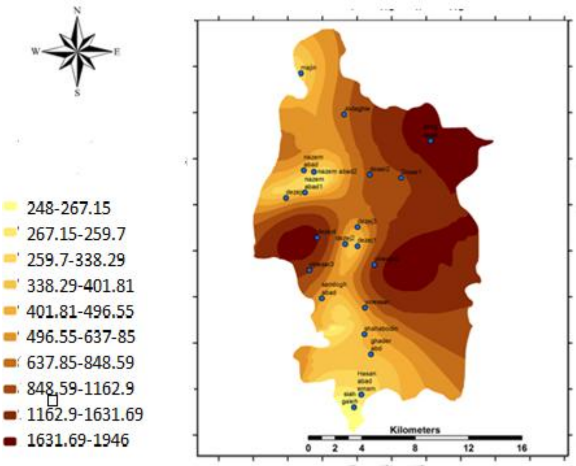

Fig. 5. Map of total dissolved solids.

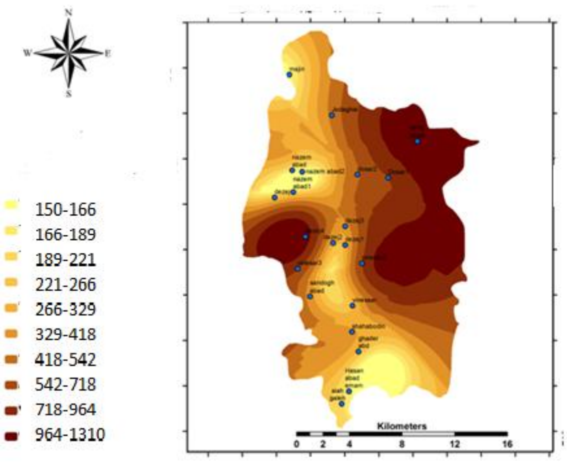

Fig. 6. Map of total hardness.

Map of drinking water based on Schuler classification

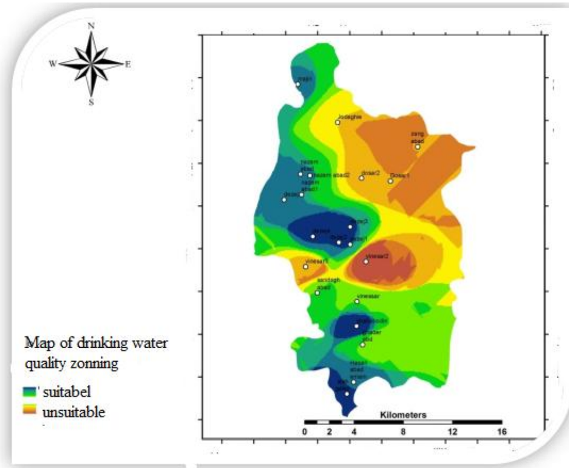

Fig. 7. Map of drinking water quality.

According to Fig.7, most of the eastern parts of the plain (south east and north east) and a small part of the west, totally by an area of 200.2 km² have poor quality of water for drinking, and a large area (292.3 km²) of the plain has acceptable water for drinking. Therefore, the area of suitable water has been reduced while, the areas of unsuitable water has been increased. Suitable water has become acceptable water, and acceptable water has become unsuitable water. Therefore, in middle parts of the plain, the water is unsuitable for drinking, and consuming it causes illness and risk to humans' life. All the mentioned happenings are caused by environmental pollutions which contaminate water by diffusion and penetration. So, the main way for control is to control the environment and keeping it clean.

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