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Geographical Zoning Physicochemical Quality Change in Groundwater Catchment Gharehsou Ten-Year Period 2003-2012

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The use of geographic information systems (GIS) and in parallel, appropriate statistical methods for analysis and management of groundwater resources is growing rapidly. Exploit these new tools and backup systems for information processing can have a significant role in the management and control of resources especially for limited water supplies, which are very valuable and vital. The main purpose of this study is geographical zoning and physicochemical quality of annual changes in groundwater catchment Gharehsou period of ten years 2003-2012. Information on the physicochemical parameters of the experiment, were obtained from the regional water corporation. Using descriptive statistics, the average annual concentration of various parameters were calculated and then using the statistical software SPSS-Ver.16 and Friedman Test and Measure_1 test with a significance level of 05/0 = ? annual changes of parameters was compare accordingly and in its parallel using software ArcGIS9.3 performed geographical zoning parameters to determine the spatial variability of groundwater quality watershed in Gharehsou. The results showed that during the year under review, in the first five years, physicochemical parameters were increased with increasing trend and has decreased in the next five years, with annual fluctuations in total has decreased. According to the statistical tests used, annual changes in the parameters of potassium, calcium, chloride, conductivity, there is no significant difference)P val<0.05).Geographically, density and chemical concentration in groundwater concentrated in the North West, West and Southwest Basin. The greatest increase cations and anions, is corresponding to the years 87-1384. This study showed that most of the groundwater catchment area is made of bi carbonate. Changes in the chemical composition of groundwater catchment, depending on the amount of atmospheric fallout, water uptake and soil type.

Key words: Groundwater, Zoning geographic, Gharehsou area.

A large part of Iran, due to exposure to the dry climate of the average annual rainfall is very low. Worsens the drought of recent years and is effective on both qualitative and quantitative changes of surface and underground water sources. By reducing the amount of surface water in many parts of the country, the use of groundwater increased as a source of water used in agriculture, industry and drinking. So that, according to the latest statistics, 55% of our water needs supplied from groundwater. Deep wells drilled in the past few years due to excessive extraction of underground water reservoirs in many basins, falling groundwater levels, and water quality and physicochemical properties has

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changed. That is undoubtedly a disaster for the country's natural resources. Besides the reduction of underground water tanks, polluting the entry of agricultural, industrial and urban has infected the groundwater aquifers. The study of changes in groundwater quality in order to offer solutions to protect, manage and optimize utilization of groundwater seems necessary[1, 2].

Preparing a mineral changes could be an important step in the proper utilization of water resources. Furthermore, changes in physicochemical properties of groundwater maps, plays a significant role in the decision-making process and management and exploitation of groundwater[3]. Various methods are used to study the characteristics of the groundwater zoning changes that each of them, depending on the area of statistics and other data that are accurate enough. The interpolation method for preparing maps of groundwater quality changes can be determined by geostatistical methods such as kriging and co-kriging and inverse distance methods, normal distance and so forth. Selection of appropriate zoning and preparing a groundwater quality characteristics is an essential and important changes in the management of water resources in the region.

In recent years, studies are done on groundwater quality and quantity of property zoning. Including, the study of Zehtabyan *et al* (2007) entitled "Spatial analysis of water quality characteristics of the catchment areas GARMSAR located in Semnan province" that using the interpolation geostatistical and the methods specified other factors assessed by comparing the RMSE concluded that Geostatistical methods have higher accuracy than the methods specified. Among the geostatistical methods, the methods of a given algorithm and radial basis function method has been shown to have higher accuracy[6]. Krsyk (1977) introduced kriging method as the best and most powerful tool for interpolation of data-measure of subsurface water[7]. Jagr (1990) was used the statistical tools such as kriging to simulate water quality variables and Showed that kriging is better than other geostatistical tools to simulate of groundwater quality variables[8]. Gauss *et al* (2003) have examined the concentrations of arsenic in groundwater in Bangladesh. This study used data from 3534 wells. The data show the skewness is high in arsenic data. To estimate the concentration and risk mapping, discrete kriging method is applied. The results showed that at the study area 35 million people are exposed to arsenic concentration of 50 milligrams per liter, and 50 million people were exposed to a concentration of 10 milligrams per liter[9].

Gauss and colleagues (2003) examined the concentrations of arsenic in groundwater of Bangladesh paid-have. This study used from 3534 data of wells. The data show the skewness is high in arsenic data. To estimate the concentration and risk mapping, kriging was used discrete. The results have shown that in the study area is 35 million people are exposed to arsenic concentration of 50 milligrams per liter, and 50 million people were exposed to a concentration of 10 milligrams per liter[9]. Barkay and Pasarla (2008) for preparing a risk of nitrate in lowland Madna in Italy are used kriging discrete simulation techniques. The results show that discrete kriging method is good for studying the degradation of groundwater quality[10]. Ftani and colleagues (2008) studied the quality of groundwater under agricultural land use in the North East region of Morocco Tryfa the amount of ammonium nitrate and bacteriological contamination, ordinary used kriging for the study and mapping of groundwater quality maps. Their results indicate significant changes compared with previous studies, respectively. They stated that if any type of preventive programs is done in the long term, the development of agricultural land in this area will destroy the quality of groundwater. Ahmad(2002) used kriging interpolation method and estimate the amount of TDS in groundwater zoning and Mahjerd Taghizadeh *et al* (2008) to predict the spatial distribution of some quality attributes such as total soluble salts, sodium ion, chloride ion concentration, salinity, sodium adsorption ratio and the concentration of sulfate ions in Rafsanjan plain geostatistical methods to evaluate the accuracy paid.

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The study area

Kermanshah, relatively wet regions of the country. Kermanshah Province, including two large catchment area of the Upper Karkheh and is Sirvan. The Upper Karkheh Basin (Basin Internal) includes the following 15 main areas, which includes the cities of Kermanshah province in Central and East-West wind Aslama, Kangavar, Javanrood the Ravansar), scene and Harsin and rivers where the river pours Seimareh. Catchments Gharehsou, 3848306.7 area of square kilometers and is a subset of the Karkheh Basin (Fig. 1 and 2).

The main source of river Gharehsou, Ravansar located 45 km northwest of Kermanshah. The river flows from the northwest to the southeast. At 25 kilometers from Kermanshah, Down River and its tributaries joins the So. The tortuous path of the flowing plains and river near the village Qazanchi Razavr connected to it. The river, with a gentle slope passes near the city of Kermanshah Faraman Gamasyab joins the river. In many parts of the margin of the river, several plants has grown into a beautiful special effects.

Methods

In this study, to investigate spatial variations in groundwater quality parameters sampled include: calcium, magnesium, sodium,

Fig. 1. Location of Kermanshah in map Iran

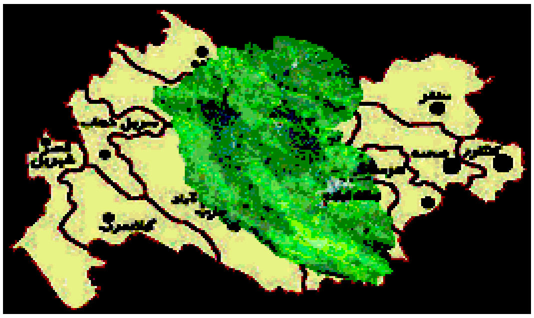

Fig. 2. Location map of the watershed in Kermanshah Gharehsou

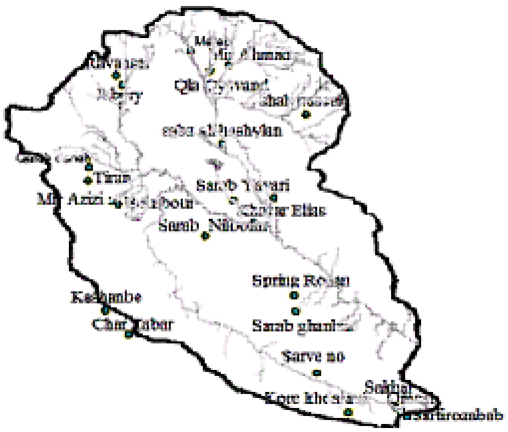

Fig. 3. Location of the wells sample

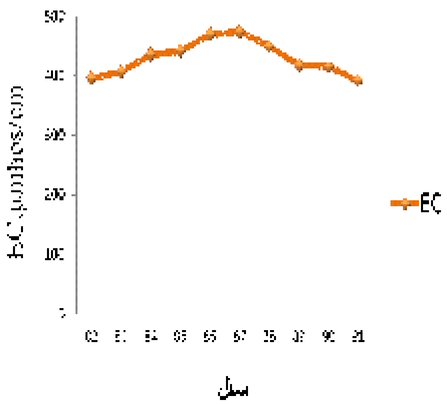

Fig. 1. Ten-year trend of electrical conductivity.

potassium, bicarbonate, chloride, sulfate, TDS, EC and pH related to the ten-year period (2003-2012) were collected. The data of 23 stations, including deep wells, deep half, aqueducts and fountains are in operation. Figure 3 shows the location of these stations is presented in Garedane-hand basin.

The potential for groundwater mapping, and application of kriging interpolation method was used ArcGIS10.1. The interpolation process, the data turned out to be generalized to the entire region. Kriging interpolation method, a nonlinear interpolation technique based on the statistical nature of the changes in the values of the unknown function[14, 15]. Using descriptive statistics, the average annual concentration of various parameters calculated using the statistical software package SPSS-Ver.16 Friedman Test and the significant MEASURE_1 05/0 = á compared to annual changes in the parameters were measured.

Findings

Throughout the watershed Gharehsou, four free aquifer (plain Kamyaran, Ravansar plain, plain, plain Mahidasht and Kermanshah) expanded. Because of the uneven stone floor and feeding areas, the aquifer is not homogeneous and the discharge is not the same situation. Tower thickness varies from 80 to 110 meters fluctuate. The thickness of the layer monument of the groundwater catchment area Gharehsou Ravansar thickness of 110 m and the lowest Kamyaran plain is 80 m thick.

Based on the results of the electrical conductivity, which changes during the ten years from East to West Basin, increases. The highest electrical conductivity, in the North West catchment (area Burbur, Tiran and margins) can be seen. The rate in 2008, 1296 ìmhos/cm reached. average conductance 407 mhos/cm with the measured value

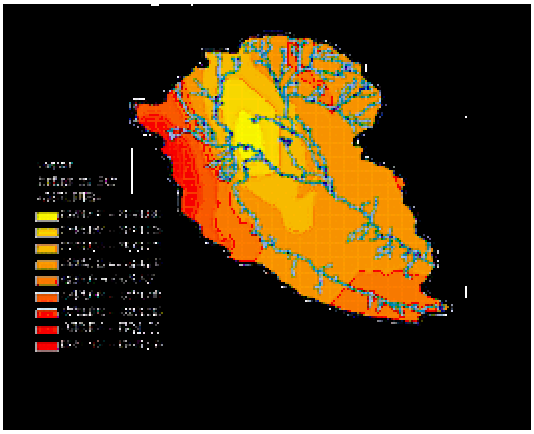

Fig. 4. Average ten-year trend of electrical conductivity.

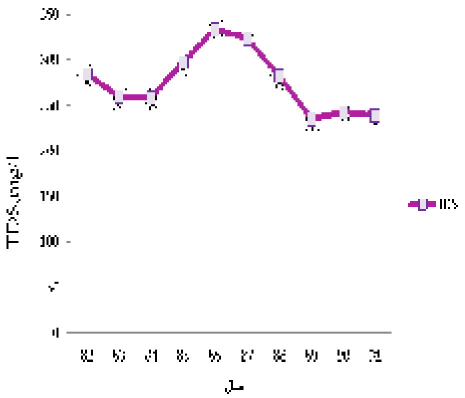

Fig. 2. Ten-year trend of total dissolved solids

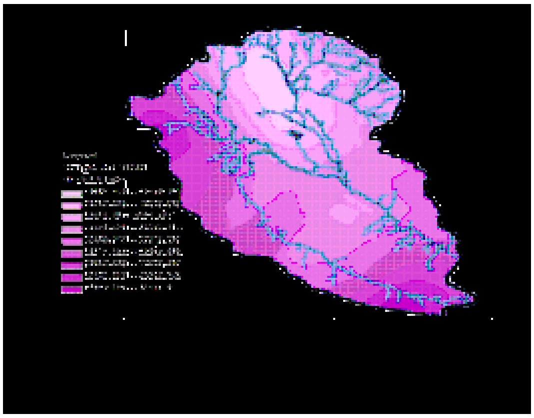

Fig. 5. Change in the ten-year average total dissolved solids

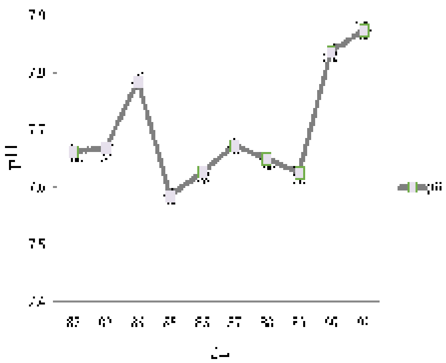

Fig. 3. Ten-year trend of pH

in Palmer and margins (SE), which is equal (Figure 1, Figure 4). The statistical analyzes measure1 Test the electrical conductivity changes during the ten year difference is not significant (0.247 = P value).

Although the maximum amount which can be seen in the North and North-West Basin, but at least it Kamyaran the Northern Plains, Plains Kamyaran, Kermanshah Plain (in the margins of rivers Razavr branches), the margins of the rivers and streams are considered Gharehsou (see Figure 2, Figure 5). Based on statistical analysis, Friedman Test Test, differences in rate of change of total dissolved solids is significant at the ten-year period (001/0> P value).

PH levels in the North East and West Basin is slightly more than the entire basin. Whatever the basin margin to the central part of the basin goes pH levels drop. In general, there was not much change in pH in the watershed. But over the course of ten years has risen slightly elevated pH (Figure 3, Figure 6). The statistical analyzes Measure 1 Test is a significant difference in the rate of pH change in the ten-year period (0.002 = P value).

The amount of bicarbonate in the groundwater, the study area of 17.5 mg/l to 460 mg/l fluctuated by up to 86 years on the plains Ravansar (Babarasul and margins), respectively (Figure 4, Figure 7). According to Friedman Test bi-carbonate changes the difference is significant at the ten-year period (0.003 = P value).

The maximum amount of sodium in 575 mg/l Mirage Ghanbar in Kermanshah in 2005 and the lowest Babarasul and Garedane of Ravansar functions to the Seed 0.69 mg/l was in 2011 (Figure 5, Figure 8). According to Friedman Test sodium changes during the ten year difference is significant (P value<0.001).

The maximum amount of potassium in 12.65 mg/l in 2009 related to Babarasul Ravansar

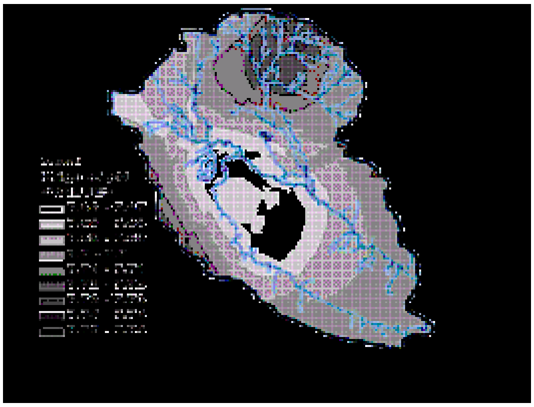

Fig. 6. Ten-year mean of the pH changes

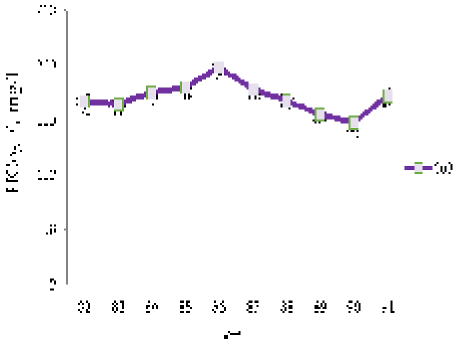

Fig. 4. The ten-year trend of bicarbonate

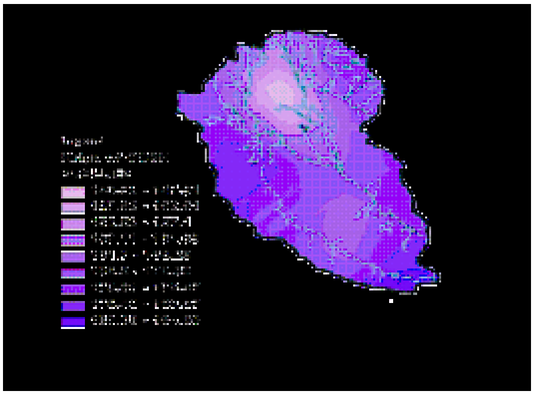

Fig. 7. Average ten-year trend of bicarbonate

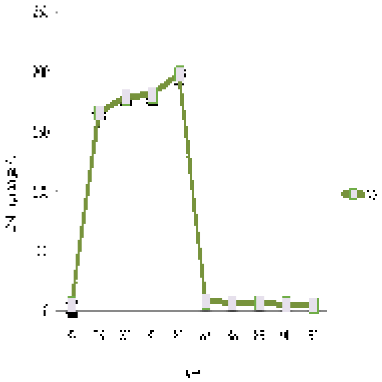

Fig. 5. Ten-year trend of sodium

and a minimum value at a rate of 1.83 mg/l in Sarfiroozabad of functions Mahidasht was in 2004 (Figure 6, Figure 9). According to Friedman Test potassium changes during the ten year difference is not significant (P value=0.109).

Changes in calcium and magnesium in the catchment area during the period of ten years is roughly similar. Although spatial variations of these two elements in the basin to form the same way as other chemical compounds in groundwater, most of these elements are concentrated in the North West Catchments. However, the average of these two elements in the North East, East, West and Southwest Basin is too dense (Figure 7 and 8, Fig. 10 and 11). Based on statistical analysis, Friedman Test, the difference is not significant calcium changes in the ten-year period (0.075 = P value). Also, based on test Friedman Test, the difference is significant variation in Mg at a ten year period (P value<0.001).

Maximum sulfate groundwater study area, 151 mg/l of the Ravansar and Jabari has been in 2007 years. (Figure 9, Figure 12). Based on statistical analysis, Friedman Test, the difference is significant variation in sulfate in the ten-year period (0.004 = P value).

Up to the Karakorum chloride grain and functions Mir Azizi and gharedane of function of Ravansar, in the 2006 with 52 mg/l. Minimum 0.1 mg/l of Palatine Prairie has been in 2007 years (Figure 10, Figure 13). Based on statistical analysis, Friedman Test, the difference is not significant variation in chloride in the ten-year period (0.464 = P value).

DISCUSSION

Optimal management of water resources and quality they require information about the

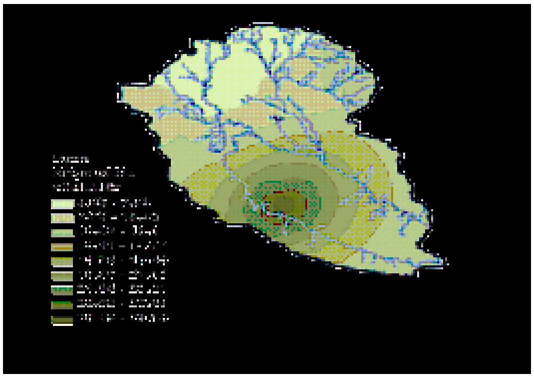

Fig. 8. Average ten-year trend of sodium

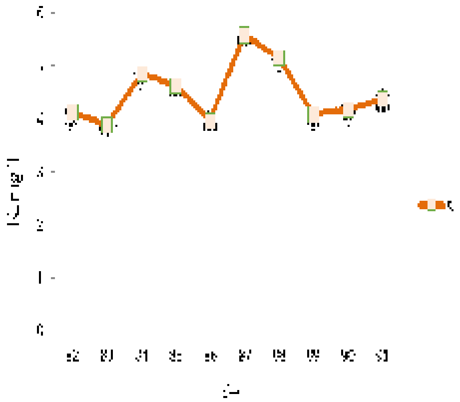

Fig. 6. Ten-year trend of potassium

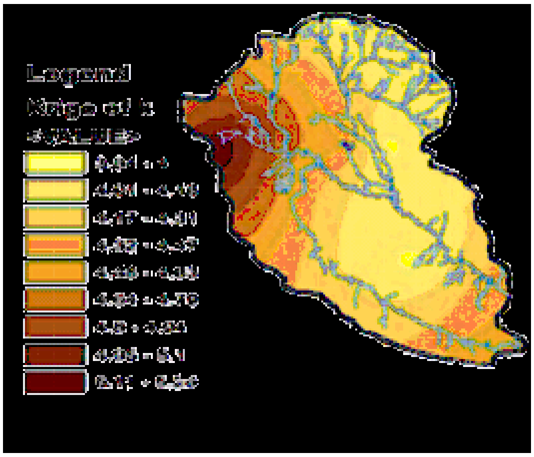

Fig. 9. Ten-year mean changes in potassium

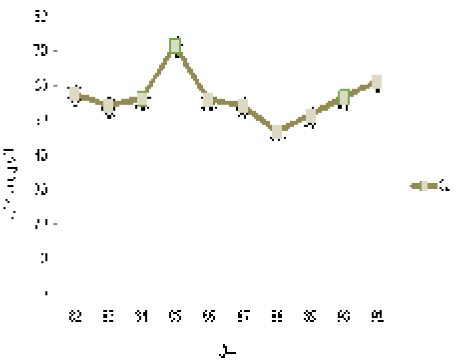

Fig. 7. Ten-year changes in calcium

location, amount and distribution of chemical parameters in a defined geographical area is water .In addition, the adoption of management approaches in the fight against environmental pollution and salinity hazard, not only requires quantitative information about the amount of pollutant in question, but also about possible dangers and risks, the appropriate measures can be effective. Zoning groundwater quality first step in identifying the geographic extent of contamination are considered. Maps of the distribution of chemical properties play a crucial role in the decision-making process[16]. It seems that the amount of rainfall, a large role in the changes of the electrical conductivity. So that in 2008 years the highest electrical conductivity changes, there has not exceeded the average rainfall of 291 mm. While in 2004 the average rainfall mm 495.3 was reported, the electrical conductivity is significantly reduced. The total soluble material, it is suggested that the decrease in the concentration of solutes in the groundwater basin has a considerable impact. Changes in bicarbonate levels in the catchment rainfalls of 2003-2007 years is the way that the rainfall is low, the amount of bicarbonate was increased. But 2007 years have shown a slight increase in the amount of rainfall, the amount of bicarbonate also gradually declined. So that, in the 2011 years that maximum rainfall occurred in the basin bicarbonate is minimal. However, spatial variations in the basin indicate that almost all the groundwater catchment of bicarbonate. However, the maximum amount of bicarbonate in the southwestern Basin and Mahidasht can be seen in the area (due to excessive withdrawal of groundwater). But in other Plains area not seen much change. Sodium and potassium levels in the decline in rainfall has increased with greater intensity than the other elements. So that in 86-83 years the trend is clearly upward. Fortunately, in the next 2008 years due to a slight increase in rainfall and reduce the amount of sodium is relatively. The amount of sodium in river basin originates in the center and periphery Plains (East

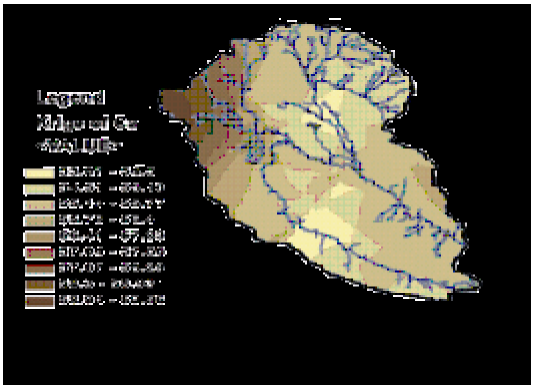

Fig. 10. Ten-year mean changes in calcium

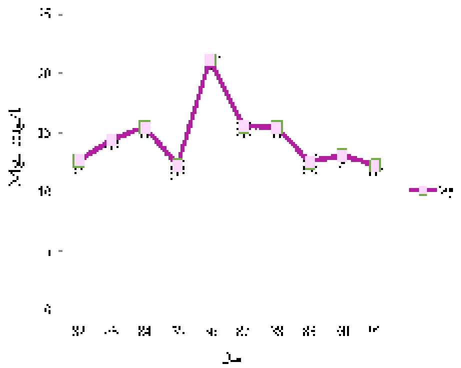

Fig. 8. Ten-year trend of magnesium

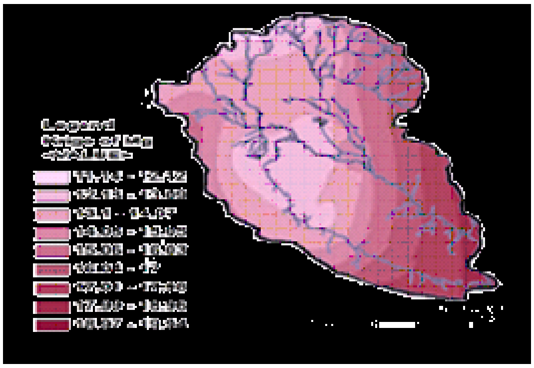

Fig. 11. Ten-year average trend of magnesium

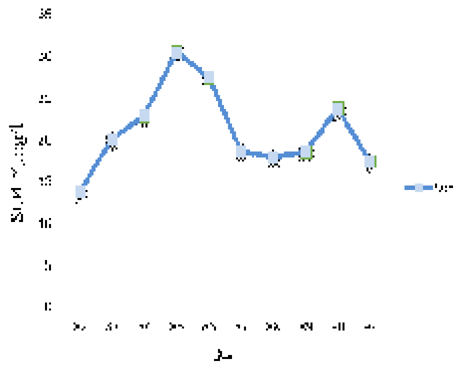

Fig. 9. Ten-year trend of sulfate

Mahidasht) can be seen. This is due to the high lands of the region, as well as indiscriminate withdrawal of groundwater in this area. Ten-year changes similar to the changes of other cations and anions sulfate in the groundwater catchment area. Sulfate for 2003 to 2007 years has been incremental changes in 2008 years later, the rate of change has fallen and been stable for about three years. But in the 2011 years that rainfall decreased slightly increased the amount of sulfate, the sulfate level in later years as the rate dropped from 2008 to 2010 years. Low amounts of sulfate in the basin and its spatial distribution is almost constant in the basin. Although the margins of the basin and slightly elevated levels of sulfate is higher than in other parts of the basin. Due to geological problems of the region. Chloride during the ten-year rate of change in a way that has been shown to gradually increase from 2003 to 2006 years. A cross cut in 2006 years, which corresponds to an increase in precipitation is observed. From 2007 years to 2011 years and then increased again in the course of the 2011-year decline suggests that these changes are proportional to changes in rainfall in the basin. This shows that the changes in chloride and other chemical parameters of the water stored in the aquifer of the basin. In relation to the spatial distribution of chloride in the basin; Note that two regions with a high concentration of chloride is observed in the watershed. A spot in the West Basin, which has similar properties to increase in other parameters at this point. A point can be seen in the southwest area that did not conform with the other parameters. Chloride concentration is a function of the quality of soil and geological catchment. Increased chloride in the margins of the Border Catchments, like other chemical parameters of the topography of the basin is the basin boundary is located at a higher altitude than the central region.

The results of most studies indicate a positive trend of water quality variables in other parts of the country and the world. Increase of chloride in the aquifer basin Glafkus in West Greece, by Lambarakys (1997) for the period from 2011 to 2014 statistics have been reported[17]. Campbell (2003), the sulfate concentration increased during October and August 2000 the United States had reported water wells around Lake Texoma[18]. Results Daneshvar Vosoughi (2010), showed that the concentration of water quality variables at all stations is increasing. Significant positive trend in the level of 5% to 23% for qualitative variables and in shallow water in wet years for 19.5% of the collections were reported[19].

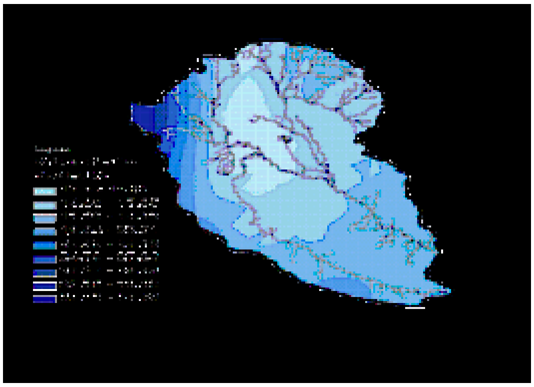

Fig. 12. Ten-year average trend of sulfate

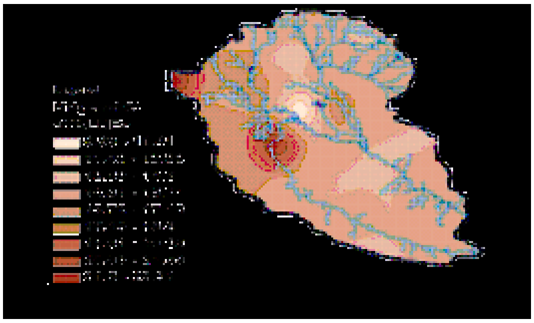

Fig. 13. Ten-year average trend of chloride

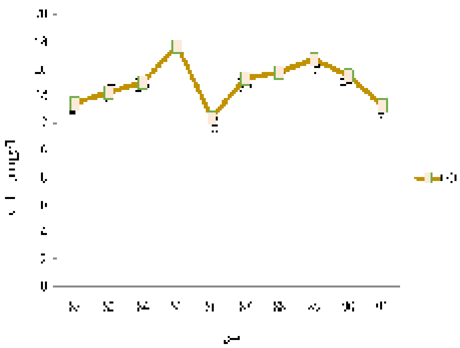

Fig. 10. Ten-year trend of chloride

CONCLUSIONS

The results showed that most of the groundwater level of catchment basin, the carbonate is made . Density and high concentrations of chemical compounds in the groundwater basin in the North West, West and Southwest Basin is concentrated. Chemical quality of the groundwater basin and the central plains of the rivers of water surface area. Changes in the chemical composition of the groundwater catchment function, the rainfalls, the water and the soil type. Due to the topography of the catchment basin, the basin boundary, the height is greater than the total surface area, average concentrations of chemical constituents more. Geology and geological structure of the catchment area can increase some parameters, such as potassium, chloride and sulfate contribute.

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