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Assessment of the Chemical Quality of Groundwater Resources in Chabahaar City using GIS Software in 2016

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Abstract: Chabahaar is located in the southeastern province of Sistan and Baluchistan in Iran and it spans over an area of 24729 km^2 (in addition, the provincial capital is 691 km away from the city center). Since, the quality of groundwater for drinking and other uses is determined based on its chemical, physical and biological characteristics and also due to the factors such as long distances for transferring water from cities nearby to Chabahaar, climate characteristics of the area and also a high demand for drinking water, it is important to investigate this topic further. As a result, due to the fundamental role of chemical elements in the process and style of utilizing groundwater resources, the present study has sought to evaluate the significant physical and chemical factors of sulfate ions, bicarbonate, calcium, magnesium, sodium, potassium, chloride, total dissolved solids, fluoride, pH and temperature which can lead to a variety of diseases, including heart, muscle, brain, skeleton illnesses and diseases and even the taste and smell of drinking water in1 00 samples from different parts of the city of Chabahaar during the years 2015-2016. The present study aims to investigate the current status and distribution of the aforementioned elements present inChabahaar groundwater resources. The findings of this study can be used to gam a better understanding of the topic at hand for a more effective management of groundwater resources at present or inthe imminent future and to help solve the water crisis in Chabahaar and the whole country. The results of the study showed that the important parameters contributing to the chemical quality of groundwater resources in Chabahaar are within acceptable ranges.

Key words: Chemical quality, groundwater resources, Chabahaar, GIS Software, acceptable

INTRODUCTION

With an area of 24729 km^2, Chabahaar is located in the southeastern province of Sistan and Baluchistan with latitude and longitude of 60°, an East longitude of 37 min and within 25° and 17 min of North. This city is surrounded by the city of Iranshahr and the Nikshahr in the North, Pakistan in the East, the Gulf of Oman from the

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South and 'ask in the West. Chabahaar's center Chabahaar port and it is composed of the Central region and Dashtiari. In addition to the central part of Chabahaar and the center of Dashtiari (Nogor city) in Konarak this area is of special importance. Chabahaar's climate is hot and dry and only on the sidelines of Oman coast, the weather is warm and humid. The distance between the center of Chabahaar and the provincial capital is 691 km. Chabahaar's population in 1996 was about 163 940 and this figure has increased to 210 975 in 2003. Compared to 1996, Chabahaar's population dynamics in 1 382 has been recorded to be 3.7% (Biglari *et al.*, 201 6a-d). Mountains, rivers, canals, wells, springs (both seasonal and non-seasonal 1) and headstreams leading to the city of Chabahr all compose a part of the Great Basin of Oman. The section of this basin which is located in this city is composed of the basin of Sarbaz, Kaju, Kahir and Rapich rivers. These rivers all Spring from mountainous areas of Makran and flow from North to South. From a hydrogen vologic perspective, the city of Chabahaar is composed of seven areas of study. The average annual rainfall in the city is 1 1 4.2 mm and the average temperature of the year 2003 changes from 40.8+ to 9.8+ c. The water for the city is supplied by 1 042 wells, 13 aqueducts, a series of springs with a discharge rate of 95.5 min.m ^{3} and Sarbaz River with the mean annual runoff of 500 bln.m ^{3}. Taking into consideration the long distances for transferring water from cities nearby to Chabahaar, climate characteristics of the area and also a high demand for drinking water, it is then of lot of importance to investigate this topic further (Biglari *et al.*, 2016; Lashkaripour and Zivdar, 2005). Quality of groundwater in the South and Southwest slopes is very suitable and as we move further from these slopes towards the North and Northeast, the amount of minerals in groundwater increases and water quality drops further in quality. Water quality has always been considered as one of the most important characteristics of drinking water and characteristics of natural water stemming from a certain area are a reflection of the soils and rocks in the area (Lashkaripour, 2003). Water quality is usually determined through water sampling and analysis of existing conditions surrounding the water (Bazrafshan *et al.*, 2012a; Ebralumi *et al.*, 2016; Moradi *et al.*, 2016; Mohammadi *et al.*, 2015). Chemical testing of water can determine the possibility of its contamination in the past or present. As a result, in order to determine whether drinking water is suitable for human consumption, certain criteria should be determined in advance and then complied with so the materials deemed as hazardous for human consumption can be detected or investigate those substances which affect the general acceptability of water (Bazrafshan *et al.*, 201 2b; Biglari *et al.*, 2016; Sajjadi *et al.*, 2016). For each of these parameters, certain values are specified as standard in Iran and the world. For example, desirable standard turbidity considered as standard in Iran is NTU = 1 and its maximum value in Iran and in the world is listed as NTU 5. Desirable pH in the national standard of 7-8.5 and its maximum between 6.5-9 and the WHO standard listed as 8 = pH. Taste and odor thresholds for chlorine in distilled water, respectively 5 and 2 mg L $^{-1}$, more people taste chlorine are 5 and 2 mg L $^{-1}$, respectively. Most people recognize the taste of chlorine or its products with concentrations below 5 mg L $^{-1}$. In fact, the taste of chlorine in concentrations between 0.6-1 mg L $^{-1}$ is recognizable to most people but it has no detrimental effect (Mirzabeygi *et al.*, 2016). The standard for maxim um acceptable Manganese (Mn), calcium (APHA, 1 992) Magnesium (Mg) and sodium (1 4) are respectively 0.5, 250, 50 and 200 mg L $^{-1}$ in Iran (Pazand *et al.*, 2012). Many studies have been conducted on this area, for example, a 2004 study by Dmdarlu and Alipour on the quality of drinking water in Bandar Abbas reported the amount of fluoride to be 2.47 mg L $^{-1}$ and the nitrite, chloride, sulfate and TDS were also reported to be higher than standard. They also categorized the water in the region as very hard and finally, classified one of the city's underground water resources as not suitable for consumption. A study by Malakoutian and Rezaei (201 4) on Zarand's water showed that the mean values of the parameters for pH, EC, TDS, total hardness, calcium, magnesium, sodium, potassium, bicarbonate, sulfate, chloride and nitrate were within the normal range. In a study by Salehi *et al.* (201 4) carried out between 201 4 on groundwater quality in the plain of Hamedan, the results showed that all the samples meet standard regulations of national standards of Iran and the WHO guidelines (Salehi *et al.*, 2014). In this regard, this study aimed to evaluate chemical parameters of water resources in Chabahaar city and also to compare them with national standards.

MATERIALS AND METHODS

This descriptive study was conducted from April 21, 2015 till October 16, 201 6 which lasted for a period of 18 months. The population of the study was Chabahaar city's groundwater resources. The sampling site was the distribution network located in the closest area to the water extraction site. Random sampling method was used in the study (Biglari *et al.*, 2016). The number of samples was two samples from each source (a week apart from each other) and a total of 200 samples (2 times) were selected and collected from different places in Chabahaar city using GIS Software and the interpolation method of IDW (Inverse Distance Weighted). The tests are divided into two general categories of titrim etric and instrumental tests. Titrim etric tests included testing temporary and permanent hardness, calcium and magnesium, alkalinity, sulfate and chloride which are based on recommended methods of testing water in reference book for water and wastewater tests. The method of measuring total hardness, calcium and magnesium, titration with EDTAT, alkalinity titration with hydrochloric acid or 0.02 sulfuric acid was calculated to be normal. Ammonium measurement is performed using iodometric and titer of silver nitrate method (APHA *et al.*, 1915). Instrumental tests were conducted using instruments such as the EC and TDS measurement with CD20 model with the EC meter instrument and the aqualytic brand and an accuracy of 0.01, made in Germany, opacity with the P2100 model with the Hatch brand, turbidity and pH with a pH meter Made in US with an accuracy of 0.01 pH meter device model 654 the brand of Meterohm made in Switzerland in the chemistry laboratory for water and wastewater of Zahedan Medical Sciences University. Anions and cations were also measured using the Spectrop Hotometry (T80 LTV Visible) in the same laboratory and the distribution of elements across the city was drawn using GIS system.

RESULTS AND DISCUSSION

As one of the strong solvents found in nature, water can be found in different qualities. Since, a variety of different minerals can possibly be found in drinking water, some of which quite dangerous to human and animal health, so continuous inspection of drinking water is a crucial and essential task in keeping public health. Physical and chemical tests show that the majority of anions and cations in the city's groundwater resources are less favorable than the standard (they are within the standard range) for drinking water and they are within an acceptable range with average calcium ions less than the maximum limit of 641 mg L^{-1}, average amount of chloride ion within normal limits and maximum of 985 mg L^{-1}, average amount of sulfate ions within the acceptable range and the maximum of 1268 mg L^{-1}. The average annual amount of turbidity which is an important parameter in water disinfection was also reported to be less than desirable with the maximum NTU of 48.6. The average values or the optimal TDS also were less than desirable and they were measured to be 1500 mg L^{-1} with the maximum value of 5386 mg L^{-1}. Average amount of sodium ions were calculated to be than the standard level (>200 mg L^{-1}) with a maximum of 723 mg L^{-1}. Average amount of magnesium ion was in the acceptable range of <50 mg L^{-1} with the maxim um 283.87 (Table 1).

Overall, it can be stated that chemical parameter indicators of groundwater resources in the city of Chabahaar were not concerning from a health perspective. As a result because of lower water quality extracted from underground sources for consumption such water should be first mixed with other water sources available to meet the desired range of standard and then consumed (Fig. 1-8).

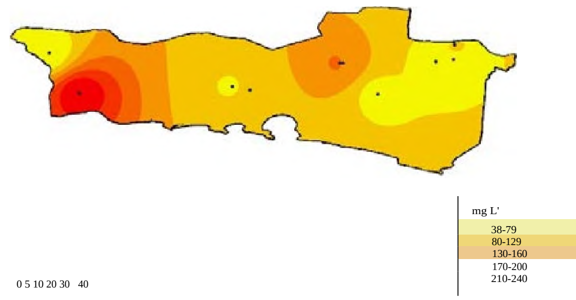

Fig. 1: Dispersion of chloride parameter

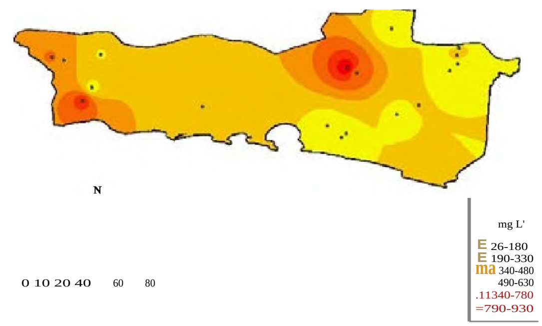

Fig. 2: Dispersion of calcium parameter

Table 1: Maximum, minimum, average and standard deviation for parameters measured in the city of Chabahaar (mg L^{-1})

Parameters	Min.	Average	Standard rate	Max.	STDEV
Sodium (mg L^{-1})	84	300.30	200	723	203.48
Potassium (mg L^{-1})	5	10.42		26	3.54
Magnesium (mg L^{-1})	15.49	47.74	50	283.87	46.73
Fluoride (mg L^{-1})	0.07	0.79	0.8	1.09	0.25
Calcium (mg L^{-1})	30.6	110.69	250	641	67.89
Ammonium (mg L^{-1})	76	256.86	400	985	300.45
Sulfate (mg L^{-1})	53	550	400	1268	414.24
water temperature (°C)	18	19.14	25	24	1.16
Alkalinity (mg L^{-1})	142	273.69		387	69.22
pH	7.3	7.68	6-8	8.21	0.29
TDS data for sodium (mg L^{-1})	386	1474	1500	5386	1027
Turbidity (NTU)	0.47	3.86	5	48.6	6.48

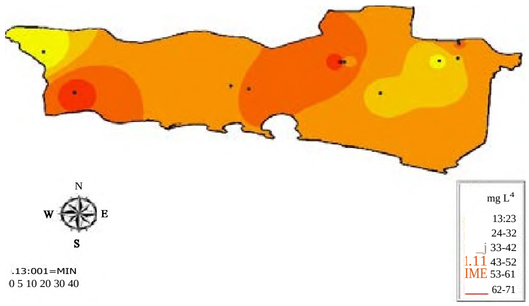

Fig. 3: Dispersion of TDS parameter

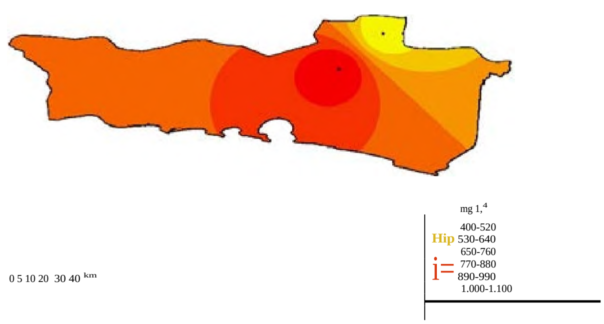

Fig. 4: Dispersion of magnesium parameter

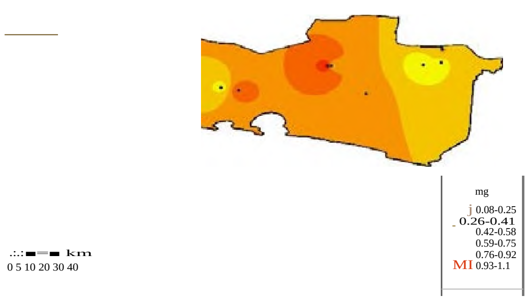

Fig. 5: Dispersion of hardness parameter

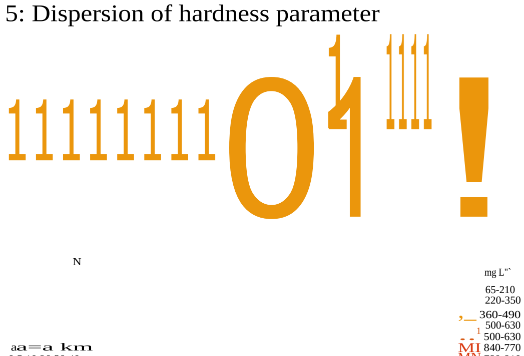

Fig. 6: Dispersion of fluorine parameter

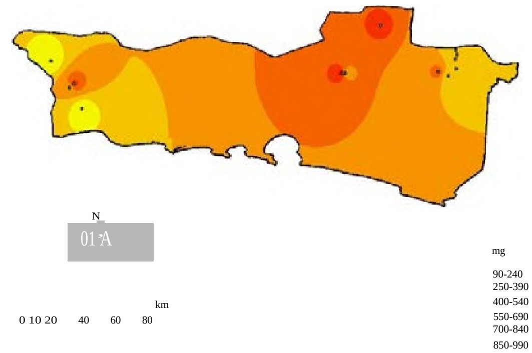

Fig. 7: Dispersion of sodium parameter

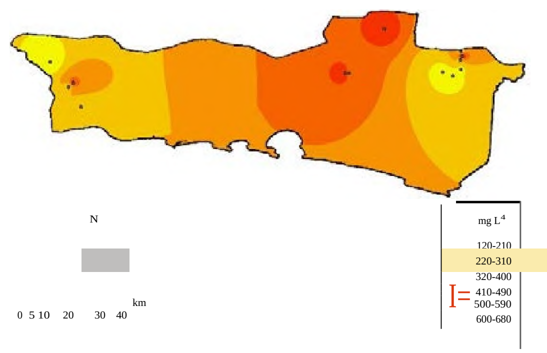

Fig. 8: Dispersion of sulfate parameter

CONCLUSION

The following tables provide measured values of all parameters as well as the geographical distribution of images of chloride, sodium, hardness, Sulphates, calcium, TDS and water type in groundwater resources in the region of Chabahaar city using GIS mapping software.

REFERENCES

APHA., 1992. Standard Methods for the Examination of Water and Wastewater. 17th Edn., American Public Health Association, Washington, DC., USA., ISBN-13: 9780875532073, Pages: 981.

Bazrafshan, E., H. Biglari and A.H. Mahvi, 201 2a. Phenol removal by electrocoagulation process from aqueous solutions. Fresenius Environ. Bull., 21: 364-371.

Bazrafshan, E., H. Biglari and A.H. Mahvi, 2012b. Humic acid removal from aqueous environments by electrocoagulation process using iron electrodes. J. Chem., 9: 2453-2461.

Biglari, H. A. Chavoshani, N. Javan and M.A. Hossein, 2016a. Geochemical study of groundwater conditions with special emphasis on fluoride concentration, Iran. Desalin. Water Treatment, 57: 22392-22399.

Biglari, H., M. Saeidi, M.R. Narooie, V. Alipour and Y. Sohrabi *et al.,* 201 6b. Survey on the quantity of hazardous wastes generated in Isfahan medical centers, Iran. Int. J. Pharm. Technol., 28: 17872-17877.

Biglari, H., M. Saeidi, V. Alipour, S. Randar and Y. Sohrabi *et al.,* 201 6c. Prospect of disinfection byproducts in water resources of Zabol. Int. J. Pharm. Technol., 8: 17856-17865.

Biglari, H., M. Saeidi, V. Alipour, S. Randar and Y. Sohrabi *et al.,* 201 6d. Review on hydrochemical and health effects of it in Sistan and Baluchistan groundwater's, Iran. Int. J. Pharm. Technol., 8: 17900-17920.

Biglari, H., Y. Sohrabi, S. S. Charganeh, M. Dabirian and N. Javan, 2016e. Surveying the geographical distribution of aluminium concentration in groundwater resources of Sistan and Baluchistan, Iran. Res. J. Med. Sci., 10: 351-354.

Ebrahimi, M.H., M. Abbasi, M. Khandan, M. Poursadeghiyan, M. Hami and H. Biglari, 2016. Effects of administrative interventions on improvement of safety and health in workplace: A case study in an oil company in Iran (2011-2015). J. Eng. Applied Sci., 11: 346-351.

Lashkaripour, G.R. and M. Zivdar, 2005. Desalination of brackish groundwater in Zahedan city in Iran. Desalin., 177: 1-5.

Lashkaripour, G.R., 2003. An investigation of groundwater condition by geoelectrical resistivity method: A case study in Korin aquifer, southeast Iran. J. Spatial Hydrol., Vol. 3,

Malakoutian, M. and S. Rezaei, 2014. Efficiency of ortho-chlorophenol removal from aqueous solutions using activated Fly Ash of Zarand fossil fuel power plant. J. Sch. Public Health Inst. Public Health Res., 12: 81-92.

Mirzabeygi, M., M. Naji, N. Yousefi, M. Shams and H. Biglari *et al.,* 2016. Evaluation of corrosion and scaling tendency indices in water distribution system: A case study of Torbat Heydariye, Iran. Desalin. Water Treatment, 57: 25918-25926.

Mohammadi, S., E. Zamani, Z. Mohadeth, F. Mogtahedi and H. Chopan *et al.,* 2015. Effects of different doses of simvastatin on lead-induced kidney damage in Balb-C male mice. Pharm. Sci., 20: 157-162.

Moradi, M., Y. Safari, H. Biglari, M. Ghayebzadeh and M. Darvishmotevalli *et al.,* 2016. Multi-year assessment of drought changes in the Kermanshah city by standardized precipitation index. Int. J. Pharm. Technol., 8: 17975-17987.

Pazancl, K., A. Hezarkhani, Y. Ghanbari and N. Aghavali, 2012. Groundwater geochemistry in the Meshkinshahr basin of Ardabil province in Iran. Environ. Earth Sci., 65: 871-879.

Sajjadi, S.A., G. Asgari, H. Biglari and A. Chavoshani, 2016. Pentachlorophenol removal by persulfate and microwave processes coupled from aqueous environments. J. Eng. Appl. Sci., 11: 1058-1 064.

Salehi, I., M. Ghiasi, A.R. Rahmani, M.N. Sepehr and M. Kiamanesh *et al.,* 2014. Evaluation of microbial and physico-chemical quality of bottled water produced in Hamadan province of Iran. J. Food Qual. Hazards Control, 1: 21-24.