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The Changes of Heavy Metals Values in Groundwater Drinking Water Networks

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Abstract: The role of water and its importance is an obvious issue in human's life and health. The source of water supply, relative to economic social and industrial growth, is in the exposure of pollution. And today the lack of alternative resources is one of the most complex problems of human societies, and especially is the problem of operators. The aim of this study is to investigate some of heavy metals in drinking water of Meshkinshahr' countries. To achieve this, selected 20 wells of 58 village's wells which sampled in two drought and wet water seasons of 2013.The sampling and measurements of heavy metal concentration like Cadmium, chromium, lead was based on Standard method. The obtained data of drought and wet water seasons compared through paired t-test (paired samples test). The results showed there is significant difference in the lead levels of two samples (sig > 0.05). But there is significant difference in Cadmium levels of two measured periods (sig < 0.05).The results of the study show that in rainfall season due to the permeation of rain sources to underground, increased the volume of aquifer waters and with two artificial origins decreased the quantities of heavy metals.

Key words: Water Pollution, Heavy Metals, Drought and Wet **Seasons**, Meshkinshahr city, Iran

1. Introduction

Today by increase of population and physical, chemical and microbial pollution sources; the water crisis is one of the world's big problems [12]. Extraction of underground waters, without regarding to environmental effects and the concept of allowed watering, is done consistently by human. The damage examining is important because in one hand ground water is one of the main source of drinking water, and on the other hand due to the human density and economic activities like industry, agriculture and residential areas it is one of the groundwater pollutant potentials so it is important in developing cities and areas[1].

Access to safe drinking water considers the basic need of any society. Increase of population, the expansion of cities and industries, etc.is the cause of environmental pollution, and especially pollution of drinking water sources[6].In particular, in recent decades, the most important concerns of people in developing countries and especially in arid and semi-arid residents, like Iran, are to supply high quality water. The increase of sensitivity and public information about environment conditions and stable development emphasis it. Therefor it is necessary to provide equilibrium between prior goals and environmental conditions and also between quality and quantity of water [13].

According to wide variety of contaminants, todays qualitative studies about water sources is essential and is one of the most important challenges of human in recent years. During recent decades, several solutions have done in different stages of identification, presentation, and remedial measures to increase the quality of water resources by various researchers. Among them identification and knowledge of water quality is primary step to reach to health and standard water, and allocated main part of research to itself. If we pay enough attention to it can be a suitable bed prevent and improve the quality of water[10]. As increase of human population, increase different water consumption, thus not only it reduce the quantity and quality of water, but also increase the pollution [5].

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The underground water table that uses as a shallow or deep water wells in country and cities, todays as a result of negligence and recklessness to urban and agriculture wastewater it polluted by microbial and chemical pollutants, heavy metals and environmental pollutants attracts the attention of scientist to itself because these elements are the main environmental pollutants, they have characteristic like stability that can't be analysis by chemical and environment process. One of main results of stability is concentration and collection of metals in food materials or in organisms context that uses that materials[11]. The existence of heavy metals in water, even a little(more than allowed amount) will be harmful to humans. According to epidemiological studies there is a relationship between tooth decay, kidney disorders and heart and nervous diseases and various forms of cancers and heavy metals[9].

In many cases, groundwater contamination pollution identified after wells. The remove of groundwater contamination is long and expensive process and often it clears when the removing is impossible. One of the suitable ways to prevent groundwater pollution is to identify the aquifer vulnerable areas and agriculture lands managing[14]. Fataei et al. after investigation of 81 percent of Ardabil wells about quality of ground water found that,45 percent of samples(31)is in C2S1 level,semi-salt,43/5 percent of samples(34) is in C3S2-C3S1,salt,11/5 percent of samples is inC4S2-C4S level, very salt. According to Piper chart, most of Ardebil water samples is in carbonate type that has lot of Sodium and Potassium. In general, the danger of saltiness is average to high, and the danger of alkali is low and such water is suitable for agricultural matters[4].

Hu et al. (2003) showed that the reason of surface water down quality coming through by establishment of new industries of agriculture, discharge of urban sewage and also non-point pollution sources, such as washed chemical material on agricultural soils, thus the effects of such activities is loss of river's self-filtration power[8].

-Ebrahimi et al. (2010) surveyed the chemical quality of underground water in Sajjad the area of Zarrin hahr, the results showed that the mean concentration of cadmium, chrome and Nickle, except lead are higher than drinking water standards[2] .

-Hassan Zadeh and colleagues (2010) surveyed the pollution of Kerman's ground water and the results showed that most of concentration of minor elements and main ions increasing as well as co-concentrate maps of main ions and heavy metals in underground water study showed that minor toxic concentrations like lead, cadmium, chrome and manganese are higher than allowed amount[7].

To maintain the quality of drinking water in terms of heavy metal concentration and potential pollution caused by the resources, planning and conducting of research is necessary and to achieve this, you need to determine the status of the concentrations of heavy metals in the drinking water sources. In this study, in order to raise awareness about status of drinking water quality in Meshkinshahr villages surveyed the concentration of heavy metal like cadmium, chrome, lead in drinking water.

2. Materials and method

To check the status of the quality of drinking water resources in villages of Meshginshahr, which is located in northwest of Ardabil Province, Iran (Figure 1) ,among 58 wells that used in the region on the basis of population density, distribution of rural areas and the establishment of pollutant resources selected 20 villages and sampled in the drought and wet water seasons and analyzed the amount of heavy metals.

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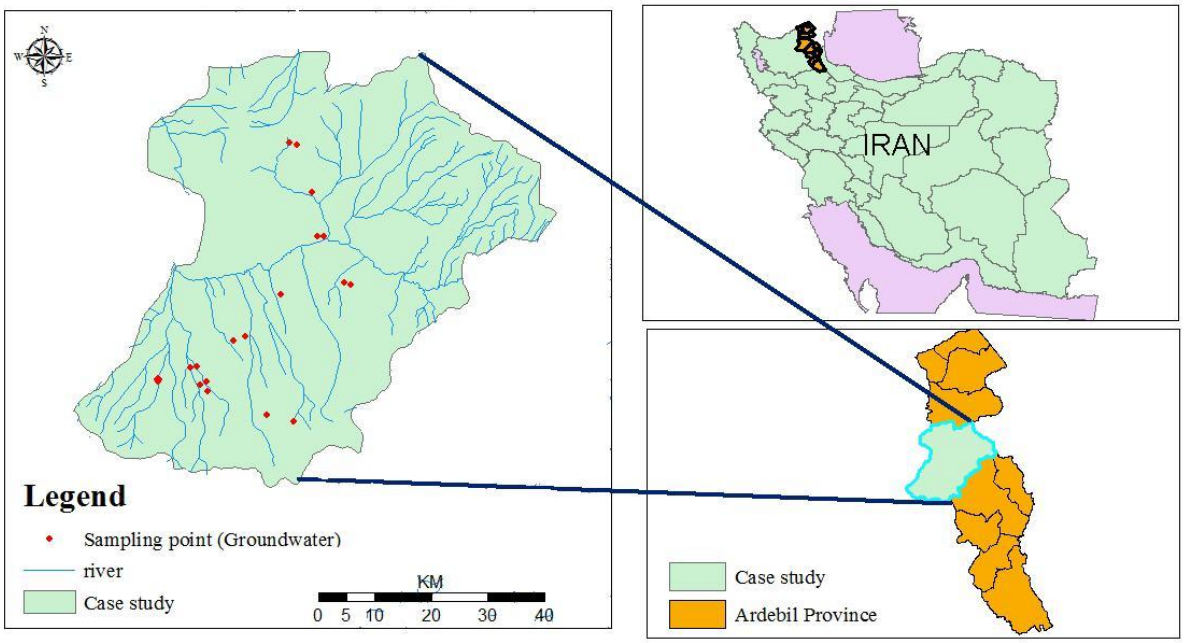

Fig.1. Location of the study area and the location of sampling stations of rural drinking water networks, Meshkinshahr, Ardebil, Iran.

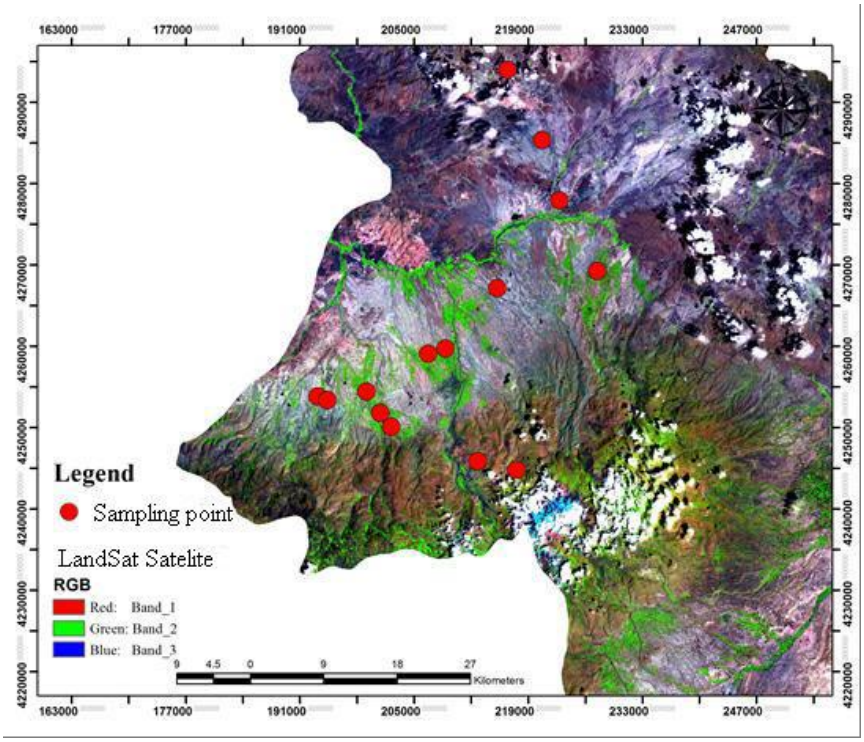

Fig.2. location of sampling areas on the satellite map.

For sampling used sterile polyethylene containers were used then it washed with 10 percent nitric acid, detergent and distilled water. At the time of sampling with water, place rinsed with water and sampling carried out on the basis of the standard method. To fix the samples used nitric acid .For 250cc of sampled water added 5-10cc pure acid nitric.

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To prepare the samples, first we pour them inside a sterile glass, second we put in on the Hot water in such a way that it doesn't boil. The evaporation of water reached to20cc. A2cc citric acid added to each of the samples and heated to reach to 10cc.Last they passed through the filter and to measure the heavy metals we used Perkin Elmer 2380 unit. In order to compare the measured results of heavy metal in the studied wells used one-way t-test by SPSS software. The used standards includes of Standard Organization, Iran Industrial Research, EPA,WHO[3] [15].

3. Results and discussion:

The results of average comparison of measured amounts of the heavy metals like lead, cadmium and chromium in 20 networks of Meshginshahr villages that supply by underground wells represented in table 1 and includes of WHO and EPA standards, Iran industrial research, Standard Organization.

Table 1. the comparison of average heavy metals in groundwater of Meshkin shahr village according to national and international standards in the rain season

		WHO	EPA	Iran
Lead	standard	0.01 b	0.015 b	0.1 b
	Mean	0.1413 a	0.1413 a	0.1413 a
Cadmium	standard	0.003 a	0.003 a	0.01 a
	Mean	0.0051 a	0.0051 a	0.0051 a
Chrome	standard	0.05 a	0.05 a	0.05 a
	Mean	0.0176 b	0.0176 b	0.0176 b

As can be seen in table1, average lead (1413/0) is higher than EPA and WHO standards. Average cadmium (0.0051) is higher than the amount of EPA and WHO standards but it is lower than national standard. Given that there is no industrial development in studied areas, high average of lead and cadmium can be due to natural origin or it can be due to discharge of sewage in wells or usage of agricultural fertilizer in the area.

As is clear from table 1, the average amount of chrome with 0.0176 is lower than values and standards of the EPA , WHO and Iran.

A single-sample t-test is represented in table 2 that compares heavy metals like lead, cadmium and chromium in terms of WHO ,EPA standards, Iran industrial research and standard organization in drought and wet water seasons.

Table 2. single-sample t-test to compare the amount of three elements in groundwater of Meshkinshahr according to national and international standards in the rainfall season

		WHO	EPA	Iran
Lead	t-value	2.681	2.579	0.844
	Significance level	*0.015	*0.018	^{ns}0.409
Cadmium	t-value	1.198	1.198	-2.207
	Significance level	^{ns}0.246	^{ns}0.246	*0.014
Chrome	T-test	-5.899	-15.003	-5.899
	Significance level	**0.000	**0.000	**0.000

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* 5% probability difference level is meaningful. ** The difference in 1% level is meaningful. Ns mean difference is not significant.

The results showed that the measured mean difference for lead is higher than WHO and EPA standards (sig > 0.05) respectively, but there is no significant difference in Iran standard (sig < 0.05).

The results showed that the measured mean difference of cadmium in EPA and WHO

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standards isn't significant (sig > 0.05) while it is lower than Iran standard (sig < 0.05), respectively. The results showed that the measured mean difference for chrome is lower than EPA , WHO standards and Iran (sig < 0/01).

The results showed average measurements for cadmium with significant differences the EPA standards and WHO has (sig > 0.05) while the lower standard of a significant form of Iran (sig < 0.05), respectively. The results showed that the measured average difference for chrome as well significant quantities of EPA and WHO standards and Iran (sig < 0/01).

Compared to the average of the results in the

Table 3.comparison of average heavy metals in groundwater of Meshkinshahr according to national and international standards in the low rain season

		WHO	EPA	Iran
Lead	standard	0.01 b	0.015 b	0.1 b
	mean	0.1529 a	0.1529 a	0.1529 a
Cadmium	standard	0.003 a	0.003 a	0.01 a
	Mean	0.0247 a	0.0247 a	0.0247 a
Chrome	standard	0.05 a	0.1 a	0.05 a
	Mean	0.0667 b	0.0667 b	0.0667 b

As can be seen in table 3, the average lead (0.1529) is higher than EPA,WHO and Iran standards. The average amount of cadmium (0.0247) is higher than the WHO and EPA standards, too.

In low rain season, average of chrome (0.0667) is higher than the amount of EPA, WHO and Iran.

Table 4. A single -sample t-test that compare amount of three elements of Meshkinshahr groundwater according to national and international standards in low rain

		WHO	EPA	Iran
lead	t-value	946/6	703/6	573/2
	Significance level	**0.000	**0.000	*0.019
cadmium	t-value	3.224	3.224	0.2002
	Significance level	**0.040	**0.040	*0.040
chrome	T-test	0.693	-1.383	0.693
	Significance level	^{ns}0.496	^{ns}0.183	^{ns}0.496

* Difference level in5% is meaningful. ** Difference level in 1% is meaningful. The means difference isn't significant.

A result of single-sample t-test of measured heavy metals in low rain season show that the mean measured difference in lead is in lead is higher than EPA and WHO standards (sig> 0/01) and Iran (sig > 0.05). Also the measured mean different in Cadmium was higher than WHO, EPA (sig > 0.01) and Iran (sig> 0.05) standards.

The result show that there is no significant different in measured amount of chrome, according to WHO, EPA and Iran standards (sig> 0.05)

To compare the amount of lead, Chrome and Cadmium in low and rainfall season of Meshkinshahr, used paired samples of T-Test.

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Table 5. The paired samples of T-Test to compare the mean of heavy metals in drought and wet rain seasons

		Spring lead-summer lead	Spring cadmium-summer cadmium	Summer chrome-spring chrome
Paired t-test	t- test	-0.235	-2.842	-1.984
	Significance level	^{ns}0.817	*0.011	^{ns}0.064

The result of paired samples of t-test showed that there is no significant difference in lead amount of drought and wet rain seasons (sig.0/05)

But the amount of cadmium in two seasons is significant (sig,0/05)so that measured cadmium amount in low rain season is higher than rainfall

Also there is no significant difference in chrome amount of two seasons(sig.0/05).

4. Conclusion

In this study to examine changes of lead, cadmium and chromium value in drought and wet rain seasons sampled the drinking water of 20 village networks of Meshkinshahr. The obtained data of drought and wet water seasons by paired-sample t-test show that there is no significant difference amount in chrome and lead in low and rainfall seasons.(sig,0/05).so that the amount of measured cadmium in low rain season was higher than the rainfall season. The result show that since there is no significant difference in lead and chrome of high and low rain seasons, the heavy metal has a natural origin. But the result of paired-sample t-test show that cadmium amount in rainfall season is different from in low rain season, because it can be caused by pollutant sources through agriculture activities and sewage discharge that absorb by wells, in rainfall season, due to permeation of rain and surface to aquifer, it increased and thus decreased the heavy metal amount through artificial origin.

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