Effects of Drought on Groundwater Quality Conditions on Kermanshah Province in Iran

Siamak Boudaghpour

***Abstract*—** Iran as a semi-arid region always faces the problem of dehydration. For this reason, successive drought and reduction in water quality is consistently raised as a serious problem and can lead to irreparable environmental damage. Groundwater is one of the major sources of water in Iran and its quality and quantity that is affected by the drought. The purpose of this study is unaffected in Kermanshah province. In order to achieve this purpose at first shown that the region has been suffering from drought. Then to finding the association of drought with reduced of water level, depth of groundwater Was studied month to month. Finally, according to tests on physical and chemical parameters of groundwater, how it influences the quality were studied in months of drought in November and May 2006. And the process of change and its causes were also described. The results show that in May due to the impact of drought water level of wells has dropped 5/3 meters more than the water level has dropped in November. Surveying Changes in parameters of hardness, sodium, calcium, electrical conductivity, dry residue (TDS), sulfate, magnesium, bicarbonate ion, the ratio of sodium to other cations in water (SAR), chlorine, in these months shows that all the parameters have changed so that the water has been contaminated in study area. These changes on reduced groundwater quality have been caused by drought.

***Keywords*—**drought, water quality, water contamination, Qualitative Evaluation

I. Introduction

RAPID population growth and in proportion increasing the needs of community to agriculture and industrial products, limited water resources with good quality And lack of precipitation caused by the specific geographical situation of the country, makes The need for conservation and proper utilization of limited resources necessary.

Lack of suitable surface currents in the Kermanshah Plain , groundwater resources play an important role in water supply needs in this area. Since in the advanced stages of drought, severe water shortages encountered, the response of Groundwater to the drought is very important . Therefore, drought and change in groundwater quality can make irreparable damage to crops, livestock and even drinking water in this region. In a study presented about the relationship between ground water and rainfall, the following definition presented for the drought of groundwater :"When the water level of ground drops below the critical level at a certain period, the drought of groundwater has occurred.". In a survey conducted in the Hamedan province within the study of the droughts and severity of falling static groundwater levels, Convincing results were obtained in relation to these two. Results the effect of drought on chemical parameters of groundwater in the city of Elam in Iran also showed despite of drought the amount of solute wells in this region has not increased.

Siamak Boudaghpour, PhD. Environmental Engineering branch, Civil Engineering Department, K.N.Toosi Technical University, Tehran, Iran

Geographical location of study area

Kermanshah Province located in the western Top End and has three sides of internal borders with the provinces of Lorestan, Kurdistan, Ilam, Hamedan and one side of international border with Iraq. Provinces affected by wet weather of the Mediterranean and an average of annual rainfall is 300 to 800 mm. Based on Coupons climate category, Kermanshah Province has 4 different climates:

Mild winters and hot dry summers In the city Qsrshyryn_ Sarpolzahab and Azglh Rural district in southwestern Javanrood

Cold winter and summer in Pave county_ Javanrood_ West Karand

Semi-arid and steppe in Sangher county and Posht dar band kermanshah Rural district.

Semi-arid and Semi-steppe in Kangavar _ Sahne _ Hersin county. As can be seen semi-arid climatic conditions are more influential on this Zone. It shows that The use of groundwater resources has special concern in the farming and animal husbandry in Kermanshah Province.

II. Material & Methods

In order to define Drought first must determine an index. SPI index is an indicator of climatic drought. These parameters use to determine the precipitation deficit in different time scales. Duration, severity and magnitude are Critical parameters associated with the SPI index.

Since for the computation of SPI index, at least a 30-year period is required, so the synoptic and pluviometry stations in the study area with 30-year period were selected for study.

Vulnerability to drought of 8 weather stations located in the plains of Kermanshah based on three criteria derived from the SPI, the longest period, number of months of dealing with drought and number of months of dealing with drought DM, was assessed .Pol kohne station with a total of has highest total of DM and Sangher station With a total of 28.37 has the The Minimum total of DM. With the longest period of drought

Jologir station with continuing period of 34 mounts has longest period and Aran station with continuing period of 13 mounts has minimum period of continuing drought. The survey results showed that all stations in the study area have been faced with drought. Then, to clarify the relationship between drought and groundwater level, correlation between the height of water wells and piezometers to the nearest weather station were also calculated. According to studies, significant relation between climate change and drought and groundwater level change is observed. Due to the large volume of data, only information of the wells with higher correlation coefficients in Table 3 has been investigated. A total, 94 piezometer wells with complete data, has the average correlation coefficient equal to-0.34

According to the classified assessment of SPI drought index shown in Table 3 can be found that all the coefficients of the study area show the face of drought . Since the minimum continuing drought in Kermanshah province has been 13 months, drought events on water resources is impressive during the course of a year. So the water level has been traced over a year. Based on the Plotted graph, months with the highest and lowest water levels have been selected and qualitative changes in those months were compared with each other. Due to the defects in qualitative information in Day, November was used instead. Difference in water level in Day and November is less than 0.5 m approximately. The aim of this study is examine the qualitative changes in water resources, particularly in periods of drought. Therefore, water samples from wells in the month of May and November (Due to having the highest and lowest water level) in different areas were randomly selected and Daily basis has been tested. After transfer to the laboratory, the parameters of hardness, sodium, calcium, conductivity, sulfate, magnesium, bicarbonate ion, and the ratio of sodium to other cations in water (SAR), chloride were measured. Finally, the results obtained for each parameter in each month compared with others and necessary conclusions were taken.

III. Results and Discussion

Although groundwater is considered as one of the major sources of water in the world, but they are not regarded in many drought-related studies. To show changes in water quality properties of several drought indicators, in this study Several parameters of quality indicators are used. These parameters include Hardness, sodium, magnesium, calcium, conductivity, sulfate, bicarbonate ion, sodium content than other cations in the water SAR and chlorine. Results of average measured values of these parameters in May and November2006 and have also been compared with the standard of World Health Organization.

(Mg)

The presence of magnesium can cause carbonate and b-carbonate hardness in water And its high concentration in drinking water cause a laxative effect in humans. Especially if coupled with a large amount of sulfate, shattered and fine-grained soil and prevents oxygen to reach plant roots and cause the drying. World Health Organization international standards, suggests amount equivalent to 30 mg of magnesium per liter for more than 250 mg of sulfate per liter and maximum allowable concentration of 150 mg per liter in condition the Sulfate concentration is less. The amount of Mg has increased In the second month And due to the points about the relationship between amount of Mg with Sulfate standards Mg levels in November is standard And in May is higher than standard and detrimental.

(Th)

Water hardness can Be divided of two types, Carbonate Hardness and Noncarbonated Hardness. This classification is often done in the form of temporary hardness and Permanent Hardness.Temporary hardness or carbonate hardness in caused with presence of calcium and magnesium bicarbonate which mainly reduce with Increase heat or excess Ph.

(Cl)

Chlorine is the most important and most effective chemical disinfectant. If chlorine, as a Pre-additive matter, is added to colored water or to water containing organic matter (Hemic acid and Fluoric acid) before water treatment, will cause the formation of trihalomethanes. Chloride ions are also absorbed by plant roots and deliver it to various parts and collect in leaves such as sodium. Chloride toxicity symptoms in plants are different with signs of Sodium toxicity. In poisoning by chloride ions, burn and drying at the tip of older leaves and progress by further growth in margins of Leaf, and severe burns can cause the premature loss of leaves. Residual chlorine in drinking water must be between 0.2 and 0.5 mg per liter.

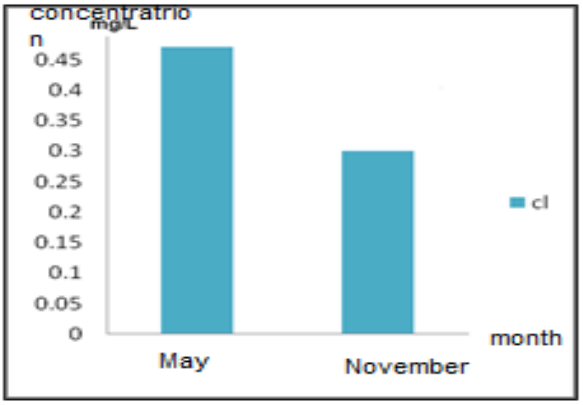

Figure 1: The amount of chlorine in the Water in the second and eighth month

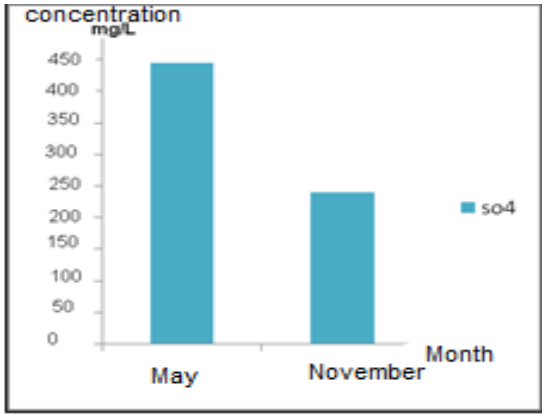

Figure 2: The amount of sulfate in water in the second and eighth month

(So4)

Sulfate in drinking water has a major contribution in establishing a permanent or non-carbonate hardness. High concentration of sulfate is effective in changing the taste of water and if it is higher than the standard could have Laxative effect in humans. The optimal value of sulfate is 200 mg per liter and its maximum is 400 mg per liter

(Ca)

Calcium usually appears in groundwater as carbonate, calcium bicarbonate and calcium sulfate. In order to health large amount of calcium in water is not important and calcium is deposited as sediment in the water. World Health Organization suggests the maximum concentration of calcium 200 mg per liter according to Ca+2.Although in the second month the amount of Ca has increased, this value in two months is in the standard range. To convert milligrams per liter to milligrams Aki Valant per liter, should divide milligrams per liter to weight of equivalent. Weight of Aki valent of Ca+2 is number 20. Thus the amount of Ca+2 in November and May respectively is 53.6 and 54.2 milligrams per liter.

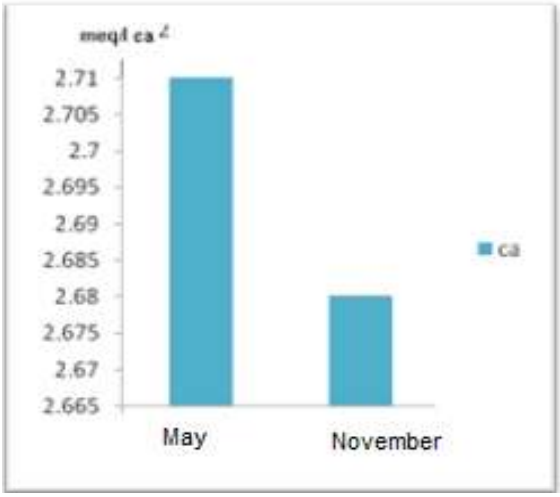

Figure 3: The amount of calcium in the second and eighth month

Figure 4 :SAR value in the water in the second and eighth month

Sodium content than other cations in the water (SAR)

A sodium level in agricultures water, due to its ability to direct accumulation in plants, is highly effective in plants growth. Sodium-water makes sodium soil. Sodium soils, usually has inadequate and destruction building. So problems of poor ventilation and the accumulation of water as the effect of irrigation can be seen in these soils and finally, they create poor environment for plant growth. Sodium ion, typically collect in the roots and lower parts of trees and release after making these sections hard and burns leaves by reaching to them. Indirect impact of sodium on plant creates an imbalance in supply and cause physical damage to the soil. Effect of dietary of sodium, depends on the concentration of sodium ions, calcium and magnesium in the soil solution. In the sodium soil that the solution salt concentration is less, Low concentrations of calcium and magnesium can reduce growth and due to the regulation of sodium absorption, prevent abundant accumulation of sodium as a toxin [11]. Normally, harmful effects of sodium in the irrigation appear in sodium concentration of 120 mg per liter. Primarily sodium toxicity symptoms are seen in older leaves, because time is needed to establish toxicity. Negative impact of the amount of sodium based on SAR parameters. According to this classification, SAR of groundwater is high in plains of Kermanshah and it is not suitable for the long usage. The SAR value in the second month is significantly more than the eighth month. It should be noted that SAR can be calculated based on ml equivalent Valant per liter of sodium, calcium and magnesium in the laboratory.

(hco3)

High concentration of bicarbonate causes the groundwater inadequate for irrigation and makes problems. High bicarbonate in water has both direct and indirect effects on plants nutrition. Indirect effect of bicarbonate in water is high accelerates in making soil sodium and also has problems of plant nutrition in sodium soils.
In plant nutrition, the direct effect of bicarbonate in water is more important. High Bicarbonate in water, cause great difficulty in absorption of iron and zinc by the plant.

Ornamental plants are susceptible to iron deficiency and soil conditions of our country have deficiency in iron. If high bicarbonate gets high the deficiency of iron in water get worsened. For example, iron deficiency causes leaf color becomes from green to yellowish and in some plants may be completely white in leaf color, or green in veins and yellowing mode in other parts of leaves. Precautions should be taken in consumption of water that has more than 200 mg per Liter bicarbonate. To convert milligrams per liter to milligram equivalent per liter, should divide Milligrams per liter on weight of equivalent. The weight of equivalent is number 61 for hco3.

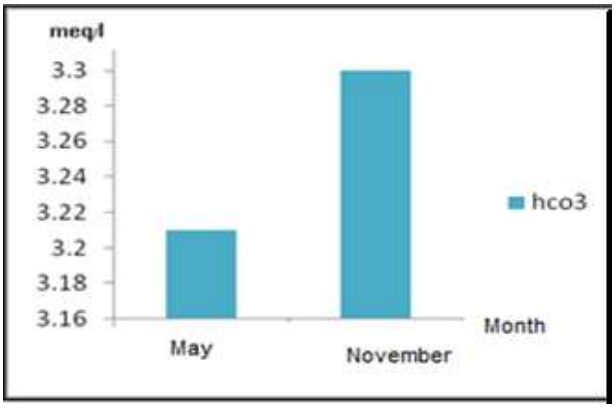

Figure 5: The amount of Bicarbonate in the water in the Second and eighth month

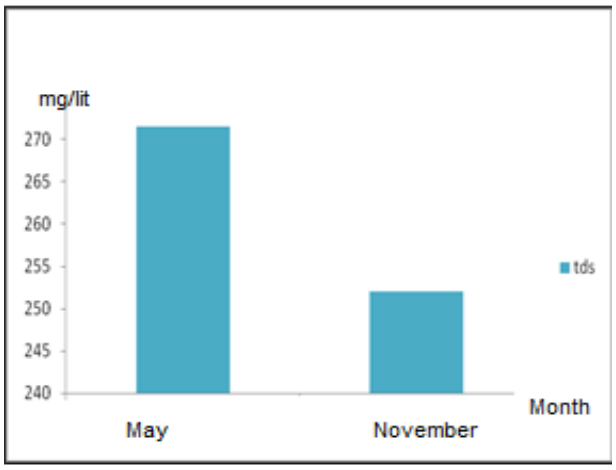

Figure 6: Capability of water electrical conductivity (EC)

Capability of the electrical conductivity of water (EC) and total dissolved salts (TDS)

One of the simplest ways to determine the concentration of dissolved salts in water is measuring electrical conductivity. Electrical conductivity has determined and direct comparison with the amount of TDS. More concentration of dissolved salts in water makes guided Solution more. If the amount of minerals that exist in the water exceeds a certain level so say the water salty. Salty water makes the soil salty. Since the salinity range of water is the most important factor in chemical quality of it, thus measuring to control water quality is important. Salinity of waters are classified into four groups. By increasing the electrical conductivity of the water its quality falls and could be destructive to the environment. The salinity of the water in every two months is C2. The exact amount of EC raised from 394 micromos per cm in November to 424 micromos per cm in May. Allowed TDS in drinking water is 1000 mg per liter. Tolerance range of plants against TDS is very broad. Low TDS in water increase quality and quantity of all agricultural products. Increase in TDS depends on the plant type and tolerance against increasing various ions in water, reduce in product from 1 to 100 percent is predictable.

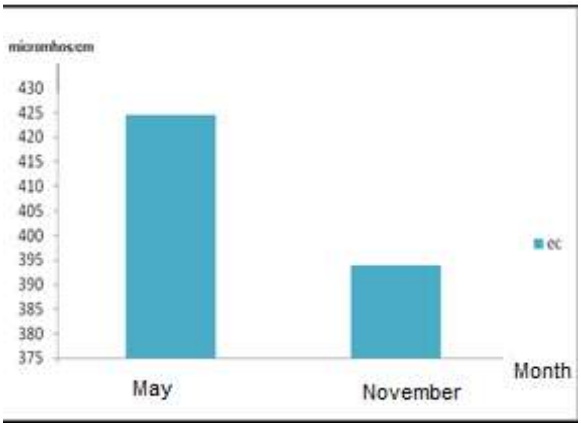

Figure 7: Total dissolved solids (TDS)

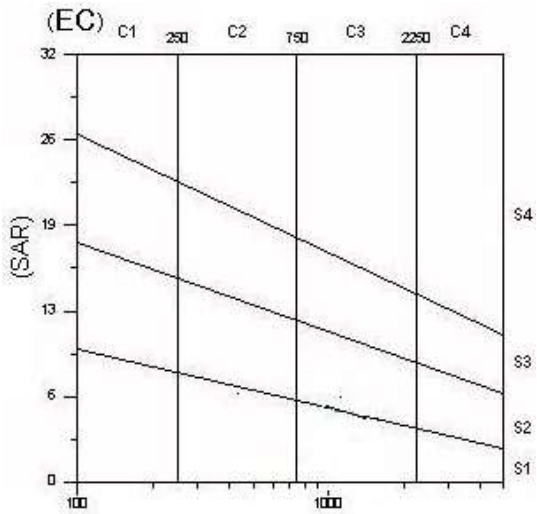

Figure 8: Cox Will Classification Wilcox

Analysis results of the predominant ions, in terms of agricultural use and also the type of water, by using of Wilcox diagram has been studied. Figure 2 shows the classification of Wilcox.

IV. Conclusion

In this research impacts of the phenomenon of drought on groundwater quality conditions in Kermanshah Plain, has been studied And the following results have been taken:

- Drought has a direct impact on groundwater resources, So that droughts had great impact on the groundwater level drops. The water level has fallen 3.5 mm from November

to May.

- Due to low water levels in the region and statistics obtained about the regional water quality as is clearly visible in the graphs, can say:
- The amount of Mg in each month of November is standard and in May is more than standard and it is detrimental. Totally amount of Mg in water shows 7/7% drop in water quality based on decrease in water level.
- In relation with hardness parameter can be seen that in this region the water has medium hardness. The hardness of water shows 5.2% drop in water quality based on decrease in water level.
- The amount of chlorine in every two months is in the standard range But in the second month it is higher than the eighth month and water quality in the second month in terms of changing the amount shows 36% reduction of chlorine.
- The amount of sulfate in water in the second month is 445 mg per Liter and it is over than standard and in the eight month is 445 mg per Liter in the standard range and water quality in terms of changing the amount of sulfate in the second month shows 46% reduction.
- Amount of Calcium in November and May, respectively is 53/6 and 54/2mg per liter. Although the amount of Ca in the second month has increased and water quality in terms of changing the amount of calcium in the second month suggests 1/1% decline, but this amount is in the standard range in every two months.
- SAR of groundwater in plains of Kermanshah is high and it is not suitable for prolonged usage. The SAR value in the second month is significantly more than the eighth month. Water quality in the second month shows 6/7% decline.
- The amount of bicarbonate in November and May is 201/3 and 196/4 milligrams per liter. The amount of bicarbonate, unlike the other parameters, in November is higher than May. At first glance this approach seems to be different with other parameters but by comparing these numbers with the recommended amount of 200 mg per liter we can find that these changes also indicates reduce the quality of groundwater in the region of 42/2% of the variation of this parameter.
- Water Class of studied area C3-S2 was assessed, By using the Wilcox diagram and Place the obtained values for EC and SAR that Indicates high sodium adsorption ratio and high salinity and is not suitable for agriculture.
- By comparing All changes in parameters in May, That the water level was lower than November, by consideration the amount recommended by the World Health Organization, this changes has led to decrease in water quality and normal function of these factors due to falling water levels as a result of drought in the studied area

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