PANEVĖŽIO KOLEGIJA ISSN 2029-1280. Taikomieji tyrimai studijose ir praktikoje – Applied Research in Studies and Practice, 2016, 12.

ENVIRONMENTAL EFFECTS ON GROUNDWATER QUALITY IN SEYFE-KIZILIRMAK SUB-BASIN

***Sultan Kıymaz** [a], **Ufuk Karadavut** [b], **Adnan Evsen** [c]*

[a]*Ahi Evran University, Faculty of Agriculture, Department of Biosystems Engineering, Kırşehir, Turkey*
[b]*Ahi Evran University, Faculty of Agriculture, Department of Biometry and Genetics Unit, Kırşehir, Turkey*
[c]*XII. Regional Directorate of State Hydraulic Works, Kayseri, Turkey*

Abstract. Water is one of the most crucial natural resources. As in most regions of the world, water quality in our country continues to decrease. The objective of this study is to determine environmental effects on groundwater quality changes of the Seyfe-Kızılırmak Sub-Basin, Turkey. The affecting water quality parameters such as pH, temperature, electrical conductivity, dissolved oxygen, total dissolved salt, hardness, sodium, potassium, calcium, magnesium, bicarbonate, chloride, ammonia, nitrite, nitrate, sulfate evaluated and determined the variations in groundwater quality parameters in months of March, May, June, and September of the years 2010-2013 selected sampling stations in Seyfe-Kızılırmak Sub-Basin, Turkey. The variation of pre-irrigation season and post-irrigation season of the data and the variation among years were employed using the parametric t test and F test for statistical analysis, respectively. In addition, using linear regression analysis to determine the forward trends of the parameters. According to this, while the increase in TDS, HCO_3, Cl and Mg is expected to continue at an accelerated rate, it is seen that the other parameters decrease and the variability becomes right. For different uses, various measures of water quality and monitoring of parameters threatening pollution are important for the availability and sustainability of our water resources, quality of life, and economic development.

Keywords: Linear regression models; ground water quality; environmental effects; Seyfe-Kızılırmak Sub-Basin.

INTRODUCTION

Water is one of the most crucial natural resources and the essence of life. The world's water supply consists of 2.5 percent fresh water and 97.5 percent saline water. The world's supply of fresh water is made up of lakes, rivers, etc. (0.4 %); snow and ice (68.7 %); and groundwater (30.9 %). Groundwater is one of our most essential natural resource often used for industry, commerce, agriculture and for drinking. It is well known that agriculture is the single largest user of freshwater resources, using a global average of 70% of all surface water supplies. But it's affected by the vicinity environment and human beings activities. Throughout the world, the process of industrialization and urbanization development, agricultural activities and mining enterprises have caused groundwater pollution (Igor, 1993, Longe & Balogun 2010, Aquastat, 2016).

Seyfe Lake is noted a special place because of its national and international protection status, such as First Degree Natural Protected Area, Natural Reserve Area, and Ramsar Area. Seyfe Lake is located in the Middle Kızılırmak Region within a tectonic-originated closed basin. It is fed by springs, underground wells, surface flow in the drainage area, and precipitation in the lake area and discharged by vaporization. The lake provides thousands of birds with ideal nutrition, shelter, and reproduction opportunities due to its salty water, rich floor sediment, and habitats of diverse ecological character (Kiymaz & Karadavut 2014a, Çelik et al. 2008). Agriculture is the most important income source throughout the basin with a composition of 91.7 % dry and 8.3 % irrigated farming. The groundwater well sites in the present study are located mainly near agricultural activities and domestic area. Therefore, quantity and chemical quality of irrigation water used is affected by these activities.

The quality of water is defined in terms of its physical, chemical and biological parameters, and assessment of water quality is very important to know the suitability for various purposes (Sargaonkar &Deshpande, 2003).

The objective of the study is to determine environmental effects on groundwater quality changes of the Seyfe-Kızılırmak Sub-Basin, Turkey. The affecting water quality parameters such as pH, temperature, electrical conductivity, dissolved oxygen, total dissolved salt, hardness, sodium, potassium, magnesium, calcium, chloride, bicarbonate, ammonium, nitrite, nitrate and sulfate evaluated and determined the variations in groundwater quality parameters in months of March, May, June, and September of the years 2010-2013 selected sampling stations in Seyfe-Kızılırmak Sub-Basin, Turkey.

MATERIAL AND METHODLOCATION AND CLIMATE CHARACTERISTICS

The study consisted of twenty selected ground water wells that are operated for irrigation and drinking purposes by the State Hydraulics Works (DSI) in the Seyfe Kızılırmak Sub-Basin. The locations of these wells are shown in Figure 1. The abovementioned groundwater wells were located in Kaman, Boztepe, and Center districts of Kırşehir Province and Kozaklı and Hacıbektaş districts of Nevşehir Province. The study area constitutes majority of the Seyfe basin. In addition, groundwater wells in these areas have been pumped to supply for irrigation and drinking water.

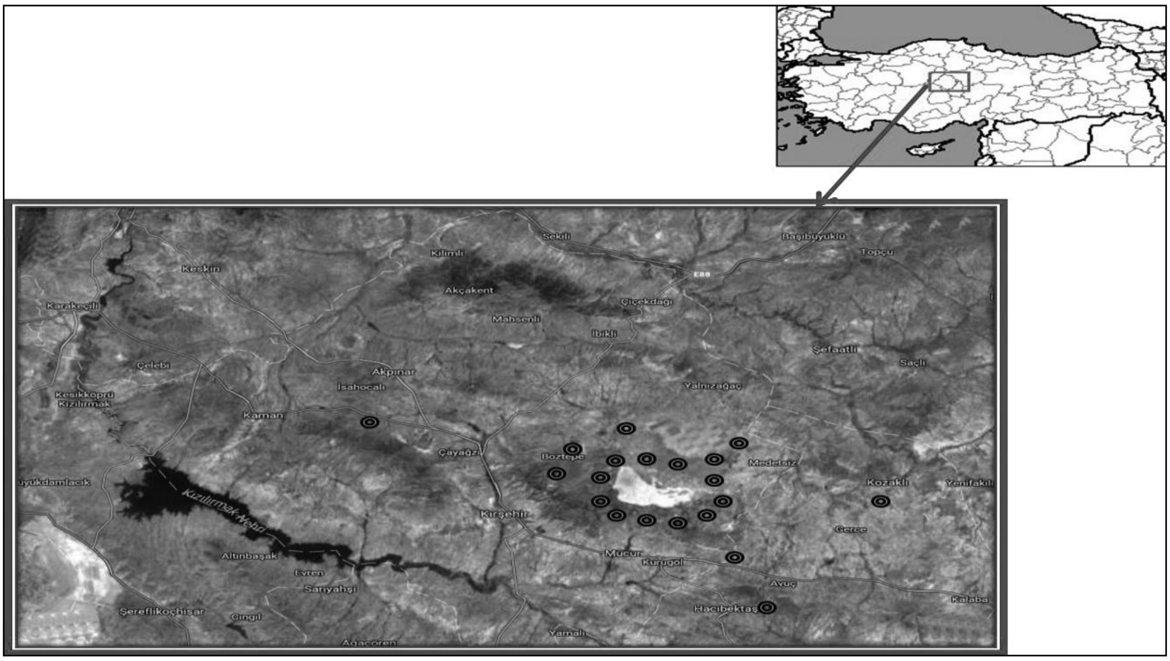

Figure 1. **The locations of groundwater wells**

Seyfe basin shows a continental climate feature. Summers are hot and dry, winters are cold and snowy. According to the climate classification, Kırşehir province has arid semi-humid climatic characteristic. The annual average temperature for the long years (1960-2015) is 11.0°C; the long-term mean rainfall is between 380-400 mm, which is lower than the average of our country (643 mm).

THE SELECTION OF GROUNDWATER PARAMETERS AND STATISTICAL ANALYSIS OF THE DATA

The parameters of some physicochemical such as pH, temperature (°C), electrical conductivity (EC), total dissolved salt (TDS), hardness, sodium (Na^{+}), potassium (K^{+}), calcium (Ca^{+2}), magnesium (Mg^{+2}), chloride (Cl^{-}), bicarbonate (HCO_3), ammonia (NH_3), nitrate (NO_3), nitrite (NO_2), and sulfate (SO_4^{2-}) were selected to determine the variation of water quality of groundwater wells in the study. These parameters were determined considering previous studies on the Seyfe Lake Basin (Bolat, 2006, Çelik at al., 2008, Başaran & Vildan 2011,Kıymaz & Ertek, 2011, Kıymaz & Karadavut 2014a, 2014b, Kıymaz et al., 2016, Bölükbaşı & Akın 2016). In addition, the adsorption ratio (SAR) and percent sodium (%Na) values using the analysis data were calculated as mentioned by Kanber et al. (1992).

Groundwater samples were taken in months of March, May, June, and September of the years 2010-2013 by Kayseri Regional Directorate of State Hydraulic Works (DSI). The data were analyzed using Statistical Package for Social Sciences (SPSS) 16.0 V Software Package program.

They were presented in the form of range, arithmetic mean, standard deviation and 95% confidence intervals. Statistical differences between the variation of parameters in months of March, May, June, and

September of the years 2010-2013 were compared using pre-post *t*-test at *p*-value < 0.05. The considering data that included the last four year estimation made by using linear regression analyze.

RESULTS AND DISCUSSIONS

The basin descriptive statistics for groundwater quality parameters is illustrated in Table 1. In the present study, pH concentration in groundwater ranged from a minimum of 7.23 to a maximum of 7.82 with a mean value of 7.50 which is suitable for irrigation by the Turkish Standard for Water Pollution Control Regulation WPRC (2004) guidelines for potable water. The groundwater samples are generally basic characteristics with a mean pH value of 7.50. The pH findings from this study agreed with the values obtained by Kıymaz & Karadavut, 2014b. These pH values are not a problem for irrigation purposes due to suitable the prescribed safe limits of 6.5-8.5 for irrigation.

The temperature (T) ranged from a minimum of 14.00 to a maximum of 17.00 ˚C with a mean value of 15.96˚C. This value was below the WPRC (2004) limits value of 30˚C. On the other hand, temperature found statistically significant at the 1% level in September-May months year of 2013 (Table 2). The temperature of water in natural conditions can change according to the conditions of the season, the latitude and the elevation of the region, the depth of flow and even the time of day (Boyd & Daniels, 1987, Cole, 1983).

The electrical conductivity of water ranged from a minimum of 37.90 to a maximum of 2710.00 dS/m with a mean value of 783.00 dS/m. According to the average of the EC values, the water is class C_3 (high saline water), in terms of irrigation water quality. Similar results were obtained by Kıymaz & Karadavut (2014b) who found that the conductivity of the groundwater well in Seyfe Plain was a mean value of 1736.91 μS/cm. Erguvanlı (1959) stated that gypsiferous Oligocene units (Kızılırmak Formation) are one of the main factors affecting the quality of groundwater. Unsal et al. (1996) point out that the Bozçaldağ Formation is of aquifer character and it feeds the Seyfe spring and deep water wells in the region.

In a study conducted by Çelik et al. (2008) in Seyfe Lake Basin, determined that the main reasons of formation and change of the groundwater salinity and hydrochemical facies in the Seyfe basin were causing the various lithogenic pollution and heterogeneity of the Kızılırmak Formation, salinity of the upper soil zones, and evaporation of the trench and channel waters open to the atmosphere. Bolat (2006) determined the EC value of the soils was 124.900 μS/cm in the around of the Lake Seyfe soils with pH values from 7.89 to 9.86, which were classified in the range of ‘‘extremely alkali’’ to moderately alkali. Bolat (2006) reported that a constant watering of agricultural lands by trench waters continues to heavily increase salinity in the soil zones, causing, them to turn into wastelands.

Chloride concentration in groundwater widely ranged from a minimum of 0.05 to a maximum of 209.5 mg/l with a mean value of 49.40 mg/l. Dissolved oxygen ranged from a minimum of 3.38 to a maximum of 10.01 mg/l with a mean value of 7.52 mg/l. The dissolved oxygen content of natural fresh water between 0-300°C varies from 5 to15 mgL^{-1}.

The Na concentration in groundwater ranged from a minimum of 0.10 to a maximum of 274.6 mg/l with a mean value of 53.40 mg/l. These values in the present study found higher than results obtained by Kıymaz & Karadavut 2014b. The concentration of Na^+ value is above the recommended limit of 5.43 me/l allowed (Ayers & Westcot 1989). Şahinci (1991) explained that the presence of sodium underground depends on factors such as the type and amount of mineral, pH, decay time, groundwater flow rate, and calcium ion exchange in ambient, natural and artificial contamination. The K ranged from 0.01 to 5.64 mg/l with a mean value of 2.04 mg/l. A similar result was observed in the study conducted by Kıymaz & Karadavut 2014b. Ca ranged from 3.20 to 380 mg/l with a mean value of 104.10 mg/l. The Mg ranged from a minimum of 19.81 to a maximum of 51.18 mg/l with a mean value of 19.81 mg/l. The results indicate that the Ca^{+2} and Mg^{+2} values of the wells were higher than recommended values by WPRC 2004.

Table 1

Descriptive statistics of groundwater quality data for 2010-2013 year

Parameters	*Units*	*Mean*	*Standart Deviation*	*Min.*	*Max.*
pH	-	7.50	0.1964	7.23	7.82
T	°C	15.96	0.970	14.00	17.00
EC	dS/m	783	700.0	37.90	2710
DO	mg /l	7.52	2.119	3.38	10.01

Na^+	mg /l	53.4	84.2	0.10	274.60
K^+	mg /l	2.04	1.738	0.01	5.64
Ca^{+2}	mg /l	104.1	97.7	3.20	380.00
Mg^{+2}	mg /l	19.81	14.69	0.74	51.18
HCO_3	mg /l	264.5	143.1	3.84	515.5
Cl^-	mg /l	49.4	69.1	0.05	209.50
SO_4^{2-}	mg /l	21.13	30.48	0.07	111.56
NO_2	mg /l	0.26	0.4250	0.00	1.99
NO_3	mg /l	75.1	86.30	18.20	319.6
NH_3	mg /l	0.09	0.0756	0.03	0.29
Hardness	mg/l	49.4	77.0	17.6	362.8
SAR	-	1.31	1.642	0.17	4.62
%Na	-	19.80	18.73	5.19	57.92
TDS	mg/l	969	1713	247	7940

The HCO_3 concentration in groundwater ranged from a minimum of 3.84 to a maximum of 515.50 mg/l with a mean value of 264.50 mg/l. Bicarbonate waters interact with gypsiferous and salty units of the Kızılırmak Formation along the flow direction and form the mixed water type and salty water type.

The Cl concentration in groundwater ranged from a minimum of 0.05 to a maximum of 209.50 mg/l with a mean value of 49.40 mg/l. The Cl^- value can create problems in the use of irrigation water due to being above the value of the limit (4 me/l) prescribed by Ayers & Westcot (1989). A high chloride value in the present and past studies shows that revealed an indicative high salinity and the EC. SO_4^{2-} concentration in groundwater ranged from a minimum of 0.07 to a maximum of 111.56 mg/l with a mean value of 21.13 mg/l. Ayers & Westcot (1989) recommended a value of SO_4^{2-}ranged from 0 to 20 me/l. This agreed with the findings of Kıymaz & Karadavut 2014b. But in the present study sulphate value is more than the recommended limit of 20 me/l allowed.

The NH_3 concentration in groundwater ranged from a minimum of 0.03 to a maximum of 0.29 mg/l with a mean value of 0.08 mg/l. The NO_3 concentration in groundwater ranged from a minimum of 18.20 to a maximum of 319.60 mg/l with a mean value of 75.10 mg/l. The Nitrate content has been found to be quality of IV class according to criteria quality of intracontinental water resources (WPRC 2004). These findings were found similar ones reported by Kıymaz & Karadavut 2014b. The NO_2 concentration in groundwater ranged from a minimum of 0.01 to a maximum of 1.99 mg/ l with a mean value of 0.26 mg /l.

The sodium hazard is defined in terms of the classification of irrigation water as Low (S1:< 10), medium (S2: 10 to 18), high (S3: 18 to 26) and very high (S4: > 26). The values of SAR in the study ranged from a minimum of 0.17 to a maximum of 4.62 mg/l with a mean value of 1.31 mg/l, which is low. The value of the percent of sodium in the study ranged from a minimum of 5.19 to a maximum of 57.92%, with an average of 19.80%. Hardness value ranged from a minimum of 17.6 to a maximum of 362.8 mg/l with a mean value of 49.4 mg/l. According to the French degree of water hardness, the hardness classification of the wells is moderately hard (14-22) and hard water (32-54). Ground water is generally harder than surface water.

TDS value ranged from a minimum of 247 to a maximum of 7940 mg/l with a mean value of 969 mg/l. According to the water classification of TDS, groundwater wells shows fresh water (0-1000 mg/l) and brackish water (1000-10.000 mg/l) (Şengün 2013).

Table 2 shows that the results of the t-tests for the data. The difference of means between pre- and post-irrigation seasons is significant at 5% and 1% level. The results clearly explain that there is evidence of seasonal effect on the mean values of groundwater quality. The quality of the water is decreasing due to the increase of the amount of irrigation water. However, the decrease in the amount of irrigation and the increase in winter precipitation water can cause temporary improvement in the level of pollution. Dissolved oxygen values were found significant at level of %1 in all years. It is an essential parameter in assessment of water quality because of its influence on the organisms living within a body of water. In the study limnology of lakes especially dissolved oxygen is an important factor second only to water itself. Dissolved oxygen levels can range from less than 1 mg/l to more than 20 mg/l depending on how all of temperature, pressure and salinity of the water factors interact. In freshwater systems such as lakes, rivers and streams, dissolved oxygen concentrations will vary by season, location and water depth (Wetzel 2001).

As for the value of temperature, it is seen that there is a serious increase in years of 2012 and 2013. Accordingly, as the temperature increased, the amount of oxygen decreased (Table 2). As the temperature and depth increase, the oxygen content of the water also decreases, while in the opposite case it increases. The salt concentration of water is also inversely proportional to the dissolved oxygen. It is expected that the amount of oxygen dissolved in the high water of salinity is low (Boyd-Tucker, 1992).

It is particularly remarkable that the differences in quantities of nitrate, nitrite and ammonia are significant at level of %1.

Table 2

The results t-test of parameters pre-irrigation seasons and post-irrigation seasons in periods of the years 2010-2013

Parameters	***2010 September- March***	***2011 September-June***	***2012 September-May***	***2013 September-May***
	t- test value			
pH	-2.85	0.47	2.43	-1.73
Temperature (˚C)	1.11	1.50	6.93**	34.37**
EC	1.24	1.18	-1.97	0.02
Dissolved oxygen	33.50**	-21.57**	-	-
Na^+	1.27	0.66	-2.05	-1.45
K^+	1.58	0.96	-1.75	-3.23*
Ca^{+2}	2.48	-0.60	-1.23	-4.45**
Mg^{+2}	3.87**	0.13	-0.90	-1.00
HCO_3	1.68	3.05*	0.86	1.39
Cl^-	1.86	-0.35	-2.30	-0.71
SO_4^{2-}	-0.24	-1.15	-2.09	-1.69
NO_2	2.36*	-1.17	4.73**	-0.80
NO_3	-4.11**	-2.04	-1.64	-4.31**
NH_3	3.91**	0.16	0.40	-4.32**

* Statistically significant at the 5% level, * *Statistically significant at the 1% level.

The estimation linear regression of the chemical parameters is shown in Figure 1a and Figure 1b. Considering Figure 1, an increase generally in the amount of nitrate in groundwater wells was observed. Although a slight decrease trend, it can be considered that it is seasonal. Considering HCO_3, regular and constant increase is the issue. It is expected that this increase will continue in the next period. Considering sulphate, it has increased very rapidly in the first year and second year of the study. In the third and last years, it showed relatively decreasing situation. It can be said that Cl has started to increase rapidly and it can be said that Cl will gradually accelerate in the later following period. Anthropogenic activities (agricultural fertilizers and irrigation-returnflows) also influence the evaporation by increasing Na^+ and Cl^-), and thus TDS. Semi-arid climate also trends to evaporation-dominance groundwater systems (Rao et al., 2008).

There is no significant change in the amount of Na + K. Mg^{+2} shows that very steadily increased. It can be said that this increase will continue in the forthcoming periods. Ca, the first year and second year of study has increased very fast. In the third and last year it showed a relatively decreasing situation. In the pH, it was relatively decreased.

In terms of electrical conductivity, there was a slight increase in the first two years, while in the last two years the increase began to decrease and stabilized. It shows that the changes in EC quantities will not be rapid in the following years. A slight but steady decrease in the amount of dissolved oxygen is seen. It is observed that this decrease will continue in the following years depending on the temperature and depth. When examined in terms of TDS amounts, it seems that there is a decrease in the first period, but a rapid increase is expected in the future periods.

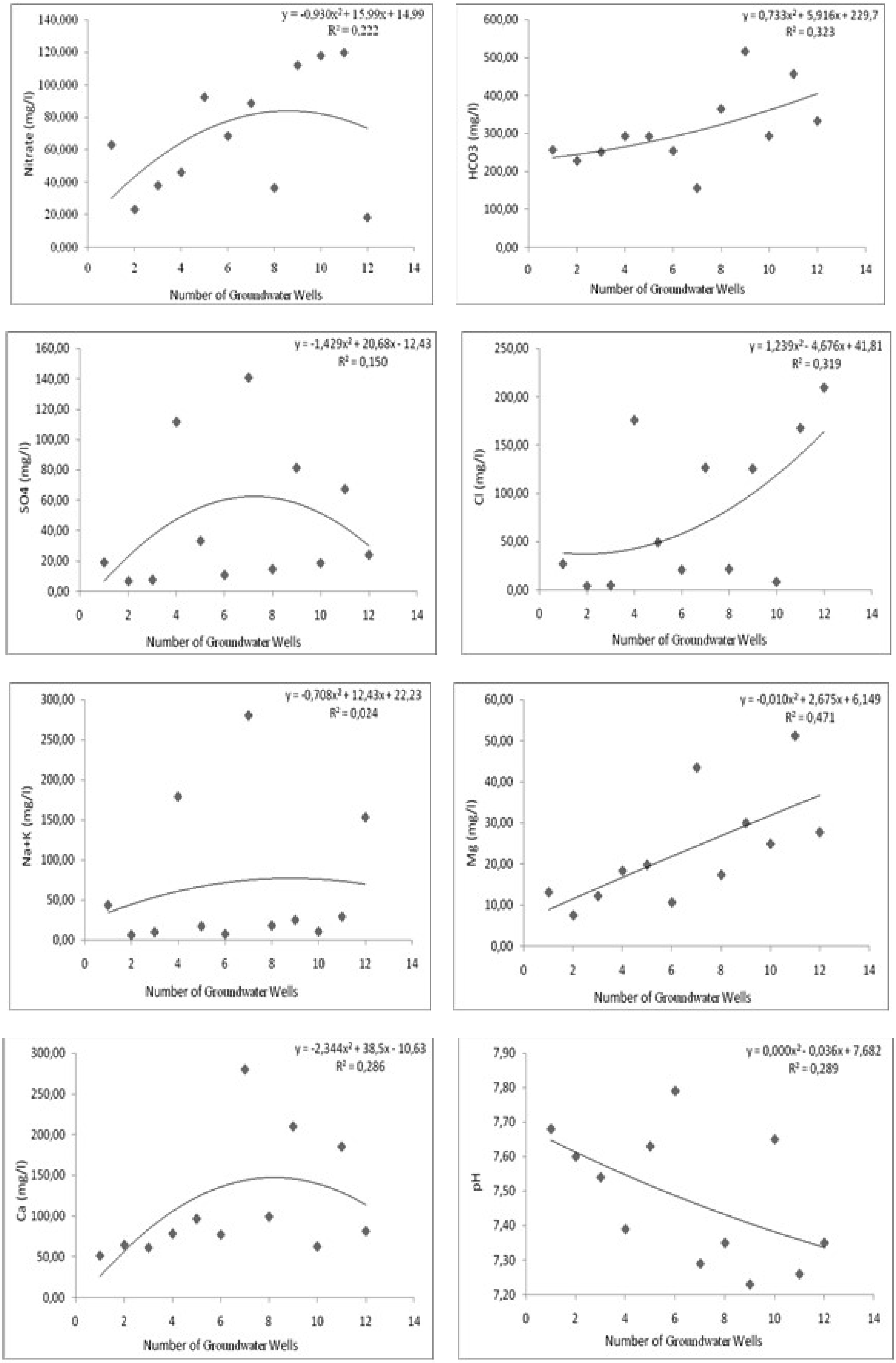

Figure 1a. **The estimation by linear regression of the chemical parameters**

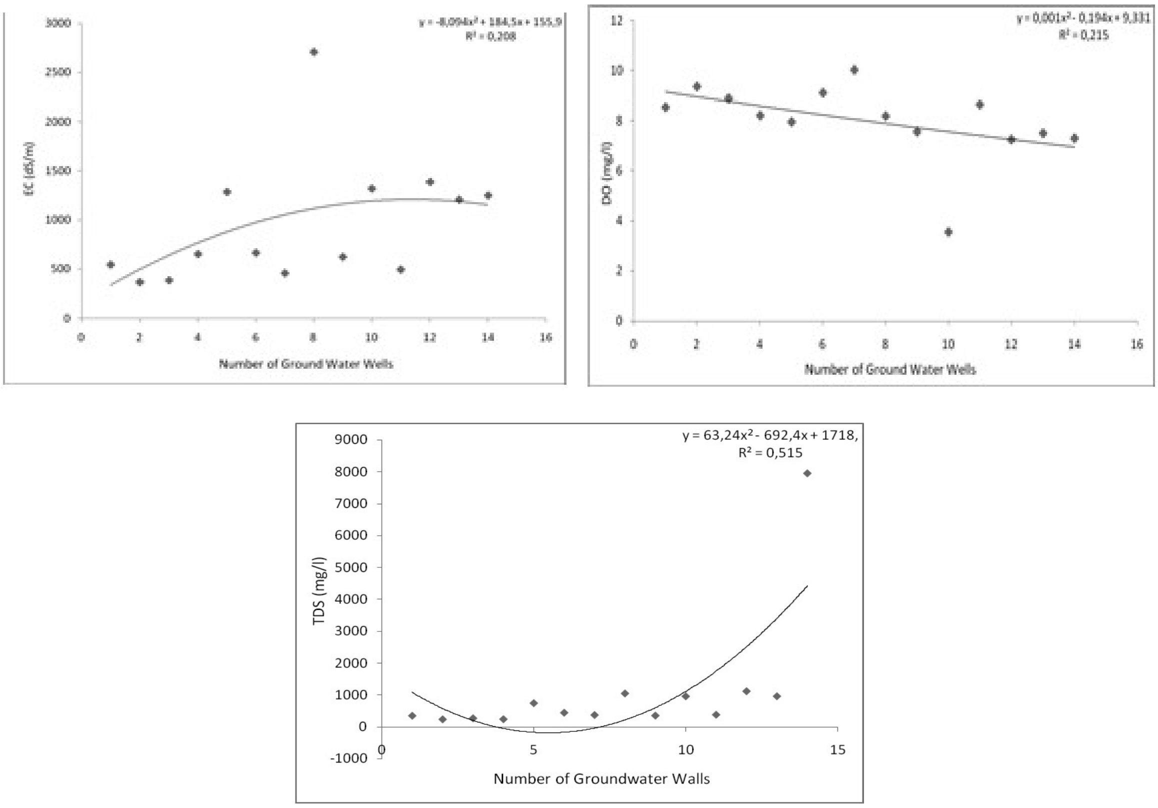

Figure 1b. **The estimation by linear regression of the chemical parameters**

CONCLUSIONS

A remarked result of the study is summarized. As the temperature of ground water increased, the amount of dissolved oxygen levels decreased depending on temperature. Also, they were affected by pressure and salinity of the water factors. In freshwater systems such as lakes, rivers and streams, dissolved oxygen concentrations will vary by season, location and water depth. EC quantities increased as slowly and stability according to years. SO_4, Cl, HCO_3, NO_3 and Na decreased to ground water quality level. When examined in terms of TDS amounts, it seems that there is a decrease in the first period, but a rapid increase is expected in the future periods. As the effects of nonpoint source pollution factors from agricultural activities will continue, the groundwater pollution in the basin is expected to increase. These results indicate that the parameters responsible for water-quality variations are mainly related to limnology, natural soluble salts, agricultural activities (fertilizers, pesticides, and animal wastes uses), the depth and pumping rate of the wells, the local hydrogeologic conditions, the size and type of the source area. The quality of the water is decreasing due to the increase of irrigation amount. However, the decrease in the amount of irrigation water pumped in wells and the increase in winter precipitation water can cause temporary improvement in the level of groundwater pollution. For different uses, various measures of water quality and monitoring of parameters threatening pollution are important for the availability and sustainability of our water resources, quality of life, and economic development.

REFERENCES

1. Aquastat (2016). www.fao.org/nr/water/aquastat/data/query/index.html?
2. Ayers R. S.; Westcot, D. W. (1989). *Water quality for agriculture*. FAO Irrigation and Drainage Paper 29, Rev.1, p.174, Rome-Italy.
3. Başaran B.; Bölükbaşı V. (2011). *Seyfe gölü su kalitesi ve dip çamuru ağır metal özelliklerinin belirlenmesi*. Gazi Üniversitesi Fen Bilimleri Enstitüsü, Çevre Bilimleri Yüksek Lisans Tezi. 133 s. Ankara.
4. Bolat S (2006). *Investigation of degree of pollution of the soil and water on Seyfe Lake and their neighborhood.* MSc thesis, Gazi University, Institute of Science and Technology, Environment Sciences, 80 p, Ankara (in Turkish).

5. Boyd C. E.; Tucker C. S. (1998). *Pond Aquaculture Water Quality Management*. PP. 700, Kluwer Academic Publishers.
6. Çelik M.; Ünsal N.; Tüfenkçi O. (2008). Assessment of water quality and pollution of the Lake Seyfe basin, Kırşehir, Turkey // *Environmental Geology*. Vol. 55, pp. 559-569.
7. Erguvanlı K. (1959). *Hydrogeology of the Seyfe Plain in northern Kırşehir, Central Anatolia, Turkey*. Institute of hydrogeology Technical University of Istanbul, Publication no. 4, Istanbul, 24 p.
8. Igor S. (1993). *World fresh water resources*. Water in Crisis: A Guide to the World's Fresh Water Resources, New York: Oxford University Press.
9. Kanber R.; Kırda C.; Tekinel O. (1992). *Sulama suyu kalitesi ve sulamada tuzluluk sorunları*. Ç.Ü. Ziraat Fakültesi Yayın No: 21 Ders Kitabı Yayın No: 6, Adana.
10. Kıymaz S.; Ertek A. (2011). Seyfe *Gölü Yüzey su Kalitesinin Farklı Gözlem Yıllarındaki Değişimleri.II.* Türkiye Sulak Alanlar Kongresi, Sözlü Bildiri Kitabı.22-24 Haziran 2011, pp. 138-147.Kırşehir.
11. Kıymaz S.; Karadavut U. (2014a). Application of Multivariate Statistical Analysis in the Assessment of Surface Water Quality in Seyfe Lake, Turkey. *Ankara Tarım Bilimleri Dergisi*. Vol. 20(2), pp. 152-163.
12. Kıymaz S.; Karadavut U. (2014b). Evaluation of Irrigation Water Quality in Groundwater Well Water in Seyfe Lake Basin. *Journal of Selçuk University Natural and Applied Science*. Vol. 3(3), pp. 55-72.
13. Kıymaz S.; Ertek A. (2011). Seyfe Gölü Yüzey su Kalitesinin Farklı Gözlem Yıllarındaki Değişimleri. *II.Türkiye Sulak Alanlar Kongresi, Sözlü Bildiri Kitabı*. 22-24 June 2011. pp. 138-147. Kırşehir (in Turkish).
14. Kıymaz S.; Karadavut U.; Ertek A. (2016). *Seyfe Gölü Havzası Yeraltı Suyu Kalitesinin Zamana Göre Değişimin İncelenmesi. Uludağ Üniversitesi Ziraat Fakültesi Dergisi*. Vol. 30(1), pp. 21-31.
15. Longe E.O.; Balogun M.R. (2010). Groundwater quality assessment near a municipal landfill, Lagos, Nigeria. *Research Journal of Applied Sciences, Engineering and Technology*. Vol. 2, pp. 39–44.
16. Rao VVSG.; Prakash B.A.; Ramesh M.; Ramesh G.; Tamma Rao G.; Surinaidu L.; Mahesh J. (2008). *Assessment of groundwater conditions & contaminant migration in groundwater in the watersheds covering M/s*. Somaiya Organo Chemicals, a Unit of Godavari Sugar mills Limited, Sameerwadi, Bhagalkot district, Karnataka NGRI Tech Rep. Environ 638, pp. 22.
17. Sargonkar A.; Deshpande V. (2003). Development of an overall index of pollution for surface water based on a general classification scheme in Indian context. Environ. Monit. Assess. 89, pp. 43- 67.
18. Şahinci A. (1991). *Doğal Suların Jeokimyası, Reform Matbaası*. 548 s., İzmir.
19.Şengün, E. (2013). *Aksu Deresi su kalitesi ve kirlilik düzeyinin belirlenmesi.*Giresun Üniversitesi fen Bilimleri Enstitüsü, Yüksek Lisans tezi, pp. 81.
20. Unsal N.; Çelik M.; Afşin M. (1996). *Genesis of the Seyfe Spring (Kırşehir) using chemical and isotopic features*. Geological Engineering Department, 30. Year, Symposium, Karadeniz Technical University, pp. 491–503. Trabzon (in Turkish).
21. Wetzel R. G. (2001). *Limnology: Lake and River Ecosystems (3rd ed.)*. San Diego, CA: Academic Press.
22. WPCR (2004). *Water pollution control regulations, Number: 25687*. Ministry of Environment and Forests, Turkey.

