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ASSESSMENT OF THE QUALITY OF GROUNDWATER IN SKAKA

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Abstract- The water scarcity is becoming an increasingly serious problem in arid and semi-arid countries. Groundwater contributes only 0.6% of the total water resources of the earth; however, it is the major and most preferred source of drinking water in rural as well as urban areas in developing countries because it does not require treatment. The aim of this work is to evaluate the quality of groundwater (used for drinking) in Skaka City, KSA. Samples were collected from some wells during the period from February' to August' 2012. Physico-chemical and bacteriological analysis were carried out in the term of pH, electrical conductivity, alkalinity, TDS, turbidity, ammonia, chlorides, sulphates, ammonia, nitrates, nitrites, total alkalinity, total hardness, calcium and magnesium hardness, iron, manganese, total and faecal coliforms. The results showed that the quality of groundwater from some selected wells was complying with the National Regulatory Standards for drinking water.

Keywords- Skaka, groundwater, water quality

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Introduction

Scarcity of fresh water resources presents the major challenges to the existence of biotic life in the Kingdom. The Kingdom not only suffers from absolute water scarcity but also decreasing per capita water availability. This decline is the outcome of continuous increase in water consumption due to population growth, household consumption patterns and an increase in production sectors [1]. Groundwater contributes only 0.6% of the total water resources of the earth [2]; however, it is the major and most preferred source of drinking water in rural as well as urban areas in developing countries because it does not require treatment. Various natural and anthropogenic ecological factors pollute the groundwater because of deep percolation from intensively cultivated fields, disposal of hazardous wastes, liquid and solid wastes from industries, sewage disposal and surface impoundments [3,4].

Saudi Arabia is limited in agriculture and water resources. Farmers are heavily depending on groundwater. One of the major problems encountered with groundwater chemistry evaluation is that there are large amounts of basic information regarding the groundwater quality in regional studies. The usefulness of water for particular purpose is determined by the water quality [5]. In recent years, with increasing number of chemical and physical variables of groundwater, a wide range of statistical methods are now applied for proper analysis and interpretation of data [6-9].

Because of the rapid economic growth and lack of precipitation, the use of groundwater resource has increased dramatically and the groundwater extraction has serious consequences such as [10]:

- Significant long time of low rainfall,
- Water-level decline,
- Increasing groundwater salinity,
- Contamination and
- Desertification.

All these factors affect the quality of groundwater.

Once pollutants enter a groundwater aquifer, the environmental damage can be severe and long lasting, partly because of the very long time needed to flush pollutants out of the aquifer [11]. Because groundwater is primarily used for drinking water, pollution from untreated sewage, intensive agriculture, solid waste disposal and industry can cause serious human health problems [12]. Due to the harmful health effect of excessive pollutants in human and animal food much research has been conducted on its accumulation in food plant and water resources. Even where available, data usually are not comparable because of the different measures and standards used, which vary by country [12,13]. However, there is evidence that groundwater contamination from fertilizers, pesticides, industrial effluents, sewage and hydrocarbons is occurring in many parts of the world.

During the last two decades, the Kingdom of Saudi Arabia has experienced comprehensive development in the agricultural, industrial, social and construction sector, with the agricultural sector being the largest water consumer. There is also a significant increase in water consumption for municipal, recreational and industrial purposes. The government has supported and encouraged farmers to contribute to securing the Kingdom's food supply. As a result of this encouragement, irrigated areas have increased from about 0.5 million hectares (ha) in 1975, to about 1.62 million ha in 1992. Therefore, irrigation water demand in the Kingdom has increased drastically. In 1992, irrigation water consumption was about 94% of total national use [10].

Material and Methods

Samples were collected from some wells during the period from February' to August' 2012. The physico-chemical analyses will cover: chlorides, sulphates, ammonia, nitrates, nitrites, total alkalinity, total hardness, calcium and magnesium hardness, iron, manganese. Bacteriological examinations will cover total and faecal coliform. Samples will be collected in sterile containers (200 ml), to carry out the bacteriological examinations within 2 hrs. from collection**.** The analyses will be carried out according to the American Public Health Association for Examination of Water and Wastewater [14].

The arithmetic averages of percent removal and descriptive statistics were applied to the collected data using Microsoft Excel XP version 2003.

Results and Discussion

Physical characteristics of collected groundwater samples:

[Table-1] shows the physical characteristics of water samples that were collected during the period from April, 2011 to May, 2012.

Table 1- Range of pH, electrical conductivity and turbidity in groundwater

Parameter	N	Max. Permissible level	Min.	Max.
pH	16	6.5-8.5	6.79	8.29
Electrical conductivity (ms)	16	2300	28	1158
Turbidity (NTU)	16	5	0.189	3

[Table-1] shows the minimum and maximum level of pH, electrical conductivity and turbidity of groundwater samples in Sakaka City. The pH level was found to be complying with the maximum permissible level for non potable drinking water [Fig-1]. The minimum and maximum recorded level of pH of the collected samples was 6.79 and 8.29, respectively. According to Stumn and Morgan [15] pH value of natural water ranged from 6.0 to 9.0, hence the pH Value of both areas fall within the WHO [16] set standard for drinking water.

[Fig-2] shows the variation of electrical conductivity of the collected samples. The minimum and maximum recorded EC was 28 ms and 1158 ms. All samples were complying with the National Regulatory Standards for drinking water.

The turbidity of the collected samples is presented in [Fig-3]. The level of turbidity ranged from 0.189 NTU to 3 NTU units.

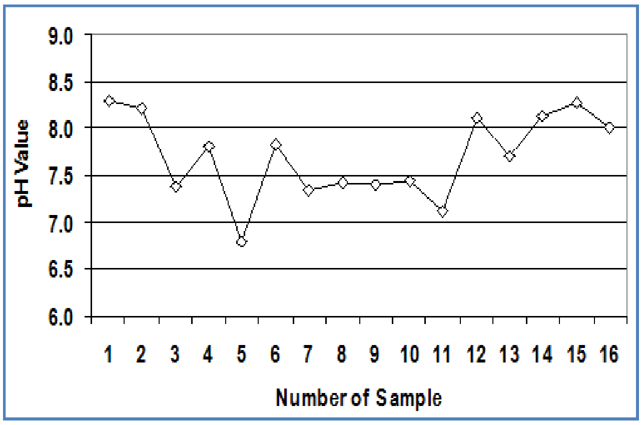

Fig. 1- pH range of the tested groundwater samples.

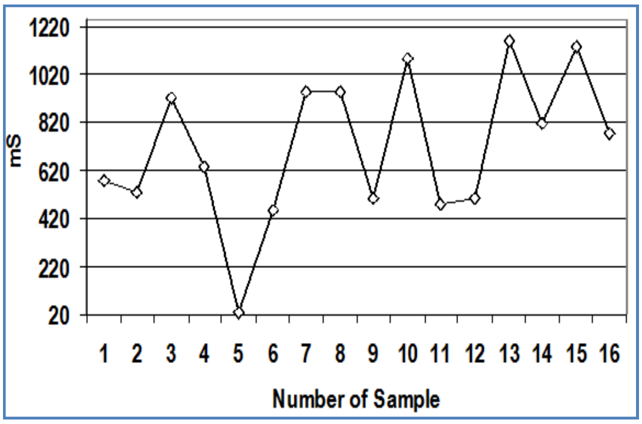

Fig. 2- Variation on the electrical conductivity in the collected samples.

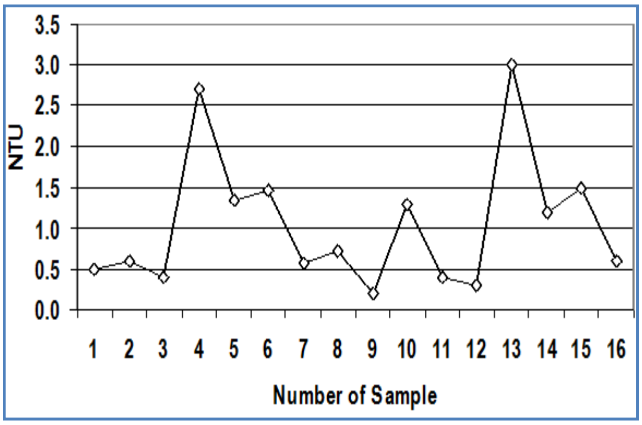

Fig. 3- Variation on Turbidity in the collected samples.

Chemical Characteristics of Collected Groundwater Samples

[Table-2] shows the range of concentration of ammonia, nitrates and nitrites in the collected samples.

Table 2- Range of the concentration of ammonia, nitrates and nitrites in the collected samples

Parameter	N	Max. Permissible level (mgN/l)	Min. (mgN/l)	Max. (mgN/l)
Ammonia	16	1.5	0	0.85
Nitrates	16	50	0	2.1
Nitrites	16	3	0	0.009

[Fig-4] shows the variation in the concentration of ammonia, nitrates and nitrites in the collected samples.

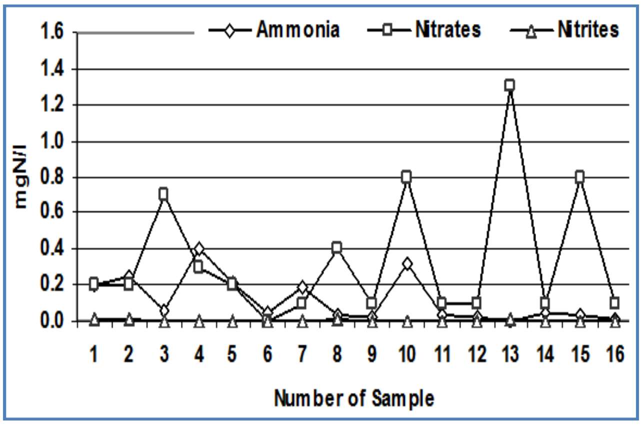

Fig. 4- Variation in the concentration of ammonia, nitrates and nitrites in collected samples.

The concentration of ammonia, nitrates and nitrites was found to be complying with the National Regulatory Standards for drinking water.

[Table-3] shows the concentration range of total alkalinity, sulphate, chlorides and TDS in the collected samples. Total alkalinity, sulphate, chlorides and TDS concentration ranged from 10 to 190mg/l, 0 to 300mg/l 30 to 825mg/l and 180 to 803mg/l, respectively.

The palatability of water with a TDS level of less than 600mg/litre is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000mg/litre. The presence of high levels of TDS may also be objectionable to consumers, owing to excessive scaling in water pipes, heaters, boilers and household appliances. While, sulphate is generally considered that taste impairment is minimal at levels below 250mg/litre [16].

Table 3- Range of the concentration of total alkalinity, sulphate and chloride in the collected samples

Parameter	N	Max. Permissible level (mgN/l)	Min. (mgN/l)	Max. (mgN/l)
Total alkalinity	15	200	10	172
Sulphate	15	250	15	141
Chlorides	15	250	30	250
TDS	15	100-1000	180	803

[Fig-5] shows the variations in sulphate, total alkalinity, sulphate, chlorides and TDS in the collected samples.

The concentration of manganese and iron is shown in the collected samples ranged from 0 to 0.002mg/l and 0.003 to 0.3mg/l, respectively [Table-4]. Manganese concentrations below 0.1mg/litre are usually acceptable to consumers. On the contrary, at levels exceeding 0.1mg/litre, manganese in water supplies causes an undesirable taste in beverages and stains sanitary ware and laundry. Iron is an essential element in human nutrition. It is one of the most abundant metals in the Earth's crust. It is found in natural fresh waters at levels ranging from 0.5 to 50mg/litre. Estimates of the minimum daily requirement for iron depend on age, sex, physiological status and iron bioavailability and range from about 10 to 50mg/day. No guideline value for iron in drinking-water is proposed [16].

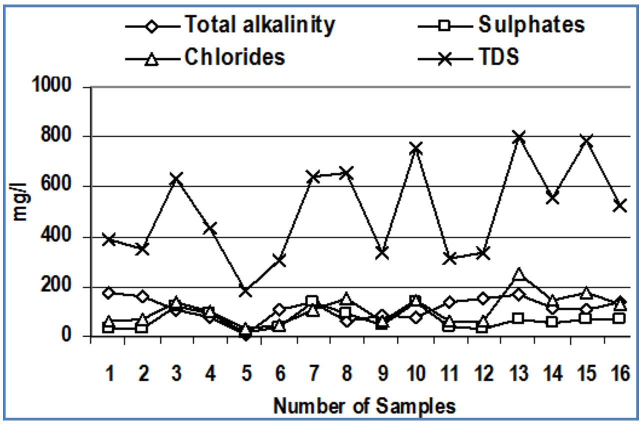

Fig. 5- Variations of sulphate, total alkalinity, sulphates, chlorides and TDS in the collected groundwater samples.

Table 4- Range of the concentration of manganese and iron in the collected samples

Parameter	N	Max. Permissible level (mgN/l)	Min. (mgN/l)	Max. (mgN/l)
Manganese	16	0.5	0	0.002
Iron	16	0.3	0.003	0.3

Variations in the concentration of manganese and iron in the collected samples is shown in [Fig-6].

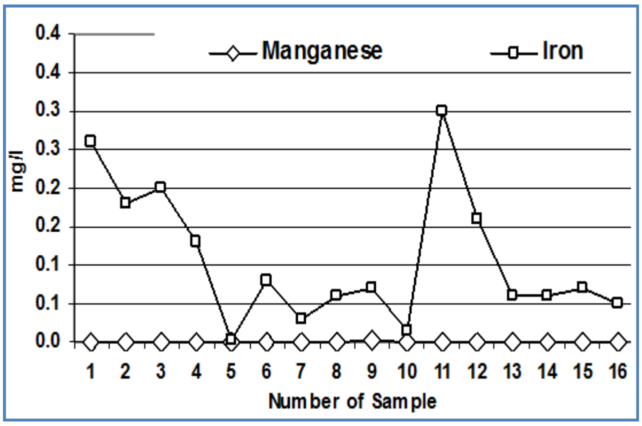

Fig. 6- Variation in the concentration of manganese and iron.

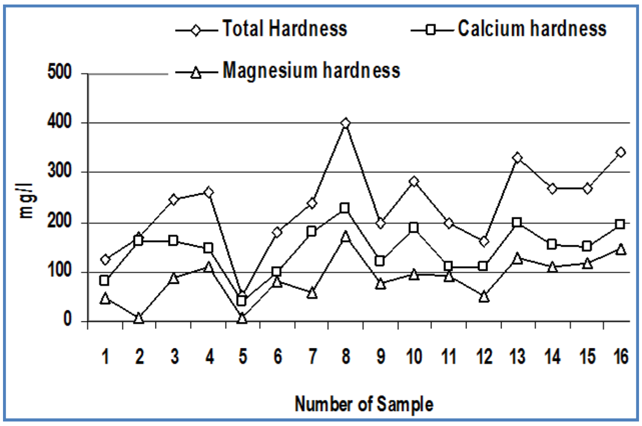

Fig. 7- Variation in concentration of total hardness, calcium hardness as well as magnesium hardness

The range of concentration of total hardness, calcium hardness as well as magnesium hardness is shown in [Fig-7] and [Table-5].

Total hardness, calcium and magnesium hardness ranged from 50 to 400mg/l, 42 to 228 and 8 to 172mg/l, respectively. Hardness above 200mg/l can result in scale deposition, particularly on heating. Soft waters with a hardness of less than about 100mg/l have a low buffering capacity and may be more corrosive to water pipes [16,17].

Table 5- Range of the concentration of total hardness, calcium hardness as well as magnesium hardness

Parameter	N	Max. Permissible level (mg/l)	Min (mg/l)	Max (mg/l)
Total hardness	15	500	50	400
Calcium hardness	15	200	42	228
Magnesium hardness	15	30-150	8	172

Microbiological Characteristics of Collected Groundwater Samples

All of the collected samples were free of total and faecal coliform. This means that there was no contamination from any source of pollution.

Conclusions

The quality of the selected wells is complying with the National Regulatory Standards for drinking water in term of physico-chemical and bacteriological parameters.

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References

[1] Al-Zahrani K.H. and Baig M.B. (2011) *The Journal of Animal & Plant Sciences*, 21(3).

[2] Meenakshi S. and Mahenshwari R.C. (2006) *J. Hazard. Mater.* B(137), 456-463.

[3] Anwar F. (2003) *Waste Manage*. 23(9), 817-824.

[4] Amina L. Lhadi K., Younsi A. and Murdy J. (2004) *J. Afr. Earth Sci.,* 39(3-4), 509-516.

[5] Hem J.D. (1989) *The Study and Interpretation of the Chemical Characteristics of Natural Water*, 3*rd ed*., US Geological Survey.

[6] Ashley R.P. and Lloyd J.W. (1978) *Journal of Hydrology*, 39, 355-364.

[7] Usunoff E.J. and Guzman A. (1989) *Groundwater*, 27(1), 27-34.

[8] Suk H., Lee K. (1999) *Groundwater*, 37, 358-366.

[9] Sanchez-Martoz F., Jimenezespinosa R. and Pulido-Bosch A. (2001) *Hydrological Sciences*, 46(2), 227-242.

[10] Subyani A.M. and Al Ahmadi M. E. (2010) *JAKU: Earth Sci.*, 21 (2), 29-46.

[11] United Nations Environment Programme (1996) *UNEP Environment,* Library No. 15.

[12] Shiklomanov I.A. (1997) *Comprehensive Assessment of the Freshwater Resources of the World: Assessment of Water Resources and Water Availability in the World*.

[13] Scheidleder, Grath J., Winkler G., Stärk U., Koreimann C. and Gmeiner C. (1999) *Environmental Assessment* Report No. 3.

[14] APHA, AWWA and WEF (2005) *Standard Methods for the Examination of Water and Wastewater* (APHA), 21*st ed*.

[15] Stumn W. and Morgan J.J. (1981) *Aquatic Chemistry. Willey*, New York., 780.

[16] WHO (2005) *Guidelines for Drinking Water Quality*.

[17] Thaddeus K.G. and Frances E.L. (2007) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 101(6), 532-533.